

ABSTRACT BOOK

**27TH INTERNATIONAL
CONGRESS FOR
CONSERVATION BIOLOGY**

**4TH EUROPEAN CONGRESS
FOR CONSERVATION
BIOLOGY**



**ICCB
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**MISSION
BIODIVERSITY:
CHOOSING
NEW PATHS FOR
CONSERVATION**

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Society for Conservation Biology

27TH INTERNATIONAL CONGRESS FOR CONSERVATION BIOLOGY

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Society for Conservation Biology

ABOUT THE SOCIETY FOR CONSERVATION BIOLOGY

SCB is a global community of conservation professionals with members working in more than 100 countries who are dedicated to advancing the science and practice of conserving Earth's biological diversity. The Society's membership comprises a wide range of people interested in the conservation and study of biological diversity: resource managers, educators, government and private conservation workers, and students.

SCB publishes the flagship peer-reviewed journal of the field, *Conservation Biology*, and the cutting-edge online journal, *Conservation Letters*. The Society provides many benefits to its community, including local, regional, and global networking, an active conservation-policy program, and free online access to publications for members in developing countries. SCB also administers a postdoctoral program, the David H. Smith Conservation Research Fellowship Program, sponsored by the Cedar Tree Foundation.



ASSESSING THE RELATIVE IMPORTANCE OF LANDSCAPE AND HUSBANDRY FACTORS IN DETERMINING LARGE CARNIVORE DEPREDATION RISK IN TANZANIA'S RUAHA LANDSCAPE

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Tanzania's Ruaha landscape, centred around Ruaha National Park (RNP), is an international priority area for large carnivores, supporting >10% of the world's lions (*Panthera leo*) and globally significant populations of leopards (*Panthera pardus*), spotted hyaenas (*Crocuta crocuta*) and other carnivores. However, Ruaha's carnivore populations cause intense conflict with local people, mainly due to livestock depredation, and are exposed to alarming rates of retaliatory killing, especially on village land adjacent to RNP. Depredation risk is likely to be influenced by both habitat features and livestock husbandry, but the specific environmental risk factors, and relative importance of habitat and husbandry, have never been assessed in this landscape. Here, we assessed which ecogeographic variables (EGVs) were associated with depredation risk for grazing livestock on village land, and generated a predictive map of large carnivore predation risk, based on species distribution modelling algorithms (SDMs). Secondly, we investigated the relative influence of husbandry and EGVs on depredation risk of enclosed stock, based on a generalized linear model. Grazing livestock predation risk was higher closer to rivers, and in areas of lower elevation and low percentage of tree cover, with 41% of the area mapped as high-risk. For enclosed stock, predation risk was mostly influenced by low percentage of tree cover and increased rainfall, with no discernible influence of current husbandry, which suggests that traditional husbandry was insufficient to outweigh the innate predation risks associated with high-risk landscape areas. Adopting new husbandry methods, such as specialised

guarding dogs and fortified livestock enclosures, could be valuable for reducing depredation and carnivore killing in the Ruaha landscape.

USING LANDSCAPE AND BIOCLIMATIC FEATURES TO PREDICT THE DISTRIBUTION OF LIONS, LEOPARDS AND SPOTTED HYAENAS IN TANZANIA'S RUAHA LANDSCAPE

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Tanzania's Ruaha landscape is an international priority area for large carnivores, supporting over 10% of the world's lions and important populations of leopards and spotted hyaenas. However, lack of ecological data on large carnivore distribution hinders the development of effective carnivore conservation strategies in this critical landscape. Therefore, the study aimed to: (i) identify the most significant ecogeographical variables influencing the potential distribution of lions, leopards and spotted hyaenas across the Ruaha landscape; (ii) identify zones with highest suitability for harbouring those species; and (iii) use species distribution modelling algorithms (SDMs) to define important areas for conservation of large carnivores. Habitat suitability was calculated based on environmental features from georeferenced presence-only carnivore location data. Potential distribution of large carnivores appeared to be strongly influenced by water availability; highly suitable areas were situated close to rivers and experienced above average annual precipitation. All three species showed relatively narrow niche breadth and low tolerance to changes in habitat characteristics. From 21,050km² assessed, 8.1% (1,702km²) emerged as highly suitable for all three large carnivores collectively. Of that area, 95.4% (1,624km²) was located within 30km of the Park-village border, raising concerns about human-carnivore conflict. This was of particular concern for spotted hyaenas, as they were located significantly closer to the Park boundary than lions and leopards. This study provides the first map of potential carnivore distribution across the globally important Ruaha landscape, and shows that SDMs can be effective for understanding large carnivore habitat requirements in poorly sampled areas. This approach could have relevance for many other important wildlife areas that only have limited, haphazard presence-only data, but which urgently require strategic conservation planning.

UNDERSTANDING AND OPERATIONALISING CORAL REEF RESILIENCE IN THE MALDIVES, INDIAN OCEAN

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Although calls for networks of representative marine protected areas have been frequent and global in the past two decades, progress towards on-the-ground protection in developing countries has faltered severely due to lack of financial resources, technical capacity, institutional will, and stakeholder collaboration. Establishing networks of marine managed areas (MMAs) that may or may not include protected, no-take zones, provides more opportunities for legal designation, credible establishment and effective and comprehensive management of marine resources than strict MPAs or individual, un-linked MMAs. We utilize this approach in the Maldives where coral bleaching and mortality has been severe due to the 1998 El Niño and where 106 individual island resorts provide the most extensive platform for coral reef management in the country. Ecological surveys to assess reef resilience on individual islands were used to develop house reef management plans that were endorsed by government and resort managers. Key strengths of this approach include the capacity to address local and regional scale ecological patterns, anthropogenic impacts, and management needs. In Small Island Developing States with large geographical expanses and diverse number of reefs such as the Maldives, this methodology may present the most useful approach for managing coral reefs.

A MECHANISTIC UNDERSTANDING OF BERGMANN'S RULE IN A GENERAL ECOSYSTEM MODEL

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Bergmann's rule has been applied to a broad range of taxa, including poikilotherms, in a number of geographic regions and predicts that body size is correlated with latitude and elevation. Mechanisms commonly considered in previous studies to explain the observed patterns in animal body size include: chance, migration ability, predation, thermoregulation, resource availability, habitat availability and starvation resistance. It is most likely that the observed clines arise from synergistic interactions between several of these mechanisms. However, despite over 160 years of scientific research, both the generality and the underlying mechanism(s) of this ecogeographic principle remains disputed. In this paper we describe the use of a General Ecosystem Model, the Madingley model (Harfoot et al., 2014), to test for the existence of broad-scale interspecific patterns of body size

in terrestrial endotherms and ectotherms. We then utilize this model to investigate the above hypotheses and identify the primary mechanism(s) driving the emergent geographic patterns of terrestrial animal body size. Harfoot, M. et al. (2014) Emergent Patterns of ecosystem structure and function from a mechanistic general ecosystem model, PLoS Biology.

DO ESTIMATES OF LANDSCAPE RESISTANCE REFLECT ANIMAL MOVEMENT?

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Evaluation and maintenance of landscape connectivity is essential to the conservation of genes, species, and habitats. Currently, estimating landscape resistance with resource selection functions is widely used to focus connectivity planning on areas where animal movement is predicted to occur. Yet, the extent to which animal behavioral state (e.g. foraging, resting, commuting) influences resource selection has largely been ignored. Recent advances in GPS technology can fill this gap by associating unique behavioral modes with location data. Here, we review resistance surface modeling studies to determine the extent to which existing connectivity models incorporate behavioral state. We evaluate: 1) the incorporation of an individual's behavioral state in development of resource selection functions; 2) the integration of behavioral influences into landscape resistance development; and 3) the validation of modeled connectivity with behavioral data. Our review suggests that most connectivity studies conflate resource selection with movement behavior, which may result in misleading estimates of landscape resistance. We then present a case study on African wild dogs (*Lycaon pictus*). Using high-resolution GPS and activity data, we develop resistance surfaces for all available location data ('full model') and alternatively for location data specific to when the study animals were traveling ('movement-only model'). Finally, we compare model predictions of connectivity with actual dispersal data. Results show that including only movement data when creating resistance surfaces reveals strikingly different patterns of connectivity than the full model. As expected, the movement-only model was a better predictor of observed dispersal patterns. Successful application of resistance surface modeling for connectivity planning therefore requires explicit examination of the behavioral contexts in which movement decisions are made.



REDUCING EMISSIONS FROM THE FORESTS UNDER REDD+: A CASE STUDY STATE FORESTRY DEPARTMENT OF PAHANG, MALAYSIA EXPERIENCE

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Abstract Forestry has been recognised as amongst potential sector for climate change mitigation. REDD Plus mechanism has been identified under the UNFCCC to provide financial incentives to allow developed countries to offset their emission through deforestation and forest degradation and enhancement of carbon sequestration, conservation and sustainable management of forests in the developing countries. Malaysia recognises that REDD Plus has potential to raise Malaysia future involvement in the Climate Change mitigation programme. In order to explore Malaysia readiness in the REDD Plus engagement, Malaysia has embarked a pilot REDD+ projects, with financial support from the International Timber Trade Organization (ITTO) entitled Reducing Forest Degradation and Emissions Through Sustainable Forest Management (SFM) In Peninsular Malaysia. The project is jointly conducted by Forest Research Institute Malaysia (FRIM), State Forestry Department of Pahang and Forestry Department of Peninsular Malaysia. The project site which is located in the State of Pahang with main objective to determine carbon emissions from forest degradation activity in logged over forests and the assessment of the contribution of sustainable forest management practices to reduce emissions from forest degradation. Financial evaluations of the improved management practices will also be undertaken to provide avenues for assessing PES. This pilot REDD Plus project has preliminary been used to assess the rate and drivers of deforestation through the use of satellite data. The combination of Landsat and SPOT satellite images coupled with Land use change maps are used to identify drivers of deforestation and further verified through ground verification. This paper will highlight the progress of implementation of this study, sharing several issues and challenges encountered and finally concluded by outlining several important future strategies as an important way forward in the REDD Plus engagement.

LANDSCAPE DYNAMICS ACROSS SPECIES IN MEDITERRANEAN OAK FORESTS: ANTHROPOGENIC VERSUS ENVIRONMENTAL DRIVERS

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Forests and woodlands dominated by oaks (*Quercus* spp.) have high conservation value across Europe. Global change seems to be negatively affecting oak ecosystems, through land use change, climate change and spread of exotic pathogens, and a drastic decrease in oak forest area is predicted, especially for sub-Mediterranean oaks. In Mediterranean Europe, oak forests and woodlands are very abundant and provide important ecosystem services. In particular, land cover in mainland Portugal is dominated by Mediterranean evergreen oaks (cork oak and holm oak) in the south. Deciduous sub-Mediterranean oaks occur in a much smaller extent in the north of the country. We used data from forest inventories for mainland Portugal for 1966 and 2006 and biophysical, climatic and anthropogenic variables to model oak landscape dynamics in a period of 40 years. General trends show that although overall persistent, oak ecosystems have been changing to shrublands, agriculture and other forest types in distinct proportions across oak species. For all oak species, shrub encroachment occurred with increasing fire frequency and change to croplands was more likely with decreasing slope. Shrub encroachment in former cork oak forests and woodlands occurred in regions of lower maximum temperatures, with higher fire frequency, population loss, and distant from roads, indicating land abandonment in marginal areas. Holm oak forests and woodlands were more persistent where temperatures were highest; changes to other land covers occurred in less warm areas but where temperatures have increased, maybe indicating that holm oak although well adapted to hot climate in its core area of distribution may not be as well adapted to variations in temperature in marginal areas. Deciduous oak forests and woodlands were less persistent in areas with higher temperatures and with increasing very warm periods, indicating that this oak group is more likely to become affected by forecasted climatic changes.

ILLEGALIZING A TRADITIONAL FISHERY IN THE BOHOL SEA: MARINE SPECIES CONSERVATION POLICY MARGINALIZING THE MARGINALIZED

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The world's marine and coastal resources are threatened by the increased exploitation of fisheries and habitat degradation. Of particular concern are large marine vertebrates with k-selected life history strategies given to their vulnerability to overexploitation. A common fishery management strategy is the implementation of fishing bans to protect species or taxonomic groups such as cetaceans and elasmobranchs. In the Philippines, all species of cetaceans, the whale shark



(*Rhincodon typus*) and the giant manta ray (*Manta birostris*) have been protected since the late 1990s. The prohibition on the hunting of these species impacted the livelihoods of thousands of fishers in the country in varying degrees but some more so than others, such as those in the Bohol Sea who have depended on the fishery for over a century. This paper presents the case of the large marine vertebrate hunters of the Bohol Sea wherein fishers were excluded from the decision-making and managing process of the fishery. Key informant interviews, archival research and policy reviews were conducted in four study sites. Conservation policies such as these have socio-cultural and economic implications on fishing communities often taken for granted by policy makers and managing bodies. Many fishing communities are marginalized and with increasing protection on marine resources, these communities are marginalized further by depriving them access to all their traditional target species. However, some defied the fishery policies and contested its legitimacy. These communities remain as the center of Mobulid ray fishery in the Bohol Sea. This fishery remains so poorly understood. The lack of real co-management systems results in implementation problems and the non-compliance to fishery policies. In order to make existing and policies for this type of fishery work, there is a need to redesign management strategies and strengthen stakeholder support and cooperation through co-management.

APPLICATION OF PROCESS BASED MODELS FOR MAPPING FRESH WATER SERVICES IN CAMBODIA

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There is a growing need to understand the links between ecosystem services and the goods they provide to people. Tools to assess freshwater services and to identify their spatial flows by linking them with multiple water users, especially under data-poor environments, are required. There are many hydrological or ecosystem services tools that could be used to map water-related services, but there is a gap on how to integrate them with an ecosystem services framework to provide performance metrics in order to prioritize and spatially identify the distribution of actual services based on use and demand from multiple beneficiaries. This paper seeks to describe the application of WaterWorld, a policy support system, spatially explicit, self-parameterizing (utilizes remotely sensed and globally available data sets for application) physical based model for mapping fresh water services. Through a case study in Cambodia, we explore the spatial distribution of three freshwater ecosystem services: quality, quantity and flow regulation and their actual provision to different beneficiary groups: drinking water for cities, hydropower production and agricultural irrigation. As a result we mapped

a fresh water services on a national level, based on WaterWorld hydrological modeling, with a spatial resolution of 1km and baseline representing the mean water balance for 1950-2000. We identified spatial connections that facilitate service flows and highlighted ecosystems important to ensure continued benefits from freshwater services. This result offers an important basis for an exhaustive assessment of freshwater services in the country and is focused to support conservation and sustainable development policies.

CHANGES IN AMPHIBIANS' DIVERSITY ACROSS LANDSCAPES MODIFIED BY HUMANS IN NORTHEASTERN COLOMBIA

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The Neotropics are well known for harbouring high levels of biodiversity and endemism especially in the Andean region, considered of high value for conservation. However, there are communities of species that occur in a mosaic of habitats where increasing human activities such as deforestation, expansion of agriculture and climate change, have clearly modified the composition, diversity and distribution of wildlife. In this study we evaluated changes in amphibians' diversity across landscapes modified by humans, aiming to find the possible causes that have driven the biodiversity loss. We sampled in northeastern Colombia from 2011 to 2014 in 15 localities including different biomes (tropical dry forest, Andean forest, High Andean forest and Paramo). We estimated Shannon index of richness and diversity and applied multiplicative diversity partitioning (Alpha and Beta) to landscapes and types of biomes. We reported 59 species of amphibians (12 families, 3 orders). The highest diversity was found in the Andean forest and tropical dry forest; however, such biomes also presented the highest level of transformation into secondary forest, pasture and other types of vegetation, with modifications of more than 40%, which resulted in 60% of species showing significant decrease in their populations. Paramo and tropical dry forest showed the highest number of endemism with 3 and 5 species; nevertheless, the transformation of habitat in such biomes was estimated between 40% and 60%. The general decrease of amphibians' diversity in modified habitats can be explained as a consequence of the low adaptability and high sensitivity to changes in landscape in the majority of amphibian species. Therefore, we hypothesize that high rate of fragmentation could accelerate processes of local extinction. We recommend to plan and establishing zones that promote higher connectivity between forest fragments and the design of monitoring plans of the species reported in the study area.



THE EFFECT OF FISH DISPERSAL CAPACITY ON YIELDS FOR TERRITORIAL USE RIGHTS IN FISHERIES: CASE STUDIES OF CHILE, MEXICO AND JAPAN

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Territorial Use Rights in Fisheries (TURFs) have existed for centuries, and most of them have been established within the boundaries of traditional fishing grounds. However, TURFs are gaining more widespread attention as a potential tool for fisheries management in new sites around the world. This growing popularity belies the fact that there are still unresolved questions about the most effective TURF designs. One of the key questions is the role of TURF size on their efficiency both from ecological and social standpoints. Larger TURFs decrease the spillover of adults and larvae to surrounding areas and thereby create greater incentives for TURF owners to take actions that enhance yields in the future. This study explores the expected effect of TURF size on yields for TURF systems in Chile, México and Japan. We calculated the expected effect of larval dispersal and adult movement on yields for TURFs in each system with and without cooperation among neighboring TURFs. Our results show that the analyzed TURF systems fall into three main categories a) TURFs that have an adequate size to reduce the effect of the expected adult movement and larval dispersal, b) TURFs that are large enough to reduce the effects of the estimated adult movement, but are too small relative to the effects of the expected larval dispersal c) TURFs that are too small to reduce the effects of both the expected movement of adults and larval dispersal. We found evidence that under the last condition strong cooperation among TURFs occurs. These analyses improve the existing theoretical framework for TURF design. They also provide empirical evidence that complementary management tools can arise when natural and social constraints prevent the construction of TURFs of an optimal size.

IMPORTANCE OF MONITORING METHODS IN A RESTORATION PROGRAM OF AN ENDANGERED DIADROMOUS FISH: CASE STUDY ON ACIPENSER STURIO SUSTAINED POPULATION

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Acipenser sturio is a critically endangered species, the last natural reproduction occurred in 1994 in the Gironde (South West France) and a captive broodstock was constituted. Since 2007, the species benefits from a European recovery plan enhanced by national action plans; since then the population is sustained through stocking (>1.5 million juveniles released).

This is a long-lived species with late maturation that need long-term measures and associated monitoring to evaluate the efficiency of the stocking practice and the functionality of the population currently rebuilding. Monitoring a migratory species in the wild is a challenging task because movements between key habitats are frequent during the life cycle so either the monitoring covers all environments with substantial resources, either it needs to take place in an environment representative of the population functionality (i.e. growth or breeding habitat). Methods and tools involved in the monitoring need to be non-invasive with respect for the species endangered status. Several stakeholders are usually implied in a recovery plan but who is in charge of the monitoring depends of the local context: scientists or/and local managers? In our case study, monitoring undertaken on the long run consists of (1) incidental capture declarations by fishermen in the whole distribution area, the data gathered being coordinated either by representative of professional fishermen and scientists (2) scientific sampling with a consistent protocol in a key habitat, the estuary, relatively convenient to sample thanks to a specific methodology. Short term studies can be added to answer specific questions on life history traits using ad hoc tools (i.e. telemetry to assess migration pattern). Data interpretation called different disciplines such as behavioural science, population dynamics which illustrates the multidisciplinary of conservation biology.

101-TEMPORARY STREAMS: CURRENT MANAGEMENT CHALLENGES AND PROMISING SOLUTIONS

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Temporary streams are not only very common in arid landscapes, but make up the majority of river networks. Temporary streams support high biodiversity, and especially in arid landscapes have a crucial role on regional biodiversity. In fact, temporary streams contribute to the regional diversity through the aquatic biota, as well as through the terrestrial biota relying on them. Furthermore, temporary streams drive connectivity for terrestrial species at the regional scale. Temporary streams provide valuable goods and services, especially in arid landscapes through the provision of recreational and aesthetic information values. However, temporary streams are being buried or degraded at alarming rates owing to development, hydrologic alteration, disposal of waste water, etc. Temporary streams are also highly vulnerable to climate change, as predictions suggest that arid regions will receive less total rainfall and with higher inter- and intra-annual variation. The most important management challenge



is however that temporary streams are often managed as if they were permanent and, sometimes are even managed as terrestrial ecosystems. Proper management of temporary streams is only possible if good information on the spatial extent and status of temporary streams is available, but this is often not the case. Another current constraint for managers is the usual undervaluation of the ecological and economic values of temporary streams, given that these values are not widely understood by the public, landowners, producers, developers etc. Promising solutions for the current management challenges include that temporary streams (aquatic and associated terrestrial habitats) should be legally defined as part of the river network, and policies to protect them must recognize that flow intermittency per se is not a stressor but a natural component of the flow regime of many streams.

CONCENTRATION OF OCEAN CHLOROPHYLL-A ALONG THE MIGRATION ROUTE EXPLAINS THE POPULATION SIZE OF FRANKLIN'S GULLS (LEUCOPHAEUS PIPIXCAN) AND ELEGANT TERNS (THALASSEUS ELEGANS) IN CENTRAL CHILE

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Monitoring migratory bird populations over large geographic areas and extended periods of time can be a difficult and resource-demanding task. Because satellite technology offers a relatively inexpensive and verifiable means to gather environmental information at multiple spatial and temporal scales, it can become a very useful tool for the latter, provided that relevant relationships between populations and remote sensing data are found. The interannual variation in abundance and movements of long-distance migratory birds often depend on both local factors and those operating on a larger scale (e.g. climate, food production in the oceans). In this study we show how the distribution of two long-distance migratory birds depends on variables at continental scales. Using census data for three estuaries in central Chile (Itata, 36°23'S, 72°51'W; Mataquito, 35°07'S, 72°10'W; and Reloca 35°43'S, 72°35'W) from 2006 to 2014 (10 campaigns/year) we modeled the variations in summer (December-January) population sizes of the long-distance migrants *Leucophaeus pipixcan* and *Thalasseus elegans* in relation to physical variables along the Pacific coast of South America, such as the ocean temperature and chlorophyll-a concentration (MODIS/Aqua Ocean Color sensor), used as proxies for food availability. The best

models included a significant negative effect of chlorophyll-a concentration during the winter (June-July) in the coast of Northern Perú. Considering a time lag associated to the transformation of phytoplankton into seagull food, the latter result suggests that the primary productivity in the migration route may determine how far South will these species travel in search of food. These models allow us to reasonably predict the number of individuals who come to the coast of central Chile every summer approximately five months in advance, constituting a valuable tool to understand and manage the populations of migrant waterbirds.

THE EFFECTS OF HUMAN INFLUENCED STAND CHARACTERISTICS ON THE UNDERSTORY VEGETATION IN HUNGARIAN OAK DOMINATED FORESTS

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The uniform shelterwood system changes the natural structure and species composition of European temperate forests, creating homogenous stand structure, lower mixture ratio, more closed canopy and removed shrub layer in some cases. In our study we assessed the main factors influenced by human activity which affect the species composition of herbs and tree seedling assemblages. 332 sampling plots were selected in 40-160 year old, recently managed, formerly managed and abandoned *Quercus cerris* and *Q. petraea* dominated stands in North Hungary. Understory was surveyed in 28 0.5 m² sized circular subplots in each plot, where presence/absence data of species was recorded. Potential explanatory variables were the distance from forest edge and the nearest settlement, stand age, canopy closure, mixture ratio, diameter diversity of the overstory and density of low and high shrub layer. To explore the relationship between assemblages and explanatory variables we used Redundancy Analysis (RDA). Light-demanding herbaceous species (e.g. *Campanula persicifolia*, *Hieracium murorum*, *Poa nemoralis*) and sessile oak seedlings preferred oak dominated stands with opened canopy. Shade-tolerant and general forest herb species (e.g. *Fragaria vesca*, *Geum urbanum*, *Melica uniflora*) occurred in forests far from settlements where rich shrub layers, heterogeneous stand structure, high mixture ratio can be found. Seedlings of most shrub and some tree species (e.g. *Ligustrum vulgare*, *Prunus spinosa*, *Sorbus torminalis*) preferred rich shrub layers, while the seedlings of most frequent associate tree species (*Acer campestre* and *Fraxinus excelsior*) occurred in formerly managed or abandoned forests, with diverse overstory, away



from settlements. As a conclusion, to conserve our forest plant species we have to regard oak forests as complex habitats, where patches with rich shrub layer, heterogeneous stand structure and tree species composition, and the oak dominated, opened patches are also essential.

MEETING GLOBAL CONSERVATION TARGETS: CREATE NEW PROTECTED AREAS OR MANAGE EXISTING ONES?

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Protected areas are a central mechanism for conserving global biodiversity. However, there is debate around the extent to which protected areas contribute to the conservation of biodiversity solely through their establishment, highlighting the importance of active management within protected areas. Given limited conservation funds and shortfalls in funding for basic protected area management needs, a critical question is whether conservation funds are best spent on purchasing land for further expansion of the protected area system or managing existing established protected areas to an acceptable standard. We use a dynamic habitat model to integrate these two actions. In contrast to current conservation spending which is focused on protected area expansions, it can be optimal to manage the existing protected areas prior to purchasing new reserves. The relative priority of protected area expansion and management is influenced by the relative costs and rates of degradation associated with habitat clearing (addressed by protection) and other threats such as animal poaching (addressed by management). We develop an easy to interpret heuristic that integrates these factors and can be applied to the range of biodiversity threats faced by protected areas. Lastly we present an example of its application.

SETTING CONSERVATION MANAGEMENT THRESHOLDS USING A NOVEL PARTICIPATORY MODELLING APPROACH

Prue Addison

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We introduce a participatory modelling approach for setting management thresholds, which represent when management intervention is required to address undesirable ecosystem changes. This approach was designed to assist when management thresholds: must be set for environmental indicators in the face of multiple competing objectives; need to incorporate scientific understanding and value judgments; and, are set by participants with limited modelling experience. The approach was tested in a workshop, where participants

set management thresholds for the alga, *Hormosira banksii*, to address the threat of trampling by visitors to an intertidal marine protected area. The approach involved trading-off the environmental objective, to maintain the condition of intertidal reef communities, with social and economic objectives to ensure management intervention was cost-effective. Ecological scenarios, developed using scenario planning, were a key feature that provided the foundation for where to set management thresholds. The scenarios represented plausible future states of *H. banksii* that may occur under increased threatening processes. Participants defined four discrete management alternatives to address key threats, and estimated the consequences of alternatives on objectives under each ecological scenario. Weighted additive model outputs express uncertainty, which can be explored and used to inform where to set management thresholds. This approach encourages a proactive form of conservation management, where management thresholds and associated management actions are defined a priori for ecological indicators, rather than reacting to unexpected ecosystem changes in the future. We discuss the application of this approach to protected area adaptive management, in particular the Reef 2050 Long-Term Sustainability Plan, which is the most recent government initiative designed to guide adaptive management of the Great Barrier Reef World Heritage Area over the next 35 years.

PREFERENCE OF LOCAL INITIATIVES IN CONSERVATION OF NATURAL RESOURCES AT YAKARI GAME RESERVE

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Local conservation initiatives had been in use by conservators since early 1990s. The major aim is to replace the state-driven conservation methods with locally driven ones. Local conservation initiatives largely originate from the rich culture of communities surrounding the protected area. Through a discourse analysis, semi-structured interviews were held with eleven groups of key informants. Ten of the communities surrounding the Game Reserve were selected through a random sampling technique. Structured questionnaires were administered to 350 community residents selected through purposive sampling technique to determine the implications of local initiatives in conservation compared with state-driven conservation. The result analysed mainly through descriptive method revealed that local initiative driven conservation technique leads to less conflict between protected area and communities; and better conservation output. Majority agreed however that integration of state-driven conservation methods and local initiative driven method would be most applicable. The role of NGOs collaborating with the park system in integrating procedure was emphasised.



DYNAMICS OF THE PARASITIC (VARROA DESTRUCTOR) IN COLONIES OF APIS MELLIFERA INTERMISSA IN THE MEDITERRANEAN CLIMATE OF ALGERIA

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Population dynamics of *Varroa destructor* were studied for two years (March 2012–March 2014) in 12 *Apis mellifera intermissa* colonies located in Blida (center of Algeria).. The number of bees, the amount of open brood and capped, daily natural mortality, level of infestation of adult bees and level of infestation of the brood, was monitored. The brood cycle and behavior of reproduction in *Apis mellifera intermissa* is set by exceptional and seasonal contrasts in climate: dry summer (June to September), with an almost complete stop brood. Autumn, relatively wet causes a second peak of activity and brood development. The values of the infestation rate of brood and bees show two peaks in August (29 % and 12.5%), this period when there is less of bees and brood in the colony. In all colonies, the population of *Varroa* presented during the spring curve of exponential growth, which is explained by the continued presence of brood. In the growth phase, followed by a collapse of populations of mites, which in our experimental conditions, occurred from early summer, along with a weakening of colonies phase. Successive brood cycles allow the population growth of *Varroa*, while the absence of brood during the summer months has the opposite effect of reducing populations of *Varroa*. It appears that the level of *Varroa* infestation in colonies varies according to climatic conditions (seasonal) and internal conditions of each colony. In Mediterranean climates of Algeria, the milder winter climatic conditions and the possibility to collect food resources during a considerable part of the winter account for the permanent brood-rearing activity of honey bee colonies, which is relevant for the intrinsic growth rate of *Varroa* in these regions.

DETERMINATION OF TRACE METALS LEVELS IN SEAWATER AND ZOOPLANKTON IN THE MOROCCAN ATLANTIC COAST

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In the marine environment, trace metal elements were mainly found as metal cation form in the dissolved, colloidal and particulate fractions. Their toxicity is largely related to their concentrations in the dissolved and particulate phases of seawaters. However, this micropollutants are accumulated in marine organisms of higher trophic level including zooplankton community. Zooplankton are very abundant and play a very important role in the marine food chain. Therefore, they can contribute to the transfer of trace metals to higher trophic levels due to their significant capacity to bioaccumulate metals from their food, as well as from seawater. The Moroccan Atlantic coast; which represents our study area; is mainly influenced by upwelling and anthropogenic micropollutants input. These two factors contribute to increasing the availability of trace elements in surface waters, thus they promote their availability for zooplankton. For this reason, this work aims to ascertain the level of trace metals in water (Cd, Pb and Cu), in particulate matter and zooplankton (Zn, Mn, Pb, Cu, Cd, Cr, Co, Ni, Fe and Ba), along the southern area of Atlantic coast off Morocco. Seawater and zooplankton samples were collected in December 2013, at 28 stations; from Sidi Ifni to the south of Dakhla (23  40'N); and all stations were located on transects perpendicular to the coast. The analysis of trace elements in dissolved phase is performed by chrono-potentiometry, and then the concentrations of trace elements in particulate phase and zooplankton were determined by inductively coupled plasma mass spectrometry. In the three compartments, the results showed that the concentrations of trace metals are increasing going from the north to the south part of the study area. We also noticed a variation in levels of contamination between the three compartments, thus the highest concentrations are recorded in zooplankton community.

PRELIMINARY STUDY OF TOMATO ROOT EXTRACT AS A POTENTIAL ECOLOGICALLY-FRIENDLY FUNGICIDE AGAINST TWO DECAY FUNGI IN WOOD

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Many wood species in Nigeria have good utilization potentials and under proper conditions, they would give centuries of service; however no timber species is immune to deterioration and disintegration if sufficiently exposed to long period of atmospheric conditions and different wood rotting organism. For most wood decaying fungi, wood offer abundant food reservoir, fungi cause more loss of wood than other biotic agents. Bamboo, an important group of woody- stemmed perennial plant and substitute for timber species was used to determine the fungicidal effect of tomato root extract against two decay causing fungi in wood. This investigation used extract of *Lycopersicon esculentum* root as test preservative agent against two decay fungi in the test blocks of *Bambusa vulgaris*. Five levels of the extract were formulated -0%, 25%, 50%, 75% and 100%. The test blocks were incubated with *Podoscypha bolleana* and *Lenzites palisoti* for twenty- one days after dipping inside the test preservatives at different concentration. The results obtained showed that *Podoscypha bolleana* exclusively caused more loss at 18.15% while *Lenzites palisoti* caused 17.65%. it was also observed that the untreated test blocks yielded more weight loss than the treated and the weight loss progressively became lower as the concentration increased. The data were analyzed using two- way analysis of variance and it was revealed that there was no significant difference between fungi and the extracts at 0,05% probability level. It was however recommended that active fungi-toxic ingredient in tomato roots should be identified and isolated for effective development and use as an eco- friendly wood preservative as conventional preservatives have adverse effects on users and environment alike.

BIODIVERSITY, BIOPIRACY AND BENEFITS TO THE INDIGENOUS PEOPLE IN CAMEROON

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An almost unprecedented amount of discussion has been stimulated on the merits and demerits of genetic engineering of crop plants, and has divided both the public and scientific communities. The arguments for and against genetic engineering are invariably based on visions of the new technology from widely different ethical perspectives. Fundamental issues of man's relationship with nature and the environment, and theological matters are issues of concern. The genetic engineering of living cells, plants, animals and human beings has brought ethical concerns and issues to conservation of biodiversity. Agricultural productivity depends in part on the availability of biodiversity for the development of improved cultivars. Until the 1970s, biodiversity was considered to be part of the "common heritage of indigenous people." Under this regime, biological resources are treated

as belonging to the public domain and are not owned by any individual, group, or state. The paper will address the link between biodiversity and biopiracy its benefit to indigenous people in Cameroon. Whether biopiracy is an antithesis to the conservation of biodiversity? The paper will examine biodiversity conservation, national and international legal framework relating to biopiracy activities if they are beneficial. It will also highlight the on-going debate in the areas of environmental protection, exploitation, risk, benefit sharing and acceptance, and intellectual property rights. The paper will end with a conclusion and some recommendations.

PHENOTYPIC DIVERSITY OF PHILIPPINE ABACA (MUSA TEXTILIS L. NEE)

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Abaca or Manila hemp is a close relative of banana that is cultivated for the fibre that can be extracted from its stalk. In Southern Mindanao in the Philippines, three abaca strains viz. Maguindanaon, Tangongon, Bongolanon are cultivated by farmers under diverse ecological conditions in the mainland. For this study, In situ characterization was done using six quantitative and twenty five qualitative morpho-agronomic traits. The dendrogram generated from cluster analysis showed the formation of two main clusters and highlighted the morphological divergence of 2 Maguindanaon strains from the remote uplands of Tboli. This divergence is further supported by purplish sap color of these varieties in contrast to the white sap color of other varieties. Morphological homogeneity was, however, noted for the first cluster implying uniformity for traits evaluated. These results imply low variability for the crop and this could have disastrous consequences vis a vis its survival in the field amidst threats posed by viral infestation, habitat degradation and global climate change. Interventions should therefore be undertaken to conserve remaining abaca population stands and to infuse new genes to the narrowing genepool of the crop.

49-FROM POLLINATION TO PLANT OFFSPRING QUALITY: WHAT IS LEFT AFTER SEX IN FRAGMENTED HABITATS?

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Sexual reproduction in flowering plants represents a key process for their long-term population viability as it provides the opportunity to maintain or to increase genetic diversity and



thus the evolutionary potential to adapt to new and changing environments. Moreover, sexually produced seeds represent an independent dispersal phase of a new unique genotype readily to colonize new habitats. To accomplish sexual reproduction, plants need mobile vectors to transport pollen grains to conspecific stigmas, which may be a risky endeavor in current changing landscapes scenarios. The loss and fragmentation of habitats by human activities are pervasive phenomena in terrestrial ecosystems and represent today the main driving forces behind biodiversity loss. Due to the key importance of angiosperm diversity for ecosystem functioning, much research has been conducted over the past several decades to assess the effects of anthropogenic habitat loss and fragmentation on the processes and interactions involved in sexual plant reproduction. Here, by means of separate meta-analyses, I present estimates of overall habitat fragmentation effects on bee pollinator fauna, pollination, plant fecundity, plant genetic diversity and offspring quality across an extensive sample of angiosperms worldwide. By estimating fragmentation effects on each of these processes, from pollination to offspring quality production, we may be able to detect the critical or more vulnerable steps in sexual plant reproduction. Finally, I explore how certain life history and ecological traits of plants can moderate the magnitude of fragmentation effects. The global response patterns observed here are important for plant conservation, as they imply that first-hand information on certain plant traits may allow us to rapidly detect potential reproductive susceptibility to habitat fragmentation.

A COMPARATIVE ANALYSIS OF TOURISM ORIENTED MODELS FOR CONSERVATION AND DEVELOPMENT; LESSONS FROM UGANDA

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Striking a balance between biodiversity conservation and community development remains a key challenge facing the developing world. Reflecting the neoliberal rhetoric of market engagement to conserve nature, nature based tourism was incorporated as a crucial conservation and development tool in Uganda. Proponents of this approach argue that it offers 'win-win' outcomes for conservation and development by generating tangible benefits (employment, income, local markets, catalysing local enterprises, donations etc) that compensate for costs and create incentives for communities to conserve. Private-Community Partnership (PCPs) and Direct community engagement in enterprises have been the main models applied to enable tourism to work for community development and hence an incentive for conservation. In the current paper, we analyze and compare the introduction, implementation and implications of these two models in

Uganda. We demonstrate that while the PCP model leads to an enhanced flow of revenue for community projects, it is also associated with a number of problems including unequal sharing of generated profits leading to huge leakages from the local economy, the creation of conflicts among the community, limited community engagement, and hence low levels of buy in by the majority of community members. On the other hand, the direct community engagement model is more engaging to communities, creates more linkages within the local economy, and creates a sense of ownership, but generates less revenue for sharing schemes. We conclude that if inherent governance issues, market challenges and skills gaps were addressed, the direct community engagement model would be a more effective tool for delivering conservation benefits to communities. Key words: Private-Community Partnerships, Conservation enterprises, Uganda, Wildlife

FROM RHETORIC TO REALITY: INTEGRATING IMPACT EVALUATION IN THE DESIGN, IMPLEMENTATION AND ADAPTIVE MANAGEMENT OF MARINE PROTECTED AREAS

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Impact Evaluation is gaining momentum in the conservation sector and has already generated novel insights into ecological impacts of terrestrial protected areas - though it has yet to be applied to Marine Protected Areas (MPAs). Marine conservation strategies often allocate considerable resources towards MPA establishment with the expectation they will provide fisheries as well as biodiversity benefits. While the "reserve effect" has been robustly shown, generating a sufficient evidence base to inform marine conservation efforts across geographies and scales will require the sector to mainstream impact evaluation techniques, bridging the current mismatches between and evaluation. Here, we describe integration of impact evaluation in an ongoing monitoring program in a network of MPAs in the highly biodiverse Bird's Head Seascape (BHS) in West Papua, Indonesia. Specifically we (1) highlight the challenges of implementation 'on the ground' and in a marine system; and (2) the transformation of an existing monitoring program into an impact evaluation appropriate design. Insights from the BHS suggest that impact evaluation can be embedded within performance measurement systems, enabling ecological monitoring efforts to simultaneously inform adaptive management and conservation policy.



DEVELOPING BANGLADESH'S FIRST "WALL-TO-WALL" FOREST COVER AND FOREST COVER CHANGE MAP

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An important component of forest management and monitoring for REDD+ and other programs is the monitoring, reporting, and verification of forest cover and forest cover change. In Bangladesh, a "wall-to-wall" map of forest cover change has never been completed. To address this data gap, USAID is funding a forest cover change map through the U.S. government SilvaCarbon program. The Bangladesh forest cover product is a joint USAID-SilvaCarbon-Bangladesh Forest Department project whose goal is to map the spatiotemporal dynamics of forest change in Bangladesh through the use of multi-temporal satellite data. The series of multi-temporal data from the Bangladesh project is a useful contribution to many environmental and planning projects including the Bangladesh REDD+ program. The Bangladesh forest cover products and publications made use of an automated "wall-to-wall" remote sensing method, developed jointly by South Dakota State University and the University of Maryland, and incorporated thousands of Landsat ETM+ images. Given the landscape heterogeneity of Bangladesh the team acquired and pre-processed RapidEye imagery to systematically validate the Landsat-derived product. This project demonstrates how a global forest product can be adapted to create important national and subnational forest cover and forest cover change maps at low cost, and that can be used as a basis for other national forest monitoring systems and other forest management and monitoring practices. The forest cover change maps is a foundational piece of future work that adds additional information regarding forest structure and biomass, in particular for mangrove forests of the Sundarbans, where field measurements have already been carried out.

WIDESPREAD SPECIES ARE RELATIVELY UNINFORMATIVE IN CONSERVATION PLANNING

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Considerations of efficient resource allocation are essential not only during prioritizing a set of conservation actions, but also

when planning for data collection. Costs may vary with the type of information collected. For example, distribution records of species with small geographic range sizes are more costly to obtain on a per capita basis, while those of larger-ranged species are relatively less costly. Here we investigate the relative influence of small and large range size species distribution data in spatial prioritization. We assessed how the number of species meeting conservation targets increased with the cost of records used for selecting areas to be conserved, using a simulation process that for each species sequentially selected areas for conservation to meet a species-specific representation target. We used the latest database on the distribution of threatened plants in Japan, which has records at 10 km x 10 km spatial resolution for 1630 species. We discovered that entering species into the model in rank order from small to large range size always outperformed a model where species were ranked in the opposite order. Moreover, the former always had lower total area needed to meet the conservation targets. Similar results were obtained using the Marxan optimization algorithm, and results are problem driven by a smaller mean overlap among species' distributions with smaller range size. Results suggest that distribution records of large-range species are of less importance than smaller-ranged species, hence, in limited budgets, their omission would not significantly change the outcome of the conservation prioritization process.

TRADE IN ENDANGERED SPECIES OF WILDLIFE: A CASE OF LAGOS, NIGERIA

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Trade in endangered species of wildlife constitute a potential threat to biodiversity conservation in Lagos Nigeria. The market growth for bush meat and wildlife trophy collection is gradually leading to a decline in animal population. A 4-month survey was carried out in four black market sites predominantly known for ivory and wildlife trade namely: Ikorodu, Oyingbo, Lekki and Badagry to investigate the activities of illegal wildlife traders in Lagos, Nigeria. The study showed that bush meat and ivory trade flourishes in some parts of Lagos State alongside with woodwork and beadwork as cover ups in hotels where they are easily accessible to foreign buyers. Ivories are sold secretly to customers in order to avoid arrest. Skins of python, Leopard, antelope and monitor lizards which artisans use in design of shoe, belts, bag are available in Lekki, Oyingbo and Badagry market while head of primates such as monkey, gorilla and chimpanzee are also displayed in Ikorodu market without impunity. Endangered species of birds such as grey parrot and many others are sold along the Lagos bar beach in amount ranging from \$32 to \$133. Tusks of elephants, warthog and rhinoceros are traded



in disguise as souvenirs like combs, key holders, bangles, rings, and cigarette holder, animal and human figurine for easy patronage and smuggling. The study identified Lagos as both the local and international trade route for illegal wildlife trade as foreign syndicates easily smuggle wildlife exploiting the porosity of the sea ports and border towns in Lagos state. The study concluded that illegal ivory and wildlife trade is real in Lagos and requires urgent attention as most animals sold in Lagos market do not comply with the convention of international trade in endangered species (CITES) as animals listed in appendix 1 and 2 are still sold without fear of punishment.

HUMAN-TIGER CONFLICT IN SUNDARBANS, BANGLADESH: UNDERSTANDING PATTERNS AND PROCESSES

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Sundarbans, the largest contiguous tract of mangrove forest in the world, is also infamous as the human-tiger conflict capitol. This region has seen some of the most intense forms of human-tiger conflict, mainly in the form of human injuries and fatalities inside the forest, and stray tiger incidents and livestock depredation outside the forest. The loss of human life leads to increased hardship for already desperately poor local people and causes negative attitudes towards tigers, who are also at the margin of extinction-vortex due to various anthropogenic threats in this unique habitat. We collected and analyzed the human-tiger conflict data for a period of seven years (2008-2014) from Bangladesh Sundarbans. We present an exploratory analysis of this data followed by a spatial analysis to identify the patterns of conflict hot-spots. After this we explored various ecological and socio-economic factors in and around Sundarbans to get a better understanding of the cause of human-tiger conflict. We also present the community based efforts practiced by WildTeam to reduce and mitigate human-tiger conflict in this region.

IDENTIFICATION OF GEOPHYSICALLY DIVERSE LOCATIONS THAT MAY FACILITATE SPECIES' PERSISTENCE AND ADAPTATION TO CLIMATE CHANGE

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Conservation of geophysical diversity has been proposed as a strategy for conserving species diversity and facilitating adaptive capacity of species in the face of changing climate. Existing protected area networks may not correspond to the most geophysically diverse places because they have typically not been selected on this basis. Our objectives were to characterize geophysical diversity across the southwestern United States, assess the sensitivity of our results to methodological choices, and assess the degree to which the existing protected areas network in this region captures geophysically diverse places. We classified the region into geophysically distinct units (land facets) on the basis of topographic and edaphic variables. We calculated land facet diversity on the basis of multiple classification methods, thematic resolutions, and spatial scales (i.e., spatial grain and neighborhood size), assessed the sensitivity of land-facet diversity estimates to these methods, and integrated the results to provide a multi-scaled estimate of geophysical diversity. We used Gap Analysis to assess the protected status of particular land facets and lands with high land-facet diversity. Land facet diversity estimates were more sensitive to spatial scale than to methods used, but results based on different methods or spatial scales typically were highly correlated. Our results indicated several key gaps exist in the southwestern protected areas network, particularly in productive soil types at middle elevations. Our analytical approach can provide guidance for identifying and prioritizing locations that may facilitate species' capacity to adapt to global climate change.

CURRENT AND POTENTIAL DISTRIBUTION OF THREATENED AMPHIBIANS FROM THE EASTERN CORDILLERA IN COLOMBIA AND ITS IMPLICATIONS FOR CONSERVATION

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Colombia is considered a megadiverse country in terms of amphibians; nevertheless, very few studies have concerned their natural history, distribution, ecology and diversity, and all of them have overlooked the assessment of levels of threat. We analysed historical occurrence records of 60 species of amphibians listed under any category of threat from the Eastern Cordillera of Colombia, a region with severe lack of information regarding diversity and conservation status. We determined the current distribution and conservation status using GIS to associate layers of land cover, land use, as well as presence and absence of protected areas. To obtain the potential distribution of the species we applied the maximum entropy algorithm for distribution models, using 19 climatic



variables. The majority of threatened species of amphibians belong to the families Craugastoridae and Bufonidae; moreover, the latter has the most of species in the category CR. The analysis of protected areas resulted in only 20 species occurring in at least one area under protection, specifically in 8 out of 20 natural parks and 8 out of 111 natural reserves, which contrasts with the remaining 40 species that occur in areas highly affected by vegetation loss, especially the middle and southeastern regions of the cordillera where more than 60% of the original forest has disappeared. Estimation of potential distribution showed that mean annual temperature along with mean values of precipitation are the variables that better describe the obtained models, with which the northeastern resulted in the region that presented favourable climatic conditions and also the highest number of protected areas that could support remaining and emerging populations of amphibians. Therefore, we identify the necessity of establishing monitoring programs that run periodically, as well as implementing ecological restoration and promoting sustainable land use, in order to identify and propose priority conservation areas.

CAN SATELLITE-DERIVED ECOSYSTEM FUNCTIONAL TRAITS ANTICIPATE SPECIES SHIFTS?

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In a world facing rapid environmental change, anticipating potential impacts of habitat change on biodiversity is of utmost relevance. Remote sensing-based Ecosystem Functional Attributes (EFAs), such as primary production dynamics, are promising predictors for Species Distribution Models (SDMs) by offering an integrative response of vegetation performance to environmental drivers and changes. This way, species responses can be linked to pressures on ecosystem functioning. In addition, biodiversity monitoring may benefit from considering EFAs since they show a quicker response to environmental changes than structural or compositional attributes (e.g. land-cover or species richness). Our objectives were to assess whether the performance of SDMs improves with the inclusion of remote sensing-based EFAs, and whether observed trends in EFAs can be used as early-warnings of potential species range shifts. Four sets of models were compared for 41 threatened and rare plant species in the Iberian Peninsula with these combinations of predictors: 1) only climate, 2) climate and land-use, 3) climate and EFAs, and 4) only EFAs. For sets 1-3, SDMs were fitted considering 2001 as baseline, and projected under scenarios of climate change for 2020. Changes in EFAs

during 2001-2013 were used to explore whether the range shifts predicted by the climate-based models (set 1) for 2020 could be anticipated by using the 2001-2013 trends in the EFAs-based models (set 4). We demonstrated, based on a large number of plant species covering all IUCN categories, a positive effect of remote sensing-based EFAs on SDMs performance and on their effectiveness to anticipate species responses to environmental changes. Our approach highlights the potential role of EFAs in the early-warning of range shifts as well as the detection of short-term fluctuations in suitable conditions, thus improving the overall effectiveness and utility of biodiversity monitoring for policy and management applications.

24-NAVIGATING GOVERNANCE NETWORKS FOR COMMUNITY-BASED CONSERVATION IN A MULTI-LEVEL WORLD

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Community-based conservation initiatives are embedded in multi-level governance networks with diverse and emerging actors. While network governance can facilitate coordinated action, social learning, and experimentation, conservation actors need to be critical and reflect upon the broader social, institutional, and relational context in which they work. Here, we identify and outline five 'waypoints' intended to help conservation actors 'know their networks' and to consider more systematically the relational ties and network structures that influence conservation efforts. The waypoints we highlight provide a reference for how conservation initiatives are framed, the network dimensions that may be of interest, choices available to analyze networks, and the embeddedness and nestedness of networks. At each waypoint there are certain decisions to be made, and these decisions lead towards certain analytical pathways. This is not to suggest that there is a singular pathway that must be followed. Rather, we emphasize that choices at each waypoint have implications on the types of networks that are perceived, which in turn reveal certain aspects of the social relationships that affect community-based conservation initiatives and influence desired conservation outcomes.

IMPOVERISHED BIRD FUNCTIONAL DIVERSITY IN TROPICAL FOREST FRAGMENTS ON HUMAN-MODIFIED LANDSCAPES

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Tropical forests are considered a key component to maintenance of Earth biodiversity. However, much of tropical wooded biomes were converted to human-modified landscapes (HML), which generated small and isolated forest fragments surrounded by agricultural matrix. Considering the growing interest by ecologists to assess the potential ecological services provided by these fragments in HML, we evaluated the current bird functional diversity (FD) in eleven Atlantic Forest fragments in southeast Brazil. Three large fragments (230, 251 and 1451ha) are protected, while eight small have no protection (3 -115ha). We considered bird data from our one year of complete sampling (mist nets and point counts) in the small fragments and recent data of bird monitoring in the larger ones (data published in literature). Habitat preference, foraging guilds, foraging strata, sensitivity to disturbance and body mass were used as traits to calculate FD. We found higher FD values in the large fragments and low values in the small fragments, which resulted FD values highly correlated with fragment size (adjusted- $R^2 = 0.9457$, $F = 175.1$, $p < 0.001$). The absence of some specialist/sensitive species, e.g. large frugivorous and understory insectivorous, explains the low FD values in the small fragments. Since HMLs are commonly found in many parts of the Brazilian Atlantic Forest domain our results warn for a birds' functional impoverishment in the small fragments. Although the use of functional traits improves the bird assemblages' assessment in fragments, they are not being considered by managers in conservation plans of HMLs.

ECOSYSTEM SERVICES, INCOME AND HUMAN WELL-BEING AMONG RURAL COMMUNITIES

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Land use changes impact on both ecosystem services and income, key factors on human well-being. To understand the weight of each factor on well-being among rural poor communities, we evaluated the (dis) similarities of the associations between variation of well-being against changes on the provision of ecosystem services and changes on income. We used empirical data from rural households from Pelluhue district, central Chile. Landscape in Pelluhue changed since 70s, currently being dominated by monoculture plantations of Monterey pine. The introduction of pine plantations triggered a decrease of water and fruit provision for local people. Among 77 rural households -most of them under poverty line-, we evaluated their perceptions of i) variation of well-being (outcome variable), and changes on ii) water provision, iii) fruit

provision, iv) surface of native forest, and v) household income (explanatory variables). We prompted informants to compare current conditions with those of 2 decades ago. Answers were reported using a Likert scale. We ran multivariate regressions to test associations between outcome and explanatory variables. We found that a decrease on well-being is associated to a decrease on both of surface of native forest available (coefficient=0.11, $p=0.04$) and the quality of water provided by them (coefficient=0.15, $p=0.05$). No association was found between variation of well-being and change on provision of fruits and quantity of water. Variation on well-being was not associated to changes on income, at least at the levels they have change over the last 20 years. Our results suggest that human well-being of poor rural communities are more affected by changes in ecosystem services than variation in income. (Funded by Fondecyt N 3140487)

THREATS TO BIODIVERSITY IN PAKISTAN: A CASE STUDY OF RARE AND ENDEMIC PLANTS IN CHITRAL VALLEY

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Biodiversity loss is a global issue but the reasons responsible may be addressed on local scale. Likewise, health of any ecosystem can be analyzed by the richness of its rare and endemic taxa. Out of total of 4758 vascular plants documented in Flora of Pakistan, 400 are endemic, among which 52 are endemic to Chitral valley. Upon critical analysis of the population size, Extent of Occurrence (EOO) and Area of Occupancy (AOO) for three consecutive years, 52 plants are assessed, according to the IUCN Red List Categories and Criteria. As a result, 4 taxa are categorized as Critically Endangered, 11 are Endangered, 12 are Vulnerable and 25 are data deficient. The reasons of endangerment of these rare and endemic plants of Pakistan include population pressure, poverty, lack of land use plans and lack of enforcement of the existing rules. Majority of these rare and or endemic plants (i.e. 65%) are used traditionally for various ailments. These plants are mostly collected by children, lacking proper knowledge regarding pre and post harvest methods, as a result major portion of the collected plants are wasted. Mainly nomads, Ajars and Gujors (nomad tribes), are the resource users, because, they are now exploiting the habitats of these high altitude plants, whereas, previously they were residing at lower altitudes. In addition rapid infrastructural development (roads, buildings), pollution, the destructive activities of massive influx of Afghan refugees also contribute in threatening the resources. It is expected that the present data will provide a comprehensive understanding of the most critical factors currently influencing depletion of rare and endemic plant



species and aid in improving the effectiveness of mitigation measures to reduce them.

A COMPARATIVE ASSESSMENT OF CLIMATE CHANGE EFFECT ON SOME OF THE IMPORTANT TREE SPECIES OF HINDU-KUSH HIMALAYAS, USING PREDICTIVE MODELLING TECHNIQUES

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A comparative assessment of the effect of global climate change on some the ethno-medically and socio-economically important tree species was carried out in the Hindu-Kush Himalayan mountains. The primary study site chosen was the Swat Valley of Northern Pakistan, which is a unique biodiversity hotspot supporting some important ethnomedicinal plant species. The species assessed for the future climate change effects were: *Acacia modesta* Wall., *Abies Pindrow* (Royle ex D.Don), *Pinus wallichiana* A. B. Jackson, Royle and *Taxus baccata* L. The Maximum entropy (MaxEnt) modelling technique of species prediction and distribution was used, applying HADCM3 (Hadley Centre Coupled Model, version 3) which is a coupled atmosphere-ocean general circulation model (AOGCM) and A2a global climate change scenario. Results suggest that by the year 2080, there will be a significant change in the distribution and density of these species. It was found that *Acacia modesta* will have significantly higher density, expanding to the southern and central parts of the Valley, i.e. the lower basin of Himalayas. The remaining three species have produced opposite results to *Acacia modesta*, as they will significantly reduce in their density and restrict in their distribution in the Valley. The results show that all species will have altitudinal movement to the northern cooler climatic regions of the Himalaya/Hindu-Kush. Results related to the validity of the models indicate "good model" for all species in both present and future predictive models attaining very high AUC values, i.e. 0.989, 0.98, 0.95, and 0.961 for training data for *Acacia modesta*, *Abies pindrow*, *Pinus Wallichiana*, and *Taxus baccata*, respectively. These changes will alter the socio-ecological environment of the fragile Himalaya-Hindu-Kush Mountains which can ultimately result in food and medicine scarcity.

MORPHOMETRICS AND URBAN ADAPTATIONS OF ASIAN PIED MYNA (STURNUS CONTRA) IN RAWALPINDI CITY, PAKISTAN

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Asian Pied Myna (*Sturnus contra*) was first reported in Pakistan at Changa Managa forest plantation in Kasur District in April 1982. Recently, a shift in the populations of pied myna (*S. Contra*) from rural to sub-urban and urban habitat has been noticed. Present study was designed to investigate the extent of expansion of population of pied myna in urban areas of Rawalpindi. For this purpose we conducted rekey surveys to find the potential habitat of pied myna (*S. contra*) and identify its seasonal population trends in the city. A total of five different sampling sites were identified for survey and periodic monitoring. Total these sites mainly consists of human settlement areas where marshes formed by the sanitation water. Point count method was used to estimate the population at selected site and observation was made through binocular (250x) for a period of a whole year. A high concentration of *S. Contra* was observed during the month of November (12.08 ± 1.01), December (12.08 ± 1.01), January (12.08 ± 1.01) and February (12.4 ± 1.16) suggesting some migratory influx during winter months. The average observed population of pied myna was (9.46 ± 0.86) throughout the city. During the whole study period, a stable population of 3-4 pairs at each study site was observed at sites which prefer to developed nest on electric and telephonic poles, feed upon dumped house garbage and animal dungs. Average morphometrics of ten captured individual was as: total length ($23.83 \text{cm} \pm 0.23$), tail length ($7.13 \text{cm} \pm 0.13$), beak length ($2.63 \text{cm} \pm 0.04$), and average weight ($82 \text{g} \pm 1.73$). It is predicted that alongwith feeding and nesting opportunities, marshy vegetation in urban open spaces and hiding places developed in urban construction which provide cover attracts *S. Contra* to adopt in urban environment and it may extends with urban expansion in the coming years.

DO SEX DIFFERENCES INFLUENCE THE ACCURACY OF POPULATION VIABILITY ANALYSIS? THE EXAMPLE OF SURVIVAL RATES IN SPARROWHAWK (ACCIPITER NISUS) IN TWO POPULATIONS IN THE UK.

Alix Aliaga

University of Southern Denmark



Fernando COLCHERO, University of Southern Denmark ; Owen JONES, University of Southern Denmark ; Dalia A. CONDE, University of Southern Denmark

Understanding how survival differs between sexes and among populations of the same species is fundamental for wildlife conservation and management. Demographic studies of wild populations have been challenged by the scarcity of long-term datasets and the difficulty of ageing individuals in the wild. Nevertheless, it is important to understand how differences in survival between the sexes and among sites contribute to overall population growth and species survival. In this work, we focus on sex and site differences in survival for the sexually dimorphic Eurasian sparrowhawk (*Accipiter nisus*) in two Scottish populations. Our dataset was obtained from the Long-term Individual based Time Series (LITS) project and collected by the British ornithologist, Ian Newton. It has the advantage of being a long-term study with a large number of individuals with age and sex information. We used BaSTA (Bayesian Survival Trajectory Analyses) to compare survival rates when we account for sex and site differences. Our preliminary results show that there are age-specific survival differences among sexes and location. Based on these results we test how the accuracy of a Population Viability Analysis (PVA) changes when we account for sex- and site-differences in survival. Although this is a study from only one species, we consider that it is fundamental to further explore how the accuracy of PVAs can change if we incorporate sex differences in demographic behaviour, which can be key for the management of species with sexual dimorphism.

HOW CAN AGRI-ENVIRONMENT SCHEMES COMPLEMENT SEMI-NATURAL HABITAT IN PROTECTED AREAS?

Jamie Alison

University of Liverpool

Simon DUFFIELD, Natural England ; Michael MORECROFT, Natural England ; Rob MARRS, University of Liverpool ; Ilik SACCHERI, University of Liverpool ; Jenny HODGSON, University of Liverpool

Protected areas may be the most important conservation investment to reduce the rate of biodiversity decline. They ensure the persistence of large areas of semi-natural habitat (SNH), and generally support higher abundances of species than the surrounding landscape. In many parts of the world agri-environment schemes (AES) are also implemented to make agricultural land less hostile for wildlife; this process is sometimes referred to as "softening the matrix". Recent research has made it clear that biodiversity responses to AES are mixed across different taxa and regions. The impact of AES management is also dependent on the landscape context. To target AES effectively we need to know whether improvements

over their conventional counterparts are greater when they are well connected to SNH in protected areas. We have tested whether connectivity to SNH improves the effectiveness of AES using a novel field study in north-west Hampshire, UK. Moth surveys were carried out on calcareous grassland reserves and on four ~3km transects running into the arable matrix, sampling both AES and conventional arable field margins. Whilst arable farming clearly decreases macro-moth abundance, our results show substantial overlap between communities on SNH and those on surrounding arable land. We find that a certain proportion of species particularly benefit from SNH, and that connectivity to SNH dictates the effectiveness of AES management for these species. We conclude that to maximise the abundance of specialist macro-moths, investment into AES margins would be optimally allocated close to patches of SNH. However, allocating AES in such a way would not be without its costs. Interestingly, agricultural land at high connectivity to SNH, whether AES or not, is associated with an increased abundance of both specialist and non-specialist insect species. Agricultural management should therefore be considerate of this fact.

HIGH ELEVATION ENDEMICS AND CLIMATE CHANGE: THE FUTURE OF RARE LICHENS IN THE SOUTHERN APPALACHIANS

Jessica Allen

The New York Botanical Garden/The City University of New York Graduate Center

High elevation species worldwide are increasingly threatened by mountain top extinction. The southern Appalachian Mountains, one of the most biologically unique and diverse region of North America, is no exception. An increasingly large body of literature is emerging that documents this pattern. Mountain top extinction in this region warrants considerable attention as it is a threat to many biological communities and species. Lichens, symbioses between fungi and algae, are particularly abundant and diverse in the southern Appalachians, including a number of species that are narrowly endemic to the high elevations. In this study, I documented the current distributions of nine endemic lichens throughout the high elevations in the southern Appalachians and used niche modeling to predict how much suitable habitat will exist within their current ranges by 2050 and 2070. Considerable data exist for lichen distributions in one small area of the southern Appalachians, the Great Smoky Mountains National Park (GSMNP), so I performed a focused inventory of the target species in high elevation ridges outside of GSMNP. To conduct the modeling in Maxent I used the resulting localities from my field work and locality data from collections held at The New York Botanical Garden. During my field work I located at least one previously undocumented population of each target species on high elevation ridges outside of GSMNP. Regardless



of the climate model and carbon dioxide concentration used, the Maxent models predict little to no suitable habitat for all species within their current ranges by 2070. The implications of these results and future research directions in light of them will be discussed.

TRAGEDY OF THE EXCLUDED: DEFINING AND ASSESSING RESOURCE ACCESS IN MARINE CONSERVATION

Margaret Allen

University of Washington

A commonly observed paradox in conservation is that restriction of people's access to nature and natural resources may protect ecosystem health, but sometimes decreases the wellbeing of local people and can invite conflict and reduce people's willingness to protect resources. At a middle ground between complete protection and unrestricted commercial use is ecosystem-based management (EBM), which strives to maximize the overall wellbeing of both people and ecosystems. An important domain of human wellbeing to track for the purposes of EBM is resource access, or the ability to gain and maintain uses and benefits of the natural environment. Access does not simply refer to the physical and legal ability to benefit from resources; it can also depend on political power, social capital, and economic capacity. Understanding who is allowed to use what, in what ways, and when also reflects other related dimensions of wellbeing, such as food security, meaningful livelihoods, fairness, and sovereignty. This paper reports on the results of a systematic process to identify indicators of resource access to inform US marine and coastal management. Based on a comprehensive literature review, 82 candidate indicators were evaluated according to predefined screening criteria. Top scoring indicators include objective and subjective measures of shoreline access, fishing permits and landings, and access to seafood markets. This working selection of indicators may be used to inform a range of EBM goals, from biodiversity conservation to poverty alleviation. The related literature suggests that measuring these indicators alone will not lead to better marine management, however; local communities must be involved in defining and implementing what counts as secured rights and access to natural resources, and how this relates to their own wellbeing and sustainable marine conservation.

194 TRAGEDY OF THE EXCLUDED: DEFINING AND ASSESSING RESOURCE ACCESS IN MARINE CONSERVATION

Margaret Allen

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A commonly observed paradox in conservation is that restriction of people's access to nature and natural resources may protect ecosystem health, but sometimes decreases the wellbeing of local people and can invite conflict and reduce people's willingness to protect resources. At a middle ground between complete protection and unrestricted commercial use is ecosystem-based management (EBM), which strives to maximize the overall wellbeing of both people and ecosystems. An important domain of human wellbeing to track for the purposes of EBM is resource access, or the ability to gain and maintain uses and benefits of the natural environment. Access does not simply refer to the physical and legal ability to benefit from resources; it can also depend on political power, social capital, and economic capacity. Understanding who is allowed to use what, in what ways, and when also reflects other related dimensions of wellbeing, such as food security, meaningful livelihoods, fairness, and sovereignty. This paper reports on the results of a systematic process to identify indicators of resource access to inform US marine and coastal management. Based on a comprehensive literature review, 82 candidate indicators were evaluated according to predefined screening criteria. Top scoring indicators include objective and subjective measures of shoreline access, fishing permits and landings, and access to seafood markets. This working selection of indicators may be used to inform a range of EBM goals, from biodiversity conservation to poverty alleviation. The related literature suggests that measuring these indicators alone will not lead to better marine management, however; local communities must be involved in defining and implementing what counts as secured rights and access to natural resources, and how this relates to their own wellbeing and sustainable marine conservation..

147 SYSTEMATIC MONITORING AND REPORTING OF ESSENTIAL BIODIVERSITY VARIABLES ON NEW ZEALAND'S PUBLIC CONSERVATION LAND

Robert Allen

Landcare Research

Peter BELLINGHAM, Landcare Research ; David Forsyth, Arthur Rylah Institute for Environmental Research ; Andrew GORMLEY, Landcare Research ; Sean HUSHEER, New Zealand Forest Surveys ; Catriona MACLEOD, Landcare Research ; Norman MASON, Landcare Research ; Adrian MONKS, Landcare



Research ; Sarah RICHARDSON, Landcare Research ; Elaine WRIGHT, Department of Conservation

There is considerable interest in designing and implementing monitoring systems that can report on the status and trend of Essential Biodiversity Variables at large spatial scales (e.g. nationally). The New Zealand Department of Conservation (DOC) began implementing systematic monitoring and reporting of some Essential Biodiversity Variables on New Zealand's public conservation land (~30% of New Zealand's land area) in 2011. DOC's Biodiversity Monitoring and Reporting System (BMRS) reports on three components of ecological integrity: indigenous dominance, species occupancy, and ecosystem representation. Building on a carbon monitoring network established in New Zealand during the early 2000s, the BMRS involves monitoring at plots on an 8-km grid superimposed over New Zealand's public conservation land, including North, South and Stewart Islands and offshore islands. The monitoring gathers information on five measures: Size-class structure of canopy dominants; Representation of plant functional types; Distribution and abundance of exotic weeds; Distribution and abundance of exotic pests; and Assemblages of widespread animal species - Birds. There are 1311 plots, with 20% monitored annually on a rolling five-year cycle. This presentation will highlight key steps in the design and implementation of the BMRS, and demonstrate how the data can be used to report annually on the trend and status of New Zealand's biodiversity.

THE ROLE OF SCALE AND SPATIAL PATTERNS IN PEOPLE'S ATTITUDES AND PERCEPTIONS OF PROTECTED AREAS

Teri Allendorf

University of Wisconsin-Madison
Volker RADELOFF, University of Wisconsin-Madison ; Nicholas KEULER, University of Wisconsin-Madison

Social dimensions of protected areas are an important aspect of protected area success. However, it is difficult to capture social dimensions of protected areas at the broad scales at which conservation planning is typically conducted. Our goal was to identify spatial patterns in people's attitudes toward protected areas across a range of scales. We sought to understand at which scale people's attitudes differ and to uncover patterns in people's relationships with protected areas. We conducted 3573 interviews in 140 villages in the vicinity of three protected areas in Nepal and four protected areas in Myanmar. We identified at which spatial scale the amount of variability in attitudes and perceptions of benefits and problems of the protected areas was largest. Our results showed that negative perceptions, such as problems with wildlife and natural resource extraction, varied the most among villages, our finest scale. In contrast, positive

perceptions, which included benefits such as conservation and ecosystem services, recreation and aesthetics, and extraction, tended to vary the most between countries, our broadest scale. Protected area benefits and problems associated with protected area management varied the most among protected areas, our intermediate scale. These results suggest that systematic patterns in park-people relationships exist at broad scales and that interventions to improve the park-people relationship may be most effectively targeted at different scales. For example, positive perceptions may be fostered with interventions at the national level, such as national media campaigns or national educational curricula, while negative perceptions may be most effectively mitigated through interventions targeted at specific villages and conflicts.

THE ROLE OF AGENCY IN STRUCTURING COLLABORATION NETWORKS IN NATURAL RESOURCE MANAGEMENT

Jorge G. Álvarez-Romero

ARC Centre of Excellence for Coral Reef Studies, James Cook University [INSTITUTE] National Environment Research Program Northern Australia Hub, Charles Darwin University
Vanessa ADAMS, ARC Centre of Excellence for Coral Reef Studies, James Cook University [INSTITUTE] Research Institute for the Environment and Livelihoods, Charles Darwin University [INSTITUTE] National Environment Research Program Northern Australia Hub, Charles Darwin University [INSTITUTE] School of Biological Sciences, The University of Queensland ; Katie MOON, Institute for Applied Ecology/Institute for Governance and Policy Analysis, University of Canberra ; Örjan BODIN, Stockholm Resilience Centre, Stockholm University ; Michaela SPENCER, Research Institute for the Environment and Livelihoods, Charles Darwin University ; Deborah BLACKMAN, School of Business, University of New South Wales

Collaborative networks are widely suggested as a key factor affecting the success of natural resource management (NRM) and conservation projects. However, our knowledge of the factors affecting their formation and structure is limited. Collaboration can emerge from the need to achieve common goals (e.g. reduce soil erosion), but also as a consequence of stakeholders being brought together by having different (even conflicting) stakes in a common resource (e.g. farmers and conservationists). The way in which different stakeholders engage with each other (or not) can be examined as social networks. Social network analysis can be useful to study social relationships and interpreting their implications for NRM, but implicitly assumes that individuals have a level of choice (agency) in establishing relationships. Yet, such interactions are not always chosen voluntarily, thus demanding the study of agency and its relation to the structure of social networks. Our study explores the role of agency and the nature of



relationships in NRM collaboration networks in northern Australia. We identified and mapped five types of collaboration networks among organizations, and assessed organizational characteristics that drive the formation of collaborative ties. We used repertory grids to characterize organizations and explain their relationships and position in those networks where agency seems to be prevalent. We found that agency was present in some networks and identified attributes of organizations (e.g. transparent, responsive) associated with the choice to collaborate with them. Through the integration of both analytical methods, we were able to better understand the relationships among NRM organizations, and identify collaboration types which are positively associated with individual agency and those which likely do not. Our study presents a novel approach that responds to increasing calls for rigorous investigations of the nature of relationships within social networks.

DELTAMETHRIN INDUCED CYTOTOXICITY AND OXIDATIVE DAMAGE TO THE FRESHWATER CILIATE PARAMECIUM TETRAURELIA

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The problem of environmental contamination by the excessive use of organics cannot be neglected. Extensive application is usually accompanied with serious problems and health risk. It is established that many chemicals, in common use, can produce some toxic effects on biological systems through their mode of action or by production of free radicals that damage all cell compounds. Deltamethrin, a widely used type II pyrethroid insecticide, is one of the most common contaminants in freshwater aquatic system. In this study, we investigate the effects of deltamethrin exposure on the induction of cytotoxicity and oxidative damage to the freshwater ciliate *Paramecium tetraurelia*. After the exposure of paramecium cells to the insecticide, we followed up the growth kinetics, generation time and generation number. Also, we studied the variation in biomarkers of stress such as: Malondialdehyde (MDA), glutathione (GSH), glutathione-S-transferase (GST) and catalase (CAT). Moreover, respiratory

metabolism was monitored. Our results showed a significant decrease in the proliferation of cells correlated by the decrease in generation number and the increase in generation time. Also, we noted an inhibition in the percentage response. Deltamethrin exposure has led to a lipid peroxidation supported by a significant increase in (MDA) level which might be associated with decreased level of (GSH). (GST) and (CAT) activities, antioxidant enzymes, were significantly induced. The response was concentration dependent. A strong disturbance in respiratory metabolism was observed. In summary, deltamethrin is highly toxic to the freshwater ciliate *Paramecium tetraurelia*. Exposure to low concentrations showed significant adverse on growth accompanied with the induction of oxidative damage supported by the alteration of respiratory metabolism. Keywords: Deltamethrin; *Paramecium tetraurelia*; Contamination; Lipid peroxidation; Oxidative stress; Respiratory metabolism.

SPATIAL AND TEMPORAL CHANGES IN THREATS TO STEPPES IN TURKEY

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Ozge BALKIZ, Nature Conservation Centre ; Aydan OZKIL, Nature Conservation Centre

To halt loss of biodiversity, it is vital to identify and describe threats accurately. This study reveals a good example of dynamic nature of threats to steppes of Anatolia, Turkey that are used by various ways and intensities for thousands of years and suffering from tragedy of commons at the same time. Information from various sources have been collated to gather information about threats such as literature on pollen records, historical books, census data, questionnaires and field survey data. Among various types of threats have been identified, grazing and ploughing were found to be the most prominent threats. But their patterns and intensities have changed in space and time as land abandonment and a major change in the use of freshwater resources for agriculture have taken place in the recent decades. In addition, there are novel threats such as residential development, afforestation in roadsides, village vicinities and eroded hillsides; mining and road constructions in remote hills. Furthermore, the future effects of climate change are being questioned as experiments around the world are implying that semi-arid regions came out to be less resistant. The perception of threats is also subject to change in terms of the profession questioning. There is a big difference in identification of threats between academicians doing research on steppe biodiversity and officers actually protecting it: officers of Department of Nature Conservation and Natural Parks do not see climate change, development and afforestation as major threats but poaching, overgrazing due to transhumant grazing, mining and agricultural pollution are their main concern. We propose to develop a national project



to foster steppes as conservation targets and conduct a large scale field survey supported by other information sources to understand the true extent and magnitude of threats to steppes, as the first step to conserve steppes.

FEEDING ECOLOGY OF EURASIAN LYNX FROM MEDITERRANEAN TO CAUCASIAN ECOSYSTEM: SPECIALIST DIET AND IMPLICATIONS FOR CONSERVATION

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Eurasian lynx (*Lynx lynx*) is one of the most widespread, but the least studied felid species in Turkey. I studied its diet by collecting scats in two different ecosystems of Turkey from Mediterranean and Black Sea, and conducted camera trap studies from 2007 to 2013 to assess the species status. Scat samples (n=101) were washed, identified with frequency of occurrences by reference samples previously collected. I found that Eurasian lynx main prey was brown hares and occurrences decreased from 95% in Mediterranean to 75% in lesser Caucasia. The number of prey items gradually increased through southern to northern ecosystems. In northern study area diet shifted to the small mammals, avian species and carnivore species including lynx. The detection rates of brown hares also sharply decreased by camera traps at the northern ecosystem that complied with shifting of prey items because there are more predators in lesser Caucasia compared to Mediterranean ecosystem. Although Eurasian lynxes feeds mainly on roe deer in Europe, their foraging adaptability provided to survive in different ecosystems by feeding with smaller mammals and bird species in Turkey. The study showed that Eurasian lynx diet is mainly specialist diet similar to Iberian lynxes, and revealed its status in Turkey. Therefore, any conservation program of Eurasian lynxes in south western Asia should also include the status of brown hares, and impact of hunters on them to implement effective conservation plans.

PECULIAR REPRODUCTION IN IBERIAN LYNX (LYNX PARDINUS): WHAT STANDS BEHIND CORPORA LUTEA PERSISTENCE?

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Leibniz Institute for Zoo and Wildlife Research
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Research ; Katarina JEWGENOW, Leibniz Institute for Zoo and Wildlife Research

The Iberian lynx is considered the most endangered felid in the world with roughly 300 individuals left in the wild. To support and restore its populations, a breeding program has been initiated, coupled with extensive research on lynx reproduction. Studies revealed that lynx genus presents a peculiar reproduction pattern, not found in any other mammalian species studied so far – corpus luteum (CL), a transient gland which supports pregnancy via progesterone secretion, persists in the ovary for over two years. We hypothesize that persistent (per) CLs ensure monoestrus in lynxes. Therefore, if a pregnancy fails to occur with the first mating, Iberian lynx is physiologically excluded from the breeding pool till the next year. As such reproductive characteristic can greatly reduce the success of breeding programs, it is essential to gain a profound knowledge on the mechanisms behind perCL. To do so, we studied the expression of potential luteotropic and luteolytic factors in perCL of Iberian and Eurasian lynxes, as well as in CL of domestic cat to establish a common luteal course in felids. Investigated factors included agents of programmed cell death (apoptosis: Bcl-2, Bax, caspase-3, Fas, tumor necrosis factor alpha and its receptors) and commonly luteotropic prolactin with its receptor. Samples were obtained after ovariectomy (two Iberian lynxes, health reason; domestic cats, shelters and clinics) or postmortem (Eurasian lynx, roadkill and hunting). We revealed the presence of pro-apoptotic factors (Bax, caspase-3, Fas) in perCL, contrary to their morphological persistence. Here, Bcl-2 might be the factor to rescue perCL from regression. Moreover, prolactin was still present in perCL of lynxes outside the breeding season. We propose prolactin as an essential factor that secures CL persistence in lynxes. The study was funded by DFG (Je163/11-1) and DAAD (A/10/86242). Iberian lynx samples were provided by Environmental Council of the Government of Andalusia and ILCBP.

DEMOGRAPHY OF EPOMOPHORUS GAMBIANUS IN GHANA

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Epomophorus gambianus is a widespread African fruit bat with ranges throughout much of West Africa and is reported to roost in loose colonies of a few individuals in a variety of habitats. The species is hunted as bushmeat within Ghana and other parts of West Africa. A variety of zoonotic viruses have been reported from the species, thus making it a potential public health



risk. Despite this, the population dynamics and demographic parameters of the species are largely unknown. The study involved mapping of the distribution of *E. gambianus* in Ghana, estimation of birth rates, population structure, survival probability and colony size changes. A total of 29 colonies of *E. gambianus* either isolated or sympatric with other species have been identified, the largest comprising ca. 5000 bats in the Ve-Golokuati town (Volta Region) which was the focus for the detailed demographic studies. The initial population of this colony declined over the 21-month study period to between 2000-3000 individuals, with peak numbers occurring in March and September. Data from the 1,702 individuals captured showed no significant variation in age categories, but the population was significantly male dominated (58.5% males; $\chi^2 = 49.4$, $df=1$, $p=0.05$). Pregnancy occurred between October-February and May-August with peaks in January and July. Based on an assessment of the proportion of adult females pregnant in each breeding period, birth rate is estimated to be 1.8 young per female per year. Attempts to estimate survival probability using Capture-Mark-Recapture (CMR) with PIT tag marking technique were unsuccessful, as recapture rates were too low (~2% of marked individuals) to provide any robust estimation. Future studies will focus on trying other methods like radio tracking to provide further understanding of movements and changes within the population.

STILL SPOTTED? SETTING A GLOBAL BASELINE FOR THE LEOPARD, PANTHERA PARDUS

Corey Anco

Fordham University

Joseph LEMERIS JR., Duke University ; Andrew JACOBSON, Zoological Society of London ; Luke DOLLAR, National Geographic Society

A basic tenet of leopard biology, its secretive and solitary nature, cuts both ways in its conservation. The leopard is a remarkable felid with the greatest known range of any cat and, appropriately, a wide habitat tolerance. The leopard can survive from tropical forests to deserts, sea level to 5,000 m on Mt. Kilimanjaro, and from undisturbed forests to urban parks in megacities. While the shy habits of the leopard certainly assist in survival, it also complicates biological study and baseline knowledge on its population and distribution. While the leopard is listed as "near threatened" by the IUCN, its overall population is declining and there are nine recognized subspecies, some of which are critically endangered. We gather an unprecedented volume of current and historical information on leopard distribution and status to create the first global map of historical leopard distribution. Additionally, we provide an updated current global range map depicting areas with known resident populations or fragmented, transient ones. This enables the first comprehensive estimate of range loss for the leopard. However, global, and in many cases, even

regional population estimates are still impossible given current data limitations. Although we are unable to provide updated population and distributional information for some regions, we assess leopard status throughout the world. In addition, we assess the quality of population and range information. Scientific and conservation focus on leopards is increasing yet still patchy; we aim to provide a comprehensive, global baseline that will stimulate and prioritize future research and conservation effort.

VITAL SIGNS: SUSTAINING ECOSYSTEM SERVICES IN THE CONTEXT OF AGRICULTURAL INTENSIFICATION AND CLIMATE CHANGE

Sandy Andelman

Conservation International

Agricultural intensification is critical to meeting the growing demand for food. Agriculture is also the greatest threat to nature, but sustained agricultural production also depends on essential ecosystem services nature provides. Two thirds of the world's arable land not currently in agriculture is in Sub-Saharan Africa, so the world is focused on Africa as the world's next breadbasket. To prevent unintended consequences of increased agricultural intensification for biodiversity and ecosystem services in Africa, a broader, more holistic approach to agricultural development and management is needed. This requires that the set of metrics used to measure and track the success of agricultural development expands from a narrow, sector-specific set (e.g., crop yield, household income) to an integrated set that reflects the interconnectedness of food security, water security, climate security, ecosystem health and human wellbeing. The Vital Signs system has a statistical sampling frame that integrates biophysical and socioeconomic domains. It spans all of the scales that are critical for agricultural decision making, from a household, to a farm, a landscape, to a nation. The system provides a strategic set of metrics that can quantify, effectively and efficiently, over time, the critical tradeoffs and synergies among ecosystem services, livelihoods and agricultural production. These tradeoffs are illustrated using the Vital Signs resilience index and data from the Southern Agricultural Growth Corridor of Tanzania. The index provides novel insights into which types of landscape interventions have the greatest likelihood of sustaining both crop production and ecosystem services in the face of increasing climate variability and shocks. The system has already been adopted by three African countries - Tanzania, Ghana and Uganda - and is poised to expand further, with potential to fill the data gap for tracking the Sustainable Development Goals in developing countries.



CONSERVING NATURE'S STAGE: A GEOPHYSICAL APPROACH FOR IDENTIFYING CLIMATE RESILIENT SITES IN THE SOUTHEASTERN US

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In light of climate change, conservationists need planning methods designed to conserve the maximum amount of biodiversity while allowing species and communities to rearrange in response to the climate. We developed such an approach for the Southeast US. First we identified the abiotic factors correlated with species diversity patterns and stratified the region into 29 geophysical settings (combinations of bedrock, soil, and elevation zones). Next, within each geophysical setting we located sites that had two key characteristics: 1) relatively complex topography and large elevation ranges that increased the number of available micro-climates, 2) highly connected natural cover that allowed species to access the local climates. The former was estimated using a 30 m landform model and spatial estimates of wetland density. The latter was estimated using a resistant kernel model applied to a landcover based resistance layer. We scored sites based on these components and hypothesized that the high-scoring sites will maintain their existing species longer relative to other sites of the same geophysical setting. Using overlays on the high-scoring sites, we tabulated the degree of rare species capture (65%) and overlap with conservation sites chosen for their high quality biodiversity features (47%). The correspondence between the biodiversity sites and the high scoring geophysical sites reveal places likely to be important to both current and future diversity.

WOOD-INHABITING BEETLES IN LOW STUMPS, HIGH STUMPS AND LOGS ON BOREAL CLEAR-CUTS: IMPLICATIONS FOR DEAD WOOD MANAGEMENT

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The increasing demand for biofuels from logging residues requires serious attention on the importance of dead wood substrates on clear-cuts for the many forestry-intolerant species. In particular, the emerging harvest of low stumps motivates further study of these substrates. On ten clear-cuts we compared the species richness, abundance and species composition of saproxylic beetles hatching from low stumps, high stumps and logs of Norway spruce. By using emergence traps we collected a total of 2,670 saproxylic

beetles among 195 species during the summers of 2006, 2007 and 2009. We found that the species assemblages differed significantly between high stumps and logs all three years. The species assemblages of low stumps, on the other hand, were intermediate to those found in logs and high stumps. There were also significant difference in species richness between the three examined years, and we found significant effect of substrate type on richness of predators and fungivores. As shown in previous studies of low stumps on clear-cuts they can sustain large numbers of different saproxylic beetles, including red-listed species. Our study does, in addition to this fact, highlight a possible problem in creating just one type of substrate as a tool for conservation in forestry. Species assemblages in high stumps did not differ significantly from those found in low stumps. Instead logs, which constitute a scarcer substrate type on clear-cuts, provided habitat for a more distinct assemblage of saproxylic species than high stumps. It can therefore be questioned whether high stumps are an optimal tool for nature conservation in clear-cutting forestry. Our results also indicate that low stumps constitute an equally important substrate as high stumps and logs, and we therefore suggest that stump harvesting is done after carefully evaluating measures to provide habitat for saproxylic organisms.

SHORT-TERM RESPONSE TO STUMP HARVESTING BY THE GROUND FLORA IN BOREAL CLEAR-CUTS

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We conducted a study in the Southern and Middle Boreal zone in northern Sweden to examine whether stump harvesting causes extra soil damage compared to conventional forestry and if stump harvesting affects the assemblage, species richness and occurrence of individual species of vascular plants and bryophytes in boreal clear-cuts. We recorded the occurrence of all species of bryophytes, vascular plants and the cover of soil disturbance in 50 X 50 cm sample plots on 20 clear-cuts, 22 - 49 months (mean 32 months) after clear-cutting. All clear-cuts were slash harvested and scarified and half of the clear-cuts were in addition stump harvested. The added effect of stump harvesting was assessed by comparing stump harvested clear-cuts with clear-cuts that had not been stump harvested. We found that the additional use of stump harvesting caused an increase in the cover of soil damages compared to conventional harvesting with only slash harvesting and scarification. Also, we found significant negative effects of stump harvesting on the plot occupancy (number of 0.25 m² plots occupied in each clear-cut) of four species of the most common boreal plant species (the mosses



Hylocomium splendens and *Pleurozium schreberii* the dwarf shrubs *Vaccinium myrtillus* and *Vaccinium vitis-idaea*). *V. vitis-idaea* had almost 80% lower plot occupancy in the stump harvested clear-cuts than in the controls. Some species did also respond positively to stump harvesting. Our results show that harvesting of low stumps can have both negative and positive short-term effects on certain common species of vascular plants and bryophytes. However, the relatively modest increase of soil damage caused by stump harvesting in contrast to the heavy impact on e.g. *V. vitis-idaea* suggests stumps, with their slightly elevated sockets, may contribute to the survival of at least some plants during the clear-cut phase.

SOCIAL SCIENCE PERSPECTIVES IN ECOSYSTEMS MANAGEMENT AND CONSERVATION IN KENYA

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Social sciences as a discipline and ecosystems management involves working with people and communities in order to assess levels of ecosystems management and empower them with knowledge and skills for better conservation of natural resources. However, there are challenges faced in the process of the introduction of better management practices in ecosystems conservation due to various factors such as slow or lack of adoption, perceptions and attitudes, group management and establishment of by-laws at the local level for ecosystems management. A qualitative baseline survey conducted in neighbouring communities of 2 river catchments in Southwest Kenya shows that ecosystems management and conservation depends on several factors such as labour allocation by gender, access and control over resources as well as the extent at which farmers know and practice ecosystems management such as soil and water conservation, planting trees, riverbank, water sources and wetland protection, establishment of indigenous tree nurseries and planting trees. The results indicate that in 6 demarcated blocks, surveyed, 90 percent of the farmers knew and were practicing soil and water conservation measures in 2 blocks as compared to 0-30 percent of the same farmers who knew and were practicing riverbank, water sources and wetland protection. In terms of labour allocation, River bank, water sources and wetland protection was the domain of male adults and male children throughout the year across the 6 blocks and agroforestry practices were done by all gender in one of the blocks as compared to the others. Fuelwood and energy saving was practiced by Female adults and sometimes female children. However, access and control over resources such as land was a male domain across the blocks. The current knowledge and practice by farmers in ecosystems management and conservation can be exploited to achieve maximum farmer benefits both socially and economically.

PROMOTING BAMBOO UTILIZATION FOR RESOURCE CONSERVATION IN THE COASTAL STRIP OF SOUTHERN NIGERIA

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The consequences of climate-change induced trends on the vulnerable coastal fringes of Africa remain critical with particular reference to human security and livelihood options. This paper seeks to evaluate the distribution and value-awareness of bamboo as a natural resource for human development in diverse sectors. Adopting a comparative format, three Local Government Areas are delineated from Cross River and Akwa Ibom states respectively, for study to examine the awareness level of communities to the potential multiple use values of bamboo as a natural resource that can be sustainably managed for ecological and human benefits. Using purposively designed semi-structured checklist for the focus group discussions with bamboo cultivators, construction engineers, craftsmen, traders and other end-users, the study obtains, respondent's perspectives on the use value of bamboos, the benefits and challenges that surround livelihood security development in the face of other competing available options. Findings indicate a wide level of awareness to the multiple-use values and potentials of bamboo within the area to improve and sustain livelihoods. The challenges indicated include, amongst others, low economic value and pricing of bamboos, including the dearth of appropriate technology to effectively harness the benefits to be derived from the resource. Recommendations include intensive education on the multi-use value of bamboos, regulated harvesting systems to prevent premature harvesting and wastage, recycling of cut-off particles to limit waste and proper finishing of ornamental bamboo products to up-grade the economic value. Key Words: Climate Change, conservation, ecology, bamboo, challenges

76-EVALUATING THE BIODIVERSITY IMPACTS OF COMMUNITY CONSERVATION PROGRAMMES IN MADAGASCAR

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Improving management of natural resources in Madagascar is challenging since conservation NGOs have to use much of their time to mitigate human pressures and improve local communities' wellbeing. People rely heavily on natural resources for their survival and the government has limited resources to enforce laws. Impacts of conservation actions are poorly understood and their measurement is rarely chosen as a priority. Since 1997, Durrell has developed and implemented a widely known community-based conservation programme in 109 villages from 6 of its 9 key sites in Madagascar. This programme includes regular participatory ecological monitoring and weekly village patrols carried out by 461 local monitors. The community based conservation project aimed to save some of the world's rarest species and their threatened ecosystems. However at the same time they addressed social issues at the local level and tried to improve human wellbeing conditions by focussing on improvement of primary education, social cohesion and public health and reduction of inequality. We performed a 30 years retrospective evaluation (1982-2013) of the effectiveness of Durrell's community conservation projects by comparing key environmental and social indicators between the 109 project villages and 109 control villages. These indicators include threat indicators such as fires, forest loss, forest fragmentation and invasion of exotic plants and biodiversity features such as area of good quality habitat and species density. Results of the studies will inform about the success of each conservation strategy and inform decision making through the regional development plan. Findings also will help clarifying the role that can be played by the community approach in the creation of protected areas targeted by the government.

110-COMMUNITIES COUNT: PARTICIPATORY ECOLOGICAL MONITORING APPROACHES IN ACTION IN MADAGASCAR

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Since 2001 Durrell Wildlife has developed the participatory ecological monitoring approach with the local communities and regional public services to annually collect data on key species, habitats and the threats to the biodiversity. This is being done in the wetlands of Lake Alaotra and the dry forests of Menabe in areas where the local communities have been given the legal rights to environmentally manage the neighbouring natural habitats (public-domain lands). The results of the monitoring are used in an environmental inter-village competition whereby prizes (development projects) are distributed to participating communities. Between 2007 and 2009 we compared the effectiveness of community led monitoring and the rigorous scientific monitoring and we did not find any significant difference on key indicators. In 2011 the participatory ecological monitoring approach has been expanded to become the largest village patrol project in the country. We engaged 461 local monitors known as local foresters committee to collect biodiversity and pressures data in three more key conservation sites: Nosivolo River, Manombo rainforest and Baly Bay National Park. Local foresters committee are composed by 6 volunteers per village. Thanks to supports from the Regional Environmental service, those local monitors received technical training about data collection and reporting system. They were given uniform, camera, telephone and simple equipments to facilitate their work. A large public meeting attended by local authorities, regional Forests and Fishery services and partners, followed by a traditional communal meal has been organised every three month in each village to discuss results of monitoring and link to decision making. Our work has shown that participatory ecological monitoring is a feasible and advantageous approach to reinforce conservation actions in developing countries like Madagascar.

ID 38: CHANGING THE INCENTIVES FOR BUSHMEAT HUNTING IN NORTHEASTERN MADAGASCAR

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Wildlife consumption can be viewed as an ecosystem provisioning service because of wildlife's ability to persist under sustainable levels of harvest. Using longitudinal survey methods, micro-economic analytical techniques, and robust epidemiological study designs to determine the health and economic value of subsistence wildlife harvest, we can begin to understand incentives for bushmeat hunting. Heightened monitoring and enforcement of hunting could increase the costs of harvesting and thus elevate the price and reduce



consumption of wildlife. Effective monitoring would incur a 66% reduction in the biomass of wildlife consumed. Increased enforcement would therefore be beneficial to biodiversity conservation but could limit local people's food supply. On average, the value of wildlife provisioning represented 57% of annual household cash income in local communities from the Makira Natural Park and Masoala National Park. In past work, we have demonstrated a nearly 30% increase in the incidence of anemia given loss of access to wildlife resources. In our current work, we will be investigating the value of wildlife to micronutrient status (vitamin A, vitamin B12, iron, zinc and fatty acid profiles). Ongoing interventions in our landscape include sustainable chicken husbandry promotion and mobile health clinics to simultaneously address the challenges of food security, lack of health care infrastructure and trends in environmental degradation from agricultural extensification and wildlife harvest.

THE CHALLENGE OF ADDRESSING WILDLIFE AND HUMAN DEMANDS: INCORPORATING MAMMALS CONSERVATION AND BIOFUELS DEVELOPMENT IN LAND USE PLANNING.

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The increased demand for the conversion of natural habitats to agricultural areas is a major threat to biodiversity and part of this demand is due to the necessity of energy generation by biofuels. Therefore, it is challenging to address wildlife conservation in a climate changed world demanding for food and energy. It is especially challenging to deal with mammals that require large territories. This study considered Species Distribution Models (SDM) techniques associated with decision-support tools to address land use planning in the most human modified landscape in Brazil (São Paulo State, Southeast, Brazil). Three endangered large mammals (i.e. Puma concolor, *Leopardus pardalis* and *Chrysocyon brachyurus*) occurrence records (2001-2012) and environmental variables (bioclimatic, topographic and landscape related) were modeled using Maximum Entropy algorithm (Maxent 3.3.3.k) and SDMtoolbox (ArcGIS 10.1). The decision-support tool Zonation has been successfully applied in a multi-species spatial prioritization approach to identify priority areas for conservation in the study area. Zonation will be also applied by March 2015 to evaluate conservation options under two realistic biofuel scenarios in the central region of São Paulo State (Tietê-Jacaré watershed): 1. current land use scenario and 2. next future land use scenario (GEOMOD model applied projecting sugarcane expansion by 2019). The results will explicitly show the overlap of areas proposed for biofuels development with areas of high conservation priority. It is important to identify land use planning opportunities

and conflicts in the study area. Also, it might serve as a model to guide similar process for others species and other environmental impacts world-wide. This study makes an important contribution to land use planning for conservation, dealing with threats and their likely impacts on biodiversity through explicit incorporation of uncertainty into decision-making process.

HABITAT CONSERVATION PRIORITY: A FLORISTIC APPROACH APPLIED TO MEDITERRANEAN WETLANDS

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Finding strategies to produce priority lists for conservation purposes is a very important issues, particularly in biodiversity "hot-spots" such as the Mediterranean basin, where biodiversity loss is a critical threat. A relevant recognition of plant communities importance for conservation purposes was established with their inclusion into the "Habitats Directive" (HD; 92/43 EEC), that relates habitat typologies to plant community syntaxonomical units. Thus, the use of plant communities as a proxy for habitats, ecosystems or ecological communities can provide a solid base to perform conservation priority lists. However, habitat definitions in HD lead to several inaccuracies in local habitat characterizations because of its central-northern European focus. Several wetland plant communities (and their corresponding habitats), rare in the Mediterranean basin, are not included in the HD. This study aims to propose some criteria and a procedure to assess the conservation importance of habitats. It deals with plant community types at the alliance level as promising units for setting conservation priorities. The main criteria used are distribution/abundance of vascular plant species of conservation interest and their greater or lesser fidelity to a plant community, considered as a key driver to set alliance value. Multivariate methods was applied and a quantitatively synthetic floristic index was set up. We tested this procedure in an important wetland area of central Italy, where a large amount of botanical data were available. Our investigations highlighted: i) the higher conservation values of some alliances not listed in the HD, bringing to light various gaps in current conservation laws affecting Mediterranean wetlands; ii) that habitats widely distributed in other biogeographical areas may have a great conservation importance, underestimated in the Mediterranean region; iii) the necessity to consider regional singularities when setting conservation priorities.



COLLAPSE OF GREY PARROT (PSITTACUS ERITHACUS) POPULATIONS IN GHANA

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The Grey Parrot (*Psittacus erithacus*), listed as Vulnerable on the IUCN Red List, is undergoing rapid population declines in most of its range owing to capture for trade and habitat loss. The status of the species is not well known in Ghana. We sought to 1. assess the distribution and abundance of the species across Ghana, 2. repeat surveys at roost sites identified two decades ago, 3. gauge people's knowledge and perceptions of the decline and the possible reasons for this, and 4. examine the trade and other factors that may have contributed to the population decline. A random sample of 48 10x10km² cells were surveyed for 3-5 days each across c.50,000km² of Ghana's forest zone between April 2012-June 2014. Searches were conducted for 40 of 60 previously surveyed roosts. Extensive interviews were conducted to sample knowledge and perceptions on GP, its trade and population declines. Thirty-two groups and 103 individual GPs were recorded in 13 (27% of) cells. Mean group size was 3.2 (maximum group size = 12). Mean encounter-rate across all sites was 0.047±0.14 (SD) groups/hr. No active roost found but GP encountered in five roost areas, with 51 sightings in one site. Only 18 individuals were recorded in three roost areas that harboured 700-1200 birds each two decades ago. Of 866 interviewees, 31% had not sighted parrots in the last six years. On population trends, 94% of interviewees indicated declines in the last 5 years and 99%, the last 10 and 20 years, respectively. GPs in Ghana have suffered catastrophic declines in merely two decades, owing to past excessive offtake from the wild for the bird trade, and persistent habitat loss and degradation. Parrots are now prone to widespread local extinctions and an ultimate nationwide extinction if trends continue. Major livelihoods have been lost through collapse of the trade.

BIODIVERSITY CONSERVATION AND ANTI-DIABETIC PLANTS USED BY THE TRIBAL COMMUNITIES OF ANAMALAI HILLS COIMBATORE DISTRICT, SOUTHERN WESTERN GHATS OF TAMIL NADU, INDIA.

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Anamalai hills ('elephant hills' in Tamil), an important biodiversity conservation area in the Coimbatore district, Southern Western Ghats of Tamil Nadu, India. This paper proposed about the tribal peoples used medicinal plants for the treatment of diabetes, livelihoods and value addition survey amongst tribal communities within or adjacent to rainforest fragments five settlements of the higher ranges were selected of the 36 tribal settlements. The present study was conducted during the period of January-October, 2014. The tribal communities are Kadar, Muthuvar, Malai Malasar and Irular. The data's are collected from the tribal peoples or healers or medicinal practitioners through oral, questionnaire method and frequent field visit. Traditional medicinal practitioners known as vaidyas from the primary health care provider in tribal settlements. A total of 37 medicinal plants belonging to 25 families were identified as being used for the treatment of diabetes in Anamalai hills. The most frequently used plants are *Coccinia indica*, *Azadirachta indica*, *Trigonella foenum-graecum*, *Syzygium cumini*, *Terminalia chebula*, *Ficus racemosa*, *Momordica charantia* and *Swietenia mahagoni*. Above mentioned traditional medicinal plants are commonly used to treat diabetes. Clinical intervention studies are required to provide evidence for a safe and effective use of the identified medicinal plants in the treatment of diabetes. The over exploitation of medicinal plants in Anamalai hills should conserve through macro and micro propagation. This paper deals the biodiversity of plant which is used by tribal's communities of Anamalai hills. Keywords: Ethnobotany, Muthuvar, Diabetes, Macro and Micro Propagation, Anamalai hills and Southern Western Ghats.

REASSESSING THE CONSERVATION STATUS OF THE THREATENED FROG DENDROPSOPHUS MERIDENSIS (HYLIDAE) IN THE NORTHERN ANDES: INTEGRATING MOLECULAR ANALYSIS AND ECOLOGICAL NICHE MODELING

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Dendropsophus meridensis is a treefrog endemic to the Cordillera de Mérida in the Venezuelan Andes. This species was listed as "Endangered" (EN) by the IUCN Red List because its



extent of occurrence is less than 5,000 km², although it inhabits in open areas and farms with ponds, and their populations are not affected by forest decline. However, the taxonomic status of *D. meridensis* is uncertain, as it is morphologically very similar to sister species *Dendropsophus pelidna* (sister species), which occurs in the massif El Tamá (Colombian and Venezuelan Andes). This prevents proposing action plans for its conservation. Our aim was assess the taxonomic status and geographical distribution of *D. meridensis* in order to obtain bases to reassessment the conservation status. For this, we use three molecular genes: *Cytb*, 12S and 16S; we estimated genetic divergence and structure between the populations from the Cordillera de Mérida and El Tamá. We made a species distribution modeling of *D. meridensis* in order to infer its potential geographic distribution in the Andean region. We found low levels (0.2-1% with *Cytb*, 0.2% with 12S-16S) of genetic divergence and a low level of genetic structure (34.5%) between the populations from the Cordillera de Mérida and El Tamá. The species distribution modeling predicted to the El Tamá as an environmental suitability area for *D. meridensis*. Our results suggest that *D. pelidna* is a synonym of *D. meridensis* and that the latter occurs in the El Tamá; therefore, geographical distribution of *D. meridensis* is larger than that known. The presence of this species in other areas of the Andes is not unexpected due to the characteristics of habitat where *D. meridensis* lives. Thus, we propose that the category EN for *D. meridensis* should be changed to VU (Vulnerable), as its occurrence area is greater than 5,000 km² but lesser than 20,000 km².

SYMPOSIUM NO. 90 - EXPOSURE ANALYSIS OF DIURNAL LEPIDOPTERA TO MAIZE POLLEN IN PROTECTED AREAS

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Several genetically modified (GM) crops have been developed to provide protection against lepidopteran pests by the introduction of *Bacillus thuringiensis* (Bt) synthetic genes (e.g. Cry 1A- or Cry 1F- expressing maize). One of the concerns for a possible adverse environmental effect, is the threat to non-target organisms in the receiving environments where GM plants can be cultivated. In Europe direct feeding on

maize leaves by Lepidoptera larvae, other than 2 target pests, is limited to handful sporadic pest species. However, the exposure of larvae to plant products expressing Cry proteins is also possible at certain distances from cropped areas, due to pollen transportation by wind on wild host plants for larvae. In the framework of the project Life+ MAN-GMP-ITA, a possible exposure scenario for Lepidoptera living in protected areas in proximity of agricultural land, was explored in five Sites of Community Interest (SCIs) in Italy. Information collected during 2 years of samplings was stored in a database. Besides allowing the characterization of Lepidoptera fauna of the study sites, the database can support the definition of exposure scenarios based on the presence-absence of the species in each habitat during the year. When the recorded flight periods were individually overlaid with the flowering time of maize in these areas, different exposure scenarios were obtained. For instance, maize pollen production in the Po valley completely overlap with the presence of larvae of *Inachis io* L. feeding on nettles nearby maize fields. At the contrary in a SCIs in the South-East of the country where silage maize is the main product, flowering peaks are recorded in July-August when many Lepidoptera species suspend their activity. Similarly, the simulation of such scenarios for a different GM crops in the area, e.g. oilseed rape, showed different results since the early flowering of the crop indicates a possible exposure to GM tissues for only few, early active Lepidoptera.

CITIZEN SCIENCE, SOCIAL LEARNING AND TRANSFORMING EXPERTISE

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Citizen science (CS) is currently gaining momentum in many different research fields, including biodiversity research, boosted by novel technologies that allow new modes of participation, inviting new social groups and extending the scope of collaboration between scientists and volunteers. CS is envisioned to bring mutual gains for the participants, as well as for society at large, facilitating, for example, 'scientific literacy', collaborative skills or empowering different social groups. While such learning processes taking place on an individual, collective or societal level are claimed to have high priority in CS projects, we provide a review of the development and state of the art of CS, focusing on the learning outcomes of CS projects. We critically assess how learning has been discussed in the context of CS, and how CS projects have been designed and implemented to facilitate learning. In this context we also discuss approaches, such as public participatory GIS, which are not currently framed as CS but provide valuable experiences and methodological approaches for it. We also explore new cutting-edge collective learning processes such as Companion Modeling and Multi-Agent Behavioral Games. Through a



number of case studies in the field of biodiversity research we explore the ways in which participants are involved, new knowledge is generated, and the potential benefits derived by different groups. We conclude with recommendations for the future development of CS processes to ensure mutual learning for improved biodiversity conservation and enhancing ecosystem services and suggestions on „appropriate avenue” for future biodiversity research that is relevant for addressing social challenges of collaborative knowledge production between citizens, scientists, and educators.

EMERGENCE OF LANDSCAPE CARRYING CAPACITY FOR COMMON BUZZARDS FROM RADIO-TRACKING AND LAND-COVER MAPPING

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Habitat destruction from landscape transformation is nowadays the main driver of terrestrial species’ extinctions. Anticipating impact of landscape structure upon animal populations can thus inform conservation. Here we present a novel modelling approach for predicting individuals’ use of space, as well as population spatial distribution and carrying capacity in real, variable landscapes. Our approach combines Resource-Area-Dependence Analysis (RADA) with Individual-Based Modelling (IBM). We call it RADA-IBM and illustrate it via modelling common buzzards *Buteo buteo* in lowland UK. Initially, to elucidate drivers of buzzard territoriality, we created three model versions that differed only with respect to which habitats individuals defend. In all models buzzards settled and incorporated habitats within parameterized foraging distances from the settling site until RADA predictions were met. When compared to a sample of radio-tracked buzzards, all models produced virtual buzzards with realistic home ranges but only one predicted an accurate pattern of home range overlap. Results from this model indicate defence of minimum areas of all habitats drives buzzard territoriality in lowland UK. This model also predicted observed population distribution and carrying capacity consistent with two independent density estimates. Additionally, it showed how variations in settling site locations and territory shapes result in the emergence of variance in carrying capacity. Our approach requires further testing, but is potentially powerful for assessing which factor or combination of factors, such as habitat distribution, climate or competition might be keeping an animal population in check. As it explicitly models landscape structure and individuals’ interactions, while requiring solely a land-cover map and individual-based behavioural observations collected by radio-tracking, it can help faster planning of, for example, landscape management or re-introductions.

SPATIAL ANALYSIS OF A POPULATION OF BOREAL FELT LICHEN ON THE ISLAND OF NEWFOUNDLAND

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The boreal felt lichen (*Erioderma pedicellatum*) is a globally rare lichen found in the Kamchatka Peninsula, Scandinavia, Alaska, Newfoundland and Nova Scotia. Although some populations have declined substantially, even to extinction in some jurisdictions, new findings in Alaska, Russia and Newfoundland have significantly increased the estimated population and geographic range. In Newfoundland, one of the epicentres for this species is on the Avalon Peninsula where there is important urban and semi-urban development. A better understanding of the ecology and dynamics of the habitat of this species is critical for land use planning to mitigate and reduce risk for this species of conservation concern. We have investigated the distribution ecology of the boreal felt lichen in a ribbed moraine landscape of the Avalon Peninsula. We have used systematic sampling of bounded plots and “walkabouts” to describe forest structure and dynamics of different ecosystem types and to examine the spatial pattern of this lichen species on individual trees and at the landscape scale. At the tree scale most of the lichen thalli were found between 1 and 2 metres in height, although some thalli could be up to 7 metres on the bole of trees. Some of the most important predicting factors for the distribution of this species include stand composition, distance to bogs, and fens, and stand age. Although the hot spots for the boreal felt lichens are not necessarily associated with old-growth gap-phase dynamics forests, they are rarely found in logged forests younger than 60 years. We will present a preliminary boreal felt lichen habitat predictive tool using a Geographical Information System (GIS) combining a number of land cover layers along with our rich field data set.

33: WHY AND HOW PEOPLE MATTER: CONSERVATION PSYCHOLOGY AND PRO-CONSERVATION BEHAVIORS

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Many conservation problems are undeniably the result of human actions. The same is true for many conservation successes. Thus, it is not illogical to think that the *Homo sapiens* is a “cornerstone conservation species”—needs considerable attention, if we are to facilitate conservation success. Mainstream conventional thought would suggest that the condition of the environment and the desire to address that condition is the main driver of pro-environmental actions. Thence, we design educational and outreach efforts with a misplaced focus only on imparting ecological knowledge to



target audiences, expecting pro-conservation action in return. First, knowledge alone is a necessary but largely insufficient driver of action. Second, there is increasing evidence that the environment, its condition and the desire to improve that condition, in and off themselves are not sufficient reasons for people to engage in pro-conservation behaviors. Instead, people are motivated—to take action in support of conservation—by other factors many of which are social-psychological. The desire to address conservation problems motivates pro-conservation behavior only to the extent that addressing those conservation problems aligns with the actualization of social-psychological motivations. I present evidence to illustrate these points. Then I briefly present the basic tenets of conservation psychology—the science of understanding and promoting pro-conservation behaviors—and emphasize its utility for fostering biodiversity conservation stewardship. I conclude with a challenge to adopt and enhance persuasive conservation science communication—one that does not necessarily ignore the essence of conservation facts but pays due attention to what may, and how to, motivate pro-conservation behaviors.

BIOECONOMIC OPTIMIZATION OF INTERVENTIONS TO AID EVOLUTIONARY RESCUE OF A POPULATION THREATENED BY ENVIRONMENTAL CHANGE

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Rapid environmental changes threaten many populations of conservation concern. Biological populations and human management may both adapt in response. Human adaptation relies on changing management policy, while biological response involves phenotypic change through adaptive plasticity or genetic evolution that may rescue the population in some cases. Biological adaptation can interact with human adaptation, affecting optimal management decisions. This occurs if population phenotypes respond plastically to an environmental cue affected by environmental management. Then, changes in management alter the relative importance of plasticity and genetic adaptation in a population. We consider a situation, motivated by Pacific salmon migrating in a regulated river, where this interaction between evolutionary and management adaptation occurs and management actions are costly. We integrate evolutionary and economic perspectives by introducing a eco-evolutionary model of this situation within a bioeconomic optimization of management costs. Specifically, our model addresses the question, "what is the optimal investment in management adaptation to achieve a specified conservation goal for a population that is evolving toward a moving optimum and demonstrates an

adaptive plastic response to an environmental factor that is (partly) manageable?" We present an approximate analytical optimization of this model, as well as numerical results. The need to consider adaptation in human systems in response to climate change is well recognized, as is the potential for biotic responses. Rarely, however, has the interaction between these two types of adaptation been considered. Here we do so, using an eco-evolutionary model within a bioeconomic framework.

195 WHAT IS CONFLICT? LEOPARDS AMONG PEOPLE IN MAHARASHTRA, INDIA

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When studying the interactions between humans and wildlife, conservation biologists tend to focus primarily on the negative interactions. This includes both the economic and material impacts that wildlife can have on human lives, property and livelihoods, and on the social conflicts that can arise between different stakeholders and institutions over the process of conservation. This focus on the negative leads to a failure to appreciate the far greater diversity of often nuanced interactions that occur. Our work has been conducted in an agricultural area of western India that is largely devoid of natural habitat and medium to large sized prey species and is home to almost 400 people per sq km. We have used a combination of camera trapping, faecal DNA and scat analysis, GPS telemetry and interviews to study the relationship between leopards and people in this region. The area contains a population of leopards and striped hyaena at a density of around 10 per 100 sq km. The leopards subsist on a diet of domestic dogs, cats and small livestock, and show an incredible ability to utilize this human dominated landscape. Because of their high dependence on dogs, the predation impact on livestock is low, and is spread across many households. Losses to leopards are minor compared to those from disease. Traditional livestock protection measures are widely used. No human deaths have occurred in the region for decades, although some minor attacks on people have occurred. Human attitudes towards the leopards are very diverse, but in general people are very tolerant, and we have even discovered that many local people have included the big cat god, Waghoba, into their pantheon. Our findings reveal that there is a wealth of positive and neutral interactions between people and leopards that need to be encouraged and maintained.

PATTERNS OF FISH DIVERSITY IN THE MHADEI RIVER BASIN GOA, WESTERN GHATS, INDIA

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Ashoka Trust for Research in Ecology & the Environment



Jagdish KRISHNASWAMY, Ashoka Trust for Research in Ecology & the Environment ; Kartik SHANKER, Centre for Ecological Sciences, Indian Institute of Science ; Shrinivas BADIGER, Ashoka Trust for Research in Ecology & the Environment

Freshwater ecosystems provide many ecosystem services to mankind. They also harbour significant level of biodiversity and are critical for a variety of threatened species. Despite their importance, many freshwater ecosystems are threatened with extinction. River systems particularly in South Asia have become fragmented due to habitat alteration and dams. As a result of this, associated fisheries have been decimated in many developing countries affecting rural and urban livelihoods alike. Quantifying species diversity in river basins is central to biodiversity conservation. With this background, we conducted a study in the Mhadei river basin in the Western Ghats region – a global biodiversity hotspot in India. The aim was to document the patterns of riverine fish diversity and quantify associated environmental drivers of this diversity. A river stretch of 100-150 m length was identified for fish sampling. In total eleven such segments were sampled from February 2012 to April 2014. We recorded, thirty one species belonging to six orders & eight families. Of these, the family Cyprinidae was most dominant with more than twenty one species followed by Gobidae, Ambassidae, and Bagridae. *Devario malabaricus* was most dominant species followed by *Salmophasia boopis*. Species richness was higher at minimum level of inorganic nitrates and phosphates and in higher stream orders. River habitats didn't show significant relationship with and air temperature, chemical oxygen demand, free CO₂ and dissolved oxygen. The habitat guild was dominated by mid columns dwellers (64 %) followed by surface dwellers (28%) and bottom dwellers (6.30%). Similarly, feeding guild was dominated by insectivorous guild (65%) followed by algivorous (12%), carnivorous (1.5%) and omnivorous guilds (0.86%) respectively. Our study thus provides insights into patterns of fish diversity and functional guilds. Segments with the highest fish species richness should be prioritized for river management.

SPATIALLY EXPLICIT DENSITIES OF TWO GENERALIST PREDATORS AT TWO MIXED-GRASS PRAIRIE LANDSCAPE: IMPLICATION FOR QUAIL CONSERVATION IN THE GREAT PLAINS

Fidelis Atuo

Oklahoma State University

Timothy O'CONNELL, Oklahoma State University

The North American Great Plains supports multiple species of diurnal raptors that potentially rely on similar sources of food (e.g., ground dwelling birds) and nesting substrates (e.g., isolated large trees). At broad scales, these species co-occur. In this study, we endeavored to determine spatially explicit densities and resource selection by two top predatory raptors

(Red-tailed hawk and Northern harrier) in two mixed-grass prairie landscapes that are partly managed for quail recovery. We also aimed to understand the spatial scale at which these species partition habitat. From December 2012–December 2014, we conducted monthly surveys of raptors at two state wildlife management areas (separated by ~ 100 km) in western Oklahoma. Using distance sampling on line transects, we recorded 112 sightings of the Red-tailed hawk and 79 sightings of Northern harrier within core quail habitat. Overall, mixed grasses, relatively sparse ground cover, prey abundance, and more abundant canopy trees were important variables in predicting predator abundance with broad overlap between the two species at both study sites. Red-tailed hawk was the most abundant of the 2 predators at both study sites (Average density: 0.16/ha), both as a breeding resident and in reaching its highest densities during autumn and winter. Wintering densities of Northern harrier were also relatively high (Average density: 0.091/ha) at both study sites and coincided with high predation specific mortalities in quail. Although both species showed significant overlap in habitat selection at broad scale (1000 m radius), fine-scale (100 m radius) habitat use indicated greater reliance on riparian trees for Red-tailed hawk and short grasses with a low probability of tree occurrence for Northern harrier. Our analysis provides evidence for fine-scale niche partitioning among the two predators and predicts higher predation specific mortalities for quail in the winter season.

EVALUATING THE DRIVERS OF TRADE ON AVIAN BODY PARTS IN SOUTH-EAST NIGERIA: IMPLICATIONS FOR BIODIVERSITY CONSERVATION IN PROTECTED AREAS

Fidelis Atuo

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Several species of wildlife are hunted around the world for the perceived potency of certain parts of their bodies in traditional medicine and fetish practices. In Africa, many cultures require animal parts for a wide range of traditional and religious practices. This has resulted in the persecution of more than 354 bird species across the continent. In this study, we evaluated the drivers and frequency of human-related avian mortality focusing on the trade in avian body parts around major protected areas in the Cross River region of Southeast Nigeria. We identified 28 bird species from 13 families that were prevalent in regional trade. Three of the top 5 most prevalent species are listed as globally threatened under the IUCN/Birdlife threat criteria. Both knowledge of and active involvement in the trade was pervasive across the study sites and across different occupational groups. Our top model for predicting involvement in avian body parts trade identified age, income, perceived personal need for avian body parts, and number of



wives as the top socio-economic drivers of participation. The probability of active involvement in the trade decreased with age and average monthly income; an indication that younger people and villagers with low monthly income are more likely to be involved in the trade. The probability of involvement also increased with the number of wives and personal need for avian body parts. The former may be an indication of a larger household that requires more resources to sustain it; the latter likely reflects personal conviction of the efficacy of using avian body parts in traditional medicine and other cultural practices. Our study highlights the importance of targeting socio-economic factors and integrating cultural needs of the people into conservation planning aimed at reducing human-wildlife conflict in the region.

EARNING YOUR STRIPES: DOES EXPERTISE AID THE ABILITY TO MATCH BUMBLEBEE IMAGES IN IDENTIFICATION GUIDES

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One element of citizen science is the collection of data by volunteers. As the discipline continues to grow so does the question of the robustness of the data collected. This study asks participants to answer whether two images of bumblebees (taken from two different UK identification guides) represent the same species. Participants varied in levels of expertise, and initial results suggest that non-expert accuracy in image matching is not significantly different to that of the experts, with the ability to correctly identify matched pairs being more accurate than the ability to identify mismatched pairs.

GRAPH THEORY AND LEAST-COST PATH: HOW THEIR COMBINATION CAN IMPROVE THE ANALYSIS OF HABITAT NETWORK CONNECTIVITY AND PRIORITIZE CONSERVATION MEASURES

Catherine Avon

Irstea

Laurent BERGÈS, Irstea

The green and blue infrastructure in France is based on the conservation and restoration of ecological continuity of habitats in relation to species' biological requirements. Recent development in landscape ecology based on graph theory and species movement modelling using least-cost paths offer promising applications in terms of landscape management and biodiversity conservation. First, we present the model of potential connectivity based on graph theory and explain why it overcomes previous approaches. Then, we illustrate with an

example of connectivity analysis in the region PACA for the Red Squirrel, a forest generalist species. The models identify the landscape areas that are connected or isolated from the rest of habitat network and prioritize the importance of patches and corridors for the maintaining of global network connectivity; they also analyse how connectivity varies according to species dispersal distance. They highlight the key habitat patches and corridors that must be protected to maintain habitat network connectivity for the species. These examples clearly show that these original methods can form valuable decision support tools for the implementation of green infrastructures at different spatial scales, and also help to locate further finer-scale studies.

EFFECTS OF ENVIRONMENTAL VARIABLES ON THE SPATIAL DISTRIBUTION OF CONIFEROUS SPECIES IN THE NORTHWESTERN ALGERIA.

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In order to assess the coniferous species-environmental relationship in the Northwestern of Algeria, we analyzed the effects of six environmental factors (continentality, altitude, exposition, mean annual precipitations, annual minimum temperatures and average annual snow days) on the distribution of five conifers species (*Pinus halepensis*, *Tetraclinis articulata*, *Juniperus phoenicea*, *Juniperus oxycedrus* subsp *macrocarpa*, and *Juniperus oxycedrus* subsp *rufescens*). The Generalized additive models (GAMs) were developed to predict the presence of these species in the study area; it were useful for estimating suitable habitats and identifying the primary factors affecting species distribution in the region. The results show that the climatic factors was the main driver determining the distribution of coniferous species in the study area especially the intensity of the cold that is a limiting factor for several plant species. These first results have provided important inputs for the management plan of coniferous species in the study area and the possible shift of the species' potential distribution in the future in cases of global warming due to climate change.

NATIONAL AND SUB-NATIONAL RED LISTS IN EUROPEAN AND MEDITERRANEAN COUNTRIES: CURRENT STATE AND USE FOR CONSERVATION

Claire-Sophie Azam

SPN



Guillaume GIGOT, SPN ; Bertrand Schatz, CNRS

Facing present statement of ongoing biodiversity loss and limited financial resources allocated to its conservation, collective tools permitting to prioritize and implement relevant operators of conservation are crucial. Red Lists (RL) have been multiplied at several scales (regional, national, subnational) during the last decades. We built here a detailed overview of the current state of national and subnational red lists (NRL and SRL) in the Europe and Mediterranean through a survey of 53 countries. We identified NRL in 41 countries and SRL in 16 countries, but with geographical and taxonomic gaps in RL coverage and with disparities in methodological approaches. Further than a statistical approach (methodology, species assessed, stakeholders, funding), we highlight the influences of the experience of stakeholders and several particular national cases. This first international review of the uses of RL in national conservation programs confirms the decisive role of NRL for conservation actions, in particular during prioritization processes. We propose a set of recommendations to increase harmonization between NRL and SRL and among neighbouring countries and to strengthen their scope for conservation.

EUROPEAN OVERSEAS, NEW FRONTIER FOR BIODIVERSITY RESEARCH?

José Azevedo

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The European Overseas Areas are strategically positioned to become a strong focus of biodiversity research in support of sustainable development. In fact, they constitute a complex geopolitical entity extending Europe's presence across the globe, incorporating all ecosystems and oceans from the tropics to the poles. Europe's overseas are mainly islands (most of them located in Biodiversity Hotspots), but also include French Guyana, one of the least disturbed areas of rain forest on Earth. Fulfilling European international commitments, such as the Convention on Biological Diversity, will require special consideration to its overseas areas. This has started to be expressed in the scope of policy instruments, such as the EU Biodiversity Strategy, and funding mechanisms, such as the LIFE+ fund, the BEST Initiative or H2020. The immense diversity of biogeographical settings and the different levels of human pressure encompassed by Europe's Overseas areas allows the testing of comparison-based hypothesis, linking patterns to processes. This unique advantage makes them an ideal setting for biodiversity research of both global significance and local relevance. Such research, however, can only be accomplished

through an extensive supporting network. This is where the European FP7 funded NetBiome partnership is making a unique contribution. NetBiome is a consortium of entities from knowledge institutions, business, government and civil society, dedicated to the mobilization of stakeholders to identify and address priority challenges in reconciling conservation of (sub)tropical biodiversity with the sustainable development of Europe's regions and territories, based on the benefits from high biodiversity. Seven international research projects are currently being funded through NetBiome, and the research recommendations under preparation will feed a second call in the near future.

A CLOSER LOOK AT BRAZIL'S FOREST CODE: ASSESSING THE NEW LAW IMPACTS

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Recent changes in Brazil's Forest Code raise environmental concerns for biodiversity conservation worldwide. Over half (53%) of Brazil's native vegetation occurs within private properties and the Forest Code is the only law protecting native vegetation within private land, enacted to conserve native vegetation, water resources and prevent soil erosion by protecting sensitive areas. In 2012 a revision of the Forest Code downgraded native vegetation protection to favor landholders who had used their land illegally. For example, changes included amnesty to all illegal deforestation by 2008 and reduction on the required buffer zone extent nearby sensitive areas. Broad assessments have estimated that these measures decreased the total area to be restored from 50 to 21 million ha. However, broad assessments may underestimate the total area changes, considering sensitive areas buffer zones range from 5 m – 500 m. Therefore, fine scale analyses of the impacts of the changes are needed. In this study, we used high resolution imagery to undertake a fine scale analysis of the impacts of Brazil's Forest Code within a case study in Atlantic Forest. We identify areas at risk of deforestation and areas to restore in one of the world's top five biodiversity hotspots with less than 16% of its original extent. We mapped 15 watersheds (67,000 ha) in the buffer zone of a protected area under a fine resolution (1:3000). Here we present preliminary results on three different policy scenarios: i) current; ii) under the old forest code and iii) under the new forest code. Our study is the first fine-scale study to identify key areas to restore and to conserve based on the Forest Code changes. Furthermore, we expect to implement our findings through a strong stakeholder engagement effort, working close to government, landowners and other key institutions.



DESIGNATING NEW TIGER RESERVES: THE CASE OF SATHYAMANGALAM TIGER RESERVE IN SOUTH INDIA

Vinoth B

CARE EARTH TRUST

The paper describes the case of a newly declared Tiger Reserve in southern India viz. Sathyamangalam Tiger Reserve (STR) in Tamilnadu, highlighting the rationale and data that contributed to effecting the declaration. The Reserve is part of a larger composite of Protected Areas viz. Mudumalai, Bandipur and Wayanad in the Nilgiri Biosphere Reserve, and the ecological integrity of this landscape is discussed. In doing so, it demonstrates the efficacy of using what is largely considered a rudimentary method viz. line transects in estimating the population and density of three major carnivores in the landscape with their indirect evidences i.e. scats and kills, the Tiger (*Panthera tigris*), the Leopard (*Panthera pardus*) and the Dhole (*Cuon alpinus*). In addition to establishing the existence of a significant population by laying 48 transects of 930 km covering a gamut of habitats, the pilot study also demonstrates the habitat preference of the three species being clearly demarcated over an altitudinal gradient. Tiger's domination is revealed through the occurrence of 121 scats out of 220 analysed; rest of which are Leopard and Dhole. Of 27 kills observed, 14 made by Leopard, 9 and 4 by Tiger and Dhole respectively. The socio-cultural factors contributing to the use of such methods especially in wake of the apprehensions expressed by the local communities is discussed in detail.

POTENTIALS AND CHALLENGES OF INDIGENOUS KNOWLEDGE IN BIODIVERSITY CONSERVATION: CASE STUDY OF OSUN OSOGBO SACRED GROVE, NIGERIA

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The significance of indigenous knowledge (IK) and cultural beliefs in biodiversity conservation has been emphasised. The Osun sacred grove was established on the IK of the people of Oshogbo which was passed down orally from one generation to another. Meanwhile, ecological encroachment and degradation activities posed great challenges to the sustenance of the grove and have been advancing at alarming rate. Data was collected through interview of twenty key informants in the adjoining communities and five officials in the grove. The riparian vegetation in the sacred grove is unique in the sense that it is the only remaining relic of the Nigeria rain forest ecosystem endemic to the grove. In

addition to the pressure from population explosion and urban expansion, the deforestation of the grove is resulting from farming practices going on along the boundary. About 90% of respondents informed that neglect of the local belief used to establish the grove is resulting in the encroachment activities. About 60% of the local people expressed their displeasure in the way the government is in total control of the grove and not involving the local communities. All the interviewed government officers of the grove indicated that poachers from the adjoining communities carry out illegal hunting of the wild animals in the grove and this has led to reduction and total extermination of some animals. To effectively strengthen this IK in conservation of remaining endemic biodiversity, appropriate local indigenes should be employed and fully incorporated in the management strategy of the grove; more guards are also required for patrol activities, and there is need for re-establishment of clear boundary and buffer zone to prevent encroachment and other illegal activities within and around the grove.

INTERACTIVE EFFECTS OF BUFFER WIDTH AND WETLAND HYDROPERIOD ON AMPHIBIAN REPRODUCTIVE OUTPUT

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Forest buffers are a major tool used to protect wetland-dependent wildlife. Though implemented widely, buffer efficacy is untested for most amphibian species. It is thus unclear whether buffers are sufficient for maintaining viable amphibian populations and if so, how wide buffers should be. We present evidence from a 6-year, landscape-scale experiment testing the impacts of forest clearcutting and buffer width on the reproductive output of 2 amphibian species at 11 vernal pools in the northeastern United States. We randomly assigned each pool to 1 of 3 treatments (i.e., reference, 100m buffer, 30m buffer) and used clearcutting to create experimental buffers. For each pool, we censused egg masses; catalogued all metamorphic *Ambystoma maculatum* and *Lithobates sylvaticus*; and used mixed-effects regression to assess the relative effects of treatment and pool hydroperiod on egg mass and metamorph production. Cutting exerted negative effects in both buffer treatments and on both species, but effects were stronger at 30m pools and for salamanders. For example, salamanders produced fewer egg masses over time in both buffer treatments, while frog egg mass abundance was unaffected by treatment. Also, at pools producing metamorphs, salamander metamorph abundance declined over time in the 30m treatment, but was unrelated to time since cut in the 100m treatment. Both species had complex interactions between reproductive output, hydroperiod, and buffer width. For instance, frog metamorph



snout-urodyle length increased with hydroperiod at reference pools, but decreased with hydroperiod at buffered pools, with stronger declines in the 30m versus 100m treatment. These results show that buffer width mediates the impacts of forest disturbance on the reproductive output and hydroperiod sensitivity of wetland-dependent amphibians and also suggest that short-lived, explosive breeders like wood frogs, may be more tolerant of narrow buffers than long-lived species like spotted salamanders.

MONITORING OF TRANSLOCATED POPULATIONS USING PASSIVE INTEGRATED TRANSPONDERS AND CAMERA TRAPS.

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The effectiveness of conservation translocations of endangered species is conditioned by the long term survival of released individuals and their successful breeding. Yet, it remains challenging to assess translocation success in the wild. In many species, individual banding has not been proven effective for studying demographic parameters. The use of tracking methods (radio or satellite tracking) are powerful for monitoring individuals but these methods remain costly and large sample sizes are rarely available. Passive Integrated Transponders (PIT) and camera traps are appealing monitoring tools for wildlife studies. However, the pros and cons of these approaches in applied conservation remain poorly documented. We combined the use of integrated PIT technology and camera trap survey to measure the breeding success of female Houbara bustards (*Chlamydotis undulata undulata*) over 2 years, in the context of a large scale reinforcement program (99 000 released birds). We compared the outcomes of such advanced techniques with traditional field monitoring of over 7 400 nests. Results showed that antenna PIT-tag readers significantly increased the sample size of breeding females identified and monitored while camera traps improved the accuracy of nest monitoring. Our results underline the potential of these tools in the monitoring of managed populations, the measure of demographic parameters and open new routes to the development of innovative monitoring methods.

DIFFERENTIAL SPATIAL AND TEMPORAL DISTRIBUTION OF ADULT LOGGERHEAD IN WESTERN MEDITERRANEAN SEA: IMPLICATIONS FOR CONSERVATION AND MANAGEMENT

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Sea turtles show relatively high fecundity and low natural mortality during the adult phase. In contrast, immature individuals (hatchlings and juveniles) present high natural mortality rates. For this reason, mortality induced by fisheries on mature phase has a higher impact on population than immature non natural mortality. Bycatch in longline fisheries is considered to be a critical global threat for loggerhead sea turtle (*Caretta caretta*), particularly important in the Mediterranean Sea. As a consequence, the most dangerous effects for loggerhead conservation in Mediterranean Sea are due to the bycatch of adult turtles. Recent studies found differences in body size of loggerhead sea turtles caught using different longline gear types in the western Mediterranean Spanish fishery. Thus the traditional surface longliners targeting swordfish (LLHB), using larger hooks than those targeting albacore tend to select larger animals. The aim of the present document is search spatial and/or seasonal trends in catches of adult loggerhead turtles in LLHB from the western Mediterranean, and model it. Loggerheads nesting reported recently in different Spanish beaches indicate the presence of adults in the study area. We analyzed the spatial and seasonal distribution of 378 loggerhead individuals caught in LLHB, with a strait carapace length size (SCR) known, of which 23 were adult specimens (i.e. SCR > 70 cm). We obtained a significant GLM model between the probabilities to bycatch a mature sea turtle in LLHB versus the independent variables: latitude, longitude, June and July. The model's goodness-of-fit was significant according to the Omnibus test (df = 4, P < 0.0001), and the model showed outstanding discrimination capacity (AUC= 0.935). According to our results, the probability to catch a mature loggerhead increases during June and July in the south of the Balearic Islands area. Conservation and management implications of our results are discussed.

EFFECTS OF HUMAN LAND-USE ON AFRICA'S ONLY FOREST-DEPENDENT FELID: THE AFRICAN GOLDEN CAT CARACAL AURATA

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Africa's equatorial forests are threatened by widespread deforestation and bushmeat hunting and face further pressure through rapid human population growth and large-scale expansions of commercial resource extraction such as logging and mining, as well as forest clearing for plantations. Using the forest-dependent African golden cat as a case study, we assess



the effects of disturbance across a human land-use gradient. We collected camera trap data between 2011 and 2013 at five sites in central Gabon to estimate density using spatially explicit capture-recapture models. Density estimates varied from 16 individuals per 100 km² at a pristine site, and 10 – 13 per 100 km² in logging concession areas, to 4 per 100 km² in a small village hunting area. Our results suggest that while golden cat populations are largest in pristine environments, logging concessions may also play an important role in the conservation of the species, particularly as they have greater land coverage than protected areas. Post-extraction management of concession areas could help to avoid further degradation and contribute to the conservation of forest endemic species. Bushmeat hunting, particularly with the use of wire snares, poses a serious threat to the African golden cat.

CLIMATE WINDOWS: ASSESSING CLIMATE SENSITIVITY USING R PACKAGE CLIMWIN

Liam Bailey

Australian National University

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Global climate change is affecting species conservation and management. Although we know that climatic change affects species in different ways, it can be difficult to gain a thorough understanding of how a specific species or population may be impacted. Selecting which climate variable to investigate, the period over which climate is considered, and the way in which climate is measured (e.g. mean, maximum) can be challenging. Consequently, it has been common to simply assess the sensitivity of species to the mean climate within arbitrary climatic 'blocks' based on a priori assumptions (e.g. spring temperature); however, this rather crude approach may not provide the best representation of a species' climatic sensitivity, and using these sub-optimal climate signals will likely compromise our ability to predict future impacts of climate change. More recently, there has been an increase in the use of 'climate window analyses' that assess the sensitivity of a species in multiple possible climatic periods. This new approach allows us to test for both short and long-term climate signals, and requires fewer a priori assumptions. Here, we present a new tool kit in R statistical software that allows for easy use of climate window analyses. We provide the ability to test different aggregate statistics (e.g. mean, slope, variance), test both fixed windows (a specific time of year; e.g. first week of August) and flexible windows (the number of days before a biological response; e.g. 10 days before egg laying), and generate multiple graphical tools that aid in selecting the best climate window. We illustrate the power of our tool kit using long-term bird data. Our new tool kit will make climate window analyses more widely accessible to people investigating the

climate sensitivity of species, which will ultimately provide us with more reliable information for future species conservation and management.

DO LONG-LIVED SHOREBIRDS CHANGE THEIR NEST PREFERENCE IN RESPONSE TO EXTREME CLIMATIC EVENTS?

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One key feature of global climate change will be an increase in the frequency of previously rare climatic extremes. These extreme climatic events can have major impacts at the individual, population and community level, thus posing a major challenge for species conservation and management. Plastic change in behavioural traits may facilitate rapid species adaptation to extreme climatic events, but empirical studies are needed to assess whether such changes occur in the wild. Here, we investigate the behavioural responses of the Eurasian oystercatcher (*Haematopus ostralegus*) to rising maximum tides, using data on nest site selection covering a 20 year period. We show that the average nest elevation of the population has increased over time; however, this change appears to be driven most strongly by slower changes in habitat selection, with low elevation territories being abandoned and left unoccupied, rather than more rapid changes in individual nest site selection. Consequently, the rate of nest elevation change in *Haematopus ostralegus* is currently too slow to keep pace with rising tides. In conclusion, plastic change in nest site selection does not appear to provide a solution to rising maximum tides in this population; however, plasticity in other behavioural traits, such as nest timing, may provide an alternative mechanism for rapid adaptation to extreme climatic events and should be investigated further.

THE INFLUENCE OF PROTECTED AREA SELECTION CRITERIA ON MEASURES OF CONSERVATION EFFORT

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Protected areas (PA) are a cornerstone of conservation biology. They are used as indicators of conservation investment (eg: United Nations Millennium Development Goals), in explicit conservation targets (eg: CBD Aichi target 11), and to monitor species-specific conservation efforts. Furthermore, the correct assessment of the benefits that current and future PAs bring to biodiversity is a key component of systematic conservation planning. While numerous literature studies have analysed the global PA network or used PAs as a key component, these



have so far used multiple approaches to determine which PAs to include; mainly according to the IUCN PA classification system. Some published analyses only include areas that provided explicit benefit to biodiversity (i.e. classified Ia-IV), others include all PAs with an IUCN classification, or even advocate the inclusion of sites without an official IUCN category. Furthermore, since no widely adopted guideline currently exists, ulterior selection criteria such as only including national sites are occasionally applied. Consequently, the comparison of results from literature is complicated and uncertain. In order to shed light on the extent to which PA selection criteria influence our perception of the current conservation effort, we analysed the impact of using differing approaches in PA selection when measuring the global, regional and national progress towards the CBD Aichi target 11 and when measuring protection levels in mammals. We used PA records from the World Database on Protected Areas to create 12 global PA maps which include combinations along 3 common selection criteria: IUCN classification, PA nationality status, and presence of an explicit PA geometry. Results show that selection criteria may have overwhelming effects on perceived protection levels. A critical interpretation of the implications tied to each selection criteria is presented along with recommendations for key conservation analysis scenarios.

DNA METABARCODING FOR DIET AND PARASITIC ESTIMATION OF MARKHOR (CAPRA FALCONERI) IN CHITRAL, PAKISTAN

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Markhor (*Capra falconeri*) population in Pakistan is facing a number of threats due to direct and indirect impact of human activities. IUCN has enlisted this wild goat as endangered. The decline might imply an intensive hunting pressure, deforestation, increasing food and habitat competition with domestic livestock. The potential impacts of intensive grazing by livestock include depletion of scarce forage, habitat degradation and reduction in breeding performance. There is a critical lack of knowledge based on molecular studies about their distribution status and needs for survival. Markhor has been found to be the definite hosts of parasitic nematodes and can be an additional cause of decreasing the population. The domestic goat is dominant livestock species, and a potential competitor with the markhor due to habitat overlap.

The issue of forage competition between livestock and wild herbivores has long been acknowledged as being important for conservation management. Thus there must be evidences available on food components of this wild mammal. This study will demonstrate that non-invasive fecal DNA sampling is feasible for wild goat population diet analysis and estimation of gastrointestinal parasitic load. The total extracted DNA also contains traces of food consumed by host species. Diet habit of markhor will be estimated by exploiting vascular plants specific metabarcoding markers followed by Next Generation Sequencing technologies. In addition; there is a possibility of disease transmission from livestock to the wild caprines. Similar strategy will be used for the estimation of parasitic disease load, especially nematodes, using nematodes specific primers on markhor population. The sequencing results will be analyzed by exploiting bioinformatics tools for diet and nematodes identification of markhor species. The result findings will highlight different threats and pressures faced by this species and provide recommendation for managing markhor habitat.

COMMUNITY PERCEPTION ON BIODIVERSITY CONSERVATION AND SUSTAINABLE USE OF NATURAL RESOURCE IN THE DEGRADED KAGORO-NINDAM FOREST RESERVE, KADUNA STATE, NIGERIA

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Many local communities surrounding forest reserves derive their livelihood from the resources the reserves provide and that make the areas prone to pressures. Understanding community perception and attitude towards these areas is important for conserving biodiversity. This study evaluates the current management practice and the perception of local residents surrounding Kagoro-Nindam forest reserve on the conservation and sustainable use of natural resource. We collected data through structured questionnaires from 148 respondents in five villages. Majority of the respondents constituting 45% primarily have farming as occupation. Despite 91.2% of respondents supporting concept of conservation of forest resource, and 90.5% agreeing with the concept of sustainable use of natural resource, 87% of the respondents are actively involved in cutting of trees from the reserve as fuel wood for both commercial and home use. Residents are also aware of other forms of degradation in the reserve. Respondents claimed primary source of recent increase in degradation to be initiated by government who cleared forest trees for timber without replacement and protection measures. The local residents though aware of



conservation and sustainable use of resource, hold negative impression on the forest management. Knowledge of residents' perception can help during conservation actions and management decisions.

4.01 INDICATOR SELECTION FOR BIODIVERSITY MANAGEMENT: WHAT ARE WE DOING WRONG?

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Indicators help to inform conservation practitioners about management decisions and assess the effectiveness of management. Despite widespread use of indicator species in management and the considerable amount of resources spent monitoring them, they are rarely selected under clearly defined management and monitoring objectives. This makes it difficult for indicator monitoring to report meaningfully on progress towards management targets or effectively inform management decision-making. A better alternative is a structured approach for indicator selection that explicitly links the indicator to the management objectives through the expected improvement in management performance from monitoring. We conducted a review to assess current methods proposed in the scientific literature for selecting indicator species to inform management and to evaluate its effectiveness. Decision theoretic frameworks available in the literature allow conservation practitioners and decision-makers to choose between uncertain consequences of selecting different monitoring strategies to evaluate management decisions. Taking cues from decision theory and the optimal monitoring literature, the review identifies research priorities that can pave the way for developing more effective indicator selection strategies for biodiversity management by highlighting gaps in existing indicator selection frameworks. In the face of limited resources for biodiversity conservation, this will allow us to identify cost-effective indicators for biodiversity management that are defensible and efficient.

INVESTIGATIONS ON POPULATION BIOLOGY OF EGYPTIAN VULTURE (NEOPHRON PERCNOPTERUS) IN MIDDLE AND UPPER SAKARYA REGION, TURKEY

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Anadolu University

Elif Yamaç, Anadolu University

Egyptian vulture is one of the scavenger raptor species classified as globally endangered. Especially the European population which is estimated about 3300-5050 individuals has decreased significantly in recent decades. Because of many threats like human disturbance, habitat change and poisoning, populations are still holding decline in many

countries in Europe. Although Turkey has the largest Egyptian vulture population after Spain in Western Palearctic region, there is no detailed information on the species. Determining breeding area, pair number, breeding success and threats on the population are very important for its viability. The aim of our study is to collect data on breeding success and nest characteristics of Egyptian vulture in Middle and Upper Sakarya Region, Turkey. Potential nest sites were searched between 2013-2014 in the study area. It was located 30 and 36 nests in 2013 and 2014, respectively. Totally 17 pairs were successful with 56.6% nesting success in 2013. The number of active nests were 30 and successful nests were 22 with 73.3% nesting success in 2014. Egyptian vulture is cliff nesting species. The mean nesting cliff distance between base and peak (m) was 11.8 ± 6.7 in the study area. The mean height of nests from ground (m) was 6.7 ± 4.5 . The mean nesting cavity's width, height and length (m) were 2.1 ± 1 , 1.48 ± 0.6 and 1.91 ± 0.9 , respectively. In both breeding seasons, negative anthropogenic activities were observed for some nest sites. Although we did not detect any poisoning case for this species in the study area, plenty scavengers killed because of poisoning in recent years in Turkey. Further detailed studies need to be maintained for fully understand threatens and conservation to Egyptian vulture populations in Turkey. This study was supported by a scientific research grant (1303F050) from Anadolu University Research Fund.

MULTI-ECOTYPE MIXTURES IN RESTORATION: A CASE STUDY ON ELYMUS GLAUCUS, A NORTH AMERICAN BUNCHGRASS

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Researchers and practitioners recognize the importance of using local ecotypes in ecological restoration. Because empirical data do not exist for the majority of restoration species, key issues are whether these species actually express local adaptation, and if local ecotypes alone are sufficiently genetically diverse to adapt to rapidly changing climates. The use of multi-ecotype mixtures incorporating both local and non-local ecotypes has been suggested as a technique to safeguard against climate change without resource-intensive empirical data. A concern with this technique is how individuals of different ecotypes will interact with one another when planted together, and in particular, whether these interactions influence the expression of local adaptation in the resident ecotype. Using *Elymus glaucus*, a North American perennial bunchgrass commonly used in restoration, we conducted a field experiment to test the effect of planting multi-ecotype mixtures in restoration. We reciprocally transplanted four ecotypes of *E. glaucus* without neighboring



plants, as well as with conspecific neighbors in mixtures containing only local ecotypes, ecotypes from the same broad climatic region, and ecotypes from two very different climatic regions. While we did find that ecotypic performance varied by environment (i.e., a GxE interaction), this pattern was not consistent with local adaptation for all ecotypes. For those ecotypes that did outperform others at their home-sites, the effect was not influenced by the addition of conspecific neighbors, or by the ecotypic identity of the neighbors. We conclude that multi-ecotype blends could be considered for restoration when sufficient local seed is unavailable or when future climate adaptation is a key project goal. Furthermore, given that logistic and economic constraints on native seed availability often prohibit the use of local seed in practice, we recommend further research on the efficacy of multi-ecotype mixtures.

175 IPBES - A NEW PATH TO BRIDGE THE SCIENCE-POLICY GAP

András Báldi

MTA Centre for Ecological Research

IPBES is the Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services, which is a major initiative of governments to copy the success of IPCC (the Intergovernmental Panel on Climate Change) in the topics of biodiversity and ecosystem services. Novelty of IPBES is that it goes beyond interdisciplinarity and considers different knowledge systems, that is besides the well-known academic knowledge system it involves knowledge from indigenous people, and people with traditional ecological knowledge. The integrative nature of IPBES is conceptualized in the IPBES conceptual framework, which was developed over several workshops and consultations to involve as broad range of expertise as possible. The framework puts society and institutions in the middle as it is the major target where IPBES intend to have an impact. The effect of society influences nature through direct drivers. Nature, however, can be seen in different ways. For science it is biodiversity and ecosystems, while it is a more complex system including intrinsic value for indigenous people, who call it Mother Earth. The different views are running parallel in the conceptual framework. The challenge for the future is to use this framework in the assessments, that is to incorporate information from different knowledge systems, to integrate different views and values, and to use it to effectively inform decision makers.

ANALYSIS OF AN ECOLOGICAL QUALITY INDICATOR USED ON INDUSTRIAL SITES

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Companies can own substantial areas. There is a need for ecological quality assessment, in order to adapt land management to ecological or conservation issues. The composite indicator, called «Land Biodiversity Indicator» (IBF: Indice de Biodiversité du Foncier), was created during A. Lacoëuilhe's thesis (MNHN - EDF R&D, 2014). This tool enables to classify plots of land according to their ecological quality at a local scale (50 to 200 hectares). IBF includes 14 criteria assembled in three thematic: (i) "diversity/heritage" including heritage species and habitats, diversity of habitats and birds, and habitat heterogeneity criteria, (ii) "functionality" based on concepts of landscape ecology (like connectivity), and (iii) "disturbance level" integrating fragmentation, light and noise pollution, artificialisation and exotic invasive species criteria. IBF tends to show the importance of evaluating the functionality and the disturbance level to assess ecological quality of a site. IBF is still experimental. It was tested on four electricity power plant sites, located in different French geographical areas, with contrasted surroundings: woodlands, pastures, crops and industrial areas. The authors will present one application of IBF and the feedback (possibilities and limits). In order to understand the relationships among criteria, statistical approaches were used, especially correlation analysis (rho's Spearman) and hierarchical partitioning analysis. No recurrent correlation among criteria was highlighted in the different tests. Each criterion seems to bring information with no redundancy. The hierarchical partitioning approach showed that the "functionality" thematic better explains the ecological quality assessment in predominantly natural areas, whereas the "disturbance level" thematic better explains it in artificial or semi-natural areas.

MAXIMIZING THE UTILITY OF MAXENT: EXPLORING THE INFLUENCE OF BIAS MASK, FEATURE TYPES, AND STATISTICAL TEST SELECTION ON MODEL PARSIMONY

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Species distribution models (SDMs) are powerful tools used to elucidate niche requirements, predict future habitat of range shifting species, support conservation plans, and more. Maximum entropy (Maxent) is a widespread presence-only modeling technique whose popularity can be attributed to



strong predictive performance and a freely available, user-friendly software package. However, building an effective SDM is both an art and a science, and model parameterization is often rife with subjective decision-making. Maxent is particularly notorious in this regard; many Maxent studies have been criticized for applying default software settings with little justification. This criticism is well warranted, as multiple reports have shown how differing (1) background samples, (2) model 'features' (i.e. mathematical transformations of environmental data) and (3) variable reduction procedures can greatly impact results. We investigate these issues further by analyzing how bias and complexity affect the believability of model outputs for two at-risk passerines: the Canada warbler and the Rusty blackbird. Specifically, we consider the implications of (1) using different masks to account for sample bias (2) including all feature types vs. 'hinge' features alone, and (3) using area under ROC curve (AUC) statistics, training gain, or Akaike's information criterion (AIC) to select the most parsimonious model. While the choice of bias mask influenced Maxent predictions, the effects were less pronounced than in other studies. We also found that the reduced complexity achieved through the use of hinge features alone was not worth the corresponding reduction in model fit. However, the poor trade-off was only revealed by AIC. Indeed, training gain and especially AUC were poor determinants of parsimony. Our findings illustrate that there is no "one size fits all" solution to Maxent parameterization and underscore the importance of tailoring modeling choices to specific study goals.

EXAMINING THE MECHANISMS AND EVIDENCE FOR CONSERVATION ACTIONS THROUGH SCIENCE LEARNING BY PARTICIPANTS IN CITIZEN SCIENCE PROJECTS

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Citizen science and other forms of public participation in scientific research has emerged as a major tool for studying biodiversity, engaging the public in science and igniting and supporting conservation actions. But evidence is lacking for outcomes and how participating in environmental science research and monitoring does or does not lead to science learning and environmental stewardship. To better understand the cumulative impacts of involving the public in science for conservation, we provide a comparative framework across different models of PPSR, including Contributory (participants collect data), Collaborative (participants also help design and analyze data) and Co-Created (participants work on all area of the scientific process), so projects may leverage strengths of broader and/or more intensive public participation. We examined how participation in citizen

science affects participants' perceptions of their roles in, use of, and contributions to science and conservation, particularly across different types of citizen science projects. Across diverse projects in the U.S. focused on birds, precipitation, air and water quality monitoring, pollinators and eels, we conducted 72 interviews with participants representing low, medium, and high levels of engagement, as defined by the leaders of the 6 citizen science projects. We focused analysis on understanding how their participation in citizen science helped to develop and/or reinforce specific aspects of science and environmental identity. Our initial findings indicate that depending on the quality of participation and participants' interests, the development or reinforcement of science identity is possible at all levels of engagement. Whether leading a local air quality monitoring team, or sporadically submitting monarch larvae monitoring data, many participants expressed deep feelings of empowerment and self-efficacy in their ability to contribute to and use science to address environmental problems.

SHORT-TERM ECO-PHYSIOLOGICAL RESPONSE TO TRANSLOCATIONS FROM CAPTIVITY TO THE WILD IN HERMANN'S TORTOISE

Jean-Marie Ballouard

SOPTOM

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Although being commonly used in population management, translocation often suffers from a lack of feed-back, notably regarding logistical constraints associated with individual monitoring. In the case of long-lived animal, long-term studies are requiring to assess survival, reproductive and recruitment rates, of translocated and resident individuals. However considering the urgent nature of many species' situations where translocation would be appropriate, fast-assessment techniques should be tested. We assessed the eco-physiological short-term response to translocation of Hermann's tortoises (*Testudo hermanni hermanni*) directly from captivity to the wild. After being maintained in captivity 2 to 8 years, two pools of individuals were released in Spring (n=12) and in Autumn 2013 (n=12) into a natural population impacted by fire after. During the two years post-release period we radio-tracked translocated individuals (N=24) and resident tortoises (N=12) during all the activity season. Movements, behaviours, body condition, basal stress level (corticosterone) and body temperature were regularly recorded. The first year after releasing, translocated tortoise released in Autumn exhibited higher dispersion than resident tortoise and translocated tortoise released in Spring. We found no differences in thermoregulation, corticosterone level and body condition between all translocated and resident tortoises. Body condition of all tortoises increased rapidly in Spring. We found



no sign of perturbation in resident tortoises. Contrarily, resident males mated with translocated females. Survival of the three groups of tortoise was mainly affected by predation. Because tortoise adapt well to their new environment, translocations should be further tested on larger spatial and time scales to improve population restoration programs, especially in threatened species with limited dispersal ability.

91: LEOPARD RESEARCH IN SOUTH AFRICA: RESPONSIBLE SCIENCE OR ACADEMIC INDULGENCE?

Guy Andrew Balme

Panthera

Peter LINDSEY, Panthera ; Lourens SWANEPOEL, University of Pretoria ; Luke HUNTER, Panthera

Science and conservation are often driven by different agendas, partly because many researchers are reluctant to tackle applied topics perceived to be less competitive for publishing or too impractical to study. Consequently, research often fails to contribute meaningfully to conservation outcomes. We use leopards (*Panthera pardus*) in South Africa to illustrate this mismatch between research and conservation priorities. A review of the scientific literature showed that leopard studies in South Africa focused disproportionately on basic research, particularly on leopard feeding ecology inside protected areas. Academics were responsible for most articles but avoided applied studies, even though they were published in higher impact journals and took less time to undertake. An assessment of active leopard projects further demonstrated that studies were clumped in areas of low conservation concern, generally employed invasive research methodologies and often failed to publish their findings. Many projects were also funded by commercial volunteer programs with financial incentives for conducting research. We recommend that leopard researchers in South Africa and carnivore researchers more widely engage with practitioners to ensure the most pressing conservation issues are addressed. Scientists must also situate their research in a broader conservation context and evaluate the outcomes of management decisions. Finally, continued funding and permissions for research should at a minimum be contingent on research outputs being published in the peer-reviewed literature. For leopards and many species like it, the case for undertaking scientific research on basic ecology or behaviour without contributing to conservation is rapidly waning.

ADVANCING INNOVATIVE CONSERVATION TOOLS BY IMPROVING KNOWLEDGE OF DECISION-MAKING ON PRIVATE LANDS

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Managing natural resources on private lands is a significant conservation challenge. Extensive private ownerships (e.g., over 60% of lands in USA and over 75% of France's total forest area) necessitate consideration of the effectiveness of conservation tools on these lands, and our research aims to improve conservation efforts by enhancing understanding of landowner goals and decision-making. By linking landowner survey responses with spatial data describing landscapes, we develop micro-scale, spatially-explicit models of landowner decision-making. We test the extent to which models of behavior are improved by the addition of detailed spatial data, consideration of spatial relationships, and recognition of heterogeneous landowners and natural landscapes. We combine data from a 2012 Maine landowner survey with spatial data on landscape features, human communities, land ownership, and public policies. Guided by the results of prior literature, we classified landowners using cluster analysis and developed discrete regression models of past and intended land management and development behaviors. Results suggest that landowner and landscape characteristics explain variation in decision-making and behaviors. The addition of spatial variables describing parcels and broader landscapes improves the interpretation of survey results and the fit of past and intended land management and development behavior models. Incorporating greater decision-making heterogeneity into the regression models also improves the performance of these models. Understanding how landowner decision-making varies across individual landowners and landscape settings could improve conservation policy development and implementation by helping policy-makers better integrate landowner perspectives into conservation efforts. In turn, this knowledge can potentially improve ex-ante assessment of conservation tools and ex-post compliance with voluntary and regulatory approaches to conservation.

SYMPOSIUM 134: APPLYING EMPIRICAL ESTIMATES OF MARINE PROTECTED AREA EFFECTIVENESS TO ASSESS AND IDENTIFY GAPS IN CONSERVATION PLANS

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While efforts to meet international commitments to counter biodiversity declines by establishing networks of marine



protected areas (MPAs) continue, assessments of MPAs rarely take into account measures of effectiveness of different categories of protection, or other design principles. We carried out a meta-analysis of ecological effectiveness of IUCN categories I-II (no-take), IV and VI (MPAs) compared to unprotected areas. We then applied our ecological effectiveness estimates – the added benefit of marine protection over and above conventional fisheries management – to a gap analysis of existing MPAs, and MPAs proposed by four indigenous groups on the Central Coast of British Columbia, Canada. Additionally, we assessed representation, size, spacing, and governance considerations against MPA design criteria. We then used Marxan to identify areas where gaps could be filled. We found significant differences in response ratios for IUCN Categories IV and VI MPAs compared to no-take reserves and areas open to fishing, although variability in responses was high. By rescaling the predicted ecological effectiveness ratios, we found that, compared to no-take reserves (biodiversity conservation effectiveness 100%) and open fishing areas (0% additional biodiversity contribution), IUCN Category IV had a predicted effectiveness score of 60%, ranging between 34% and 89% (95% lower and upper CI, respectively), and IUCN Category VI had a predicted effectiveness score of 24% (ranging between -12% and 72%). We found that the existing MPAs did poorly when compared against most MPA design criteria, whereas the proposed MPA network achieved many of the best practices identified in the literature, and could achieve all if some additional sites were added, as identified using Marxan. Our case study demonstrated a method for applying empirically-based ecological effectiveness estimates to an assessment of MPA design principles for an existing and proposed network of MPAs.

BIG CAT AT OUR DOOR STEP: RECOVERY AND FUTURE OF ENDANGERED LIONS IN INDIA

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Asiatic lions elucidate India's conservation commitments and portray a success story. The species that once ranged from Persia to Palamau in eastern India, was almost driven to extinction by indiscriminate hunting and habitat loss. A single relict population of about 50 lions persisted in the Gir forests of Saurashtra peninsula, western India by late 1890's. With stringent protection offered by the Nawabs of Junagadh and subsequently by the State run Gujarat Forest Department, Gir lions have increased to a current population of over 400 with an annual rate of about 2%. Lions were restricted to the Gir forests (1,800 km²) till the mid-1980's, but have since dispersed to occupy over 20,000 km² of human dominated agro-pastoral landscape of Saurashtra. We herein present our 20 years' research findings on Gir lions based on radio-

telemetry to understand multiple factors responsible for the recovery and future viability of the species. Several factors were responsible for the recovery of lions in Saurashtra, there were: stringent protection from hunting, tolerant and benevolent attitudes of local communities, tolerant behaviour of lions, abundant livestock and other prey, a fair and transparent livestock predation compensation scheme and low density of lions in the human dominated landscape. The paper articulates the importance and role of each of these factors to lion recovery and future viability. Lions now occur in areas where they had been locally extinct for over 5 generations, how communities cope and what their attitudes are towards this large predator are discussed. Mechanisms that would permit long-term persistence of an increasing lion population in human dominated landscape in terms of lion demography, habitat needs, prey availability, conflict resolution and active management are presented. The facets of politics of lion conservation in India and the roles State and Federal Governments, Scientific Institutions, and the Judiciary have played are discussed.

DESIGNING MARINE PROTECTED AREAS IN A CHANGING WORLD: METAPOPULATION RESPONSE TO SPATIALLY-STRUCTURED FLUCTUATIONS IN LARVAL CONNECTIVITY

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Metapopulation theories predict the dynamics of ecological systems that are connected through the limited movement of individuals over heterogeneous landscapes. One key property of such spatial dynamics is the fluctuation in the rate of movement between populations. In coastal habitats, spatial and temporal heterogeneity in movement and dispersal can result from changes in ocean transport and life histories. It can thus be driven by climate change and human activities, and should be integrated into coastal management tools such as marine protected areas. Based on observed and predicted evidence of fluctuations in marine connectivity, we present a theoretical framework that predicts how spatial structure found in temporal fluctuations of connectivity between populations can affect regional metapopulation growth. We build on recent work showing how the sign and strength of overall temporal covariance in connectivity between populations can affect metapopulation growth. In spatially-explicit metapopulations, we show that the effect of connectivity can be captured by the scale and density of regions of positively and negatively correlated fluctuations in connectivity. This spatial aggregation greatly simplifies the description of spatial dynamics in complex metapopulations, and allows optimizing the design of reserve networks in relation to current and predicted changes in ocean connectivity. Finally, we show how two life-history



traits of species, larval phase duration and timing of larval release, can be used to predict the response of species to the spatial structure of covariance in connectivity. We illustrate our predictions using quantitative models of larval transport along the West coast of Canada (British Columbia). In the context of marine protected areas, we discuss the optimization of size and spacing of protected areas, using either the spatial distribution of average connectivity or of its temporal covariance

MOVEMENTS OF AN ENDEMIC FRUIT PIGEON IN URBAN AREAS

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Urban areas are often described as being highly modified and fragmented, characterised by a matrix of different land uses, some of which are capable of supporting native wildlife. The presence of native species within urban areas can provide ecosystem services as well as help to connect an increasingly urban human population with the surrounding native biota. In New Zealand, the kereru (*Hemiphaga novaeseelandiae*), a large (c.650g) endemic fruit pigeon is known to occur in urban environments. Within urban areas kereru are not restrained to just the remnant areas of native forest, but also utilise the resources found in many private gardens. However, little is known on the amount of time kereru spend within these different habitat types and how they move within the urban matrix. As kereru are key seed dispersers, known to consume the fruits of over 70 native plant species and several introduced ones, understanding their movements within urban areas is key to understanding the potential dispersal distances in these environments. We present kereru movement data collected using multiple tracking technologies (e.g. PTTs and GPS) from within the Auckland urban area. These data provide insight into how urban kereru move between and utilise different habitat types within the urban area.

GENOMICS INFORMING CONSERVATION STRATEGIES: WHICH POPULATIONS SHOULD BE RECONNECTED IN AN ENDANGERED RODENT?

Soraia Barbosa

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To develop appropriate conservation practices in the context of current climate change and habitat reduction, it is important to determine which environmental factors most influence a

species distribution across the landscape. New sequencing technologies allow now the collection of genome wide data that can be used to detect functional connectivity between populations and, by associating it with the species ecological requirements, detect effective dispersal corridors. The Cabrera vole (*Microtus cabrerarum*) is a rodent of conservation concern, with fragmented populations within Iberia. Its specialisation to fast-disappearing Mediterranean herbaceous habitats, low dispersal ability and metapopulation like structure, makes this species highly susceptible to climate change and habitat loss. In this study we used Genotyping-by-Sequencing to analyse 86 samples representative of the species entire distribution, resulting in a set of over 5 400 SNPs. We were able to define 2 major evolutionarily significant units (ESUs): Western (W), distributed in Portugal and central Spain; and Eastern (E), distributed from northeast to southeast Spain. This ESU is further subdivided in three populations, matching the four described nuclei of the Cabrera vole distribution. There is, however a signal of population expansion from the southern regions of E to W, contrasting with previous results for the mitochondria. Despite this extensive admixture, analysis of least-cost paths and genomic similarity showed limited predicted and functional connectivity of populations between and within the ESUs, and detected the major limiting factors for the Cabrera vole to be associated with the maintenance of its herbaceous habitat year-round. Conservation efforts should thus focus on landscape management strategies that promote connectivity within each ESU, particularly in the inferred corridor areas, by preventing wetland drainage and ultimately the increasing isolation of the metapopulations.

THE RANGE EXPANSION OF THE KUH'L'S PIPISTRELLE BAT IN ISRAEL: WHAT CAN BE LEARNT FROM THE POPULATION'S GENETICS?

Shirli Bar-David

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An understanding of the process of a population's range expansion can be applied to the conservation of recovering species and species that are shifting their range due to climate change and human activity. The insectivore bat Kuhl's pipistrelle, *Pipistrellus kuhlii*, is a common, Mediterranean species that is highly associated with anthropogenic habitats. During the last decades, the species has expanded its range in Israel from the Mediterranean zone south to the desert region. We aimed to explore whether genetic structuring occurred during range expansion, and if so, what can be learnt from the genetic structuring about the expansion process itself. 160



individuals were sampled in 18 foraging and roosting sites, here defined as “subpopulations”; throughout Israel and DNA samples were amplified by seven microsatellite loci. Significant genetic differences were found among subpopulations (AMOVA, $\phi_{ipt}=0.03$, $P=0.001$). STRUCTURE analyses indicated a composition of three main groups ($k=3$): the Mediterranean zone, the Negev Desert and Eilat (the most southern range of distribution). The Negev Desert subpopulations were genetically closer to each other than the other subpopulations (PCA). The Eilat subpopulation was characterized by the lowest genetic diversity: the lowest heterozygosity, the lowest number of alleles and no private alleles, indicating a recent founding event at the wave front of the population’s expansion. These findings support theoretical models and agree with some empirical studies that have shown that genetic structure can arise during range expansion, within a few generations and a limited range. Founding events at the range expansion’s wave front can lead to a decline in genetic diversity along the expansion front. Such a genetic structure, though it might diminish over time due to gene flow and additional range expansion, has the potential to facilitate adaptive evolution, thereby affecting the population’s long-term persistence.

82 QUANTIFYING THE RELATIVE IMPORTANCE OF FOREST QUALITY AND FOREST EXTENT FOR THE CONSERVATION OF TROPICAL BIOTA

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Most efforts to reduce human impacts on tropical forest biodiversity focus on maintaining forest extent, and recent reductions in the rate of deforestation in countries such as Brazil are considered a conservation success story. Yet the rate of forest degradation is rising in many parts of the tropics as remaining forests are affected by selective logging, wildfires and edge effects. Although these degradation events are known to reduce the conservation value of tropical forests, the relative importance of forest quality versus forest extent remains unclear. We evaluated this in two regions of the eastern Brazilian Amazon, using biodiversity data (dung beetles, birds, large and small stemmed plants) collected from over 250 forest transects in thirty-five 5000 ha catchments distributed along a gradient of forest loss (12-100% forest cover). We used Random Forests, a decision tree classification method, to link measures of deforestation and degradation with the occurrence of forest species. Across most taxa, measures of forest degradation were found to be as important as forest extent in determining species occurrence. Moreover, species responses to degradation were often correlated with life history traits associated with conservation importance, such as small range sizes. Finally, we quantify the extent to which forest degradation reduces biodiversity over and above

deforestation, defining conservation value as the summed reporting rate of forest species in catchments. On average, catchments which lost 25% of their forest cover lost 50% of their conservation value, indicating that degradation can be as important as deforestation in reducing forest biodiversity. Our results demonstrate that legal frameworks focussing only on forest extent are not sufficient to safeguard the unique biodiversity of tropical forests, and emphasize the importance of including forest condition as a key objective in forest conservation policies.

INVESTIGATION OF REPRODUCTIVE BIOLOGY OF ENDANGERED GREATER ADJUTANT LEPTOPTILOS DUBIUS IN ASSAM

Purnima Barman

Aaranyak

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The breeding biology of endangered *Leptoptilos dubius* was investigated from August 2009 till December 2014 in Dadara-Pasariya-Singimari (26° 13'13.47"N or 26.2204083 N and 91° 38' 03.03 " E or 91.6341750 E) nesting colony, Kamrup District (25°46'- 26°49'N and 90°48'- 91°50'E) where more than 50% of the species' global population exist. We recorded 95 numbers of nests in 2009-10, 90 nests in 2010-11, 114 nests in 2011-12, 152 nests in 2012-13, and nests 128 in 2013-14 and 171 nests in 2014-2015. The breeding season of *Leptoptilos dubius* starts from late August to early April. Nesting colonies are very rarely seen within Indian Protected Area network in India. This colonial nesting bird forms nesting colonies in tall trees in thickly populated village in Assam. The bird mainly prefers tall trees *Anthrocephalus cadamba*, *Artocarpus heterophyllus*, *Pithecellobium monadelphum* and *Bombax ceiba* for nesting. We recorded up to 10 active nests in one single Dewa (*Artocarpus lakoosha*) tree In Assam. Breeding plumage of the birds appears on the onset of peak monsoon in July. From August they start moving to the breeding locations. Soon after they start making pair and select nesting trees. Nest building, Parental investment was studied. Both sexes participate in the nest building activity. Clutch size varies from one to four eggs although hatching success of four eggs is not reported earlier. In 2014 we recorded four clutch with four successful hatchling success in atleast four nests. The fledgling period varies from a minimum of 138 days to 145 days. We recorded high nest fall chick mortality of 46.5% in 2011-12, 50.9% 2012-2013, and 41.9% in 2013-2014. During our study period, some of the nest fall chicks were rescued and successfully released after hand raising at Assam State Zoo. Investigation was also carried out in guts contents of dead juveniles. Blades, nails, and some unusual foods were found in the stomach which is alarming for the population.



COMMUNITY DRIVEN MODEL VILLAGE OF ENDANGERED GREATER ADJUTANT STORK LEPTOPTILOS DUBIUS IN ASSAM

Purnima Barman

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The Greater Adjutant is a globally endangered bird with less than 1000 global population. Habitat Loss and poaching are the major threats and the population trend is displaying decreasing trend. Assam is considered to be its last stronghold. In Assam, this colonial nesting bird makes nesting colonies in thickly populated villages. In recent years, many nesting colonies in Assam have disappeared. Nest-tree owners were cutting down the trees to avoid having rotten and smelly nest materials and the excreta of this carnivorous bird in their backyards and also to support income. The participation of the nest-tree owners is key. Since 2009, we initiated a community conservation programme in Assam. Objectives: a. Building support of tree owners and communities and develop an "ownership feeling factor" b. To protect the breeding and foraging habitat of Greater Adjutant. Methods: We promoted the environment education of a school where tree owners children get education. Youths of the villages including those youths disturbed the birds were engaged in bird rescue program and designated as "nest protector". To motivate women, we first organised crafts, cooking, weaving competition among women communities and also trained on various livelihood opportunities. Integration with local religious programme. The mythological story about the stork delivering a baby was narrated to elderly local women. We involved a famous filmstar to encourage the tree owners and sponsored scholarship programme for tree owners children. We motivated local Police Department as one of the stakeholder for the bird. As a result, the population of this bird has increased in this nesting colony. "ownership feeling" was developed. Kamrup police became the major stakeholder. Women became the responsible guardian. Local School sustains the campaigns by their own. This conservation story is recognized as a model of community conservation now.

TOWARDS A SYSTEM OF NATIONAL ENVIRONMENTAL ACCOUNTS: PRIORITIES FOR MONITORING

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There is a long-standing need for reliable surveillance of national trends in ecosystem health and wildlife populations, to support decision-making and reporting in environmental and natural resource management at National scales. We are undertaking a prioritisation in Australia to select a draft national set of fauna indicator species using existing monitoring programs and capacity, as a component of a national environmental surveillance capability. We compiled a meta-database of existing monitoring initiatives and other key attributes for Australian fauna as a basis for developing and applying a prioritisation framework for selecting fauna indicator species. The prioritisation framework was developed to enable transparent evaluation of trade-offs between different species and monitoring methods based on attributes relating to required effort and investment, power to detect change and capacity to produce data that will permit reliable detectability across geographies and threats. The prioritisation tool selects a cost effective and complementary set of monitoring programs across geographies, threats and taxonomic groups using a greedy heuristic. Moreover, it can be modified to include specific institutional goals – for instance, citizen science based monitoring projects. The selected set in Australia is a first step towards a national environmental accounting system.

BATTITUDE: AN ASSESSMENT OF HUMAN ATTITUDE AND BEHAVIOUR TOWARDS THE CRITICALLY ENDANGERED PTEROPUS RODRIGUESIS (RODRIGUES FRUIT BAT).

Paul Barnes

ZSL and UCL

The study follows a period of 40 years of conservation action that has seen the bat population recover from only 70 individuals in 1974. Today, with human and bat populations higher than at any time in history, the likelihood of increasing conflict between people and bats has potential to threaten survival of this vulnerable species and undermine 40 years of conservation. The research was carried out using focus groups, structured questionnaires, semi-structured interviews and simplified questionnaires and games for young children, with over 350 respondents of all ages across the entire island. Attitudinal analysis was carried out on a 40-item Likert scale, which confirmed a number of attitude dimensions that could be analysed independently. The results showed that 90% of respondents held neutral to positive attitudes overall although there were significant numbers of respondents who now believe that bat numbers, roosting locations and



feeding patterns should be controlled. Perceived and actual knowledge were found to have significant relationships with all attitude dimensions tested. In relation, there was a large disconnect between respondents perceived and actual knowledge, suggesting that although people are very knowledgeable about bats they have low confidence in their ability. Taking part in conservation activities was related to a higher perceived knowledge and more positive attitudes but there are significant perceived and actual behavioural controls preventing respondents from taking part on bat counts. There was high social pressure to carry out mitigation (using deterrents to protect fruit) and persecution (killing bats to protect fruit) and nearly half of all respondents intent to use deterrents in future. The research gave unique insights into the effectiveness of sensitisation and education conservation work to date and results will be used as evidence for continued protection of bats and to alter the conservation strategy to improve efficiency.

INNOVATIVE CORPORATE-COMMUNITY PARTNERSHIP IN REHABILITATION AND CO-MANAGEMENT OF MANGROVE WETLAND IN CENTRAL PHILIPPINES

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The decimation of Philippine mangroves due to fishpond conversion stimulated several sectors to rehabilitate the damaged habitat. Several mangrove projects were initiated by the government and non-government agencies; however several efforts failed or had poor survival due to inappropriate site and species selection and lack of long term management. Presently, several industries initiated environmental activities as Corporate Social Responsibility (CSR) and planting mangroves is one of common options. This paper focused on mangrove conservation efforts in Olango Island, central Philippines which is the first Ramsar site in the country initiated through a corporate-community partnership. The private entity innovated and shifted the paradigm of widely accepted event-driven into integrated approach, mobilized locals in replanting degraded mangroves, established plant nursery and protection of the plantations. Lessons learned showed that community involvement is crucial in the success of industry-initiated effort. The locals serve as resource managers directly responsible for day to day decisions. Assessment of plantation showed remarkable survival rate of $87.78 \pm 5.6\%$ with mortality rate of $12.22 \pm 5.6\%$ and significant post-planting recruitment. In retrospect, the industry-led effort showed effectiveness of corporate-community partnership with streamlined long term management plan, appropriate technical design

and community participation. In addition to increasing the mangrove awareness, it promotes the locals' sense of resource stewardship to manage the natural resources where their daily subsistence depends.

68. EFFECTS OF MONOCULTURES AND MIXTURES ON ARTHROPOD COMMUNITIES

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A mixed tree species composition is frequently proposed as a way to increase habitat heterogeneity and support greater biodiversity in commercial forests. International forest policy is increasingly advocating stands of mixed tree species, although supporting evidence of the biodiversity benefits is still needed. We investigated the effect of forest stand composition on arthropod community structure and composition. We conducted pitfall and malaise trapping in three common plantation forest stand types: oak monocultures, Scots pine monocultures, and intimate Scots pine and oak mixtures. The arthropod assemblages sampled by pitfall and malaise trapping showed different responses to the three forest stand types. The pitfall trapping results revealed that there were few differences in the species composition of ground-dwelling arthropods between the stand types and indicator species analysis found few species specifically affiliated with any of the stand types. The malaise trapping results showed a strong effect of stand type on the composition of arthropod communities, although species richness did not differ significantly between stand types. Our results do not support the perception that intimate mixtures of dominant tree species support greater overall levels of species richness or diversity. The composition of a forest stand was more important in shaping arthropod community composition, although the strength of this relationship was dependent on the taxonomic group being studied. Further research is required to determine optimum landscape-scale planting matrices of multiple canopy tree species in order to support forest biodiversity.

LARGE-SCALE DECLINE OF BATS AND BUSH-CRICKETS REVEALED THANKS TO AUTOMATIC ACOUSTIC MONITORING SCHEME.

Yves Bas

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A nation-wide acoustic monitoring program based on both car transects and point counts carried out by volunteers



was launched in France in 2006. Data gathered on 3560-km car transects and 1270 point counts, surveyed twice a year, revealed a negative trend for three common bat species whose decline was previously unsuspected: *Pipistrellus pipistrellus*, *Nyctalus leisleri* and *Eptesicus serotinus*. Useful data were also serendipitously collected on several species of bush-crickets (Orthoptera Tettigonioidae) thanks to their nocturnal activity producing ultrasonic songs. Using a new automatic identification process on the recordings, these data also revealed unexpected decline for two common species of bush-crickets: *Tettigonia viridissima* and *Ruspolia nitidula*. During this same period, new technologies allowed to achieve full-night sampling, and thus to increase sampling efficiency, especially for elusive species of both groups. This led us to propose in 2014 a third protocol taking advantage of these new detectors. Using both current data and simulations, we compared the three different types of acoustic data collection (car transect, short point counts, and full-night point recordings), and their statistical power to detect alarming species trends (-30 % over 10 years). Results showed that car transects were optimal for monitoring most bush-cricket species, and some of the most mobile and large bat species, while full-night recordings would provide a better monitoring for most bat species, especially those which have a high activity rate along the night. The protocols therefore showed a very good complementarity and keeping up them should help avoiding any representativeness bias.

STATUS AND FOOD HABITS OF THE ENDANGERED DHOLE CUON ALPINUS IN KHANGCHENDZONGA, SIKKIM, INDIA

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We investigated the ecology of the endangered dhole or wild dog *Cuon alpinus* in Khangchendzonga Biosphere Reserve in Sikkim, India. Based on camera trapping and sign surveying along trails we assessed the relative abundance, distribution and activity pattern of dholes. Morphological characteristics evident in the camera-trap photographs indicated the dhole population in the area as the rare and genetically distinct subspecies *C. alpinus primaevus*. Dholes were detected over a wide elevation range (2,501–4,100 m) that encompassed the upper temperate, subalpine, and alpine scrub zones. Dholes were diurnal, with peak activity at 0800–1000 hours. Analysis of 41 scats indicated a diet comprising mainly mountain ungulates, rodents and pikas *Ochotona* sp. Based on historical reports (1888–1894) dholes were known to be formerly abundant in Sikkim but were hunted to meet the high demand for their alleged medicinal properties. With no information

on their status for over a century, our study suggests that the species is now rare in the area. Therefore, to aid the conservation of this rare population of dholes, extensive research and monitoring is required in the area and elsewhere in the Eastern Himalaya.

PLANT-LEAFHOPPER FOODWEBS IN LARGE VS. SMALL HABITAT FRAGMENTS AND OF COMPLEX VS. SIMPLE LANDSCAPES ARE SIMPLIFIED, BUT HARBOR MORE SPECIALIST SPECIES

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Decline of grassland species diversity due to increased management intensity has been shown at local and landscape scales. However, studies on foodweb interactions are still very scarce. In 2010 we surveyed leafhoppers and plants on 14 small (0.1-0.6 ha) and 14 large (1.2-8.8 ha) semi-natural calcareous grasslands in Germany, differing in isolation from other calcareous grasslands and in composition of the surrounding landscape (i.e. a gradient from simple to complex landscapes). We quantified weighted trophic links between plants and their phytophagous leafhoppers for each grassland fragment. Analysing major characteristics of the foodwebs, we showed that both generality (no. of hostplant species per leafhoppers) and linkage density (mean of generality and vulnerability) increased with increasing connectivity in small fragments, but decreased in large fragments. This implies the prevalence of generalist (oligophagous and polyphagous) species in better connected small fragments, whereas better connected large fragments appeared to be dominated by specialist (monophagous) species. This pattern was also reflected in interaction diversity (Shannon diversity of interactions). Additionally, we found that in simple landscape the interaction diversity was enhanced by connectivity, but in complex landscapes the better connected fragments hosted more specialist species resulting in less complex interactions. In summary, our results show that in the remaining protected calcareous grassland fragments, hostplant-herbivore foodwebs are moderated by several interacting variables of landscape structure. If the conservation aim is to preserve the specialist species then we should focus on their simpler foodwebs in large and better connected fragments in complex landscapes.

EVIDENCE AND VALUE JUDGEMENTS IN CONSERVATION DECISIONS

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The global biodiversity crisis demands effective, defensible environmental decision making. The drive towards an “effectiveness revolution” akin to that of medical practice has gained momentum in recent years. The impact of cognitive factors such as unconscious biases and heuristics on management and decision making is an important but rarely-acknowledged barrier to effective decisions. A common reliance on subjective judgement is problematic in conservation management as findings of judgement and decision making (JDM) research reveal that it is prone to systematic unconscious bias. This study explores the effect of one such bias in the interpretation of evidence informing a conservation decision scenario. Confirmation bias is a well-established phenomenon in which information that is consistent with a pre-existing conceptual understanding of an issue is privileged over contradictory information. Insights from JDM on decision making under uncertainty have direct relevance to conservation practice, due to the high uncertainty of complex natural systems intersected with social, economic and political dimensions. Using Australia’s Great Barrier Reef as a case study, the effect of confirmation bias on judgement tasks related to conservation management was investigated via an online experiment. A biasing effect of confirmatory interpretation was evident in the evaluation of factual and value-based arguments, for and against competing management alternatives, in addition to the degree of subjective belief in preferred management options. This research addresses the under-acknowledged issue of cognitive frailties in conservation decision making. In practice, confirmation bias may limit effective decision making by cognitively “filtering” the range of alternative management options in decisions reliant on subjective judgement. Understanding this phenomenon may help improve the effectiveness of management strategies in practice.

INFLUENCE OF SOCIAL SYSTEMS AND POPULATION DYNAMICS ON THE EVOLUTIONARY RESPONSES TO ENVIRONMENTAL PRESSURES - A CASE STUDY IN WESTERN LOWLAND GORILLAS

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The group of genes coding for the major histocompatibility complex (MHC) are among the most polymorphic ones because they are involved in pathogens’ defense. A high MHC variability improves the defense of individuals against a large range of pathogens and contributes to population sustainability. Population demographic crash is expected to strongly negatively affect the diversity of MHC. However, in social species, the type of social system is additional factor acting on the redistribution of MHC genes. Indeed, MHC is supposed to play a role in mate choice, although behavioral mechanisms (through olfactory communication or recognition of kinship) remain to be specified. We studied changes in MHC variability in a western lowland gorilla (*Gorilla gorilla gorilla*) population that suffered from a demographic crash due to Ebola epidemics. In this species, groups include only one dominant male that monopolizes the reproduction of its females. During natal or secondary dispersal, females join a solitary male or a new harem where they reproduce. We aimed at understanding the influence of gorilla social system on the effects of Ebola disturbance on MHC variability. We collected data on population structure and group composition through a long term monitoring of this population before and after Ebola and we used noninvasive DNA (i.e. feces) genetic analyses in order to investigate the intra and inter-group MHC variability before and after Ebola, and mate choice. We developed MHC haplotyping in gorillas using NGS and DGGE sequencing and a linked microsatellite. Preliminary results suggest that formation of new groups by solitary males after Ebola, possibly related to female mate choice, explained the changes in MHC variability. Applying this approach to other primate species with different social systems and different environmental pressures will allow to determine general patterns of the relative role of social and environmental pressure on MHC variability.

101-MANAGING SMALL NATURAL FEATURES: A SYNTHESIS OF EMERGENT SOCIO-ECONOMIC ISSUES

Dana Bauer

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Several types of small natural features provide ecological benefits and ecosystem services disproportionate to their size. Desert springs, vernal pools, and rocky outcrops are a few examples. Key socio-economic issues associated with their conservation include: uncertainties over the location of individual features; temporal variations in their contributions to ecosystem services; a lack of understanding in their linkages to each other and to the surrounding landscape; spatial correspondence of the accrual of beneficial services and the costs of protection; the policy context; tensions between private property rights and public rights to environmental protection; and public perceptions of insignificance. However, their size and spatial distribution allow unique opportunities for experimenting with different conservation tools as they may require less total protected area, less coordination across diverse stakeholders, and less intensive forms of resource protection than their larger counterparts. In addition, interesting opportunities for diverse and nested management structures arise from different landscape-scale perspectives of these features. To improve understanding of these management challenges and to seize future management opportunities, we review current and historical approaches for conserving small natural features and synthesize emergent socio-economic issues and conservation success strategies. Comparing and contrasting experiences across distinct types of features reveals interesting patterns of the similarities and differences in conservation outcomes and the sensitivity of these outcomes to social, economic, and ecological factors. Further examination and testing of conservation approaches across different landscapes and features will advance our understanding of small natural features and yield important guidance for achieving greater strategic coordination and ecological coherence across disparate management efforts.

FOOD BASE OF THE SPOTTED HYENA (CROCUTA CROCUTA) IN ETHIOPIA MOSTLY ANTROPOGENIC

Hans Bauer

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We investigated the food base of the spotted hyaena (*Crocota crocuta*) across Ethiopia. Scat was analysed from 17 randomly selected study sites, including two National Parks. We assessed livestock depredation in 10 sub-districts, interviewing 3080 randomly selected households. We found that most scat from all sites contain mostly antropogenic food remains. Garbage is the dominant food source, but households also reported losses of 2230 domestic animals, 3.9% of their stock over the past 5 years. All hair in all scat was of domestic origin, except for a

few hairs of natural prey in National Park. Survival of spotted hyenas in Ethiopia is thus dependent on livestock and waste management.

LARGE-SCALE FACTORS ASSOCIATED WITH BROWN BEAR DAMAGES IN EUROPE

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Conflicts between humans and large carnivores are a challenge for conservation biologists and resource managers. Besides the large body of literature that tackles this issue, the mechanisms underlying these conflicts still remain unclear. We investigated which large-scale factors are associated with differences in the occurrence of brown bear (*Ursus arctos*) damages across European countries. We hypothesized that damage occurrence is related to (1) bear population size and density; (2) landscape features; (3) bear management; and (4) economic variables. We collected information on bear damages to livestock, apiculture and agriculture for 18 European bear population segments (hereafter populations), and used the number of compensated claims as an approximation for the number of damages. For each population, the most recent 6-year period was used to calculate the annual mean of claims divided by the estimated bear population. Overall, 45% of bear damages were to livestock, 34% to apiculture and 10% to agriculture. Damage patterns varied a lot among populations; e.g. in Southeastern Poland, 97% were damages to apiculture and in the Pyrenees 86% were damages to livestock. Our analysis reveals that, at a continental scale, the number of damages is associated with landscape features, such as the proportion of agricultural cover;



with management factors such as supplementary feeding practices and also with economic factors. Our results highlight the complexity of the mechanisms underlying this conflict and shows that a wide range of factors, from purely ecological to economic ones, affect the incidence of bear damages.

ECONOMIC ASPECTS OF BROWN BEAR DAMAGE ECOLOGY IN EUROPE

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Human-wildlife conflicts occur whenever human activities and wildlife habitat overlap. In particular, damages to human properties are of special concern as may cause important economic losses and decrease social acceptance. Damage compensation systems aim to soften this conflict by covering the economic losses due to damages caused by wildlife. Taking the brown bear (*Ursus arctos*) as a study species, we found that the magnitude and typology of damages vary widely across Europe, as the schemes of the compensation systems do: some countries, like Ukraine have no compensation system at all, whereas other countries, like France, compensate all bear damages. We aimed at comparing the economic losses due to bear damages across European countries and exploring associations between economic indicators (e.g. the gross domestic product based on purchase power parity) and the amount of money compensated in each country. We expected that the countries that have a stronger economy (e.g. higher gross domestic product per capita) would spend more money to compensate bear damages. To answer this question we collected information on the money reimbursed

due to bear damage claims from 2007 to 2010 for 14 bear population segments across 10 different European countries. Compensations widely varied and ranged from 4 to 12,600 Euros per year and bear in Croatia and Norway, respectively. Overall, an annual mean of 2.3 million euro (± 0.03 ; standard deviation) was paid for the compensation of bear damages, which only represents less than 0.001% of the net national income at market price of the countries investigated. We discuss the influence of different indicators of the economic activity on the amount of compensations and its possible management implications.

EVIDENCE FOR INCREASING IMPACT OF INVASIVE SPECIES ON HUMAN HEALTH

Helen R Bayliss

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Invasive alien species are frequently considered a serious conservation threat but some species also impact on human health through injury, allergy, or as vectors of disease. Despite this topic receiving increasing attention in the scientific literature, there have been few attempts to quantify recent changes in human health impacts. We present findings from a systematic mapping of the literature to identify evidence demonstrating a change in the occurrence, frequency or severity of impacts of invasive species for human health in Europe. Most studies relate to only a few species and often report specific cases. Difficulties in attributing human health impacts such as stings or allergies to a specific species likely complicate attempts to measure changes. Better cooperation between invasion ecologists, conservation managers and health professionals working in affected areas are likely to be necessary to reduce health and biodiversity impacts and improve the evidence base on this topic for the future.

WIRETAPPING THE WILDERNESS: USING AUTOMATED ACOUSTIC RECORDERS AS A COLLABORATIVE MONITORING FOR ASSESSING THE IMPACT OF ALBERTA'S OILSANDS

Erin Bayne

Alberta

Soundscapes provide a diverse mixture of wildlife, human, and other natural sounds that can be used for documenting status, trend, and impacts. Historically, many animal populations have been monitored by human observers visiting a location for a short period of time once a year and recording the species heard. These approaches have been uncoordinated



and poorly standardized, which has prevented large-scale assessment of the cumulative effects of different types of human development in space and time. Ineffective decision making has been the end result. Automated recording units (ARUs) provide a new approach to environmental monitoring that relies on a physical record of soundscapes that can be stored and used by various partners to make more informed decisions about the environmental impacts in a consistent and repeatable way. The Bioacoustics Unit at the University of Alberta – Alberta Biodiversity Monitoring Institute is a collaborative partnership working in Alberta’s oilsands region that has standardized approaches to the collection and processing of sound information using ARUs. Recent advances in computer-based species recognition, proper handling of species detection error, and ARU sampling design will be highlighted. The success of the approach in coordinating government, non-profit, and industry in an effort to assess and mitigate the effects of industrial noise and light on amphibians and owls in the oilsands region of northern Alberta will be described as case studies of how technology can improve environmental monitoring performance.

110 - UNDERSTANDING LOCALLY DEFINED HUMAN WELL-BEING TO MEASURE IMPACTS OF CONSERVATION PROJECTS ON THE NORTHERN PLAINS OF CAMBODIA

Emilie Beauchamp
Imperial College London

Successful natural resource management requires understanding human dimensions of system change including livelihoods and human wellbeing, which ultimately drive behaviour and participation in conservation. High resolution, contextual studies using social science methods are needed to take local realities, priorities and incentives into account in management decisions. Going beyond the principle of ‘doing no harm’, a wellbeing approach to conservation means giving communities an opportunity to voice what is important in their lives and to integrate such factors in impact assessments of conservation interventions. The concept of wellbeing recognises that poverty is multi-dimensional and bare economic proxies are an insufficient measure of a good life. I will present a flexible universal framework for monitoring and evaluating policy grounded in local definitions of wellbeing, which has been developed within a collaborative ESRC-DFID funded project. I applied this approach to the area of the Northern Plains in Cambodia where there are protected areas and Payment for Ecosystem Service (PES) projects implemented amidst rapid land use change and tenure insecurity. This talk will highlight challenges and guidelines for applying a wellbeing approach, and present early results from a year of field research. I will demonstrate the importance of

qualitative methods in providing internal validity, explaining relationships between phenomena, and in formulating locally meaningful quantitative indicators and appropriately disaggregating data. I will point to next steps and future directions in social monitoring and evaluation for improved management especially in rural communities in the global South.

SYMPOSIUM 177- NEWDISTRICT TRAINING TOOL: A DISTRIBUTED SIMULATION TO INTEGRATE BIODIVERSITY ISSUES IN PERIURBAN DEVELOPMENT PROJECTS

Nicolas Becu
CNRS
Nathalie FRASCARIA, AgroParisTech ; Julie LATUNE, AgroParisTech

In Europe where land use planning is an everyday headache due to the almost total absence of vacant spaces, peri-urbanisation projects often endanger biodiversity. The integration of biodiversity issues in the reflections of urban planners and construction companies on how and where to extend the urban areas is a real challenge. Biodiversity issue now receives attention from urban planners and builders starts to integrate in-house environment services. In order to bring these actors to best integrate the key concepts of environmental management such as ecosystem services or ecological land-use complementation, we developed a training tool based on participatory agent-Based simulation approach. NewDistrict tool aims at providing knowledge and sharing experience about biodiversity processes but as well at understanding how other’s activities impact urban development choices and consequently biodiversity. It is a distributed simulation: each participant interacts with the others using an individual computer. Participants interact as well verbally as they are all in the same room. There are six different roles represented, each one having his own interface providing specific information and action means. This asymmetry between roles and interfaces induce differentiated learning. A dozen of sessions have been carried with employees of construction companies and their learning experience has been assessed through inquiries carried at the end of the session. The results show that employees of construction companies learn a lot about how to communicate on urban development between stakeholders having different objectives: a context that recalls to them the difficulties to collaborate between services and branches they face within their own company. They also get to understand the relations between land use and biodiversity, the impacts of land use change and how the perceptions of the environment varies by trade group.



CRYPTIC DIVERSITY AND CONSERVATION PLANNING: THE CASE OF AMPHIBIANS AND REPTILES IN ALGERIA.

Menad Beddek

Centre d'Ecologie Fonctionnelle et Evolutive. UMR 5175 / Bureau d'Etudes Naturalia-Environnement

Olivier PEYRE, Bureau d'études Naturalia-Environnement ; Philippe GENIEZ, Ecole Pratique des Hautes Etudes (CEFE-CNRS, UMR 5175) ; José-Carlos BRITO, CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos da Universidade do Porto / Instituto de Ciências Agrárias ; Pierre-André CROCHET, Centre d'Ecologie Fonctionnelle et Evolutive. UMR 5175

This study aims at improving our knowledge about the distribution of distinct genetic lineages within vertebrate species in the Maghreb region. Although the Maghreb is recognized as a biodiversity hotspot, its diversity is still underestimated. Indeed, several studies on bats, rodents, reptiles and amphibians have shown that a cryptic diversity is prevailing in most studied taxa. Furthermore, these studies show a common pattern of genetic lineages distribution: a deep divergence - often at specific rank - between eastern (Tunisia) and western (Morocco) populations of the same "species". However, a frequent lack of data from Algeria blurs our comprehension of diversity distribution in the Maghreb. Thus, several key questions remain unanswered: 1) is the location of the disjunction zone of the eastern and western lineages similar between taxa and if so, what is the processes behind the east-west disjunction in the Maghreb, 2) what is the impact of this cryptic diversity on conservation planning in the region? We propose a comparative phylogeography approach to address these questions. We selected a list of reptiles and amphibians of Algeria on which previous studies revealed an East-West disjunction (between Morocco and Tunisia) in the lineages, we collected samples of these species in Algeria along an east-west transect, then assigned these samples to either the eastern or the western clades based on mtDNA sequence data. Preliminary results show that 1) the two lineages are found in Algeria for every species, each time with distinct allopatric distribution and 2) for each species, both eastern and western lineages come into contact in the centre of Algeria. Finally, we 3) test whether conservation planning based on evolutionary lineages distribution is significantly different from conservation planning based on traditional species limits.

CONNECTING HABITATS, GENE FLOW, LARVAL DISPERSAL AND TURTLES: IMPLEMENTING CONNECTIVITY IN MARINE SPATIAL PLANNING

Maria Beger

The University of Queensland

Jennifer MCGOWAN, The University of Queensland ; Pei Ya BOON, Consultant ; Tessa MAZOR, CSIRO ; Eric TREML, University of Melbourne ; Cynthia RIGINOS, The University of Queensland ; Hugh POSSINGHAM, The University of Queensland

Connectivity in marine conservation is one of the last frontiers. Advancements in modelling of marine dispersal, identifying parentage of individuals, calculating recent migration from genetic data and telemetry to track migratory animals mean that spatial planning methods also need to be updated to integrate better ecological connectivity in conservation plans. I will review the different types of connectivity and demonstrate a portfolio of methods and solutions for them: a) mangrove-coral reef adjacency, b) larval dispersal in the Coral Triangle, c) recent gene flow in Indonesia, and d) connecting feeding and nesting habitats with migration routes for sea turtles in the Coral Triangle and the Mediterranean. I will demonstrate how incorporating larval connectivity creates very different sets of solutions from other potential conservation objectives. I further ask: what is the value of information of turtle tracks in marine conservation, and how should tracking target their research to help conservation planning questions.

DOES REPLANTING NATIVE TREES CREATE A FUNCTIONING COASTAL FOREST?

Jacqueline Beggs

University of Auckland

Stephen WALLACE, University of Auckland ; Robin GARDNER-GEE, Plant & Food Research

Revegetation is one of the most widely used interventions in terrestrial restoration, as the structure and extent of vegetative cover profoundly shapes both the physical and biotic features of a landscape. Such projects typically proceed on the premise that there is a causal link between re-establishing native forest cover and restoring native biodiversity, even though there have been relatively few assessments of the success of replanting native forest. This study assesses the response of biodiversity and ecosystem function to native re-forestation on Motuora Island, an 80-ha island about 40 km north of Auckland City, New Zealand. The island has been actively restored by a community-led group since 1991. We measured the beetle and plant communities, and litter decomposition rates on Motuora in 2004 and in 2014, comparing the successional trajectories of unmanaged natural restoration (c. 80 years old), native tree planting, and retired pasture. While planted sites followed the predicted successional pattern for some measures (e.g. beetle assemblages in planted forests have converged toward those found in unmanaged forest), other measures suggest that there is some way to go in order to establish a more natural forest (e.g. the low frequency of seedling and sapling establishment). This study illustrates the challenge of identifying a suitable



restoration target in the absence of a suitable reference site. Nevertheless, revegetation has established a native dominated community, which appears to be on a trajectory to forming a forest broadly typical of coastal northern forest in New Zealand.

CONSERVING NATURE'S STAGE: ABIOTIC SURROGATES EFFICIENTLY PRIORITIZE SITES FOR SPECIES REPRESENTATION

Paul Beier

Northern Arizona University

Fabio ALBUQUERQUE, Northern Arizona University

If a planner has species inventory data for all sites in a planning area, she can prioritize sites for their ability to represent species. But without wall-to-wall inventories, a planner has been unable to prioritize sites for species representation – until now. Here we show that Environmental Diversity (ED) can prioritize sites without ANY species inventories, and that Predicted Rarity-Weighted Richness (PRWR) can prioritize sites with inventories for < 20% of sites. ED (invented by Faith & Walker in 1996, but untested and forgotten) selects sites that best span multivariate space defined by freely-available abiotic data (e.g., elevation, insolation). Across 8 study areas, sites prioritized by ED (using no species data) represented species with 40% efficiency – i.e., ED was 40% as effective as having species inventories for 100% of sites in its ability to improve on random selection of sites. PRWR (invented by us, and described here for the first time) does require species inventories for a subset of sites in the planning area, and performance improves as the percent of sites inventoried increases. But with species inventories for a mere 20% of sites, PRWR can prioritize 100% of sites based on their abiotic conditions. PRWR's efficiency was a whopping 66% across 6 test datasets. ED and PRWR should be most useful in tropical regions with the highest biodiversity, greatest biodiversity loss, most severe lack of inventory data, and poorly-developed protected area networks.

27. THE '100 QUESTIONS FOR BIODIVERSITY CONSERVATION IN MEDITERRANEAN-TYPE REGIONS' INITIATIVE

Pedro Beja

InBIO - Research Network in Biodiversity and Evolutionary Biology

Francisco MOREIRA, InBIO - Research Network in Biodiversity and Evolutionary Biology

Researchers have a key role in providing solutions for conserving biodiversity in the face of multiple anthropogenic stressors and socio-economic challenges, but there is often a gap between the data generated by research and the information required by practitioners and policy makers. Here we make the opening presentation of an initiative contributing to bridge the gap between science and policy, focusing on

biodiversity conservation challenges in the five Mediterranean Type Regions (MTE) of the world: the Mediterranean Basin, the Cape Region of South Africa, Southwestern and South Australia, California, and central Chile. Despite their small geographic area, MTEs harbor a significant and exclusive proportion of the planet's biodiversity, which is threatened by a range of factors such as land use changes, overexploitation of natural resources, and global climate change. The initiative has joined a group of researchers from the 5 MTE regions of the world, who have worked together with a wide range of policy makers, conservation practitioners, natural resource managers, and environmental consultants, among others, to identify the 100 priority questions that, if answered, would contribute to preserve biodiversity values in the region. To set the context for this initiative, we provide in this presentation an overview of comparable exercises of research prioritization carried out in different parts of the world, outlining methodological approaches, potential limitations and shortcomings, and some key results. We then describe the methods adopted in the Mediterranean initiative, and how it has been implemented across regions and individual countries. Finally, we set the stage for the forthcoming presentations, providing a quick overview of the objectives and contents of the symposium.

THE ETHICS OF OFFSETTING BIODIVERSITY

Sarah Bekessy

RMIT University

Christopher IVES, RMIT University

Biodiversity offsetting has proliferated in recent years. Academic discussion has primarily concerned the ecological validity of offsetting with virtually no exploration of its ethical implications. Biodiversity offsetting was introduced as a novel approach to meeting technical legal obligations, yet the underlying values and duties that underpin environmental laws have not been referenced. Upon re-examining the ethical basis for conservation, we find that conservation policy exists to protect either the intrinsic or instrumental values of nature. Biodiversity offsetting raises ethical concerns on both these grounds. First, if individual living organisms have worth in themselves (intrinsic value), then a policy that makes it easier to destroy plants and animals is questionable ethically, regardless of conservation actions elsewhere. Similar concerns are raised if ecological communities are considered to have intrinsic value, since offsetting is based on two scientific fallacies: (i) ecological communities are identical, and (ii) ecosystems can be recreated. The intrinsic value of species is also jeopardised by offsetting since many policy applications heighten the uncertainty of species' long-term persistence. Second, biodiversity offsetting compromises the instrumental values of nature related to human benefits. If biodiversity is valued for the ecosystem services it provides then disconnecting people from biodiversity, as commonly done in urban contexts, may be



considered unethical and unjust. Finally, biodiversity offsetting emphasises anthropocentric philosophical view of nature (it can be owned, manipulated and traded), which is opposed by many people. We warn that biodiversity offsetting represents a fundamental shift in the ethical foundation of conservation and requires further scrutiny.

101 USING A HYBRID REGULATORY APPROACH TO CONSERVE SMALL NATURAL FEATURES: A MAINE CASE STUDY.

Kathleen Bell

University of Maine

Aram Calhoun, University of Maine ; Robert FREEMAN, Eastern Maine Community College

Small natural features introduce novel opportunities for designing and testing conservation tools. These features interact in complex ways and at multiple scales with social and ecological systems. The payoffs from advancing tools that embrace rather than overlook this diversity are not well understood. A recent policy process to conserve temporary ponds in Maine, USA, offers insights about the development and returns from such approaches. A stakeholder group including ecologists, economists, regulators, and the development community proposed a conservation approach that advances local-scale tools to complement an existing national regulatory framework. This mechanism recognizes variability in social and ecological systems, enables parallel pursuits of socio-ecological goals, and prioritizes flexibility and tradeoffs. Implemented at the local scale, the policy recognizes existing land-use planning tools that recognize growth and rural areas. Under the proposed mechanism, landowners in growth areas may meet current regulatory requirements using the new local tool. For a fee, landowners in growth areas can develop land that will result in the loss of temporary ponds. The mitigation dollars raised from these fees enhance conservation of pools in rural areas by supporting landscape-scale conservation. By employing an incentive-based mechanism that varies markedly from top-down regulatory requirements, the "hybrid" mechanism gained support from developers, regulators, ecologists and municipal planners. The mechanism fosters opportunities for improved conservation partnerships and outcomes. Policy simulation analyses completed in collaboration with the stakeholder group show opportunities for improved conservation outcomes from this emergent, innovative approach. Documentation and analysis of this policy process and mechanism provide an important first step towards greater strategic coordination and ecological coherence across efforts to conserve small natural features.

WHERE TO DEVELOP AGRICULTURE AND FORESTRY? PERSPECTIVE FROM STUDIES ON ANIMAL COMMUNITIES IN GRASSLANDS AND SUBTROPICAL FORESTS OF THE SOUTHERN NEOTROPICS

Isabel Bellocq

University of Buenos Aires

Gustavo ZURITA, Instituto de Biología Subtropical ; Julieta FILLOY, University of Buenos Aires

Each human activity that requires large extensions of land imposes a particular environmental filter to the species regional pool. Our general objective is to contribute to land use planning that considers biodiversity conservation in the context of native ecosystems, cultural values and local and regional socioeconomic scenarios. Here, we analyze how similarity in the composition of animal communities is influenced by agriculture and forestry depending on the native ecosystem in which the human activity is developed. In the study design we considered two widely used indicator taxa (birds and ants) from two contrasting conservation priority biomes in the southern Neotropics (southern Atlantic forest and Pampean grassland) and extended human-created habitats (eucalypt plantations and soybean cropfields). We used an integrated approach to study community differentiation considering three complementary facets of beta diversity (taxonomic, functional and phylogenetic), which are only recently being incorporated in conservation objectives. Non-metric multidimensional scaling showed that taxonomic, functional and phylogenetic differentiation in composition between bird and ant assemblages were associated to biome and land-use; study sites grouped into four groups on the bi-dimensional space (cropfields in forest and grassland, and tree plantations in forest and grassland), and that was consistent across beta diversity facets and taxa. Mantel and PERMANOVA tests showed that the three facets of beta diversity were positively correlated for both bird and ant assemblages. Tree plantations retained more bird native species when developed in forest than in grassland biomes, whereas cropfields held more native species in grasslands than in forests. In economies depending on human activities that require large areas, our results help to select the most appropriate biome to develop agriculture and forestry, contributing to sound land use planning and beta-diversity conservation.

ANTI-BIRDS NETTING IN FISH PONDS: ASSESSING THE ADVANTAGES FOR FISHERIES VERSUS DAMAGE FOR BIRDS

Gilad Ben Zvi

Ben Gurion University



Yossef LESHEM, Tel Aviv university ; Yoram YOM-TOV, Tel Aviv university

Fish-ponds provide a readily available food source for piscivorous birds. The geographic location of Israel on a major avian migration route increases predation pressure in Israeli fisheries to cause a conflict between fish farmers and piscivorous birds. During the last 30 years many fish ponds in Israel were netted against predation. However, birds are trapped and killed in the nets. A couple of studies dealt with this phenomenon but were limited in scope. The aims of our study were to estimate number of birds entangled in nets; to characterize the phenomenon in terms of bird species affected, season, area and other important factors; and to examine the possibilities to minimize harm to birds without causing economic harm to fisheries. 150 netted ponds in north and central Israel were observed throughout a year for dead and live birds. Pond, net and crop characteristics were documented. In addition, experiments compared predation in identical ponds that were netted, cabled (cables are a non-harmful protection measure cheaper than nets) or left unprotected. Our findings show that capture rate and numbers of trapped birds are lower than previously estimated, but that no less than 60 bird species are trapped. The major problem was found to be mortality of rare and vulnerable species. Foremost among these is the Black Stork (*Ciconia nigra*), dozens of which were entangled yearly. Capture rates were affected by crop species, fish mortality, net stretching level and net mesh size. The least harmful net was well-stretched one with small mesh size of up to 5*5 cm. Most importantly, cables were found to be equally effective to nets in predation prevention. Our management recommendations are thus to replace nets with cables, and to protect highly sensitive crops with nets of the sort mentioned above. We also encourage allocation of governmental budget for making fisheries more environment-friendly, thus turning conflictual status-quo into future cooperation.

TOWARDS MORE INCLUSIVE CONSERVATION: WHAT IS THE ROLE OF THE CONSERVATION SOCIAL SCIENCES?

Nathan Bennett

University of British Columbia

Robin ROTH, York University

While there have been numerous calls for increased engagement, the social sciences still remain somewhat marginalized as a conservation science, this is particularly true amongst small to medium sized conservation practitioners and organizations. The conservation social sciences are often underutilized, yet each sub-field can make unique and important contributions to understanding the relationship between humans and nature and to improving conservation practice and outcomes. This presentation will provide a

broad overview of the different fields of conservation social science, the topics and types of questions explored by each field, and the past and potential contributions of each field to conservation. It will draw from a report titled "The Conservation Social Sciences: What?, How?, and Why?" that emerged from a workshop hosted by the Social Science Working Group of the Society for Conservation Biology that was held at the North American Conservation Congress in 2014. Moreover, we urge that it is time to move beyond simply recognizing the potential of the conservation social sciences to fully engaging with all types of knowledge that will allow us to produce more effective and socially just conservation. It is time we mature beyond an 'add and stir' approach to one that engages the full range of social sciences to help build a renewed, integrated and more robust conservation science and practice.

124 BIODIVERSITY OFFSETS BY REGULATION: CAN WE DEFINE THE ELEMENTS OF GOOD POLICY?

Leon Bennun

The Biodiversity Consultancy

Kerry TEN KATE, Forest Trends ; John PILGRIM, The Biodiversity Consultancy

Although biodiversity offsets are the focus of much discussion, most actual offsets have so far been implemented under just a handful of Government regulatory schemes, notably in Australia and the USA. However, Government interest in biodiversity offsets is increasing. Over 30 countries or states now have policies or laws facilitating or requiring offsets or other compensatory measures, while many others are investigating policy options. Depending on how they are designed and implemented, regulatory offset schemes could help to slow biodiversity loss at national level – or could make it worse. Over the next few years, conservationists have a window of opportunity to input to and influence these emerging national offsets frameworks. While there is no 'one size fits all' solution, some important elements of good policy include (a) rigorous application of the mitigation hierarchy to avoid, minimize and restore project impacts before offsets are considered; (b) an aggregated approach that is integrated into wider land-use planning and takes into account cumulative impacts and national conservation objectives; (c) legal and financial instruments to secure long-term implementation; and (d) effective arrangements for performance monitoring and enforcement. Secure and transparent governance mechanisms are a key overarching requirement. In addition, individual and institutional capacity are needed nationally to support offset design and implementation, including the management of biodiversity data, assessment of biodiversity losses and gains, and brokering of outcomes acceptable to all stakeholders. In many countries, inadequate capacity could undermine the effectiveness of regulatory offsets, and investment in capacity strengthening should be a key component of offset schemes.



ECOLOGY AND CONSERVATION GENETICS OF THE ENDANGERED BARBARY MACAQUE IN ALGERIA

Lamine Mohamed Benrabah

University of Lincoln

Bonaventura MAJOLA, University of Lincoln ; Malgorzata PILOT, University of Lincoln

Primate population assessments provide valuable data for both comparative and conservation studies. The Barbary macaque (*Macaca sylvanus*) is the only surviving primate in Africa north of the Sahara desert, the only native species of primate to occur in Europe, and the only member of the genus *Macaca* found outside Asia (ICUN, 2008). The species once ranged through parts of Europe and across North Africa (Delson, 1980; Camperio Ciani, 1986). Its current geographic range is limited to fragmented patches of forest and scrub gorges in Algeria and Morocco (Fa, 1984; Camperio Ciani, 1986; Menard and Vallet, 1993; Scheffrahn et al., 1993). As an endangered species there is an urgent need for successful management strategies. In developing such strategies, it is essential to have reliable baseline population count estimates and assessments of changes in size through time (Plumptre and Reynolds 1994). In Algeria, the population was estimated at 5,500 approximately 30 years ago (Taub, 1977) since then numbers are unknown (Hodges and Cortes, 2006). The Moroccan populations were more recently estimated to be 6,000-10,000 individuals (Ross, 2004), whereas in 1975 it was estimated to be 17,000 (Taub, 1975). Similar pressures present in Morocco have been recorded in Algeria of habitat loss, human disturbances and inadequate conservation policy & enforcement (Fa et al, 1986; Deag, 1900; Taub, 1986). Through our longitudinal study in Algeria, we present the current population size estimate, distribution and genetic variability of the endangered Barbary macaque for future conservation consideration.

STATUS, HABITAT USE AND BEHAVIOUR OF WINTERING GREATER FLAMINGOS PHOENICOPTERUS ROSEUS IN SEMI-ARID AND SAHARAN WETLANDS OF ALGERIA

Ettayib Bensaci

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Menouar SAHEB, Department of Natural and Life Sciences, University of Oum El-Bouaghi ; Yacine NOUIDJEM, Department of Natural and Life Sciences, University of M'sila ; Abdelaziz BOUZEGUAG, Institute of Natural and Life Sciences, University of Mila ; Asma ZOUBIRI, Department of Natural and Life Sciences, University of Oum El-Bouaghi ; Moussa HOUHAMDI, Biology, Water and Environment Laboratory, University of 08 May 1945, Guelma

The Greater flamingo is considered the flagship species of wetlands across semi-arid and Saharan regions of Africa,

especially Chotts and Sebkhass, which also concentrate significant numbers of bird species. Flamingos have different status (wintering and breeder) which vary between sites in different parts of Algeria. We conducted surveys and recorded banded flamingos across distinct regions within two climatic belts: semi-arid (Hauts Plateaux) and arid (Sahara), showing the importance of these sites in the migratory flyways particularly the relation between West Mediterranean and West Africa populations. The distribution of Greater flamingos varied between sites and seasons, where the concentrations mainly were in the wide, lees deep and salt lakes. Many of the sites (17) in the surveyed area were regularly supporting at least 1% of regional population during winter. The analysis of Greater flamingos behaviour in different climatic regions in relation showed that the feeding is the dominant diurnal activity with rates exceeding 60 % of the time. While feeding varies between seasons, and showed a negative relationship with the degree of disturbance. Keywords: Greater Flamingo, *Phoenicopterus roseus*, semi-arid, Sahara, Algerian.

EFFECTS OF FOREST EDGE ON PEST CONTROL SERVICE PROVIDED BY BIRDS IN FRAGMENTED TEMPERATE FORESTS

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The natural control of herbivorous insects by insectivorous birds is considered to be one of the most important regulating services in forest ecosystems. The fragmentation of forest habitats and associated edge effects, however, modifies the abundance and community structure both of birds and insect herbivores, and thereby may have an impact on the predator-prey interactions. In the present study we aimed to examine how the insectivorous bird abundance as well as bird predation rate on caterpillars was affected by edges and how far the edge effect penetrated into the forest patch in a fragmented temperate forest of southwest Hungary. To measure edge effect, four middle aged forest stands dominated by turkey and sessile oaks were selected situated next to meadows. In the selected forest stands, four transects were laid out parallel to the forest edge at the distances of 0 m, 10 m, 25 m and 50 m. Predation rate was measured using artificial caterpillars made by green plasticine fastened to the branches of selected trees situated along the assigned transects. To estimate insectivorous bird abundance, a line transect method was used. Forest structural variables included stand structure and shrub density were also examined along the assigned transects. We found



an unusual non-linear pattern to predation rate as well as bird abundance, having peaks both at the edge and forest interior. A significant positive correlation between bird abundance and predation rate was shown, supporting the important role of birds in pest control. Interestingly, insectivorous bird abundance had negative relationships to forest structural variables, e.g. to the basal area and tree species richness, where positive interactions were expected. We may conclude that this is due to the context-dependency of edge effects that can not be fully explained by our study. Therefore, further studies are needed to explore the general pattern of edge effect on insect pest control.

SYM ID 88: THE EFFECTS OF LEARNING ON THE MOVEMENT PATTERNS OF REINTRODUCED PERSIAN FALLOW DEER AND ARABIAN ORYX

Oded Berger-Tal

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David SALTZ, Ben-Gurion University

Knowledge improves performance, and experienced animals succeed better than animals without the relevant experience in almost all aspects of their life history. We therefore expect animals that lack the appropriate knowledge to make the gaining of that knowledge a high priority. We investigated the post-release behavioral modifications (PRBMs) movement of two ungulate species reintroduced in Israel: the Persian fallow deer (*Dama mesopotamica*) and the Arabian oryx (*Oryx leucoryx*). Both species were equipped with GPS collars prior to their release and their movement recorded from their first steps into the novel landscape all through their familiarization with the environment process. Despite a reduced sample size, our results clearly show that the movement behavior of both Persian fallow deer and Arabian oryx immediately following their release into the wild is very different from the movement behavior of the same individuals several months later, supporting the hypothesis that explorative movement in an unknown landscape differs from knowledge-based movement in a familiar environment. We will go through the principles given in the symposium's opening lecture and demonstrate how they apply for the reintroduction programs of the Persian fallow deer and the Arabian Oryx in Israel.

SYMPOSIUM #20 SMART: A NEW TOOL FOR MONITORING AND INCREASING THE EFFECTIVENESS OF CONSERVATION LAW ENFORCEMENT

Richard Bergl

North Carolina Zoo

Alexa MONTEFIORE, SMART Partnership ; Emma STOKES, Wildlife Conservation Society ; Jonathan PALMER, Wildlife Conservation Society

One of the greatest threats to biodiversity is the illegal exploitation of wildlife. Even within legally protected areas, conservation agencies encounter significant challenges effectively enforcing wildlife laws. The Spatial Monitoring and Reporting Tool (SMART) is a software application and associated management approach developed by a broad partnership of conservation organizations to improve overall law enforcement effectiveness in general, and anti-poaching efforts in particular. SMART enables the collection, storage, communication, and evaluation of a wide variety of conservation-relevant data including patrol effort (e.g., area patrolled, patrol distance), patrol results (e.g., number of snares removed, arrests made), and threat levels (e.g., number of gunshots heard, number of hunting camps encountered). When effectively employed to create and sustain information flow between ranger teams, analysts, and conservation managers, SMART can help to substantially improve protection of wildlife and their habitats and enhance accountability of protected area staff. SMART can be used to manage protection programs at any conservation area that relies on patrol teams enforce wildlife laws and regulations. SMART has demonstrated its effectiveness in improving conservation law enforcement, improving morale of enforcement teams, and reducing threats to wildlife and other natural resources at numerous sites around the globe. SMART is free, open source and supports the use of mobile devices. Additionally, the SMART Partnership is committed to providing ongoing support, training and developing additional functionality for the software. Recently released additions to the software include a biological survey module and a networked version is in development. At present SMART is being implemented in more than 120 conservation areas in 27 countries worldwide and is fast becoming a global standard for conservation law enforcement monitoring and management.

MEASURING AND MONITORING COMPLIANCE IN NO-TAKE MARINE RESERVES

Brock James Bergseth

Australian Research Council Centre of Excellence for Coral Reef Studies

Garry RUSS, Australian Research Council Centre of Excellence for Coral Reef Studies ; Joshua CINNER, Australian Research Council Centre of Excellence for Coral Reef Studies

No-take marine reserves are increasingly popular tools for conservation and fisheries management. While much attention has been paid to evaluating the effects of design aspects (size, location, etc.) in achieving reserve objectives, less emphasis has been placed on the role of stakeholder



compliance. Therefore, the first aim of this study was to evaluate the state of compliance literature and examine the methods used to measure compliance in reserves. The state of compliance literature is limited, although publications with compliance information have increased sixfold in the last decade. However, most studies containing compliance information (63%) fail to provide quantitative estimates. Furthermore, most (95%) quantitative estimates of compliance were reported using a single method, which is problematic because each method has biases and limited applicability. Methods used to indicate compliance include (i) direct observation; (ii) indirect observation; (iii) law enforcement records; (iv) direct questioning; (v) expert opinion; and (vi) modelling. Our second aim was to empirically demonstrate the critical role of compliance in reserve outcomes by comparing a mixed-effects model on compliance data synthesized from 63 marine reserves to that of a null model. The model of best fit demonstrated a negative relationship between non-compliance and target species biomass response ratios. Thus, without incorporating any aspects of reserve design, compliance data predicted reserve response ratios of fish biomass. Accordingly, researchers should explore ways to better understand and measure non-compliance. Therefore, future research should triangulate multiple sources of quantitative compliance data collected using standardized techniques and conduct baseline surveys before reserve implementation.

24. THE PROBLEM OF SPATIAL FIT IN SOCIAL-ECOLOGICAL SYSTEMS: DETECTING MISMATCHES BETWEEN ECOLOGICAL CONNECTIVITY AND LAND MANAGEMENT IN AN URBAN REGION

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Diego GALAFASSI, Stockholm University; Örjan BODIN, Stockholm University

The problem of institutional fit in social-ecological systems has been empirically documented and conceptually discussed for decades, yet there is a shortage of approaches to systematically examine the level of fit. We address this gap focusing on spatial fit in a peri-urban region where natural wetland habitat is ecologically fragmented at a scale beyond the control of single managers; requiring them to coordinate their activities to address institutional fit at the appropriate scale. We present a research approach that maps patterns of collaborations between actors who manage different parts of a landscape, and then relates these patterns to structures of ecological connectivity. We apply our approach to evaluate the fit between a collaborative wetland-management network comprising all 26 municipalities in the Stockholm County in Sweden, with an ecologically defined network of dispersed but ecologically interconnected wetlands. Many wetlands in this

landscape are either intersected by the boundary between two or more municipalities, or located close to such boundaries, which implies a degree of ecological interconnectedness and a need for inter-municipal coordination related to wetland management across boundaries. We first estimate the level of ecological connectivity between wetlands in neighboring municipalities, and then use this estimate to elaborate the level of social-ecological fit vis-à-vis inter-municipal collaboration. We find that the level of fit is generally weak. Also, we identify critical misalignments of ecological connectivity respectively inter-municipal collaboration, as well as collaborations that represent an adequate alignment. These findings inform on where to most effectively allocate limited resources of collaborative capacity to enhance the level of social-ecological fit. Our approach and results are graphically illustrated using maps, which facilitates the potential application of this method in land-use planning practice.

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RECOVERING THE LAST WILD BLUE-THROATED MACAWS

Igor Berkunsky

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The Blue-throated Macaw (*Ara glaucogularis*) is a rare, critically endangered and endemic macaw of savannahs in northern Bolivia. The species was discovered in the wild in 1992, and during the last decade intensive conservation work was carried out in order to identify and solve the critical parameters delaying the population's recovery. Field conservation actions were aimed at increasing nest site availability, protecting active nests against predators, increasing nestling's survival and establishing protected areas. We evaluated the performance, limitations and costs of these field conservation actions; and we analyzed the information documented by this long-term study related to occupancy, density, and breeding success of Blue throated Macaws in northern Bolivia. The application of these actions resulted in higher nest success and higher nestling survival. Despite this reproductive improvement, the breeding population is not yet recovering. The number of macaws at each breeding site has been stable or decreased; and at a few sites, local extinction has taken place. As the Blue throated Macaw is currently a conservation dependent species, we consider the value of increasing the wild population through the release of confiscated and captive-bred individuals.

SUMATRAN ELEPHANT FEEDING PREFERENCES TOWARD 10 AGRICULTURAL AND PLANTATION COMMODITIES IN ACEH-INDONESIA

Kaniwa Berliani

North of Sumatra University

Hadi S ALIKODRA, Faculty of Forestry IPB ; Burhanuddin MASY'UD, Faculty of Forestry IPB ; Mirza D KUSRINI, Faculty of Forestry IPB ; Wahdi AZMI, Center for Wildlife Veteriner Medicine of Syiah Kuala University

Research on feeding preferences of Sumatran elephants (*Elephas maximus sumatranus* Temminck) toward 10 agricultural and plantation commodities in Aceh's Elephant

Conservation Center has been conducted in December 2014. The method used is a test method to feed 10 of commodities crops cultivated by people in conflict areas using two captive elephants. Feeding is done by the method of restricted feeding. The data were then analyzed using the equation Neu's index. The results of the research showing various preferences of the crops ranked from the highest as follow; paddy plant (*Oryza sativa*), banana (*Musa sp*), rubber (*Havea brassiliensis*), palm (*Elais guenenensis*) and nut (*Areca atechu*). While the types of cacao (*Theobroma cocoa*), chilli (*Capsicum frutescens*), Tamarind (*Aleurites moluccana*), coffee (*Coffea Arabica*) and Patchouli (*Pogostemon cablin*) showed a low preference. Low elephant preferences for the type of crops cultivated by the villager is some commodity crops that could potentially be developed in the area adjacent to the elephant habitat to mitigate human elephant conflict. Key words : elephant, conflict, plantation commodities, preferences

30 YEARS OF LAND USE DYNAMICS IN THE COASTAL MEDITERRANEAN WETLANDS

Marianne Bernard

Tour du Valat

Coralie Beltrame, Tour du Valat ; Isabelle LEVIOL, Muséum National d'Histoire Naturelle ; Thomas GALEWSKI, Tour du Valat

Mediterranean wetlands are ecosystems especially important for biodiversity and human well-being. They lost about 50% of their area in the 20th century. The Mediterranean coast is also under heavy pressure from urbanization, tourism and development of industrial and transport infrastructures. There is thus a convergence of ecological, human and economic issues in the Mediterranean coastal wetlands. Changes in land use / land cover between 1975 and 2005 were characterized in 214 of them. We observed an artificialisation of wetland habitats. Indeed, within them, the area of natural wetland habitats decreased by 10% in 30 years, a loss of 1248 km². At the same time, artificial wetland habitats increased by 54%, that is to say, a gain of 661 km². The main direct pressure on natural wetland habitat was agriculture with 71% of these habitats converted into agricultural areas. Urbanization had less direct impact but had eaten into peri-urban agricultural areas, and these lost agricultural areas are displaced to surrounding natural habitats. Furthermore in this water-scarce region, the increasing abstraction of water and intensified water management practices have a major impact on natural wetland habitats as the transformation of wetland hydrological regimes, the conversion of natural wetlands into artificial wetlands, and decreased flows in watercourses.



POPULATION ESTIMATES OF AN ENDANGERED GAME BIRD IN THE OVERHUNTED BRAZILIAN ATLANTIC FOREST HOTSPOT

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Joedison Santos ROCHA, UESB ; Fernando Cesar GONÇALVES, UESB ; Aiala SOUZA, UESB

Threatened species are frequently difficult to record, leading to few data available for helping to select the best conservation strategies. When deforestation of the northern Atlantic forest and poaching intensified in the late 1960's, red-billed curassows (*Crax blumenbachii*, Cracidae, Galliformes) began their slow journey towards the center of the extinction vortex. This endangered game bird is nowadays one of the largest frugivores in the northern Atlantic Forest, where other game species with similar ecological niche are already extinct, such as the white-lipped peccaries and tapirs. We surveyed populations of the species from 5 a.m. to 18 p.m. by line-transect in two of the largest forest fragments of northeastern Brazil, Una Biological Reserve (18,000 ha) and Conduru State Park (9,000 ha), totalling 496 km of walked trails. Red-billed curassows are most abundant in the north region of Conduru (0.42 records/10 km), where the species were mostly recorded from 9 to 11 a.m. This abundance is similar to findings in the southernmost region with the largest population ever recorded (Vale Natural Reserve - 23,000 ha). However, the species is absent from most of the forest fragments of the species extension range, where hunting pressure is high. Red-billed curassow abundance is small in Una (0.20 records/10km), similar to the smallest population ever recorded for the species (Descobrimento National Park, 21,000 ha). This important demographic data on wild populations of red-billed curassows helps on the update of the conservation status of this endangered game bird, which is targeted by reintroduction programmes and conservation actions led by national and international conservation boards. Furthermore, it is the first step for monitoring wild populations of the red-billed curassow in the long-term.

BEYOND DELINEATION: EXPLORING THE BIOLOGICAL SIGNIFICANCE OF GLOBAL ZOOGEOGRAPHICAL UNITS

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The identification of biogeographic entities is essential to understand large-scale ecological and evolutionary processes and resulting biodiversity patterns. The recent increased in

availability of geographic information and the development of new statistical tools have resulted in diverse studies aimed to define biogeographical regions. However, these studies have largely focused on delineating the spatial regions without identifying the species that determine them, even though understanding the biological components could provide valuable information. Here we address this shortcoming using a derivation of flow-based method to analyze global distribution data for terrestrial non-volant mammals (n=3948). Our analysis identifies 36 distinct zoogeographic units determined by species assemblages with a median of 52 mammals (range 2-779). These assemblages are formed by species with distinct life-histories and levels of vulnerability to extinction. For instance, assemblages in Southeast Asia include many species with large adult body masses whereas in North and Central America small-sized mammals prevail. The most sensitive units (those formed by highly threatened assemblages) are found in Madagascar whereas the entire Holarctic is characterized by mostly unthreatened species. The present study goes beyond zoogeographical entities delineation to explore the biological significance of these entities, identifying sensitive regions based on their assemblage composition and proposing new hypotheses for observed biogeographic patterns.

1. THE RELATIONSHIP BETWEEN POPULATION SIZE, EFFECTIVE NUMBER OF BREEDERS AND THE ENVIRONMENT IN BROOK TROUT

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Concordia University

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The understanding of interannual fluctuations in the effective population size (N_e) and the relationship between N_e and census population size (N) is important to predict genetic and demographic changes for populations of conservation concern. Difficulties in measuring N_e have spurred interest in a more practical surrogate: the effective number of breeders per cohort (N_b). We empirically evaluated the relationship between the environment, N_b , and N , for five consecutive cohorts in brook trout populations located in Cape Race, Newfoundland, Canada. These populations are isolated, pristine, and differ greatly in population size, life history and environmental characteristics. We found a strong, positive correlation between N_b and N . There was no evidence that year, populations, or stream conditions affected this relationship. These results provide valuable insights onto the relationship between the evolutionary and the demographic parameter across populations. Collectively, our results suggest that it might be possible to infer N_b from N , or vice-versa. The better understanding of the relationship between N_b and N is crucial for wildlife management and conservation as it would provide valuable insights into local and contemporary environmental, genetic or demographic threats in natural populations.



DETECTING SEX-BIASED DISPERSAL THROUGH NETWORK TOPOLOGIES

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Sex-biased dispersal is characterized by the propensity of individuals of one sex to disperse while individuals of the other sex tend to stay or return to its natal site for reproduction. With the recent advances of molecular tools, this evolutionary process is commonly observed in vagile species but show an important variation in magnitude and directions. Methods available for both population- and individual-level have been successful at detecting such process but investigation at the system-level is yet to be explored. Considering such level let investigators exploring patterns lying in higher dimension where genetic structure among all populations is capture concurrently. Population Graph is a multivariate network-based framework that investigate the significant structural covariation patterns of intraspecific systems. Population Graph connectivity structure is built upon the statistical significance of the interactions. Although not yet explore, decomposition of the interactions by variation of the alpha-value (i.e. significance level) reserves the capacity to explore the strength of the interactions within system. Based on these patterns, we propose a novel approach to investigate sex-biased dispersal process from Sex-Specific Graphs (i.e. Unisex networks). Based on the rational that dispersing sex would demonstrate a higher level of functional connectivity, we hypothesize that dispersing sex-network would show a more resilient behavior to alpha-decomposition. Global topological metric, such as the averaged shortest-path distance between nodes, were used to assess the hypotheses. Significance of the test is evaluated by randomization approach. Type-I and Type-II errors are currently under evaluation using individual-based Monte Carlo simulations. We believe that this new perspective could enhance the investigation of sex-biased dispersal, leading to a better understanding of dispersal process and its effects on wildlife population viability.

ECOLOGICAL CORRIDORS AS STRATEGY FOR FOREST ECOSYSTEMS CONSERVATION OF THE CAPARO FOREST RESERVE, BARINAS STATE, VENEZUELA

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Deforestation is causing a landscape transformation leading the degradation and fragmentation of ecosystems, with the consequent loss of biodiversity. The semi-deciduous forests in Venezuela are critically endangered and threat due to its intervention, including plant and animal species that inhabit these forests. In the country, Forest Reserves north of the Orinoco have had bad management and have largely been completely deforested; however in some of them as the Caparo Forest Reserve (CFR), there are still large patches of forest that can be used for restoration and conservation. A conservation proposal for forest ecosystems is presented in this work, mainly focused on the semi-deciduous forests of the CFR, establishing preliminary ecological corridors to rescue biodiversity flows, assuming that the negative consequences that may have impair connectivity in patches, are despicable for being a forest that was connected 60 years ago. For the development of these corridors, was used as spatial basis, the distribution of all natural ecosystems and human intervention systems (Ecosystems Map). By satellite imagery analyzing and processing and GIS use, six ecological systems or ecosystems and four human intervention systems were defined. The spatial arrangement of forest fragments was determined and analyzed, and the corridors as conservation strategies were defined. Based on the use of ecological criteria, 66 links between patches of the original forest was proposed. The next step in the conservation process of the CFR is the development a concerted conservation planning with the community, in order to present a project that includes this strategy to the government environmental authorities. With this strategy we are one step further towards the restoration of the forest in the reserve, with more biodiversity, with a healthy composition and structure maintained over time, in harmony with its inhabitants for the people of today and tomorrow

SYMPOSIUM 126: CRITICAL REFLECTIONS ON THE EFFECTIVENESS OF BIOMASS STANDARDS TO ENFORCE SUSTAINABILITY

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With the emerging bioeconomies in Europe, more biomass is imported. Sustainability concerns led to the development of EU regulations esp. regarding bioenergy. Hence, private certification standards for biomass proliferate but with major differences regarding environmental and social criteria. The potential of these standards for human development are e.g. income opportunities for farmers and workers or



the compliance with human rights and labour standards. To protect the environment, regulations exist to safeguard biodiversity and natural resources. Positive but also negative changes for the environment and livelihoods are observed on and around certified farms in developing countries. While the standards can monitor good agricultural practices, they are limited in controlling complex issues such as food security, transparency/informed consent, biodiversity or land conflicts. The question arises whether standards can satisfy sustainability expectations regarding complex problems and basic human rights and what (governance) arrangements could enhance their effectiveness. In addition, there are implementation problems of the certification system. It must be critically scrutinized what can be verified in the field due to missing documentation, financial reasons, fraud or capacity constraints. The financial dependency between auditors, standard setters and employing enterprises raises questions of the system's legitimacy. Research institutes and CSOs can play an important role as evaluators regarding the performance and implementation of the standards. Given the positive impact of standards on some criteria, political and societal expectations in private labels are high. Regarding complex problems and settings like in biomass exporting counties with governance, poverty and hunger problems, the overall performance of certification systems is unsatisfactorily. More research is required to solve these complex challenges and increase the performance towards sustainability.

ONE PLAN TO HELP THEM ALL: SPATIAL HABITAT RESTORATION PLANNING FOR MULTIPLE SPECIES IN METAPOPOPULATIONS

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Species persistence often depends not only on habitat protection, but also on habitat restoration. The effectiveness of species conservation through habitat restoration can be enhanced by explicitly considering the combined effects of the total amount of habitat and its spatial configuration. Metapopulation theory indicates that habitat configuration can have a profound influence on extinction risk but also that species respond to habitat configuration in different ways depending on patch size requirements and dispersal ability. Here, we address the problem of how to prioritise restoration spatially in order to maximise benefits to a broad range of species. There are two dimensions to this problem. How do we quantify the value of habitat configuration to a species? And how do we prioritise restoration for a set of species? Although these issues can often be solved exactly using mathematical

optimisation for very small problems, we are interested in realistically complex problems such as the restoration of the Brazilian Atlantic Forest (>250,000 patches). We developed an approach that uses the probability of connectivity (PC) metric to quantify patch and configuration value at the species level, and distributions of patch size and dispersal variables to prioritise restoration for all species of interest using heuristic optimisation methods (simulate annealing). Differences in the relative value of species can be accommodated with weights. The benefit of this approach is that, unlike simple measures of connectivity, PC is closely related to metapopulation dynamics, and simultaneously considering many species can greatly increase the cost-effectiveness of the solution. We apply the method to landscape restoration problems in Australia and Brazil.

133-FAITH, FORESTS, AND FOOD: TOWARDS A CONCEPTUAL FRAMEWORK FOR FAITH-BASED FOREST CONSERVATION IN AFRICAN AGRICULTURAL LANDSCAPES

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The Open University

Culturally-protected forests are an integral component of agricultural landscapes in many low-income countries of Africa. Indigenous and community-conserved areas include Kaya forests of coastal Kenya, customary forests in Uganda, sacred forest groves in Benin, and dragon forests of The Gambia—all of which are embedded within agricultural landscapes and have significance for the people who live within or in close proximity to them. Faith-based forest conservation plays an important role in maintaining biodiversity in highly human-dominated landscapes and by providing smallholder farmers with food, fuel, fodder and shelter on non-farmed land. However, the links between faith-based organizations, their forest protection traditions, and the ecosystem services they provide to predominantly agricultural landscapes remain unrecognized, unexplored, and under-theorized. Understanding and communicating the contemporary relevance of these culturally-protected forests are keys to their future protection. How can multifarious connections between faith, forests and food (a primary force of life) help reinvent reasons for safeguarding culturally-protected forests?

IRRIGATION TANKS, BIRD SANCTUARIES OR WETLANDS- THE MANAGEMENT DILEMMA

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Care Earth Trust

Jayshree VENCATESAN, Care Earth Trust

In a tropical country like India, rainfall distribution varies both spatially and temporally. In Tamil Nadu, a state located



in southern part of the country, low and seasonal rainfall and unfavourable geology for groundwater storage led to development of a traditional means of water harvesting through a system of tanks as early as 9th century AD. There are nearly 40,000 tanks in the state. Over time these local water bodies apart from providing water for irrigation turned into havens for both resident and migratory birds and other forms of biodiversity. Consequently, some of these tanks were declared as Protected Areas. Hence, over time their management shifted hands from village communities to Public Works to Forest Department affecting their ecological character. Our study of the socio-ecological character of 10 bird sanctuaries located on irrigation tanks revealed an array of management and conservation issues ailing these wetlands. For instance the wetlands in Ramanathapuram experienced low water levels owing to conflicts amongst villages and caste groups in the tank cascade, encroachment, and maintenance irregularities by different departments in the upstream region. In some cases, the close association of wetlands and agriculture was found to be conducive both for birds and farmers, as in the use of agricultural fields as feeding ground by birds and use of guano rich silt from tanks as fertilizer. However, on the other hand, drainage of agricultural runoff into the tanks resulted in eutrophication favouring invasive fish species like Tilapia and Giant African Catfish to thrive. Further, while on some occasions birds visiting the farms were hunted, on others, the farmers complained of crop raiding. The study led to conclude that while wetlands in India still do not have an exclusive administrative status, their management at all levels entails community participation in addition to regulatory policies and scientific planning.

THE PAST, PRESENT AND FUTURE OF THE WORLD DATABASE ON PROTECTED AREAS

Nina Bhola

United Nations Environment Programme World Conservation Monitoring Centre
Diego JUFFE-BIGNOLI, United Nations Environment Programme World Conservation Monitoring Centre ; Brian MACSHARRY, United Nations Environment Programme World Conservation Monitoring Centre ; Marine DEGUIGNET, United Nations Environment Programme World Conservation Monitoring Centre ; Naomi KINGSTON, United Nations Environment Programme World Conservation Monitoring Centre

Conservation planning requires reliable information on the location and extent of protected areas that is often difficult to obtain. Building upon the mandate behind the UN List of Protected Areas in 1981, IUCN and UNEP established the World Database on Protected Areas (WDPA). The WDPA is managed by UNEP-WCMC in collaboration with governments and NGOs in 240 countries and territories and is the most

comprehensive global database of marine and terrestrial protected areas. The WDPA has been and continues to be used extensively in conservation science and policy to inform conservation planning and monitor progress in global biodiversity indicators. However, the WDPA is not without its limitations. For example, some protected areas do not have boundary data or are not accurately mapped and many sites are not assigned IUCN management categories. The decision to include or exclude such sites during data analysis likely affects the results of conservation studies. There is also little understanding about how the WDPA is compiled and hence the implications of the decisions taken during data preparation for data analysis. Prior to 2015, the WDPA did not include information on particular types of conservation areas that did not meet the IUCN definition of protected areas but which might still contribute substantially to biodiversity conservation in some countries, such as private or communal reserves. To address these limitations, some existing fields within the WDPA have now been updated and new fields added. Improved validation processes and quality metrics have also been put in place. We review the evolution and application of the WDPA, highlighting key statistics derived from recent analyses, and caveats associated with analytical decisions made in preparing the database. We then explain in detail the improvements made to the database in 2015 and how they will help move the conservation agenda forward.

FOREST RESTORATION THROUGH AFFORESTATION AND CONSERVATION PROCESS BY SOCIAL PARTICIPATION IN INDIA

Shashi Bhushan

Jawaharlal Nehru University

Forest has always contributed an influential role to maintain natural resources in India but last two decades were very important in terms of Afforestation scenario, when it faces the flutter due to several daunting challenges like development process and social activities. Accordingly, it attracts government and policy maker attention towards protecting the existing forest area and restores the degraded land by introducing the afforestation and management process by social participation. Present study attempts to identify the structure of forest management and afforestation scheme with social participation involving local people in and evaluate the role of Joint Forest Management (JFM) in context of forest conservation in India. This paper is at micro level study covers all districts of India and the estimation of forest growth has been analyzed by FSI (Forest Survey of India) bi-annually using the Digital Image Processing (DIP) to estimate the forest area on a map at 1:50,000(2001-09) scale. The results of the study revealed that, there has been a significant increase in the total forest cover in India in last two decades,



where forest management with social participation helped to reduce the illicit felling of trees, reduces area under illegal encroachments and forest fire prevention. Results also indicate that Afforestation programme helped in forest conservation and regeneration by community involvement for non timber forest production which has impacted on the livelihood of the districts. Community involvement assures the participation of different caste, class, religion and gender according to available population proportion in particular region through 'Van Panchayat (village administration of forest)' system. Scheme of Afforestation programme succeed by focusing on agro forestry, linear forest plantation and regeneration of native plants in degraded area under National Afforestation Programme (NAP).

EVALUATING THE SYNERGISTIC EFFECT OF MULTIPLE ANTHROPOGENIC STRESSORS ON THE POPULATION DYNAMICS OF PLANTS, USING A HAWAII ENDEMIC SHRUB, DELISSEA WAIANAENSIS, AS A CASE STUDY

Lalasia Bialic-Murphy
University of Hawaii at Manoa

Anthropogenic stressors can have long-lasting effects on a species' vital rates and thus is thought to be the primary driver of population decline and extinction. To understand the influence of species interactions and environmental changes on population persistence, it is necessary to explicitly link the impact of stressors on plant vital rates to population dynamics. For endangered species that occur in extremely altered environments, it is also important to assess which combination of management actions will likely result in the desired end goal – autogenic (i.e., self-sustaining) populations. In this five-year study, we examined the synergistic effects of fruit depredation by non-native rodents and pollen limitation on the population dynamics of a critically endangered Hawaii endemic shrub, *Delissea waianaensis*. We used a stochastic stage structured model and transient analysis to explore how plant interactions with multiple biotic stressors influenced the long and short-term population dynamics. This study provides insight into the likely outcomes of employing various rare plant conservation strategies.

THE TEMPORALITY OF POSITIVE AND NEGATIVE IMPACTS ON LOCAL PEOPLE

Cecile Bidaud
Bangor University

In developing countries, conservation projects are addressing to precarious people who are asked to change their land use. Those projects have different kind of actions, with in one hand

positive incitation and in another hand restrictions more or less repressed. If both types of actions can be developed in parallel, their impacts have not the same temporality. If restrictions can take place immediately, land use change actions will be longer to have an impact on local people. This temporal gap and its effect on local people will be here questioned through a case study of biodiversity offset project of a mining company working in Madagascar. Biodiversity offsets are projects developed by big infrastructures degrading the environment in which they engaged beyond their environmental obligation to protect nature. BOs have been designed very much as a response to mitigating biodiversity impacts of development, but have potential impacts on local livelihood. As most of conservation projects, they combine restrictions and agricultural development project. In this communication, I will balance the positive and negative impacts as bare by the local population living around a biodiversity offset project showing their different temporality. This will lead to broader considerations on ethics and environmental justice.

USING STRUCTURED DECISION MAKING TO SELECT CULTURALLY, ECONOMICALLY AND ECOLOGICALLY APPROPRIATE SALMON HABITAT RESTORATION STRATEGIES IN THE QUINALT INDIAN NATION

Kelly Biedenweg
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Incorporating socio-cultural needs and their potential impacts from restoration into environmental decision-making is complicated by the fact that many of these issues are difficult to measure. This paper presents the collection of socio-cultural data to inform a Structured Decision Making process for selecting culturally, economically, and ecologically appropriate salmon habitat restoration strategies in the Quinalt Indian Nation, U.S.A. Socio-cultural data were collected during two seasons of interviews with 36 tribal members and a subsequent survey launched to a representative sample of the nation. Interviews identified the important socio-cultural aspects associated with salmon and riparian areas while the survey measured the status of those aspects using constructed (i.e., Likert-style) and economic measures. This data was then used in a structured decision making process with QIN resource staff to compare three alternative scenarios across social, economic and ecological goals. The author will present the indicators identified in the interviews, the measures developed to quantify those indicators, and lessons learned from incorporating cultural values in a decision making process.



SYMPOSIUM ID 94: FOSTERING THE EMERGENCE OF CONSERVATION IN A BUDGET-CONSTRAINED WORLD: COMMUNITY-BASED ACTION TO COUNTER THE ILLEGAL WILDLIFE TRADE

Duan Biggs

University of Queensland

SYMPOSIUM ID: 94 Biodiversity is under increasing threat, whilst available budgets to mitigate against these threats continue to be constrained. There is an urgent need to become more cost-effective. One strategy is to create an enabling environment that facilitates individual agents to self-organise and behave in a way that leads to conservation outcomes. In contrast to externally-driven initiatives which are formulated and implemented by government departments or conservation NGOs, conservation outcomes can therefore also be achieved by the autonomous and self-organised action taken by individual agents. This enhances the cost-effectiveness and the sustainability of conservation outcomes. But how can this 'emergence of conservation' be achieved? Emergence, and robustness, two related concepts from the common pool resources and the complexity literature provide guidance. Emergence refers to the coming about new activities and initiatives that can deliver conservation benefits, and robustness refers to the durability of these new behaviours and actions over time. We demonstrate the application of the concepts through presenting a theory of change to strengthen community-level action against the illegal wildlife trade to achieve more cost-effective and lasting conservation outcomes than externally driven-initiatives.

ECOLOGICAL NETWORK DYNAMICS IN A FLOODPLAIN ECOSYSTEM UNDERGOING EXTREME WET-DRY FLUCTUATIONS

Gilad Bino

University of New South Wales

Skye WASSENS, Charles Sturt University ; Jennifer SPENCER, Office of Environment and Heritage ; Rachael THOMAS, Office of Environment and Heritage ; Richard KINGSFORD, University of New South Wales

Ecological networks, the interactions between species and nutrients, represent the flow of energy and biomass through the ecosystem. This continuum and its supporting linkages are critical for stability and persistence of ecosystems, often only represented by single "snapshots" in time. We carried out repeated surveys over five years (2008-2014) of a range freshwater-dependant biota (frogs, tadpoles, fish, and waterbirds) in wetland complexes that form part of the Lowbidgee floodplain, a large terminal delta system in inland south-eastern Australia. Surveys encompassed the last three

years of the Millennium Drought, one of the most extreme drought events in Australia's history and subsequent large scale flooding and normalisation of the system. We quantified direct and indirect interactions within the floodplain ecosystem between underlying ecological drivers (inundation extent, water quality) and our biota, using structural-equation models. Key biological responses significantly linked to inundation, reflecting predicted top-down and bottom-up interactions. By separating analysis into two periods: drought (2008-2009) and post flood recovery (2010-2014), we found considerable variation in trophic interaction strengths, mediated by strong regulating factors such as water availability and temperature. Our work, part of an ongoing long term monitoring project, provides a unique empirical opportunity to test relationships between water availability and biotic responses. As pressure on the world's freshwater resources increases, understanding of these often complex interactions between hydrological, biological, and geochemical processes undergoing extreme hydrological fluctuations is critical for identifying the impacts of water extraction and managing their long-term persistence with management tools such as environmental flows under increasing climatic uncertainty.

DESTABILISATION OF COASTAL DUNES FOR CONSERVATION OF BIODIVERSITY IN ISRAEL

Tania Bird

Ben Gurion University of the Negev

Pua BAR (KUTIEL), Ben Gurion University of the Negev ; Amos BOUSKILA, Ben Gurion University of the Negev ; Elli GRONER, Dead Sea & Arava Science Center

The proximity of Nizzanim Nature Reserve to both desert & Mediterranean ecosystems has resulted in unique species assemblages in this Israeli coastal dune reserve. Due to land use changes over the last 50 years, there has been rapid dune stabilization leading to loss of mobile dunes, the preferred habitat for many endemic and specialist species, causing concern for the conservation of these species. Unlike most coastal dune restoration projects that seek to stabilize dunes to prevent coastal erosion, restoration in Nizzanim involves perennial vegetation removal to create a heterogeneous environment of different dune types for biodiversity conservation. Species diversity and community structure have been monitored on mobile, semi-stabilized and stabilized dunes (with removal and control replicates) for more than 10 years in five taxonomic groups; annual & perennial plants, arthropods, reptiles & rodents. Such long-term data across so many taxa is rare in conservation biology and to our knowledge, unique in coastal dune research. We examine species composition and diversity trends on natural dunes and treated dunes and compare differences in responses among taxonomic groups. Complex standardization techniques and multivariate analyses are required to deal with this extensive



multi-taxa database. Preliminary ordination analysis suggest that different taxa respond differently to dune treatments, with implications for conservation management decisions. Specific recommendations will be provided in the next phase of this research for coastal dune management under different conservation priorities that can be adjusted according to changes in societal conservation values.

EFFECTS OF LANDSCAPE COMPLEXITY ON MULTI-TAXON INDICATOR BUNDLES FOR ECOSYSTEM SERVICES

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Species across taxa can be directly or indirectly related to the provision of ecosystem services (ES) and a multi-taxon indicator approach may therefore act as a reliable assessment tool to allow predictions about the level of ES provision in agricultural landscapes. We use information on more than 680 invertebrate, vertebrate and plant species to create bundles of species that act as indicators for the provision of several ES in agricultural landscapes in Southern Sweden. We find that a relatively high proportion of invertebrate and plant species are reliable indicators for the provision of ES, but that individual relationships differ markedly between taxonomic groups. Grouping species with similar relationships to ES across taxa allows quantifying the effect of landscape complexity on indicator bundles. Positive indicators (positive relationships between abundances and an ES) for biological control benefitted from landscape complexity, whereas negative indicators were less abundant in complex landscapes. Positive indicators for the conservation value of an area were more abundant in complex landscapes. Negative indicators for yield were more abundant in complex landscapes, with the opposite relationship observed for positive indicators. Indicators for hunting quality, pollination potential and soil organic carbon content did not show such contrasting patterns. Identifying response patterns of indicator bundles to landscape complexity across taxa is an important step in understanding how landscape complexity affects the provision of multiple ecosystem services via alterations of biotic communities. The provision of multiple ecosystem services can be promoted by taking up conservation measures that simultaneously promote sets of positive indicator species. We therefore argue that the identification of indicator bundles can be useful to develop conservation strategies that target the provision of multiple ecosystem services in agricultural landscapes.

IUCN RED LIST IN EASTERN EUROPE: DO WE HAVE ENOUGH INFORMATION FOR CATEGORIZING VERTEBRATE SPECIES?

Zsolt Biró

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International nature conservation often uses IUCN categorization and criteria for evaluating threatened species. A given species degree of vulnerability might change in different spatial levels, thus categorizing species on a national level can be beneficial for nature conservation. Experts from five Eastern Europe countries (Hungary, Slovenia, Slovakia, Poland and Serbia) were asked about IUCN related questions. Every countries use national conservation levels, such as "protected", "strictly protected" or "huntable", but only Slovenia's government has officially adopted the IUCN evaluation. Free and easily accessible online databases are rare in these countries. In Serbia there are no such information sources on vertebrate species, in Slovenia all of these databases have a price to pay. Online databases exist in almost all countries but these are based on voluntarily data collection. Volunteer helps are favourable in nature conservation, but in case of monitoring it raises the questions of representativeness, reliability and regularity. We think basic data collecting should be based on scientific monitoring methods, and for IUCN categorization it should be carried out on a historical scale. We could only find one reliable and representative information source (National Game Management Database of Hungary), which can be used on a long term basis. Based on NGMD, we have evaluated game species of Hungary and found that grey partridge (*Perdix perdix*) and brown hare (*Lepus europaeus*) should be in threatened categories (CR, VU respectively), due to their population decrease in the last 10 years. With the lack of sufficient and reliable data we might end up protecting species that are flourishing and neglect species that are in need of help.

HOW FARMERS INFLUENCE BIODIVERSITY ON THEIR FARMS

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Across Europe, agri-environment schemes (AES) have been established to reverse the decline of farmland biodiversity. However the impacts of AES on biodiversity are mixed, and no general increase in farmland biodiversity has been observed. One reason for partial success of AES at plot scale but mostly failures at regional or national level might lie in the fact that farmers base their management decisions on economic aspects rather than on what is most effective for biodiversity. The principle unit of decision making is the farm, and decisions about participating in AESs are also taken at the farm level. Thus we investigated how farmers can best enhance biodiversity on their land with a whole-farm approach. We therefore compared diversity of breeding birds and abundance of several farmland bird species on 133 Swiss lowland farms with factors that are directly influenced by farmers and considering a range of environmental variables. We found a highly positive effect of quantity and ecological quality of habitats under AES management on diversity of breeding bird species and on abundance of several bird species. There was also a significant correlation between these variables and habitats in the surroundings of the farm, average field size and proportion of grassland, whereas farm type (organic vs. integrated farming), density of livestock and some arable and grassland management option seem to be of minor importance. We also correlated diversity of plants, grasshoppers and butterflies with the same explanatory variables and found similar relationships. We conclude that farmer's decisions are a major driver for diversity and abundance of biodiversity. The most effective way for farmers to support biodiversity on their farms is to maintain or create habitats (semi-natural habitats or AES options) with high ecological quality.

HOOLOCK GIBBON CONSERVATION: PROMOTING COMMUNITY OUTREACH AND EDUCATION IN KARBI ANGLONG UNDER KAZIRANGA-KARBI ANGLONG LANDSCAPE, ASSAM, INDIA

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Hoolock gibbons, the only two representatives of lesser apes in India, is threatened by habitat loss and hunting throughout its range in seven northeastern states, resulting $\geq 90\%$ decline in population during last few decades. The state of Assam, NE India alone holds $>70\%$ Indian population and Karbi Anglong

district of Kaziranga-Karbi Anglong Landscape contribute about $\geq 65\%$ population in the state. But despite having huge scope, severe anthropogenic pressure due to poor social condition of the fringe communities in the district and lack of knowledge and appreciation towards conservation and lack of capacity of the management authority remains the main challenges. Community Education and Outreach programs, which are often based in areas that face such challenges, have been a vanguard in creating means to integrate people with their natural environment and thus conquer supporters for the protection of natural habitats. Educating students, school-teachers, foresters and community members in support of conservation and sustainable development and improving the management capacity provide a basis for long-term changes in attitude and practice. Extensive conservation education, outreach and orientation programs have been conducted during 2011- 2014 for various target groups. Integrated teaching modules containing information on the species, its ecological role in forests and biodiversity were carried out using different indoor and outdoor teaching-learning activities like drama, role play and debates besides audio-visual presentations and field visits. During the campaign ($n=15$), we covered 5 PAs and educating 4500 community members, training 60 foresters and sensitizing management authorities and decision makers. To assess what was offered and effectiveness of such program evaluation was carried out which suggested that protection became enhanced through awareness and capacity building and such programmes can be effective and should be established far more widely.

24 - WHO IS RESPONSIBLE FOR BIODIVERSITY OUTCOMES? A FRAMEWORK FOR EVALUATING THE PERFORMANCE OF CONSERVATION NETWORKS

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Large landscape conservation seeks to mitigate contemporary ecological problems through conservation interventions at multiple and overlapping scales. Implementation requires leveraging networks and as conservation practitioners increasingly work to integrate local-scale conservation action with broad-scale goals and objectives, an informed understanding of the governing dimensions of these systems is needed. However, empirical research that measures the performance of network governance in this context is limited. This paper uses a well-established large landscape conservation network, the Roundtable on the Crown of the Continent, to explore application of a performance evaluation framework. We propose a framework that provides an organized way to set goals, track progress towards those goals, and collect data for feedback to an adaptive management network. We discuss the challenges of "counting" network outcomes in large landscape conservation and present a



framework that guides the evaluation of ecological outcomes, the network itself, and the value-added benefits to network participants.

HUMAN MODIFICATION: CONCEPTS, METHODS, AND A CALL FOR STANDARD TERMINOLOGY

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It is becoming increasingly important to document the extent and intensity of human modifications on the surface of the Earth, both as a first step in understanding the effects of these modifications, and also as a necessary input for developing conservation strategies for resource-management. This broad motivation has led to a growing demand for spatially explicit metrics that describe human modification, and marks an interface where science and managers meet. For example, the Crown Managers Partnership – an international collaboration of managers from the U.S. and Canada – is using human modification analysis in the Crown of the Continent Ecosystem to identify priority areas for conservation in this 42,000-square-kilometer transboundary landscape. As with any growing field of research, the study of human modification faces a number of methodological and ontological challenges. For example, many of the fundamental terms used in these studies are poorly or inconsistently defined - including human modification, human footprint, impact, and intensity - leading to substantial confusion about what the corresponding metrics are actually measuring. Additionally, the limitations and assumptions made in academic studies using these metrics are not always explicit, leading to inappropriate interpretation and applications. In this study, we review the current literature on human modification in order to identify problems with methods, definitions, assumptions, and stated limitations. After doing so, we outline a proposal for standard terminology, and identify key areas research required in this important and burgeoning field. Our goal is to ensure that the results of these studies provide useful and meaningful information that can be used to inform resource management guidelines and environmental legislation, as well as effective stepping stones for ongoing conservation research.

AN ASSESSMENT OF TARGETING IN A COMPENSATION SCHEME FOR HILSA (TENUALOSA ILISHA) CONSERVATION IN BANGLADESH

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Conservation payments are increasingly advocated as a way to meet both social and ecological objectives, particularly in developing countries, but payments often fail to reach the right individuals. A payment scheme for hilsa (*Tenualosa ilisha*) conservation in Bangladesh provides compensation to coastal and riverine fishers affected by temporal fishery closures. The primary goal of the scheme is hilsa conservation through the protection of juvenile hilsa, locally called jatka, but it also has an implicit goal of vulnerability reduction, targeting households which are fully dependent on fishing. However, concerns have been raised over the distribution of compensation in terms of targeting effectiveness, equity and fairness. This research used data collected from 800 recipient and non-recipient households within the area affected by the fishery closures to examine the current drivers and distribution of compensation allocation. Generalised linear mixed effects models demonstrated that the probability of receiving compensation is largely influenced by geography; households in some villages and districts are much more likely to receive compensation than others as a result of the political influence and the importance of hilsa fishing in the area. The models also showed a weak positive effect of household size and, to a lesser extent, dependency ratio, on the probability of receiving compensation. Contrary to what would be expected from the goals of the scheme, no evidence was found for an effect of fishing dependence (measured using an index developed through principle component methods), household income, or jatka fishing. These results provide evidence of poor targeting effectiveness. By setting clearer selection criteria and specifically targeting jatka fishers and high dependence on fishing within ecologically important areas, the scheme's perceived legitimacy, effectiveness and efficiency could be improved.

DEVELOPMENT AND APPLICATION OF THE DANISH HIGH NATURE VALUE (HNV) FARMING INDICATOR

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It has been recognized that farmland areas play an important role in the conservation of European biodiversity. Based on the UN Biodiversity Convention all EU membership countries are obliged to develop a High Nature Value (HNV) farming



indicator. In 2015 the Danish HNV indicator will be used to allocate part of the agricultural subsidies under the Rural Development Program to areas that are expected to be particularly important for biodiversity conservation. Here, we present the HNV indicator and its application in the Danish agricultural subsidy system. The HNV indicator has been developed in accordance with the guidelines of the European Commission and is based on landscape parameters, current land use, occurrence of seminatural habitats, analysis of vegetation plots and known distribution of threatened species. It ranks all agricultural and seminatural areas on a 0-13 point scale from low to high nature value. Farmers can apply for subsidies to areas reaching at least 5 points. Higher scoring areas are given preference when allocating the subsidies. The indicator will be updated annually to include the growing knowledge of species occurrences and land use changes.

RESTORING A VIABLE POPULATION OF LYNX IN THE FRENCH VOSGES MOUNTAINS: INSIGHTS FROM A SPATIALLY EXPLICIT INDIVIDUAL-BASED MODEL

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Habitat destruction and fragmentation are important threats to large carnivores as they are wide-ranging species and live in human-dominated landscapes. The road network is getting denser and acts as a barrier for these species as well as it increases the risk of collisions with vehicles; the creation of corridors is often advocated in these situations as a way to restore connectivity. Because of increasing conflicts with humans, large carnivores are also particularly vulnerable to poaching resulting in small and isolated populations; reintroductions are often used as a reinforcement strategy in such situations. Here we compared these two conservation strategies, reintroduction and corridor, in order to determine the optimal solution to halt the decline of the Eurasian lynx population in the Vosges Mountains (France). We developed Spatially Explicit Population Viability Analyses (SEPVA) to evaluate the efficiency of alternative conservation strategies. The SEPVA is particularly relevant in the context of species viability in fragmented landscapes as it combines a population dynamics model and a habitat model through explicit dispersal. We explored the efficiency of i) different reintroduction scenarios in the German Palatinate that is in continuity with the Vosges and ii) a scenario involving a corridor between the stable lynx population in the Jura Mountains, shared between France and Switzerland, and the

declining population of the Vosges Mountains. We found that performing reintroductions performed better than building corridors, and reduced significantly the extinction risk. Further work will focus on refining the corridor strategies and the integration of inbreeding effect. Overall, our approach has the potential to provide an efficient and relevant tool for setting up a management plan for the species.

117-INVESTIGATING MARKET ENTHUSIASM AMONGST CONSERVATION PROFESSIONALS

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Market-based instruments have recently become more common within biodiversity conservation, reversing an earlier, more adversarial, relationship between conservation, markets, and economic development. Whilst a number of conservation organisations have aligned themselves with this 'neoliberal' shift, relatively few studies interrogate the extent to which this move reflects the values of conservation professionals. An earlier study (Sandbrook et al 2013b) used Q methodology to understand the views of conservationists participating in the 2011 Society for Conservation Biology annual conference. This paper extends the work of the original study by applying the same Q-survey to a group of Cambridge, UK-based conservation professionals. Both studies reveal positive and negative perspectives on the use of markets in conservation; however, whilst the negative perspectives differed in various ways, the positive perspectives in both samples were virtually identical. Such similarity across two studies is unusual, as Q methodology is designed to illuminate subjective opinions that are typically not consistent across groups, or periods of time. This finding confirms a growing body of research that suggests that pro-market attitudes have permeated the thinking of decision makers and staff of conservation organisations around the world, and lends some support to the suggestion that a transnational conservation elite represents an epistemic community that is driving the uptake of such pro-market approaches.

TREES AND PEOPLE TOGETHER AGAINST DESERT: THE POSITIVE EFFECT OF SAHARAN AGROPASTORALISM ON ACACIA WOODLANDS

Julien Blanco

IRD

Drylands encompass 41% of the global land area and 38% of the human population. Ten to 20% of the drylands are considered to be threatened with severe desertification,



which constitutes a major challenge for the conservation of ecosystems and biodiversity and for human well-being. Meanwhile, the causes and processes of desertification still remain subject to debate, mainly because of the lack of understanding of dryland Human-Environment systems. In particular, the respective roles of anthropogenic and natural factors on desertification processes remain unclear. We addressed this issue in a multidisciplinary perspective in Saharan Morocco, in an area used as a rangeland for semi-nomadic herders and for grain cultivation during wet years in zones liable to flooding. We considered woodlands as indicators of ecosystem degradation and assessed (1) the dynamics and vitality of acacia woodlands and (2) the effects of human activities on their structure. Our results showed that acacia woodlands were constituted of sparse trees (4.8/ha) and had high regeneration (47.8%) and recruitment rates, associated with low mortality (3.3%). Tree regeneration and density was especially high in cultivated areas and human activities had more influence on stand structures than topography or edaphic conditions. Despite intensive traces of pruning (60.3% of the trees) and debarking (33.9%), no correlation with tree mortality was found. Our results contrast with the common discourse of a human-induced desertification, on which are based most of forestry policies in drylands. On the contrary, the overall positive effect of human activities on Acacia woodlands suggests that traditional Saharan agropastoralism may be compatible with dryland conservation. Such conclusions may serve local conservation policies, which ones fail to simultaneously address socio-economical and ecological issues. In particular, a better involvement of local populations in conservation projects may be considered.

DEVELOPING ECOSYSTEM VIABILITY ANALYSIS TO INFORM THE IUCN RED LIST OF ECOSYSTEMS

Lucie Bland

The University of Melbourne

Emily NICHOLSON, Deakin University ; Tracey REGAN, Arthur Rylah Institute ; David KEITH, The University of New South Wales ; Nick MURRAY, The University of New South Wales ; Jon Paul RODRÍGUEZ, IVIC

The IUCN Red List of Ecosystems (RLE) is a new global protocol to assess the risk of collapse of terrestrial, freshwater and marine ecosystems. The RLE will monitor progress towards international biodiversity targets, and promote conservation and natural resource management from global to local scales. The RLE assessment protocol comprises five criteria based on distributional and functional symptoms of ecosystem decline. However, predicting the risk of ecosystem collapse remains difficult due to the lack of appropriate theory and tools, in particular for quantifying functional declines. To estimate the probability of ecosystem collapse in the next decades, we

develop Ecosystem Viability Analysis (EVA) as an analogue to PVA for species. EVA will synthesize existing knowledge on the key processes and functions of ecosystems to underpin criterion E of the RLE ("quantitative estimate of risk of collapse"). Models for EVA should be: 1) relevant to key ecosystem processes, 2) applicable among a range of ecosystem and threat types, 3) stochastic rather than deterministic, 4) easily understood and applied by RLE assessors. Other desirable attributes include the ability to integrate multiple types of data (e.g. spatial, temporal, and expert-derived), transparently communicate uncertainty, and availability through open-source software. Candidate modelling methods include state-and-transition models, mass-balance models (e.g. Ecopath), bifurcation plots, network theory, individual-based models (e.g. Dynamic Global Vegetation Models), and general ecosystem models (e.g. Madingley). EVA will provide an overarching framework for RLE criteria, as PVA does in the species Red List. Its application will improve our global understanding of ecosystem dynamics, degradation and recovery. We also demonstrate how EVA can be incorporated into wider conservation approaches, such as climate change adaptation and disaster risk reduction.

KNOWN UNKNOWN: GLOBAL PATTERNS OF CONSERVATION DATA DEFICIENCY

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Knowing which, where, and why conservation data are lacking is crucial to assessing the reliability of conservation schemes and identifying priority areas for research. Focusing on IUCN Data Deficient (DD) species, we present the first species-level analysis of global conservation data deficiency. We focus on six taxonomic groups: mammals, amphibians, reptiles, freshwater crabs, crayfish and odonates. We assess the spatial congruence of centres of data deficiency among groups, with a grid cell size of just under 1.5°. We investigate the relative roles of species biology and human sampling effort in driving patterns of data deficiency, both at the geographical assemblage (grid cell) level and at the species level. We use two contrasting proxies of global sampling intensity: human population density and remoteness. We find that centres of data deficiency are not congruent among groups, and that the highest levels of data deficiency are closely associated with species-poor areas in all groups. Species-level analyses reveal that DD species share few biological characteristics, representing a range of data deficiencies rather than a homogenous group. We conclude that initiatives to prioritize areas for conservation research should be taxon-specific. Our analysis suggests that global patterns of conservation data deficiency are primarily driven by



spatial patterns of natural history research. Our study highlights the importance of taxonomic and fundamental ecological information in conservation assessments, and calls for renewed investment in taxonomy and field inventories globally. Taking into account biases in biodiversity knowledge is paramount to designing robust conservation and data collection schemes, particularly for the world's poorly known and speciose taxa.

DEVELOPING A GEOCOLLABORATORY FOR INDIGENOUS TOURISM RESEARCH AND BIODIVERSITY CONSERVATION (217)

Sylvie Blangy

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Collaboratories have been defined as virtual places where collaborative research can be undertaken. As part of the Aboriginal Tourism Network (ABORINET) www.aboriginal-ecotourism.org, a geocollaboratory was developed to support Indigenous tourism research and cultural and biology diversity. Indigenous communities are culturally distinct and remotely located and this presents geographic and sociocultural constraints when conducting research on issues affecting these communities. ABORINET's development focused on the specific goal of enabling collaboration between researchers and Indigenous peoples on issues related to Indigenous tourism planning, land management, biodiversity conservation and the general issue of enabling the sharing of differing knowledge and management approaches among research and Indigenous communities. The purpose was to develop a multi-scale and multi-method data collection and analysis protocol for better understanding Indigenous tourism in a way that supports multi-site and longitudinal comparisons, for connecting Indigenous communities across the world, and for sharing the results in ways that are meaningful to stakeholders within and beyond Indigenous communities. This presentation outlines the development of the geocollaboratory and describes the lessons learned with specific attention afforded the geographical nature of the collaboratory. Recommendations for mitigating challenges are proposed and future research opportunities are identified.

USING BIO-ASSESSMENT OF DNA IN THE ENVIRONMENT TO INFER SPECIES DISTRIBUTION

Scott Blankenship

Cramer Fish Sciences

Gregg SCHUMER, Cramer Fish Sciences

Commonly, geneticists infer population boundaries when elevated "between-group" variance is observed in genetic diversity data. These barriers to gene flow could be natural or anthropogenic in origin. While it may be important to identify these barriers, given they provide a means for local adaptation,

documenting barriers that are strong enough to influenced genetic diversity may be beyond what is necessary for basic conservation/management objectives, as well as being costly and technically challenging. Application of molecular biology methods to ecological issues is increasing, with technical advancements on species detection directly relevant to barrier issues. In essence, these methods detect (or sense) DNA in an environment (i.e., water, soil, organic matter) through the collection and interrogation of biological particles. This presentation includes a brief description of methods and protocols surrounding species detection (barcoding coupled with quantitative polymerase chain reaction). Following, examples studies are shown where these methods were applied, with emphasis placed on how species distributions can be inferred using detection of DNA. The first example pertains to detecting the presence of Oregon Spotted Frog (*Rana pretiosa*), a medium-sized cryptic (visually evasive) aquatic frog endemic to the U.S. Pacific Northwest that is a candidate species Federal protection (U.S. Endangered Species Act). The second example pertains to interactions between bull trout (*Salvelinus confluentus*), a native fish, with non-native (invasive) brook trout (*S. fontinalis*). The last example pertains to documenting the distribution of native a Smelt (*Hypomesus* spp.) using detection of DNA in stomachs of a larger invasive piscivorous species (*Morone* spp.). In other words, the target species was detected post-ingestion, where the predatory species (diet) was used as sampling mechanism.

THE SEMI-AQUATIC ANTELOPE KAFUE LECHWE SHOWS A REMARKABLE, BUT EFFECTIVE, FOOD ADAPTATION UPON CHANGED FLOODING CONDITIONS AND SHRUB ENCROACHMENT

Wilma Blaser

ETH Zurich

Griffin SHANUNGU, Zambia Wildlife Authority ; Peter EDWARDS, ETH Zurich ; Harry OLDE VENTERINK, Vrije Universiteit Brussel

Declining populations of many African herbivores have been linked to habitat modification and destruction. However, the magnitude of these impacts will vary depending on how they affect the resources that are most critical for population persistence. We studied annual habitat use alongside changes in the nutritional status of the vulnerable semi-aquatic antelope, the Kafue lechwe (*Kobus leche kafuensis*), in relation to two major drivers of habitat modification - flood management through dam construction, and shrub encroachment. The annual migration pattern of lechwe in Kafue Flats floodplain ecosystem is driven by flood height in the floodplain and availability of food resources in the wet season habitat, which is not flooded and accessible throughout the year. Faecal nitrogen levels indicate that lechwe suffer from nutritional stress at the beginning of the dry season when they are forced to remain in their wet season habitat



(termitaria grasslands) until floods recede. During this period of food scarcity, lechwe - although considered a strict grazer - alter their diet to consume seedpods of the encroaching shrub *Dichrostachys cinerea*, which appear to have positive effects on their nutritional status. Our results demonstrate that the migrating lechwe antelope are dependent on both wet and dry season feeding habitats, but a critical factor affecting population dynamics is the timing of the flood, which is now strongly dependent on dam management. Dam management affects both grass production as the waters rise and animals' access to the floodplain as the waters fall, while shrub encroachment has allowed lechwe to offset some of the negative effects of this altered hydrological regime. By combining information about habitat availability, movement patterns, and nutritional status, our results demonstrate a complex interaction between two major drivers of habitat modification on the population dynamics of a threatened herbivore.

126. DOES SUSTAINABILITY CERTIFICATION OF NATURAL RESOURCE PRODUCTION AND SUPPLY CHAINS DELIVER POSITIVE IMPACTS ON BIODIVERSITY? APPLYING AN ECOSYSTEMIC APPROACH IN THE EVALUATION OF CERTIFICATION SCHEMES

Jeanette Blumroeder

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The environmental certification scheme for the sustainable management of natural resources such as timber, soy and palm oil, is a market-based tool designed to reduce negative impacts on ecological and social systems. A set of standard principles, criteria and indicators for sustainability are adopted by growers and manufacturers operating under certification. Whilst the certified resource use and production systems cannot avoid any negative impact, they claim to be significantly more sustainable than homologous production systems without certification and various conservation NGOs actively support corresponding certificates. In many cases the adoption of certification-related measures promise benefits for the target systems, but systematic effectiveness evaluations are still scarce. A systemic approach derived from an ecosystem-based method for adaptive risk and vulnerability management (MARISCO method related to the Open Standards for the Practice of Conservation) is proposed as a holistic approach to

evaluating the industry. First, a conceptual model is generated to depict the breadth and depth of human impact on natural systems. Derived cause-effect 'webs' leading from factors related to social systems (e.g., politics, socioeconomics, land use) include the range of threats and stresses to biological and social systems caused by resource use management. Certification criteria and indicators representing mitigation strategies are mapped into the model to allow for an analysis of the perceived theory of change and the plausibility of effectiveness of certification. Finally, indicators considered to be most appropriate to measure effectiveness in the field are then identified. The method is illustrated by examples from boreal Russia (Forest Stewardship Council – FSC) and tropical Malaysia (Round Table for Sustainable Palm Oil – RSPO; International Sustainability & Carbon Certification – ISCC).

CONSERVATION IN THE MAKING: CONFLICT AND CONTESTATION AROUND TERRITORIALITY FOR WILDLIFE CONSERVATION CORRIDORS IN SOUTHERN TANZANIA

Jevgeniy Bluwstein

Copenhagen University

Jens Friis LUND, Copenhagen University

Tanzania's policy on Wildlife Management Areas (WMA) entails the creation of new territories for conservation of natural resources and wildlife on village lands. Underlying the policy is an idea of functional separation of landscapes for settlements, agriculture, photographic and hunting tourism, livestock grazing, and wildlife. Implicit in this separation is the creation of new territories through the negotiation, demarcation, and representation of boundaries in an institutional context that is characterized by competition over authority to spatialize, authority that is often claimed by project partners by means of producing maps. We show how territoriality for wildlife conservation operates within the context of historically evolving project-based attempts to demarcate and map community land. We unpack the dynamics of territoriality by examining how 1) neglect to adequately appraise challenges of boundary-making in combination with 2) politics of conservation and development interventions 3) foreclose a genuine participation and inclusion of local residents in decision-making over conservation territory and rules of access. This inevitably creates or exacerbates conflict and contestation of project-based processes of territorialization, further undermining the success of conservation interventions.

110: WHAT ARE LOCAL VOICES AND WHY DO WE WANT TO HEAR THEM?

Jevgeniy Bluwstein

Copenhagen University



Jens Friis LUND, Copenhagen University

This talk will outline different ways of including local people in community-based conservation practice. From manipulation and tokenism, consultation, informed consent to participatory action research we try to include people who are part of conservation interventions. Every form of inclusion involves a particular way of giving voice to people and a particular way we imagine 'community' for community-based conservation. Typically we include local people because we have to (e.g. following ethical standards or donor requirements in conservation & development practice), because we think that this will benefit the intervention (believing in win-win outcomes), or because we see value in including people (just) because they are humans. With this we want to ask what are the implications of the different ways of giving voice to local people for project success, in other words what are the conservation outcomes, what are the development outcomes, and how sustainable will the intervention be?

PANGOLIN BUSHMEAT TRADE IN GHANA: A THREAT TO THEIR SURVIVAL

Maxwell Kwame Boakye

Tshwane University of Technology

Darren William PIETERSEN, African Pangolin Working Group ; Antoinette KOTZÉ, African Pangolin Working Group ; Desiré Lee DALTON, National Zoological Gardens of South Africa ; Raymond JANSEN, African Pangolin Working Group

Bushmeat remain a key source of animal protein and income during lean agricultural periods in Ghana and mammals are regarded as the prime source of bushmeat. A mammal that is frequently hunted as a source of bushmeat in Ghana are the endangered pangolins (*Pholidota: Manidae*). Currently, pangolins can be regarded as the most traded group of mammals on Earth, however, very little is known with regards to the level of trade of pangolins in Ghana. The aim of this study was to determine the level of trade among additional stakeholders outside of major bushmeat market surveys in the bushmeat commodity chain for pangolins in Ghana. Data were gathered through semi-structured interviews and direct observation from 153 stakeholders comprising 84 chopbar operators, 48 farmer hunters and 21 wholesalers between September 2013 and January 2014. A total of 341 pangolins were recorded to have been traded in this study period and, of this number, 98 pangolins were personally observed. 82% of pangolins traded were white-bellied pangolins (*Phataginus tricuspis*) and 18% were black-bellied pangolins (*Phataginus tetradactyla*), but no trade was observed for the giant ground pangolin (*Smutsia gigantea*). The number of pangolins traded was negatively correlated to the distance between stakeholder's settlements and protected forest regions where the animals are mostly sourced. Snares were the most

commonly used hunting technique. The current levels of pangolin harvest in Ghana can be considered as unsustainable due to the very high offtake levels and the low reproductive rates of these mammals. In addition, the Wildlife Conservation Act of 1971 (LI 685) classifies pangolins under Schedule 1, prohibiting any person from hunting or being in possession of pangolins, an indication that legislation pertaining to pangolin conservation is not being implemented in Ghana.

185-OPTIMAL MULTISPECIES ERADICATION SCHEDULES FOR A COMMON INVADED ISLAND ECOSYSTEM MOTIF

Michael Bode

University of Melbourne

Symposium: Complex systems modelling to support biodiversity conservation Oceanic islands are global hotspots of both biodiversity and extinction. Invasive species are a primary threat, and many islands have been invaded by more than one. Multispecies eradications are therefore essential to island conservation, but eradicating invasives in the wrong order can be disastrous for endemic species. We use dynamic control theory and qualitative modelling to construct optimal multispecies eradication schedules – temporally explicit allocations of resources between species – when eradication budgets are limited. We identify an eradication schedule that is consistently optimal for any realisation of a common ecosystem motif, where two prey species (one endemic, one invasive) are consumed by an invasive predator. Our results show that it is always best to target the predator first, and thereafter gradually shift efforts towards the invasive prey. Invaded islands could be described by a limited taxonomy of ecosystem motifs. Our approach could therefore offer decision-support for many data-poor eradication projects.

76-THE RETURN OF LARGE CARNIVORES TO EUROPE

Luigi Boitani

University of Rome La Sapienza

John LINNELL, Norwegian Institute for Nature Research ; Petra KACZENSKY, Research Institute of Wildlife Ecology ; Guillaume CHAPRON, Grimsö Wildlife Research Station ; Arie TROUWBORST, Tilburg Law School ; Urs BREITENMOSER, FIWI and KORA, Bern University

Europe hosts five species of large carnivores (bear, wolf, Eurasian lynx, Iberian lynx and wolverine). With the exception of the Iberian lynx that survives only in southern Spain, the other species have all shown a generalized expansion of range and increase in numbers. What appears to be a remarkable conservation success is the outcome of a mix of active conservation measures and policies, changes in human values and attitudes, and independent social and economic



transformations of European societies and landscapes. During the post-WW2 decades, these transformations have extensively affected patterns of land use across the continent and facilitated the conversion of former marginal agricultural land into abandoned pastures and secondary forests. Wild prey populations recolonized these areas both naturally and through active reintroduction mainly by hunters, and provided the favourable conditions for the natural recolonization of large carnivores. Furthermore, the successive introduction of national and pan-European legislation has reduced the direct human persecution of large carnivores. While the concurrent impact of all these processes is indisputable in causing the return of the carnivores, it is extremely difficult to disentangle the role of individual processes and assess their effectiveness. In this presentation, we will present and discuss the potential role of conservation actions and historical processes that are reasonably linked to the return of the carnivores, including national and European legal frameworks, changes in human attitudes, financial support to conservation action, improved techniques to prevent and mitigate human-carnivore conflict, availability of suitable habitats, new protected areas, and increases in prey populations. We will then discuss the practical, legal, economic and social challenges associated with moving from a "saving from extinction" phase to one where we seek to turn this success story into one of lasting coexistence.

MODELLING POLLINATOR COMMUNITIES IN HETEROGENEOUS LANDSCAPES

Arvid Bolin

Lund University

Eric LONSDORF, Franklin & Marshall College ; Henrik SMITH, Lund University ; Ola OLSSON, Lund University

There has been a general decline in pollinator abundance and species richness over the last century, which is at least partly due to changes in the agricultural intensity, habitat loss, and changes in landscape structure. This could have profound implications for pollination ecosystem services, and their resilience. We present an expansion of a recent central place foraging framework into a spatially explicit competitive model based on pollinator behavioral strategies. The strategies are based on how species makes tradeoffs between foraging efficiency and travel efficiency. Using this modelling framework we predict which landscapes would be more beneficial for species with different traits and whether or not coexistence between species could occur. We can show how pollination services could be affected by landscape structure, for example the proportion and distribution of semi-natural habitat. Further, we show how interspecific competition could either lead to coexistence or competitive exclusion depending on landscape structure. We also demonstrate how an agri-environmental scheme could benefit both biodiversity and pollination service in mass flowering crops.

142 HOW MUCH AND WHERE: THE MOST CHALLENGING QUESTION FOR ENHANCING BIOLOGICAL DIVERSITY IN FRAGMENTED LANDSCAPES

Janine Bolliger

WSL Swiss Federal Research Institute

Felix KIENAST, WSL Swiss Federal Research Institute

Conservation management aims at mitigating the negative effects of landscape fragmentation by enhancing connectivity between the remaining populations. Such measures include e.g. locally established stepping stones or agri-environmental schemes (AES) which have a legal component. Since many of these conservation measures are expensive for the tax payer, a broad scientific assessment is needed to check under what spatio-temporal circumstances the measures fulfill their goals. Thus empirical studies for implementation into action plans are urgently needed. In our paper we give an example of such an assessment. Starting point is a large-scale European assessment of landscape fragmentation using effective mesh size. This appealing and widely applied land-use indicator is able to identify hotspots of high structural landscape fragmentation at any given spatial scale. If the indicator had any link to population processes, it would be an ideal tool to steer connectivity measures. To challenge this link we assessed functional connectivity in various regional structural fragmentation hotspots and evaluated measures that may mitigate connectivity. Results from various case studies in highly fragmented landscapes suggest that the link between structural fragmentation or measures for improvement (e.g., AES) and functional connectivity is often weak. Also, that demographic parameters such as population size or the spatial arrangement of the populations may contribute significantly to driving functional connectivity... Are we at the onset of a revival of the SLOSS debate?

A COLOURFUL HISTORY OF A POLYMORPHIC FINCH: A MOLECULAR ANALYSIS OF DEMOGRAPHIC HISTORY AND POPULATION STRUCTURE IN A THREATENED AUSTRALIAN FINCH (ERYTHRURA GOULDIAE)

Peri Bolton

Macquarie University

Lee Ann ROLLINS, Deakin University ; Andrea WEST, Deakin University ; James BRAZILL-BOAST, Macquarie University ; Jeremy AUSTIN, University of Adelaide ; Sarah LEGGE, Australian Wildlife Conservancy ; Kimberley MAUTE, University of Wollongong ; Simon GRIFFITH, Macquarie University

The Gouldian finch (*Erythrura gouldiae*) is an iconic finch from northern Australia, with a history of population decline. Little is known about their past and present population size



and how these birds move across their now restricted range. Moreover, the Gouldian finch has two common co-occurring colour morphs, which correspond to different behavioural and physiological strategies. Theoretically, distinct strategies associated with colour polymorphism can have effects on population dynamics and on the partitioning of genetic variation in the population. But this has not been explicitly examined in a conservation context. Studies in captive birds have shown strong positive assortative mate preference and a genetic incompatibility between morphs that reduces offspring survivorship. This incompatibility between morphs has restricted gene flow and there is genetic structuring between colours. Based on the captive studies, we predict that there should be significant genetic structure between colour morphs in the wild. However, our results from 10 microsatellite markers and mtDNA, from five contemporary populations indicate that there is extensive gene flow across their range and between morphs, suggesting successful interbreeding in the wild. Our analysis of these contemporary samples against museum samples from 1890-1920 also provides important insight into the depletion of genetic variation through the precipitous decline of this species over the last century. We discuss our results in the context of previously unforeseen consequences of colour polymorphism for conservation.

A 20 YEARS MONITORING OF THE BROWN BEAR POPULATION IN THE PYRENEES, FROM 1994 TO 2013: RESULTS AND PERSPECTIVES

Nicolas Bombillon

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During the 20th century, the Pyrenean brown bear population dramatically decreased down to only 5-6 individuals in 1995. To avoid the extinction, two reinforcement plans were carried out in 1996-1997 and 2006 with the translocation of 8 bears from Slovenia. This study presents the effects of those reinforcement plans on the distribution area and the population dynamics. In this framework, the monitoring of the population in all

Pyrenees (France, Spain and Andorra) during the 20 past years (1994 to 2013) is used. The study was divided into 5 distinct periods tied to the two reinforcements. The monitoring of the population relies essentially on no invasive techniques (detection of bear signs, DNA typing and camera traps). In 1994, the bear is only present in a small area located in the western Pyrenees. In 1996-1997, the first reinforcements of 3 individuals occurred in central Pyrenees, 50 km apart of the main bear range, in an area where the last specimen disappeared 10 years ago. The species expanded largely on the French and Spanish slopes and reached a threshold of 5-6 bears. With the second reinforcement of 5 individuals in 2006, the population increased up to a minimum of 23 bears in 2013. Consequently, the central Pyrenees distribution area grew quickly until some individuals disappeared or came back to the core area and so the area was made smaller in the last past years. Simultaneously, whereas the western population size strongly decreased with only 2 male bears in 2013, the related bear area increased to the same size of the central area. Despite reintroduction plans, the brown bear is still an endangered species in the Pyrenees and new releases would be necessary. We discuss also the necessity to have both a reliable monitoring population to develop viability analysis and sociological studies for the conservation of this population.

ID177 FROM SCIENTIFIC MODELS TO COMPANION MODELLING: ENGAGING A DIALOGUE WITH LOCAL ACTORS IN AN AMAZONIAN FLOODPLAIN ABOUT BIODIVERSITY MANAGEMENT AT A TERRITORIAL LEVEL

Pierre Bommel

CIRAD

Marie-Paule BONNET, IRD ; Emilie COUDEL, CIRAD ; Eva HAENTJENS, CIRAD ; Cleber Nunes KRAUS, Universidade de Brasilia - UnB ; Anne-Elisabeth LAQUES, IRD ; Gustavo MELO, CIRAD ; Stéphanie NASUTI, Universidade de Brasilia - UnB ; Ina De Souza NOGUEIRA, Universidade de Brasilia - UnB

The Amazonian floodplain is among the most productive and diversified ecosystems in the world. The moving littoral enables a rapid nutrient recycling, explaining the large productivity and biodiversity of the system. Attracted by such favourable conditions for agricultural activities and fishing, populations have settled in the floodplains and developed complementary activities to cope with important variations in their environment, between the flood season and the dry season. However, in the past decades, the rhythm of these floodplains has changed, obliging the actors to deal with great uncertainty. Based on several years of hydrological and biogeochemical studies to understand the reasons of these environmental changes, the "life scientists" of our team invited the "social scientists" with the following question: Can the results about



the dynamics of these floodplains help local populations better anticipate the future fluctuations of the river and adapt their activities to be less vulnerable to such change? To address this, we first chose to turn the perspective around: what were the preoccupations and strategies of local populations and what did they expect from scientists? The challenge was to enable the perceptions and knowledge of local populations to dialogue with scientific knowledge. Based on a Companion Modelling approach, we engaged a participatory process to collectively discuss the current situation and possible future scenarios. Using a role-playing game as an interface for this dialogue, we have progressively built a model to integrate both the knowledge of the local actors regarding their practices and possible environmental impacts and the knowledge of the scientists on environmental dynamics. This has obliged researchers to learn to work together and simplify their knowledge, and requires finding common points of interest with local populations, translating "biodiversity" into concrete issues that have a meaning for local actors.

RHINOS ARE NOT VICUNAS: THE COMMERCIAL USE DELUSION

Cristian Bonacic
Fauna Australis, UC

Rhinos are under heavy threat from poaching. Their horns are being used for medicinal purposes although no scientific evidence exists to suggest rhino horn has such medicinal efficacy. Yet meeting this demand from Asia potentially elsewhere, via a regulated trade in white rhino horn, is being currently proposed. Trade has been suggested as a last resort for saving rhinos from extinction in the wild. Those who promote commercialization of rhino horn, tout the vicuna, a South American Camelid, as an example of conservation through sustainable use. Vicuna wool shearing for international markets is said to be a good model for rhino horn harvesting. We discuss the ecological, ethical, economic and practical dimensions and pitfalls of the sustainable use model learned during 15 years of vicuna shearing for markets in The Andes of South America. We also explain why vicuna poaching is escalating and difficulties for control. We also address the viability of commercial use of keystone species like Rhinos and Vicunas for conservation in a globalized world with never-ending demands.

WHY PUMA AVOIDANCE OF LIVESTOCK IS NOT ENOUGH TO MINIMIZE CONFLICTS BETWEEN AYMARA SUBSISTENCE FARMING AND PREDATORS IN THE HIGHLANDS OF NORTHERN CHILE

Cristian Bonacic
Fauna Australis, UC

Jorge LEICHTLE, Pontifical Catholic University of Chile ; Omar OHRENS, University of Wisconsin-Madison ; Adrian TREVES, University of Wisconsin-Madison

Puma concoloris well known as a livestock predator along its entire distribution range in the Americas. Pumas living in the Andes of South America cause problems to Aymara farmers. Retaliation by hunting and poisoning is common, but puma population density, prey preference and human perceptions about them are barely known. We studied livestock concentration areas and estimated domestic and wild prey availability during two years in an area of 12,997 km² between 3,500 and 5,000 masl. Also, we described herding practices and perceived threat by local farmers. Puma density was estimated by capture-recapture camera trapping and is one of the lowest known for the species (0.6/100 km²). Diet preferences were Lama pacos (total biomass), but wildlife prey (*Vicugna vicugna*) was higher in terms of frequency in feces compared to prey availability (Ivlev index). A total of 61 Aymara farmers listed the puma as their main wildlife threat followed by foxes (*Lycalopex culpaeus*). However, 41% declared that predation events are in decline, 24% that events were rising. In contradiction to what was perceived by the authorities, we conclude that a minority of individuals perceived increasing conflict with pumas, which has implications for future decision making on puma-human coexistence in the Altiplano region. Also, puma preyed mainly on wild prey despite low abundance and camera trapping detected puma presence in areas where livestock was not attacked. We conclude that managers should focus on further human dimensions work to identify causes of recent complaints, and at the same time understand the variables that are leading the puma to prey upon livestock.

POPULATION STRUCTURE OF CARIBBEAN TURTLE "HICOTEA" (TRACHEMYS CALLIROSTRIS) UNDER EXTRACTION PRESSURES

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Colombian populations of "hicotea" turtle (*Trachemys callirostris*) have been used at the Caribbean region since Pre-Columbian times. Nowadays it is used by local people for consumption during Holy Week and is pressed by extraction, illegal traffic and degradation of natural habitats. The objective of this work was to analyze the structure of a "hicotea" population in four swamp areas near Cartagena, Colombia, in March and May 2014 during the extraction season. In each swamp area we tagged, measured and sexed all turtles captured by local fishermen. We analyzed 197 individuals, 75%



were adults in sizes between 10 and 26 cm. The sexual ratio was 1.62 females for each male. Comparing with sampling made in other places at the Caribbean Region we found that the size of turtles of our study site was smaller probably related with differential conditions of water productivity or the effect of extraction that is moving the structure of the population toward smaller sizes. This study was the first step looking to involve local people for a long term communitarian monitoring of "hicotea" population dynamics.

DEALING WITH OBSERVER BIAS WHEN MAPPING SPECIES DISTRIBUTIONS USING CITIZEN SCIENCE DATA: AN EXAMPLE ON BROWN BEARS IN GREECE

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Citizen science data are increasingly used to map species distribution. These are useful as they are cheaper, they come in greater quantity and cover much larger areas than data that scientists alone can collect. However, such data are presence-only data (no information on absences, hence no possibility to estimate detection rates) and suffer from observer bias (individuals are more likely to be detected where more people are going). Warton et al. (2013) developed a method to deal with these issues, using Poisson point processes and correcting for observer bias (by making the difference between variables that are likely to affect the species presence – environmental variables – and variables that are likely to affect detection – observer bias variables). Here we apply this method and use citizen science data collected on brown bears in Greece as a showcase. It is particularly relevant to map this species' distribution as there is evidence of human-bear conflicts in Greece. Besides, citizen science data are especially relevant for these large carnivores which are very difficult to detect (they are cryptic and solitary, and occur in low densities in very large areas). This study emphasizes the usefulness of citizen science data, and the need for a deeper modelling of what influences not only how the species uses space but also how the people collect data.

HALTING BIODIVERSITY LOSS IN AGRO-ECOSYSTEMS OF CENTRAL GREECE: CREATING A TECHNICAL GUIDE FOR TARGETED RESTRUCTURING OF SELECTED ELEMENTS IN THE AGRICULTURAL LANDSCAPE IN ORDER TO PRODUCE AGRI-ENVIRONMENTAL SCHEMES

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Biodiversity loss in intensified agro-ecosystems has been one of European Union's rural policy main aims. According to recent holistic approaches, the EU target "halt biodiversity loss" by 2010 was not finally met, at least in human induced agricultural landscapes. Although agri-environmental schemes are far more enhanced in the new CAP, still, according to recent scientific reviews the danger of not reaching the target "halt biodiversity loss by 2020" is eminent once again. One main factor driving this possible new failure is a gap between European legislation, EU member's national regulations and the application of concrete in-situ measures in agro-ecosystems management. A try was initiated in Greece in order to bridge that gap as a post-doctoral research project in the Agriculture Economics & Policy Research Institute. The project is based in 4 main pillars. Firstly, in situ field work will assess avian and small mammal diversity indices in selected sites in the largest agro-ecosystem of Greece, the Thessaly plains, with standard international methodology. The diversity indices will be explored upon environmental gradients which define the major land uses in the agro-ecosystem (irrigation schemes, arable and non-arable crops, annual and multi-annual crops, set-aside fields and natural grasslands, different crop types such as cereals & industrial crops). Secondly, meta-analysis of all existing literature in the region concerning diversity indices will also be realized. Thirdly, modeling the results in large spatial scale. Finally, a technical guide will be produced written in "simple language", which will aim to the main stakeholders of the area, the farmers who exploit the land. The technical guide will be a product of the Hellenic Agricultural Organization Demetra which is part of the Ministry of Rural Development, and will try to bring the land stakeholders in a direct application of proper agro-environmental schemes

'MANNEM THAPNEE': THE CROCODILE WORSHIP RITUAL OF AN AGRARIAN COMMUNITY OF INDIAN STATE OF GOA, AND ITS CONSERVATION CONTEXT

Manoj Borkar

BIODIVERSITY RESEARCH CELL, CARMEL COLLEGE FOR WOMEN



Crocodiles have been an indivisible part of Goa's ecology, history, culture and religion. Incorporation of this reptile in the local folklore, cultural artefact and folk-religion confirms and reiterates its sociological relevance in the state's cultural ethos. The crocodile in Goa evokes both; a rational fear and a spiritual submission. On one hand its introduction and 'deployment' in the territorial waters; by the then Muslim Rulers as deterrents to invasions from the sea is an amusing piece of Goa's history, whereas on the other hand its veneration by the agrarian Gawdas of this maritime state even till date is curious folk-religious response replete with conservation value. Of the 3 Indian species of crocodiles, it is only *Crocodylus palustris*, (Lesson, 1831) a Schedule I candidate as per the Indian Wildlife Protection Act, 1972, whose largest natural population is found associated with the mangrove forests of the Cumbarjua canal, an important backwater system. This reptilian population has swung from almost a point of no return, to the present day teeming numbers, with a spill-over beyond the metapopulation habitat. Despite the general anthropogenic pressures of local habitat loss, pollution, and hunting for meat and hide, the reptile has shown signs of recuperation in Goa. Complementing the efforts by the state wildlife authorities in conserving this reptile, is the agrarian community of Hindu Gawdas settled on the banks of the Cumbarjua canal who have been zealously guarding and protecting these 'lizards of the Sea'; as they have been referred to in some Portuguese chronicles. These indigenous people who reside in the proximity of crocodilian habitat, have bestowed upon the crocodile, a sacrosanct status, and their reverence of the reptile manifests into an interesting folk-religious practice locally known as 'Manngem Thapnee', whose anthropological context and conservation spin-off has been discussed in this paper.

POWER LINES AND BIRD COLLISION: ESTIMATING BIASES ASSOCIATED WITH CARCASS DETECTION AND PERSISTENCE

Leyli Borner

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Bird mortality by collision along power lines is an international conservation issue. Quantification of this mortality is complicated by the heterogeneity of the survey methods used and the biases associated with carcass persistence and observer search efficiency. To estimate these biases we conducted three persistence experiments, lasting 30-days each, by placing 239 carcasses of red-legged partridges (*Alectoris rufa*) and common pheasants (*Phasianus colchicus*) under

power lines in 14 sites, and two search efficiency experiments, testing the detection of 108 carcasses by 19 observers. We used mark and recapture survival analysis and generalized linear mixed models to estimate daily carcass persistence probability and detection probability. We also investigated the factors affecting scavenger and search efficiency biases. The daily average carcass persistence probability was highly variable between sites up to an 8-fold variation (0.11 to 0.92). Carcass age was also significant, with a fast decrease of carcass persistence probability for the first 10-days of the survey, followed by a stabilizing after the 10th day. Carcass detection by observers was significantly affected by carcass size. Observers detected a common pheasant with a 0.48 mean probability while smaller partridge chicks were detected with a 0.0027 mean probability. These results suggest that carcass persistence varies strongly at a small landscape scale, although this is often not taken into account when correcting estimates of birds mortality surveys. In the site with highest persistence rate, the probability that a bird of the size of a common pheasant is not scavenged for 7 days and then detected by an observer conducting a mortality survey was 0.267. This reached a low of 0.0015 in the site with the lowest persistence rate. Unbiased estimation of bird collision mortality along power lines might thus require a substantial field effort.

JAGUAR AND ASSOCIATED BIODIVERSITY CONSERVATION ACROSS INCREASING OIL-PALM LANDSCAPES IN COLOMBIA

Valeria Boron

University of Kent

Esteban PAYAN, *Panthera*; Joseph TZANOPOULOS, University of Kent

Habitat loss is considered the main threat to biodiversity worldwide, and especially for large carnivores like jaguars (*Panthera onca*), due to their slow reproduction rate and large-area requirements. Information on Neotropical species in unprotected areas is scarce and baseline data for conservation and management are crucially needed, especially in ever increasing oil-palm (*Elaeis guineensis*) landscapes. We used camera trapping (50 stations, 2 km apart, 120 survey-days) across an agricultural area with oil-palm plantations in the Magdalena river valley of Colombia in order to compile a species inventory, calculate species capture rates across different habitat types, and estimate jaguar density through classic and spatially explicit capture-recapture models. In addition, we conducted 42 semi-structured interviews with relevant stakeholders and reviewed Colombia's agricultural policy to understand how to foster jaguars' conservation through adequate policies and management. We recorded 61 species, of which 21 mammals, and 12 jaguar individuals (143 independent capture events) with density resulting in 3.06-5.45 jaguars/100 km² depending on the analysis used. At the edge



of oil-palm areas with natural habitats capture rates increased for several species with respect to the oil-palm habitat showing that species can co-exists with agriculture and even oil-palm plantations if natural habitats persist in the landscape. It's therefore worthwhile to manage these landscape for species connectivity and survival. Potential solutions to achieve this emerged to be incentives for multi-crop farms and agroforestry, mandatory investments by large producers in small farmers alliances/projects, enforcement of land use plans, and tax breaks conditional to establishing conservation areas and respecting environmental laws. Other key sustainability objectives for the area would also benefit: conservation of natural resources, rural and social development, and institutional capacity.

ORGANIC MATTER DECOMPOSITION IN SOIL AFFECTED RATHER BY ABIOTIC ENVIRONMENT THAN TOPOGRAPHY AND LANDSCAPE HETEROGENEITY

Gergely Boros

Centre for Ecological Research

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Organic matter decomposition in soil is a fundamental regulating ecosystem service. However, it is the sum of three different processes (leaching, comminution, and mineralisation) decomposition typically measured as mass and nutrient loss from dead organic material. These materials are influenced by biotic and abiotic factors but their effect can be considerably different. We studied the effects of topographical complexity, landscape heterogeneity and wood cover as landscape traits as well as soil properties and herbaceous plant cover as local abiotic and biotic variables on decomposition rate in traditional grasslands in Southern Transylvania, Romania, Central Europe. We had 14 geographical distinct study sites around 11 villages, characterized by three environmental variables; a) high or low topographical complexity with diverse relief, b) landscape heterogeneity and c) wood cover – latter two measured on a trivalent rank scale. Decomposition of fine litter was pursued during 5 months by the minicontainer method with 2 mm mesh size to allow access micro- and mesofauna. Soil temperature and moisture were continuously measured on field by buried data loggers, other physical, chemical properties and inorganic nutrients were measured in laboratory from soil samples. There were no differences in decomposition rates concerning topography, heterogeneity and wood cover. Decay curves showed that decomposition rates were affected by soil moisture and temperature on the first place. Thus, we can conclude that

organic matter decomposition in soil is influenced by abiotic soil properties rather than landscape features and other biotic factors.

A GIS-BASED DECISION MAKING APPROACH FOR PRIORITIZING SEABIRD MANAGEMENT FOLLOWING PREDATOR ERADICATION

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Given that 29% of seabird species are threatened with extinction, protecting seabird colonies on offshore islands is a global conservation priority. Colonies of seabirds are vulnerable to non-native predator invasions, which reduce or eliminate seabird populations. Consequently, predator removals have been the focus of conservation efforts to protect seabirds and island biodiversity. However, affected populations are often left to passively recover following predator eradications, and while seabirds are highly mobile, their life history traits can limit passive re-colonization to newly predator-free habitat. In such cases, seabird colonies can potentially be re-instated with active restoration via chick translocations or social attraction methods, which can be risky and expensive. We used biogeographic and species behavioral data in the Hauraki Gulf, New Zealand, a global hotspot of seabird diversity and predator eradications, to illustrate the use of geographic information systems based multi-criteria decision analysis to prioritize islands for active restoration of seabirds. Using habitat criteria, seabird colony data and recolonization evidence, we identified islands that have had little or no observed passive recovery of seabirds post-eradication, and classified these as sites where active seabird management could be prioritized. This included Hauturu (Little Barrier Island), a restoration site with multiple complex conservation challenges, including ambiguity of ecological targets, and the recent discovery of the critically endangered New Zealand Storm petrel (*Fregetta maoriana*). On seabird islands with complex restoration challenges, decision tools that help island conservation practitioners to decide whether active seabird management should be paired with eradication can optimize restoration outcomes and ecosystem recovery.

POPULATION GENOMICS OF THE INVASIVE LIONFISH, PTEROIS VOLITANS: IMPACTS OF DRIFT AND SELECTION ON GENETIC DIVERSITY DURING RAPID RANGE EXPANSIONS

Eleanor Kathleen Bors



Woods Hole Oceanographic Institution

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The invasion and ecological damage of the Indo-Pacific lionfish *Pterois volitans* in waters off the US Atlantic Coast, Gulf of Mexico, and Caribbean Sea are unprecedented for a marine fish invasion. Lionfish have invaded the Atlantic in a matter of decades, representing a model system for understanding rapid genetic change on the leading edge of marine invasions. Our research uses population genomics to address two fundamental questions central to invasive genetics and other range expansions (e.g., climate-driven spatial shifts): 1) what is the relative contribution of pre-invasion vs. post-invasion adaptation to invasion success and the evolution of invasive species; and 2) what are the roles of genetic drift and selection in the shaping of post-invasion genetic diversity and post-invasion adaptation? We describe patterns of genetic diversity and population structure throughout the lionfish's invaded range using genome-wide genetic markers (i.e., loci) generated through double digest restriction enzyme associated DNA sequencing (ddRAD-seq). RAD-seq methods generate tens- to hundreds-of-thousands of loci distributed throughout the genome (including neutral, regulatory, and protein-coding regions). We use these data to identify outlier loci in the genome that may be associated with selection or extreme genetic drift known as 'allele surfing'—the process by which rare alleles or new mutations can "surf" the front of the invading population wave to high frequencies near the edge of a species' newly-colonized range. Allele surfing is predicted to have marked impacts on genetic diversity and future adaptive potential. Alignment of loci of interest to existing fish genomic resources will highlight which genomic regions are subject to invasion-specific genetic drift and natural selection. This work lends insight into patterns of genetic diversity in order to better approach the management of biodiversity in the face of rapid range expansions and species invasions.

GENETIC AND FIELD SAMPLING TECHNIQUES FOR TIGER MONITORING IN LOW POPULATION DENSITY PROTECTED AREAS OF NORTH EAST INDIA

Udayan Borthakur

Aaranyak

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Application of molecular genetic tools in wildlife monitoring has gained a tremendous momentum in India in past one decade, especially with mandatory application of these techniques in monitoring of tiger in protected areas with low population density. In the present study, we employ faecal DNA analysis and field sampling techniques to ascertain

species, individual and sex identity of tigers in several protected areas in North East India, viz., Orang National Park, Manas National Park, Dampa Tiger Reserve, Pakke Tiger Reserve and Namdapha Tiger Reserve. The process of genetic monitoring starts with the development of mitochondrial DNA sequencing markers for species identity, optimisation of a panel of microsatellite loci for individual identity and development of sex-chromosome linked markers for sex identification of tiger individuals. In low population density areas, sampling techniques for population estimation requires consideration of the field efforts, accessibility and repeatability, as most of these areas lie in physically challenging hilly terrains. We have adopted a single session sampling design and maximum likelihood estimator for genetic population estimation, instead of the traditional multi-session sampling in capture-recapture framework. This single session sampling based monitoring was applied using beats as sampling units, which are the smallest management blocks in a protected area. Using management blocks as sampling units allowed us to carry out joint tiger genetic monitoring with several protected area authorities. Our work has revealed the presence of tigers in areas such as Dampa and Namdapha, in addition to robust population estimates for Orang, Manas and Pakke. We plan to conduct long term genetic monitoring of tigers in these protected areas, in order to understand population dynamics and corridor functionality through demographic and genetic exchange in tigers of North East India.

A METHODOLOGICAL COMPARISON FOR REAL POPULATION SIZE AND ESTIMATES FROM A CONSERVATION PERSPECTIVE THROUGH THE USE OF THE SUWEON TREEFROG (HYLA SUWEONENSIS) AS A MODEL SPECIES.

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The estimation of amphibian population size has been a notoriously difficult task since the earliest ecological studies on the subject. No sound comparison of all general methodologies is readily available and amphibian conservation is strongly impacted as a result. The need for an ideal model species for a comparison of the methods used for population size estimation lead to the selection of the endangered Suweon Treefrog (*Hyla suweonensis*). This species is ideal for model testing because it can be easily surveyed by counting calling males, and since it has a limited geographic range and small population size it is possible to sample the entire extent of the population in a single field season. The population size was estimated for this species from a field survey over a single season. This information was used to test the efficacy of two types of models, one based on surface occupancy and



the other on ecological preferences. The software PRESENCE and genetic tools agreed on four out of five instances on the size of the population for the species. This methodological comparison demonstrates that four of the methods used for population size estimation are effective and provide similar results. Our results indicate that the tools described here can accurately estimate population size and can therefore be used for making informed decisions for identification of populations of importance and for preserving endangered species.

49-THE EFFECTS OF LANDSCAPE FRAGMENTATION ON THE HABITAT USE OF WOODLARKS LULLULA ARBOREA AND THEIR INVERTEBRATE PREY

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Vineyards in Switzerland are among the most intensively managed crop systems where up to 90% of the parcels do not have any ground vegetation cover. However, there has been a considerable reduction in the application of herbicides over the past decades, leading to more vegetation of higher diversity on the ground. These different management types lead to a fragmented and almost binary system of few parcels with ground vegetation and lots of parcels with bare ground. The woodlark (*Lullula arborea*) is an endangered ground-nesting bird species that occurs in vineyards and during the breeding season mainly feeds on arthropods. Here, we investigated whether fragmentation negatively affects arthropod abundance and diversity using a combination of pitfall traps and sweep nets sampled along a gradient from low to high fragmentation effects (connectivity and habitat amount). In a second part we studied the habitat use of woodlarks using radio-telemetry with respect to arthropod abundance and fragmentation effects. Our findings indicate that fragmentation directly impedes the movement of arthropod prey, as in areas with higher connectivity and habitat amount the abundance and richness of arthropods increased. As a consequence the woodlark adjusts its habitat use in relation to the availability and abundance of its prey by using less fragmented areas more intensively. Using these findings, our project aims to give clear recommendations to winegrowers about the amount, distribution and connectivity of parcels with ground vegetation within the vineyards, which should ultimately favour biodiversity in general and woodlarks in particular.

USING CASE STUDIES FOR ENHANCING CAPACITY IN CONSERVING FOREST GENETIC RESOURCES

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Forest trees are long-lived species with high genetic diversity that is central for their survival, regeneration and adaptation to climate change. However, forest managers and conservationists are often not well informed about genetic aspects of population viability. Lack of understanding of forest genetic resources (FGR) therefore constrains conservation of tree species, increases genetic risks in subsequent generations and hinders adaptation to climate change. Tertiary education curricula cover FGR issues poorly or not at all. A vicious cycle is looming in which teaching and understanding of FGR and its importance to conserving forest tree species – in protected areas and in production landscapes – becomes increasingly marginalised. We describe a case study-based approach to teaching and learning about FGR use and conservation, based on real research results and subsequent recommendations. For example, the three case studies in the first module of the Training Guide focus on development of conservation strategies for tree species with different reproductive biology and ecological niches. Module two contains two case studies on conservation of trees outside of forests. Designed to promote 'FGR-friendly' decision-making, the Training Guide covers practical issues in forest and tree conservation and management of both global and local relevance. Each case study provides genetic, ecological and socioeconomic information as a basis for students' analysis. Teacher's notes, PowerPoint presentations and videos give background information to each case. The guide is intended for both tertiary education and on-the-job training. It is or will soon be available in English, Spanish, French, Russian and Chinese. The material has proved popular with trainees and is flexible and easy to use in a range of formal and informal learning situations.

HIGH PLANT AND ARTHROPOD DIVERSITY IN GRASSLAND AND SAVANNA FIELD MARGIN HABITATS OF SOUTH AFRICA

Monique Botha

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Stefan SIEBERT, North West University ; Johnnie VAN DEN BERG, North West University ; Bheki MALIBA, Eskom, Research, Test and Development

Intensive, large-scale cultivation has led to a postulated decrease in biodiversity worldwide, which have been ascribed to fragmentation and degradation of natural habitat bordering crop fields. Maize is the most widely planted grain crop in the Grassland and Savanna Biomes of South Africa, but it is unknown what effect crop production has on species diversity and composition. This study intends to address this knowledge gap by comparing diversity patterns and species assemblages



between maize fields and margins of six localities in South Africa across two biomes for plants and associated arthropods. A total of 15019 individuals and 824 native and exotic species were recorded for plants and 39 497 individuals and 1 629 morpho-species for arthropods. Although biodiversity loss was apparent in maize fields, field margins between 30 and 100 m from maize fields and natural areas had similar plant and arthropod diversity. Field margins and natural areas also shared very similar plant and arthropod species assemblages. Plant species assemblages were best predicted by agricultural disturbance while arthropod communities were mainly determined by biome. Our results suggest that the crop field margins (30-100 m from field edge) were not species poor ecosystems, but were surprisingly rich in plant and arthropod diversity. Field margins may therefore be of conservation value in the agricultural landscape with a diversity of species supporting important ecosystem services.

IMPACTS ON FOREST-BIRD DIVERSITY DOWN TO SINGLE INDIVIDUAL'S THROUGH RECREATIONAL ACTIVITIES - AN EXPERIMENT

Yves Bötsch

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The human world population increases continuously, and more and more humans also conduct some outdoor recreational activities. Because it is difficult to distinguish between the effect of disturbance caused by the presence of humans and the anthropogenic changes in habitat, we decided to do a study in which we experimentally applied a disturbance similar to recreational activities, but without modifying the habitat. Our main objective was to evaluate whether human disturbance affects breeding site selection of birds. For this, we set up a split-plot design, in which plots with highly homogeneous habitat were divided in half and one half was then disturbed and the other one served as control. The disturbance consisted of a small group of people walking through the woods, twice a day, with human conversations coming from a loudspeaker. This disturbance was performed during early breeding season (from March until mid-April) to try to influence breeding site selection. In each split plot the same number of nest boxes was distributed for small cavity nesting birds (mainly tits). In order to evaluate the effects of the disturbance, several parameters were measured later in the season. We monitored the breeding territories of all species through monthly counts. Moreover, we examined nest box occupancy, breeding biology, physiology, and behaviour of tit species. Despite the low level of disturbance, we observed a lower number of species and a lower number of overall

breeding pairs in the disturbed split plots compared to the control. Although the results are still preliminary, there seemed to be also differences in physiological parameters between control and disturbed split plots. Overall, it appears that the level of human disturbance that we applied was enough to negatively affect breeding site selection of forest birds.

EVIDENCE FOR THE IMPACT OF NATURE CONSERVATION ON HUMAN WELL-BEING

Madeleine Bottrill

Conservation International

Samantha CHENG, University of California, Los Angeles ; Janet EDMOND, Conservation International ; Margaret HOLLAND, University of Maryland, Baltimore County ; Samuel DUPRE, University of Maryland, Baltimore County ; Sierra SHAMER, University of Maryland, Baltimore County ; Ruth GARSIDE, University of Exeter

Global policy initiatives and international conservation organizations have sought to emphasize and strengthen the link between the conservation of natural ecosystems and human development. While many indices have been developed to measure various human well-being domains of conservation intervention, the strength of evidence to support the effects, both positive and negative, of conservation on human well-being, is still unclear. Rigorous and comprehensive evidence is necessary to enable efficient, defensible and targeted decisions and investment in advancing goals for improved human well-being in conservation. We present a systematic map, a thematic synthesis that visually illustrates the extent and diversity of published and unpublished sources of evidence, of studies linking conservation interventions to human well-being. We identified over 1000+ relevant studies based upon a search of online databases, specialist websites, and key informants. Data were extracted on characteristics of the study, types of conservation interventions, and human well-being outcomes. The map enables us to articulate pathways by which different interventions affect different aspects of human well-being, from income and basic materials to rights and equality. Furthermore, the results will inform priorities by pinpointing knowledge gaps to guide future monitoring and evaluation efforts. In this presentation, we explore the implications of the existing evidence base and its key findings for different audiences, in particular, conservation and development non-governmental organizations, donor agencies, and researchers.

BIODIVERSITÉ ENTOMOLOGIQUE INVENTORIEE PAR L'UTILISATION LA TECHNIQUE DES POTS BARBER AUX ABORDS DU MARAIS DE RÉGHAÏA(ALGER)

Belkacem Aimene Boulaouad

Ecole nationale supérieure agronomique



Oussama ALLAM, Ecole nationale supérieure agronomique ; Abdeljalil BOUAZIZ, Ecole nationale supérieure agronomique ; Samia DAOUDI-HACINI, Ecole nationale supérieure agronomique ; Saleheddine DOUMANDJI, Ecole nationale supérieure agronomique

La présente étude est déroulée aux abords du marais de Réghaïa (3° 19' à 3° 20' E. ; 36° 46' à 36° 47' N). L'inventaire des arthropodes a été réalisé par la méthode des pots Barber. Nous avons installé 10 pots-pièges pendant la période du mois de septembre jusqu'au mars de l'année 2013-2014, avec 1 série par mois. 916 individus sont recensés. Ils appartiennent à 6 classes, 21 ordres et 77 espèces. Les Insecta est la plus fréquente (A.R.% = 50,76 %), suivi par les Arachnida (A.R.% = 41,16 %). L'ordre des hyménoptères est le mieux représenté en espèce (A.R.% = 83,23 %), il est suivi par les diptères avec (A.R.% = 5,38).

IDENTIFYING CLASSES OF DEGRADED FORESTS IN AN AMAZONIAN LANDSCAPE FROM REMOTE-SENSING

Clément Bourgoïn

CIRAD

Nicolas BAGHDADI, IRSTEA ; Lilian BLANC, CIRAD ; Joice FERREIRA, EMBRAPA ; Valéry GOND, CIRAD ; Lucas MAZZEI, EMBRAPA ; Yohann OZWALD, Université Rennes

In the Brazilian Amazon, deforestation and forest degradation have resulted in a complex mosaic of forest types. Nearly 20% of the Brazilian Amazonian forests have been cleared. In this area, abandonment of fields led to regrowth of secondary forests of varying ages. A fraction of the remaining forested land has also suffered from anthropic degradation (mainly over-logging and fire). Human-modified Amazonian landscapes are therefore an assemblage of these various forests associated with pastures and agricultural lands. These landscapes are now at the centre of political concerns. Coercive measures taken by the Brazilian government to curb deforestation, associated with private initiatives (soy and beef moratoria) drastically reduced deforestation rates. The colonization of the Amazonian territory through agricultural expansion over forest areas is now severely restricted. Consequently, conciliation between agricultural production and environmental conservation should be pursued in all human-impacted forests. However these secondary and degraded forests have not received the necessary attention. While identification and characterization of degraded forests became a critical task, there is an overall limitation in the remote sensing analyses developed so far. To define management plans for these areas and to understand their role in the maintenance of ecological services, the first challenge is to identify and characterize the forests that result from different disturbance trajectories. We carried out a study aiming at classifying the large spectrum of degraded

forests into forest classes based on degradation levels using satellite data. The study area took place in the municipality of Paragominas (eastern Amazonia). A large range of captors (optical, radar and lidar) have been tested combining with ground-truth validation. This classification has important applications in ecological studies as well as in supporting decisions for land-use planning.

USING REAL-TIME FOREST LOSS ALERTS AND GLOBAL DEFORESTATION MAPS TO ASSESS THE EFFECTIVENESS OF AFRICA'S TROPICAL PROTECTED AREAS.

Jenna Bowker

University of Cape Town

Graeme CUMMING, University of Cape Town ; Alta DE VOS, University of Cape Town

Tropical forests are the most biologically diverse and vulnerable ecosystem, undergoing rapid changes over the last two decades and resulting in the loss of irreplaceable biodiversity. Parks have been established in an attempt to slow biodiversity loss, but the effectiveness of this tool has been questioned, particularly in areas such as tropical Africa suffering from widespread conditions of poverty, rapid population growth and political instability where little or no formal management exists on the ground. As few countries within Africa have stable monitoring systems to generate time-series data of forest cover change, remotely-sensed satellite imagery offers a practical way to examine trends in forest cover change within and outside parks. Recent advances in remote sensing technology have allowed conservationists to investigate forest cover trends at increasingly large scales at high resolutions across whole biomes, offering an efficient, practical and affordable way to explore park effectiveness. I used the remotely sensed global forest change data of Hansen et al. (2013) and near-real-time tree cover loss alert system (FORMA) released by the World Resource Institute in early 2014 to analyze forest loss within parks and immediate surroundings in Africa at 50m and 500m resolution respectively. A total of 224 parks within the tropical and subtropical moist broadleaf forest biome were chosen. Results indicated that the majority of African tropical parks in this study are effective in deterring forest loss inside park boundaries. Smaller parks were less effective at preventing forest loss than larger parks and parks of differing IUCN categories showed no difference in effectiveness. West African parks exhibited the largest amount of forest loss, while Central Africa exhibited the least. This study highlights the potential of remote satellite imagery for estimating the relative impact of park establishment for Africa and identifying effective and failing parks.



FINE-SCALE GENETIC STRUCTURE IN AN AFRICAN ANTELOPE SPECIES DISTRIBUTED ACROSS A LANDSCAPE OF FRAGMENTED FORESTS.

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Fine-scale genetic structure has important implications for population management and conservation but has not previously been studied in a duiker species. We investigated spatial genetic structure in Harvey's duiker *Cephalophus harveyi*, a small-bodied antelope dependent on vegetation cover, in the high biodiversity fragmented forests of the Udzungwa Mountains, Tanzania. We genotyped 141 geo-referenced fecal samples collected over 35 months from across the central Udzungwa range at eight microsatellite loci. We found a highly significant pattern of isolation by distance across the study area (Mantel test: $r_{xy} = 0.189$; $P < 0.001$) and positive global spatial autocorrelation at distances below 10 km ($r = 0.033$; $P < 0.001$). However, within sampling areas of continuous forest there was little evidence for genetic structure, indicating possible local panmixia. There was no evidence for temporal structure across the sampling period. Bayesian individual-based methods indicated a genetic structure of either two (location prior model in STRUCTURE) or four (correlated alleles model in Geneland) clusters with a well-supported division between the central forest blocks and two outlying forests. Although designated as Forest Reserves, these latter forests are outside of the Udzungwa Mountains National Park and Kilombero Nature Reserve and subject to illegal hunting of forest antelopes and other species. Our results indicate that different landscape features, in addition to isolation by distance, influence genetic structure in Harvey's duiker with the area's large rivers appearing to separate genetic clusters. This study suggests that Harvey's duiker is able to disperse through non-forested habitats and therefore will likely benefit from attempts to establish wildlife corridors between protected areas in the Udzungwa Mountains.

CANOPY CAMERA TRAPPING WITHIN AN OCCUPANCY FRAMEWORK TO MONITOR ARBOREAL WILDLIFE IN THE PERUVIAN AMAZON

Mark Bowler

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University ; Mathias TOBLER, Institute for Conservation Research, San Diego Zoo Global

Camera trapping as a means to assess animal communities has grown in popularity in recent decades, but forest canopies have rarely been surveyed using camera traps and never within an occupancy modelling framework. We installed 42 camera traps on a randomly positioned grid for six months in the rainforest canopy at a moderately hunted site, in the Maijuna-Kichwa Regional Conservation Area in the northeastern Peruvian Amazon, with the objective of estimating occupancy for arboreal mammals. We obtained reliable occupancy estimates for nine species including five primates, kinkajou, olingos, Brazilian tree porcupine and the two-toed sloth. Half of these species are nocturnal and therefore hard to survey by alternative means. Occupancy of the frequently hunted woolly monkey was positively correlated with distance from the village, whilst the occupancy of two smaller-bodied primates and the tree porcupine were negatively correlated with distance from the village. Whilst detection probabilities were low, our traps were positioned in a number of configurations and not targeted at particular species. Thus, detection is likely to increase as experience improves and trap positioning is being standardized. That detection was correlated with trap height for four species further illustrates the influence of trap positioning on detection probability.

ID34: CITIZEN SCIENCE MEETS SATELLITE REMOTE SENSING: OPPORTUNITIES FOR LAND COVER MAPPING

Doreen Boyd

University of Nottingham

Giles FOODY, University of Nottingham

Citizen science has a long history but has grown rapidly in recent years, notably due to technological developments. This growth indicates considerable potential to develop and indeed revolutionize aspects of remote sensing, with a real potential to address major barriers to progress. This is evident in many application areas of remote sensing but perhaps most apparent in relation to the acquisition of ground data that are used in support of remote sensing studies. Within the context of biological diversity it is the production of land cover maps that is particularly important and ground data are central to the production process providing producers and users with confidence. The key focus of this paper will be on how citizen sensors can provide useful data to support land cover mapping endeavours which are underpinned by remote sensing. A number of case studies will be covered to demonstrate how unknown volunteers as well as internet projects can provide the ground reference data needed to validate land cover maps. Moreover, it will be shown that without any formal ground data at all it is possible to gain information on map accuracy



and the quality of the individual volunteers in relation to their contributed data. The latter is important as citizen derived data is typically highly imperfect and critically is of unknown and variable trust levels. These examples are important in terms of helping to realize the potential of remote sensing as a source of land cover information robust enough to support conservation initiatives within scientific, management and policy communities.

EFFECTS OF SIMULATED RECURRENT INCLEMENT WINTER WEATHER ON THE STRESS RESPONSE AND FEEDING BEHAVIOUR OF WHITE-THROATED SPARROWS (*ZONOTRICHIA ALBICOLLIS*)

Andrea Boyer

University of Western Ontario

Climate change has been linked to increasing frequency and severity of violent, unpredictable winter storms and other extreme weather events at nearly all latitudes. As such, it is important to study and understand the effects that changing weather patterns have on avian species. There has been prior research regarding how birds cope with winter weather and their ability to predict oncoming inclement weather, but limited research surrounding how birds respond, both physiologically and behaviourally, to recurrent inclement winter storms over a long-term period. I investigated these effects of recurrent inclement winter weather cues on the stress response system and feeding behaviour of a native Canadian songbird species, the white-throated sparrow (*Zonotrichia albicollis*). I used a hypobaric climatic wind tunnel to simulate storms approaching, residing, and subsiding by altering barometric pressure and temperature accordingly, and measured behavioural responses, body composition, and baseline corticosterone levels in birds exposed, or not exposed, to weekly simulated storms. After environmental manipulations, experimental birds had a significantly higher fat mass, in addition to increased lean mass. Baseline corticosterone levels decreased over time in both groups, and feeding duration increased over time among both groups as well. This novel research provides further evidence that birds can detect changing weather patterns and respond appropriately. Understanding how species will respond to predicted environmental changes will give an insight into future conservation and management strategies surrounding climate change.

INCORPORATING INTRA-ISLAND MOVEMENT IN A SPATIALLY EXPLICIT CAPTURE-RECAPTURE REEF SHARK POPULATION DENSITY ESTIMATE AT AN UNFISHED CORAL REEF

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Reef shark populations have been devastated by ever increasing fishing pressure and baseline population density estimates are lacking. Traditional diver based visual surveys suffer from a lack of comparability and reproducibility and different survey methods have been shown to result in a contradictory picture of shark abundance. The grey reef shark (*Carcharhinus amblyrhynchos*), which is listed as Near Threatened on the IUCN Red List of Threatened Species, is highly mobile and therefore particularly difficult to monitor. At the same time, its mobility is precisely what has stymied its protection in much of the world – without understanding the spatial behavior of reef sharks, it is impossible to design spatial management strategies to protect them. Shark abundance through both space and time can be better estimated by directly accounting for reef shark movement in population estimates without the biases inherent in diver-based visual surveys. A spatio-temporal understanding of animal movement and abundance also allows managers to identify critical habitats, movement between habitats, and track changes to population size and structure. To directly address and incorporate animal movement in estimates of reef population size and density, we used a spatially explicit capture-recapture model from an eight year capture-recapture program augmented with telemetry data to produce the first baseline population density estimate of grey reef sharks and to further describe their spatial and temporal distribution at Palmyra atoll, a remote U.S. National Wildlife Refuge in the central Pacific Ocean. We found that diver based visual surveys had significantly over estimated shark density at an island wide scale. While our analysis revealed density 'hot spots', sharks also underwent regular excursions around the atoll, indicating that large scale spatial protection is necessary to recover reef shark populations globally.

HUMAN POPULATION REDUCTION IS NOT A QUICK FIX FOR ENVIRONMENTAL PROBLEMS

Corey Bradshaw

University of Adelaide

Barry BROOK, University of Tasmania

The inexorable demographic momentum of the global human population is rapidly eroding Earth's life-support



system. There are consequently more frequent calls to address environmental problems by advocating further reductions in human fertility. To examine how quickly this could lead to a smaller human population, we used scenario-based matrix modeling to project the global population to the year 2100. Assuming a continuation of current trends in mortality reduction, even a rapid transition to a worldwide one-child policy leads to a population similar to today's by 2100. Even a catastrophic mass mortality event of 2 billion deaths over a hypothetical 5-y window in the mid-21st century would still yield around 8.5 billion people by 2100. In the absence of catastrophe or large fertility reductions (to fewer than two children per female worldwide), the greatest threats to ecosystems—as measured by regional projections within the 35 global Biodiversity Hotspots—indicate that Africa and South Asia will experience the greatest human pressures on future ecosystems. Humanity's large demographic momentum means that there are no easy policy levers to change the size of the human population substantially over coming decades, short of extreme and rapid reductions in female fertility; it will take centuries, and the long-term target remains unclear. However, some reduction could be achieved by midcentury and lead to hundreds of millions fewer people to feed. More immediate results for sustainability would emerge from policies and technologies that reverse rising consumption of natural resources.

123 FOREST ECOSYSTEM SERVICES: FROM THE PAST INTO THE FUTURE

Richard Bradshaw

University of Liverpool

Modern forests provide a broad range of ecosystem services ranging from the provisioning of wood and fibre, to the regulation of flooding and soil erosion and the cultural benefits of recreation and wilderness experience. Their contribution to human security, health, welfare and social relations has changed through time and analysis of these changes helps with anticipation and planning of future dynamic relationships between forests and human needs. The transition from hunting and gathering to agriculture altered the provisioning and regulating role of forests and subsequent changes in agricultural practice further readjusted the service role of forests in Europe and North America. Forests have always contributed significant cultural services, formerly through a spiritual role and latterly through their contribution to recreation and the conservation of 'natural' values. Case studies illustrate the temporal dynamics of forest ecosystem services: 1) carbon sequestration in temperate deciduous forest; 2) 13 500 years of red-listed beetle diversity, and 3) the changing cultural values of European forests. Suggestions will be made for the future of forest ecosystem services.

SURVEILLANCE IN ZONOSSES AT ATLANTIC FOREST BOUNDARIES

Martha Brandão

FIOCRUZ

José Luis Passos CORDEIRO, FIOCRUZ; Daniela Dias Araújo ALBUQUERQUE, FIOCRUZ; Renato Orsini ORNELLAS, FIOCRUZ; Carlos José BARBOSA FILHO, FIOCRUZ; Sandro A. PEREIRA, FIOCRUZ; Fabiano Borges FIGUEIREDO, FIOCRUZ

The dynamics of pathogens in the environment is very complex depending of factors as host susceptibility, host-pathogens interactions, transmission's route, abiotic factors influence and many other variables that vary widely introducing further complexity. Reducing public health risks from zoonosis and other health threats at the human-animal-ecosystems interface is not straightforward. Management and reduction of these risks must consider the complexity of interactions among humans, animals, and the various environments they live in, requiring communication and collaboration among the sectors responsible for human health, animal health, and knowledge of the environment. Our study area is at Campus Fiocruz Mata Atlântica that is in an area with disturbed environment and loss of biodiversity, with humans' activity, domestic and wild animals interacting all together near the biggest Atlantic forest fragment at Rio de Janeiro/ Brazil. The Zoonosis Control Program was created to take actions for management of domestic, livestock and wild animals from the campus and its boundaries and also management and care of local people that lives in this area and frequents the Health Care Facility Unit. We visit houses of the communities periodically to collect and recollect samples from domestic animals and livestock. These are the same houses registered in the Family Health Program from Unified Health System in Brazil. Bats, sloths, small rodents and snakes are used as wild animals sentinels once they are the most common species that usually appear around houses in conflict with humans. After two years of surveillance from domestic and wild animals, we do have results for Leishmaniasis, Trypanosomiasis, Esporotricosis, Leptospirosis, Toxoplasmosis, Rabies, Helminths, oral and rectum bacterial fauna in some of those animals. Human cases of Leishmaniasis and Esporotricosis were diagnosed as well.

CONSERVATION GENETICS OF THE WESTERN DERBY ELAND IN SENEGAL: INTEGRATION OF PEDIGREE AND MICROSATELLITE DATA

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Less than 200 wild individuals of the critically endangered Western Derby eland (*Taurotragus derbianus derbianus*) live in Senegal. A breeding programme was established in 2000 with six founding individuals (one male, five females) in a fenced reserve. In 2015, the population consists of about 90 individuals living in seven separate herds in the two reserves of Bandia and Fathala in Senegal. Because of the low number of founding individuals in the breeding programme and the resulting high kinship, we compared the results from genealogical and genetic approaches to assess the level of genetic diversity. We used the data from three generations. In F1, the founder contribution was highly biased towards the only founding male, which sired all the offspring. In F2, the founder contributions were more balanced, as the male descendants of founding females entered the reproduction. This resulted in higher gene diversity and lower inbreeding (based on pedigree data) in F2 than in F1. Results of molecular analysis using microsatellite loci confirmed the highest level of heterozygosity and lowest level of inbreeding in the founder generation; however, the implementation of a management strategy was not reflected in the empirical results. The results differed for F2, where empirical values of heterozygosity continued to decrease and inbreeding continued to increase. The allelic richness corresponded with the results of pedigree analyses, reflecting the more equalized founder contributions. We concluded that the overall results for genetic parameters were comparable with other breeding programmes for endangered ungulates. Our suggestions correspond with the Western Derby Eland Conservation Strategy and confirm the need to introduce new founders into the semi-captive population, in order to minimize the risk of inbreeding depression and improve its genetic diversity and suitability for potential reintroduction. The study was supported by CIGA 20135010 and 20134311.

A VIRTUAL SPACE TO JOIN WILDLIFE AND HUMAN HEALTH

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The Center for Information on Wildlife Health (CISS) of Oswaldo Cruz Foundation (Fiocruz) is a virtual space (www.biodiversidade.ciss.fiocruz.br) driven to consolidate in a participatory way, wildlife and human health knowledge, good practices, actions and policies that together can strengthen the conservation of Brazilian biodiversity with quality of life. One of the Center's communication strategies is to be an open space, which stimulates collaborators to publish articles, congresses, events and news on wildlife and human health subjects. The Center integrates two participatory networks:

Wildlife Health and Wildlife Health Laboratory Network that strongly contribute to the site content. In addition, a bimonthly newsletter is sent to a mailing list that includes specialists, students, stakeholders and interested people. Along eleven months, since the Center was established in March of 2014, the website has increased its visitor number totalizing almost 3.000 users from 39 different countries around Latin America, Europe, Asia and Africa. The peak of access until now reflects scientific agenda and the results of the workshops promoted by the Center. Around the total visitors, 47.3% are returning visitors. In addition, the Center strategies to increase and fidelize the users are (i) associate a scientific publication to an easy language article in order to reach different citizens profiles, (ii) publish the Center content on the open media and (iii) host the website at the Fiocruz Portal, a centenary public health institution in Brazil.

MOUNTAIN FOREST BIODIVERSITY UNDER CLIMATE CHANGE: COMPENSATING NEGATIVE EFFECTS BY INCREASING STRUCTURAL RICHNESS

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Species in mountain environments are expected to face a high risk of range contractions, if not local extinctions under climate change. Yet, many endothermic species are not primarily affected by physiological constraints, but indirectly by climate-induced changes of habitat quality. In mountain forests, where vertebrate species largely depend on vegetation composition and structure, deteriorating habitat suitability may thus be mitigated or even compensated by habitat management. We tested this possibility using four mountain bird species of conservation concern, capercaillie (*Tetrao urogallus*), hazel grouse (*Bonasa bonasia*), pygmy owl (*Glaucidium passerinum*) and three-toed woodpecker (*Picoides tridactylus*), which are considered as indicators for complementary forest structural parameters. Based on species data and environmental information collected at 300 1km²-plots distributed across three mountain ranges in Switzerland and southwestern Germany, we investigated (1) how species' occurrence was explained by climate, landscape, and vegetation, (2) to what extent climate change and climate-induced vegetation changes will affect habitat suitability, and (3) whether these changes could be compensated by adaptive habitat management. Species presence was modelled under current



climate and extrapolated to the conditions of 2050, assuming the moderate IPCC-scenario A1B. Climate variables contributed significantly to explaining species occurrence and expected climatic changes, as well as climate-induced vegetation trends, decreased the occurrence probability of all four species, particularly at the low-altitudinal margins of their distribution. These effects could be partly compensated by modifying single vegetation factors, but full compensation would only be achieved if several factors were changed in concert. The results illustrate the possibilities and limitations of adaptive species conservation management under climate change.

4.12 COMPILING RED LISTS: COULD SDM'S CONTRIBUTE TO BETTER ASSESSMENTS?

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Red Lists are the most important source of information about the threat and conservation status of single species and biodiversity. Two main criteria of Red List assessments are the absolute geographic range size and its relative change in time. According to IUCN both criteria could be measured by either the extent of occurrence (EOO) or the area of occupancy (AOO). While EOO and AOO include only spatial information, Species Distribution Models (SDMs) also include ecological information to measure range size. In addition, multivariate ordination of the inhabited environment can be used to quantify the realized ecological niche without a direct reference to range size. Here, we test if SDMs and niche size measured via ordination provide additional information on rates of change compared to the standard geographic IUCN scores (EOO, AOO, and α -hulls). We therefore simulated randomly as well as spatially and ecologically directed local extinction events of varying magnitudes (10, 30 and 50%) and tested how accurate the different methods detect these extinctions using occurrence data of 148 vascular plant species in Switzerland. We show that SDMs are not suited to quantify rates of change in contrast to current IUCN scores and niche quantification via ordination. Although SDMs and also niche quantification cannot substitute or "improve" standard IUCN scores, they provide additional information which is helpful to better assess the threat of a species.

FROM BEHAVIORAL ECOLOGY TO CONSERVATION: INVESTIGATING INDIVIDUAL BEHAVIORAL TRAITS AND SOCIAL INTERACTIONS OF PROVISIONED LEMON SHARKS (NEGAPRION ACUTIDENS) AS A TOOL FOR MANAGING SHARK-FEEDING ACTIVITIES

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Non-consumptive wildlife tourism is presented as a modern tool for conservation, by providing economic incentives for conserving biodiversity and contributing to enhanced public awareness. In order to ensure the economic viability of the wildlife-watching industry, appetitive stimuli are commonly used to prompt artificial aggregations of emblematic species. In particular, increasingly popular « shark-feeding » operations are being conducted worldwide, albeit with sketchy information on their effects on the targeted species. Deleterious effects on individual fitness have been described in fed terrestrial species, along with behavioural alterations including increased aggression to conspecifics and humans. Such behavioural aspects have not yet been studied among fed sharks, although (1) increased competition between individuals can incur physiological costs and (2) preventing shark bites on humans remains fundamental to promoting shark conservation. Drawing on theoretical behavioural ecology, we investigate individual behavioural traits and social interactions in a group of regularly fed lemon sharks off Moorea, French Polynesia. We use underwater video recording to describe context-dependent social behavior through agonistic interactions towards conspecifics and divers, along with passive acoustic telemetry to monitor individual spatial use. We believe our findings will allow a better understanding of the individual and social behavior of lemon sharks, and inform management plans to ensure the sustainability of shark-feeding activities and their effective contribution to conservation.

194 DEFINING HUMAN WELLBEING FOR CONSERVATION: A SOCIAL SCIENCE FRAMEWORK

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The wellness of people and nature are interdependent, and thus the notion of human wellbeing has taken root in conservation science. But what exactly is human wellbeing, how is it coupled with environmental change, and how might it be conceptualized for ecosystem assessments? Ecologists and economists have popularized an ecosystem services approach to human wellbeing, and development scholars are measuring subjective wellbeing as an alternative to GDP. Yet neither approach captures the complexities of the human-environment relationship that environmental social scientists have long studied. This paper reports on our effort to define and operationalize human wellbeing for ecosystem-based management. Drawing from the social science literature and an analysis of environmental management priorities, we introduce a conceptual typology of human wellbeing that can be tailored for a range of conservation contexts. Our framework moves beyond the prevailing focus on conditions to include additional dimensions of wellbeing: capabilities and connections, as well as cross-cutting domains, such as equity and justice, certainty and resilience, and the wellbeing of future generations. We illustrate how this general framework can be used to identify focal domains and indicators of wellbeing that serve specific stakeholder, management, and decision-making needs. Ultimately, our goal is to provide a tool to better link conservation strategies to interrelated improvements in human wellbeing.

MOVE IT OR LOSE IT: A SYSTEMATIC REVIEW OF THE MOTIVATIONS, SPECIES, REGIONS, AND OUTCOMES OF NORTH AMERICAN CONSERVATION TRANSLOCATIONS

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A conservation translocation is the intentional release of organisms for the purpose of measurably improving the conservation outlook at the population, species or ecosystem level. We undertook the first systematic review of faunal conservation translocations in North America, a global hotspot for this conservation tool, by reviewing over 2000 articles from 1974-2013. Additionally, we surveyed 230 related authors to understand what motivated their translocations and how they were evaluated. We identified 736 conservation translocation projects on 298 different species and found that translocations were widespread and increasing for all taxa, their frequency was correlated with the number of species at risk per state/province, and reintroductions and reinforcements were more prominent in the US and Canada than in the Caribbean, Mexico, or central America. Moreover, translocated species had a higher

threat status regionally (state/provincial level) than globally (IUCN Red List categorization), suggesting that translocations were motivated by regional priorities rather than global risk. Survey participants identified the reduction of extinction risk at a national, state or provincial level as their main motivation for translocating study species, and most translocation projects were requested, supported and/or funded by government agencies. Thus, we identify an opportunity to explore how local conservation concerns for individual species may affect their global conservation status in the long-term. Translocation projects were generally reported as 'successful,' measured mainly by survival and reproduction of translocated species, population establishment, or an increase in population size. Barriers to success included biological and non-biological factors. We recognize a need to clearly identify the rationale and motivations for conservation translocations and link them with measurable outcomes to aid and ultimately maximize the benefits of translocation projects.

LACK OF PEATLAND SPECIALISTS OF MULTIPLE INDICATOR GROUPS INFORMS FUTURE CONSERVATION PLANNING IN THE WESTERN BALKANS PEATBOGS

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Peatbogs are small in size, highly fragmented and unique habitats in the Western Balkans. They are critically endangered due to drainage and especially to the progressive vegetation succession. Ground beetles (Coleoptera, Carabidae) and ants (Hymenoptera, Formicidae), as suitable indicators, were studied by pitfall traps in the isolated Đon mocvar peatbog (Blatuša, central Croatia). The Đon mocvar peatbog is the oldest (preboreal origin) and one of the largest peatbogs in Croatia. The study was carried out at the peatbog centre and at the edges of the peatbog during one growing season. In total, 818 ground beetles representing 37 species, and 11 550 ants representing 25 species were collected, respectively. Species richness and activity density of both taxa were higher at the peatbog edges than in its centre. True tyrphobiotic species (peatland specialist) of both taxa were not found. Tyrphophilous species of ground beetles, such as *Pterostichus rhaeticus* and *P. diligens*, were rare and mostly occurred at the peatbog edges, while tyrphophilous ant species, such as *Myrmica scabrinodis*, was abundant and occurred at the peatbog centre. Most of the species from both taxa were



primarily hygrophilous without a clear preference for peatbogs and most likely colonise the peatbog from surrounding colline belt oak forests. The lack of true tyrphobiontic species in both insect taxa could be explained by the biogeographical dispersal limitations in the Western Balkans and Southern Europe and the significant reduction of suitable habitats for colonisation. We suggest that an evidence-based conservation planning may halt the abandonment of these unique habitats, and ground beetles and ants as indicator taxa can assist in monitoring the effectiveness of those efforts.

DEVELOPING PHYSIOLOGY-DRIVEN POPULATION DYNAMICS MODELS TO ASSESS CLIMATE CHANGE IMPACTS ON KOALAS, EVALUATE KOALA CONSERVATION ACTIONS AND PRIORITIZE THE PROTECTION OF POPULATION REFUGES

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Michael KEARNEY, University of Melbourne ; Warren PORTER, University of Wisconsin ; Brendan WINTLE, University of Melbourne

How climate change impacts on species persistence will depend on physiology, landscape, population and dispersal dynamics, and existing stressors such as habitat loss. To generate robust predictions that can form the basis for conservation actions we therefore need an approach that integrates physiological constraints on survival and reproduction with other demographic processes and threats. We outline a modelling framework that addresses this gap by integrating biophysical models with population dynamics models – and demonstrate its application using the koala (*Phascolarctos cinereus*) as a case study. Biophysical models calculate the survival, energy and water requirements of an animal based on daily weather, individual traits and local habitat features. Where data are available on energy and water availability, this approach can be used to capture how climate change will influence vital rates. Biophysical model output can then be integrated with a stage-specific population dynamics model to predict how climate change will interact with other demographic processes and threats to impact population persistence. Our innovative approach overcomes the widely-recognized short-comings of current static, correlative approaches to predicting the impacts of climate change and provides insight into the synergistic effects of multiple threatening processes. It can be used to identify key refugia for populations and to evaluate different management actions. The koala case study also illustrates the benefits of using process-based models that provide insight into the mechanisms through which climate change will influence species persistence: the impact of climate change on koalas is heavily dependent on water content of food (leaves), which

differs between tree species. Selective planting of particular tree species could therefore be a useful management option, and the modelling framework we describe can be used to identify where and when such actions would be most effective.

NOTICING THE ELEPHANT IN THE FOREST: COMBINING OCCUPANCY ANALYSIS WITH SOCIAL SURVEY FOR RAPID ASSESSMENT OF FOREST ELEPHANT STATUS

Stephanie Brittain

Imperial College London

Information on the distribution and abundance of elephants must be available in order to appropriately allocate limited resources and to set conservation goals. However, monitoring over large spatiotemporal scales in forest habitats remains a serious challenge. At the root of this challenge lies tension between monitoring methods that prioritise accuracy, and those that rather emphasise long-term practicality. This trade-off between effectiveness and cost is a pervasive and unresolved problem in biodiversity monitoring. Transect surveys of dung density are the most widely used method for determining the distribution and abundance of forest elephants. This is arduous and as such has only been used in parts of the species' range. Interviewing people who live and work in the forest on the presence of elephants is a potential way of rapidly assessing distribution, collecting information over areas and timescales that cannot be tackled using conventional surveys. In practice, uncertain detectability makes this unreliable, but occupancy analysis allows uncertainty to be controlled for. This rapid survey assessed distribution and trends in forest elephant (*Loxodonta cyclotis*) populations over six years across 30,000 km² of east Cameroon, a survey that may have taken years using transects. This study finds that this method is a reliable and suitable method for a rapid assessment of forest elephant occupancy across a large scale, as a compliment or first stage in a monitoring process.

KEY ROLE FOR NUCLEAR ENERGY IN GLOBAL BIODIVERSITY CONSERVATION

Barry Brook

University of Tasmania

Corey BRADSHAW, The University of Adelaide

We recently published a well-publicised but controversial paper in SCB's flagship journal 'Conservation Biology' in which we argued that environmental scientists need to engage with energy issues more rigorously, and also consider supporting nuclear power to avoid future fossil-fuel dependency and worsening climate change. This call was supported by an 'Open Letter to Environmentalists' that was co-signed by 75 leading conservation biologists and ecologists. In this talk I will



outline the case we made in the paper for a role for nuclear energy (and the broader need for robust energy systems analysis) in biodiversity conservation, and then describe some of the reaction to, engagement with, and criticism of, our proposals, from the broader community and media. In the paper we evaluated the land use, emissions, climate, and cost implications of three published but divergent storylines for future energy production, none of which was optimal for all environmental and economic indicators. Using multi-criteria decision-making analysis, we ranked seven major electricity-generation sources (coal, gas, nuclear, biomass, hydro, wind, and solar) based on costs and benefits and tested the sensitivity of the rankings to biases stemming from contrasting philosophical ideals. Irrespective of weightings, nuclear and wind energy were shown to yield the highest benefit-to-cost ratios. We argued that although the environmental movement has historically rejected the nuclear energy option, new-generation reactor technologies that fully recycle waste and incorporate passive safety systems might resolve their concerns and ought to be more widely understood. Because there is no perfect energy source however, conservation professionals ultimately need to take an evidence-based approach to consider carefully the integrated effects of energy mixes on biodiversity conservation. Trade-offs and compromises are inevitable and require advocating energy mixes that minimize net environmental damage.

TAKING AN INTEGRATED APPROACH TO MINIMIZING HUMAN-WILDLIFE CONFLICT USING A RAPID ASSESSMENT TOOL THAT IDENTIFIES CRITICAL GAPS IN INTERVENTIONS

Ashley Brooks

WWF - Tigers Alive Initiative
Nilanga Jayasinghe, WWF

Conflicts between people and wildlife are occurring with increasing frequency. Human-wildlife conflict (HWC) is complex in nature and involves a diverse array of stakeholders, including the wildlife themselves. Because all elements of HWC management (prevention, mitigation, policy, research/understanding of conflict, response and monitoring) are inextricably linked, management actions should also be integrated. In order to identify the best combination of interventions that can ultimately minimize HWC, WWF has developed a rapid assessment tool that takes an integrated approach to HWC. The tool can be applied anywhere in the world across species to identify the key elements missing in HWC management approaches. The tool will provide practitioners working on HWC with the opportunity to identify critical gaps and the improvements they must make in order to minimize conflict and enhance management actions. This two-part presentation will a) focus on the need for an integrated approach to address HWC and provide an introduction to

the rapid assessment tool, and b) demonstrate results from applying the tool at four sites where WWF is active – two pilot sites address human-tiger conflict, and the other two focus on human-elephant conflict. Results from this assessment will be illustrated further with patterns that have emerged from a wider species-based capacity mapping exercise conducted across WWF's tiger and Asian elephant landscapes.

130-QUANTIFYING THREATS TO GLOBAL BIODIVERSITY THROUGH EXTINCTION RISK ASSESSMENT

Thomas Brooks

IUCN

Stuart BUTCHART, BirdLife International ; Craig HILTON-TAYLOR, IUCN ; Michael HOFFMANN, IUCN Species Survival Commission

The IUCN Red List Categories and Criteria provide a standard system for measurement of species extinction risk. They have been applied to 76,199 species, with the resulting assessments published on The IUCN Red List of Threatened Species. Moreover, repeat assessments have been conducted for all mammals and amphibians (twice) and birds (six times), allowing derivation of Red List Indices of the aggregate rates at which species groups are sliding towards extinction. Over the last decade, standard classification schemes for recording threats and stresses have been developed, along with coding of timing, scope, and severity. These are now required or recommended elements of assessments for The IUCN Red List. The application of these classification schemes opens important new avenues for quantification of human pressures on biodiversity. These include: a) spatial distribution of the number of threatened species facing given threats; b) spatial distribution of the proportion of threatened species facing given threats; and c) spatial distribution of threats that have driven species into higher categories of extinction risk owing to genuine increases in extinction risk. This information is a key input into attempts to model scenarios for biodiversity, and such work is already underway to explore future threats to biodiversity from ecosystem conversion and climate change. The development of methods to model future threats to biodiversity from invasive species, disease, and unsustainable harvest are priority research fronts.

A NEW OPEN-SOURCE SOFTWARE TOOL FOR MORE EFFECTIVE CONSERVATION PLANNING

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James Cook University

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We describe the main features of a new, interactive software tool for conservation planning, with initial applications to management of tropical islands in Australia. Island



conservation management is a truly multidisciplinary problem that requires considerable knowledge of ecosystems characteristics, species, and their interactions. Our study sites in the southern Great Barrier Reef (Queensland) and off the Pilbara coast (Western Australia) are characterised by globally- and nationally-significant conservation values and persistent threats to those values, mainly in the form of invasive plants and animals. Management staff and funds are not sufficient to eliminate all threats on all islands. With a limited budget, managers need to select conservation actions according to expected payoffs (in terms of protecting or restoring desired species) versus cost (the amount of resources/money) required for the actions. We wanted to approach real-world complexity in decision-making while building new capabilities that current software systems lack. The new capabilities include: the ability to allocate multiple actions to single areas; temporal explicitness in responses of native species to threats and threats to conservation actions; and dynamic updating of threats, costs and the effectiveness of actions. We describe a working prototype of a new decision-support system, tailored to meet the needs of pest control on islands for conservation managers. The software includes i) a model of the ecosystem and the impact of conservation actions, and ii) a solver selecting the best solutions, and interactivity and flexible around the needs and expertise of the managers.

CHANGES OF THE GRASS AND WOODY COMPONENT ON THE PLATEAU AREAS OF MOUNTAIN ZEBRA NATIONAL PARK: 1980 - 2015.

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The vegetation of permanently marked plots distributed within plateau grassland of the Mountain Zebra National Park was monitored by means of point surveys for canopy spread cover over a 26 year period spanning from 1989 to 2015. Datasets were collected over five periods (1989, 1993, 2001, 2011, 2015). The observed changes between 1989 and 2001 conformed to some extent to the succession model that forms the basis of veld condition assessment for the Nama-karoo Biome. Annual grasses were abundant after the drought season in the 1980's and decreased with an increase in perennial grasses after a few years. The nature of the rainfall-induced changes differed between different communities with the perennial decreaser grasses in one area never becoming dominant. It seemed that rainfall influenced the vegetation and that grass species react the quickest to rainfall. Total cover for both grass and dwarf shrub species declined in dry years and increased in wet years. The monitoring of these areas was repeated in 2011 and 2015. Above average rainfall years preceded the monitoring.

The prominent and dominant grass and dwarf woody shrub species were analysed with the above hypothesis in mind. It was expected that the perennial decreaser grasses would have increased with the above average rainfall. The new data that was collected did not conform to the previous hypothesis. It seems as though certain grasses change their ecological status during dry and wet periods and that the system may have shifted to a more grassy structure due to overall good rains.

SYMPOSIUM ID 123. CONSERVATION STRATEGIES FOR FOREST MANAGEMENT IN RELATION TO DIFFERING ECOSYSTEM SERVICES SHAPED BY LEGACIES OF PAST LAND-USE.

Guntis Brumelis

University of Latvia

Humans have had tremendous impact on the World's ecosystems and understanding of their historical interactions with nature is required to determine options for management. There is a range of provisioning, regulating, habitat and cultural ecosystem services associated with each ecosystem. Novel ecosystems differing in composition and function from historical ecosystems have developed, which offer important ecosystem goods and services. In view of this, and the impact of climate change, the objective of maintaining naturalness might not even be suitable in some conservation areas. In natural to novel ecosystems, biodiversity has a profound positive effect on the functioning of ecosystems, providing a wealth of ecosystem services for human well-being. Developing spatial planning tools for conservation needs to consider functions of biodiversity in providing ecosystem services, which will depend on regional gradients in human footprint legacies. We describe, for case landscapes in biogeographical regions of Europe, the main drivers of impact on forests and the resulting characteristics of forest landscape. Within these regions we then illustrate how quantitative targets to meet the goal of conservation and enhancement of biodiversity and associated ecosystem services will differ depending on the legacies of past land-use by humans. These range from high non-use existence value in poorly accessible pristine forest, to predominantly wood production and carbon assimilation and storage services in populated but still forested landscapes, to high recreation value in regions with predominantly agricultural land use. We argue that the current and past ecosystem services offered by forests need to be considered in developing biodiversity targets and management plans in a multiple land-use setting. This presentation is based on collaborative work of 30 coauthors and stems from a workshop arranged by the network PRIFOR.



ECOSPACE - A UNIFIED FRAMEWORK FOR UNDERSTANDING VARIATION IN BIODIVERSITY

Ane Kirstine Brunbjerg

Aarhus University

Hans Henrik BRUUN, University of Copenhagen ; Jesper Erenskjold MOESLUND, Aarhus University ; Jonathan SADLER, University of Birmingham ; Jens-Christian SVENNING, Aarhus University ; Rasmus EJRNÆS, Aarhus University

Understanding patterns in biodiversity is an ever-prevalent topic in ecology and a useful framework to gain this understanding is the prerequisite for effective management. Contrary to previous ecological theories, "ecospace" is a holistic concept not constrained to specific species or species groups. We define ecospace as the multidimensional space of conditions and opportunities in which biodiversity develops. Every biotope - regardless of habitat type, area and condition - can be described in terms of its ecospace and we claim that ecospace can serve as a tool for assessing variation in biodiversity and its causes. Our definition of ecospace comprises two levels: 1) Biotope level ecospace encompasses three components: position, expansion and continuity-all affecting biodiversity of a given area (α -diversity). We define position as placement along the classical abiotic gradients, such as temperature and pH, providing an environmental template for biodiversity through 'filtering' processes. Expansion represents organic resources that are not given by position, e.g. the build-up and diversification of live and dead organic matter in the ecosystem. Continuity is defined as the spatiotemporal extension of position and expansion. 2) Landscape level metaspace is an extension of biotope ecospace and comprises variation. Variation is the spatial turnover of biotope ecospace. In general, every position is linked to a set of species from the regional species pool and the larger the expansion of an area the more habitats are available for biodiversity. At larger geographical scales biodiversity also depends on variation in positions and expansion levels. This way, even species poor biotopes with extreme positions (e.g. bogs, foredunes) can contribute to the overall biodiversity. If the concept successfully links physical and environmental factors and biodiversity the model can be used as a flexible and cost-effective predictive indicator for management and conservation.

171-LESSONS LEARNED IN THE FIRST FIVE YEARS: CONSERVATION LEADERSHIP THROUGH LEARNING

Brett Bruyere

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After five years and four iterations of the Conservation Leadership through Learning (CLTL) master's program at Colorado State University in the United States, lessons learned

and best practices emerged to help inform the future direction of the program. CLTL is an applied program focused on training practitioners, though the tradition of graduate work in the department is rooted strongly in research. After five years and four iterations of the Conservation Leadership through Learning (CLTL) master's program at Colorado State University in the United States, lessons learned and best practices have emerged to help inform the future direction of the program. CLTL is guided by values of applied and project-based learning, though the tradition of graduate work is rooted more strongly in research. While this combination provides an opportunity to bridge practice with research, it also presents unique challenges of functioning within a larger university context and culture that is conventional in its instructional delivery. In addition, the term "conservation leadership" is a term lacking a shared understanding about its definition and scope. It can encompass a wide spectrum of skills and knowledge, and therefore, the curriculum for a program in "conservation leadership" can be difficult to settle. In this presentation, best practices and lessons learned related to how these issues have been addressed and navigated within CLTL will be presented, including evaluation results from prior CLTL students and feedback from conservation practitioners about the scope of skills and content in the program.

PATHWAYS TO EVIDENCE BASED POLICY AND PRACTICE IN THE SCOTTISH UPLANDS

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University of the Highlands & Islands

Mark REED, Birmingham City University ; Steve REDPATH, University of Aberdeen ; Xavier LAMBIN, University of Aberdeen

Although evidence-based conservation is widely advocated, evidence from research represents just one of many lines of argument that compete to inform complex decisions in policy and practice. In reality, evidence is often distorted as it is passed from person to person through social networks, and is sometimes misappropriated to achieve the goals of special interest groups. Robust evidence may be overlooked by decision-makers who do not always have the time or expertise to critically interrogate its theoretical, methodological or empirical basis. Instead it is often easier to trust evidence on basis of the trustworthiness of its source, whether that be the quality of the journal it is published in or the credentials of the person who communicates it. As research funders increasingly emphasise the need for research to deliver societal and/or economic benefits, there is growing interest in tracing the pathways through which research influences decisions in policy and practice. However, few studies have focused on the perceptions of those responsible for using this evidence in policy or practice, or analysed the pathways through which this evidence reaches (or is transformed or blocked by) these actors. We addressed these aspects in a case study of the Scottish



uplands. In this presentation, we show, using social network analyses (SNA), the pathways by which evidence is exchanged between stakeholders in upland management. This illustrates the dominance of NGOs in the production and propagation of information received by land managers and policy makers. We discuss the characteristics of research findings that make them more likely to be picked up by stakeholders and the information sources that different stakeholder groups most frequently use. Finally we give the results of a qualitative analysis of stakeholder perceptions of the barriers to the use of research evidence in upland policy and practice and potential ways of overcoming these.

GENETIC VARIATION AT MHC AND TOLL-LIKE RECEPTOR GENES AND THEIR RELATIONSHIP TO DISEASE IN ENDANGERED RED WOLVES AND SYMPATRIC COYOTES

Kristin Brzeski

Louisiana State University

Michael CHAMBERLAIN, University Georgia ; Sabrina TAYLOR, Louisiana State University

Infectious diseases pose a significant threat to global biodiversity and may contribute to extinction events. Endangered populations are particularly susceptible to disease-mediated population declines because they are small and often inbred, lacking the genetic variability necessary to combat pathogens. As such, identifying factors that influence disease susceptibility, such as associations between immunogenetic variation and parasite prevalence, can help predict risk for endangered species. In this study we evaluated if immunogenetic variation or inbreeding influenced disease susceptibility in endangered red wolves (*Canis rufus*) and sympatric coyotes (*Canis latrans*). We assessed both innate (Toll-like receptors (TLR)) and adaptive (major histocompatibility complex (MHC)) immune gene variation, collected immunocompetence data, calculated pedigree inbreeding coefficients, and estimated parasite load to assess: (1) immunogenetic variation, (2) associations between heterozygosity, specific alleles, and haplotypes, and immunocompetence and parasite measures, and (3) how inbreeding influences disease susceptibility. We sequenced 4 TLR genes and 3 MHC genes, and collected immunological and parasite data from 71 canids. Coyotes had higher TLR and MHC variation than red wolves; however we detected coyote introgression which increased red wolf immunogenetic variation over time. Red wolves and coyotes had similar pathogen communities but coyotes had higher parasite diversity. Preliminary results suggest no significant associations between immune gene variation and disease, but further sequence analysis may reveal a stronger relationship. Additionally, red wolves are extremely inbred and may be more susceptible to pathogens compared to the outbred coyote

population. Our study has significant conservation value for endangered red wolves and provides novel results on the implications of reduced innate and adaptive immune gene variation in threatened populations.

COMPARING BIOGEOGRAPHIC PATTERNS OF BUTTERFLIES, ORTHOPTERANS AND VASCULAR PLANTS IN THE SWISS WESTERN PREALPS

Valeria Bucher

University of Lausanne

Manuela D'AMEN, University of Lausanne ; Jean-Nicolas PRADERVAND, University of Lausanne ; Antoine GUISSAN, University of Lausanne

Spatial modeling of community properties is a key tool for better understanding the biogeographic patterns of biodiversity components and their relation with environmental factors. Species richness is the most studied community property but little work has yet been devoted to analyze its different aspects. A particularly interesting question for modeling purposes is the effect of the rare species component on the modeling outcome. In this study, using datasets and species richness models for butterflies, orthopterans and plants in the Swiss western Prealps, we aimed at assessing (i) the influence of the "common/rare" species ratio on the model predictions for each group, (ii) the degree of similarity among the predicted biogeographic patterns of the three groups and (iii) the congruence between their potential diversity hotspots. Three richness models were built per taxon, fitted either on (i) the whole dataset (all species), (ii) the pool of common species (> 30 occurrences), or (iii) the complementary pool of rare species. For each model, we assessed its performance and the predicted richness pattern across the study area, and then identified the emerging diversity hotspots. Our results showed that performance is greater for models fitted on common species for butterflies and plants, but on all species in the case of orthopterans. For all groups, models fitted on all species predicted highest richness at mid-elevation, mostly in slopes facing south. Accordingly, predicted patterns of richness along elevation showed a clear hump-shaped curve for the three taxonomic groups when considering all or common species. Finally, diversity hotspots covered extensive areas for all groups, but overlap of hotspots for the three groups were scarce. In conclusion, richness predictions diverge whether accounting or not for rare species, with usually better model performance observed when these are excluded, likely because they are often more difficult to predict.

141 RESEARCH-LED EVOLUTION OF UK AGRICULTURE ENVIRONMENT SCHEMES TO ADDRESS FARMLAND BIRD DECLINES

David Buckingham



Royal Society for the Protection of Birds

Tony MORRIS, Royal Society for the Protection of Birds

Agri-environment schemes (AES) are the most important large-scale land management tools being used to reverse population declines in widespread farmland bird species. The design of early AES management options was based on autecological studies of declining species. Ongoing bird declines and pressure on governmental spending have necessitated further research to make AES options more effective and affordable and to develop novel solutions to problems that AES were not addressing. In this talk we will review the role of ecological research in the development of British AES options. We will include examples of approaches used in arable farming regions, where knowledge of farmland bird ecology and the development of conservation measures are most advanced. The arable situation will be contrasted with that in livestock-rearing regions, dominated by grassland. In grassland regions, bird declines are qualitatively different, but investigation of the causes and development of solutions are at an earlier stage. In addition to exploring AES measure development, we will present results of large-scale monitoring of the value of AES to bird populations. Limited progress has been made on scaling up the effects of AES measures to estimate the impact of AES on national bird population trends. We will show how this makes it difficult to answer important, practical questions posed by politicians and AES administrators: such as how much land should be managed by AES and where this AES spending should be targeted.

PREVENT HISTORY REPEATING: IDENTIFYING CORAL REEF FISH DISAPPEARANCES TO PREDICT VULNERABILITY TO EXTINCTION

Sarah Buckley

University of Queensland

Tim MCCLANAHAN, Wildlife Conservation Society; Erendira QUINTANA MORALES, Museum National d'Histoire Naturelle; Victor MWAKHA ALATI, Kenya Marine and Fisheries Research Institute; Jatiemo NYANAPAH, Wildlife Conservation Society; Levy OTWOMA, Kenya Marine and Fisheries Research Institute; John PANDOLFI, University of Queensland

Without an understanding of historical baselines, dramatic declines in population abundance and even extinctions can occur undetected. In particular, the historical exploitation and susceptibility of tropical marine species to extinction is rarely investigated. By comparing archaeological records (750- 1500AD) with contemporary catch (1995-2103) and underwater visual censuses (UVC) (1987-2013) from coastal Kenya, we revealed that 81% of the tropical marine fish species that were historically exploited are now absent. We established a list of 45 threatened coral reef fish species by conducting presence/absence tests using combinations of the catch data,

archaeological records, and UVC with the modern species list. We verified the historical decline and disappearance of threatened fish species using 288 interviews with fisher, divers and fish traders and corroborated with UVC (2013-2014). Identifying decline and local extinction of historically exploited species enabled us to predict the contemporary exploited species that exhibit similar vulnerability to extinction using fuzzy logic analysis. Knowledge gained from this research will contribute to ongoing local conservation priorities by raising awareness amongst stakeholders of species at most risk to local extinction. The results are also relevant for species-specific management and prioritization of species for conservation.

IMPORTANCE OF ETHIOPIAN SHADE COFFEE FARMS FOR FOREST BIRD CONSERVATION

Evan Buechley

University of Utah

Cagan H. SEKERCIOGLU, University of Utah; Anagaw Meshesha ATICKEM, Oslo University; Gelaye GEBREMICHAEL, Jimma University; James Kuria NDUNG'U, Front Trail Safaris; Bruktawit Abdu MAHAMUED, Manchester Metropolitan University; Tifases BEYENE, Arba Minch Crocodile Farm; Tariku MEKONNEN, Jimma University; Luc LENS, Ghent University

Coffee is the most important tropical commodity and is grown in high-priority areas for biological conservation. There is abundant literature on the conservation value of coffee farms internationally, but there has been little research on this topic in Africa. Ethiopia is a diverse and little-studied country with high levels of avian endemism, pressing conservation challenges, and where *Coffea arabica* originated. We sampled bird communities in shade coffee farms and moist evergreen Afromontane forest in Ethiopia utilizing standard mist netting procedures at seven sites over three years to evaluate bird species richness, diversity and community structure. Although species diversity did not differ between shade coffee and forest, shade coffee farms had over double the species richness of forest sites and all but one of the nine Palearctic migratory species were captured only in shade coffee. There was greater relative abundance of forest specialists and understory insectivores in forest, demonstrating that little-disturbed forest is critical for sustaining these at-risk bird groups. Nonetheless, all species recorded in primary forest control sites were also recorded in shade coffee, indicating that Ethiopian shade coffee is perhaps the most "bird-friendly" coffee in the world. This is an important finding for efforts to conserve forest birds in Africa, and for shade coffee farmers that may benefit from avian pest regulation and biodiversity-friendly coffee certifications. Biological Conservation Special Issue: Tropical Insectivores



CAUSES AND CONSEQUENCES OF AVIAN SCAVENGER DECLINES

Evan Buechley

University of Utah

Cagan SEKERCIOGLU, University of Utah

The consumption of carrion by vertebrate scavengers has been largely overlooked in ecological studies, in part due to human's aversion to decomposing matter. However, recent research has begun to illuminate its significant and valuable role in ecosystems. The world's 22 vulture species are the only obligate vertebrate scavengers and play a predominant role consuming carrion. Vulture populations have been declining at catastrophic rates in the last few decades and are currently regarded as the most threatened avian functional guild. This is due largely to anthropogenic toxins found in carrion, including the anti-inflammatory veterinary drug diclofenac, poisons used to deliberately kill mammalian carnivores, and lead from spent ammunition. Meanwhile, many facultative avian scavengers—including species of storks, gulls, starlings, ravens and crows—seem less affected by the factors causing vulture declines. In this paper we: (i) use a global database to identify all bird species for which scavenging is a major dietary component, (ii) compile data on the intrinsic ecological traits and extrinsic threats to these species, (iii) use random forest models to identify correlates with extinction risk, and (iv) discuss the implications of changes in abundances of avian scavengers. One hundred and fourteen avian scavenger species were identified from 16 families. Random forest models show that large mass, long generation length, diet specialization and reliance on carrion are strongly positively correlated with extinction risk. Two ecological traits, average mass and scavenger rank, account for a surprising 37% of the variance in extinction risk in avian scavengers. The most important extrinsic threats are dietary toxins, decreasing food availability, persecution, habitat destruction, and, for marine scavengers, fishery bycatch. Rapid declines in vulture populations are expected to have profound impacts on ecosystems and humans, including trophic cascades and disease outbreaks.

MOVEMENT ECOLOGY OF THE GLOBALLY ENDANGERED EGYPTIAN VULTURE NEOPHRON PERCNOPTERUS IN THE MIDDLE EAST AND NORTH AFRICA

Evan Buechley

University of Utah

Emrah COBAN, Kuzey Doga ; Lale AKTAY, Kuzey Doga ; Cagan SEKERCIOGLU, University of Utah

The Egyptian vulture *Neophron percnopterus* is globally endangered and declining throughout its range in Europe, South Asia, and Africa. There have been extensive efforts

to conserve Egyptian vultures in Europe, but very little is known about the ecology, status, or threats to the species in other regions of the world. We summarize data from the first satellite telemetry study on a breeding population of Egyptian vultures in the Middle East. In the past 3 years, we have tagged 13 individuals and fitted them with satellite transmitters in Turkey, Ethiopia and Djibouti. To date, we have collected over 300,000 GPS locations on these birds. This data has provided an unprecedented look at the movement ecology of the species in the Middle East and North Africa, revealing a previously undocumented migration route for the species over the Arabian Peninsula and crossing the Strait of Bab al Mandeb into Africa. To date, these birds have visited nineteen countries, migrated over 4,000 km to their wintering grounds, reached a maximum elevation of nearly 8,000 m, and traveled in excess of 50,000 km in a year. In this paper, we evaluate habitat use in both summer and winter ranges and highlight migratory strategies and routes. This information, coupled with surveys on the ground in Turkey and Ethiopia, has improved our understanding of how these birds use their environment; an important step in targeting conservation actions for this endangered species.

NEST SITE SELECTION AND RISK OF PREDATION IN THE GROUND-BREEDING WOODLARK (LULLULA ARBOREA)

Roman Bühler

University of Bern

Laura BOSCO, University of Bern ; Alain JACOT, University of Bern ; Raphaël ARLETTAZ, University of Bern

The woodlark is a ground-breeding bird, which is listed as a priority species in Switzerland. In Valais, a stronghold of this species, the birds breed in intensively managed vineyards and show a preference for parcels with ground vegetation when foraging and during territory establishment. As a ground-breeder, the species is highly vulnerable to nest predation by avian and mammal predators. The aims of our study were to investigate the effect of ground vegetation on the nest-site preference and to estimate the importance of ground vegetation on nest predation rate. Nest site selection of the woodlark was investigated by comparing woodlark nest sites to the surrounding habitat on two different spatial scales. Here we demonstrate that the woodlark shows a preference for patches of high and dense vegetation within "green" parcels and avoid parcels that have been treated with herbicides. In a follow-up experiment we conducted a study comparing the predation rate between these parcel types, i.e. among parcels with mineral appearance (<20% vegetated area) and green parcels (>40% vegetated area). Artificial nests equipped with one quail egg were distributed pairwise between two adjacent parcels that fulfilled the upper criteria and monitored by trail cameras during 10-12 days. Predation rate was significantly



higher in parcels with mineral appearance and was unrelated to the number of observed predators. These data suggest that conspicuousness of avian nests are decreased in parcels with ground vegetation and that the amount of vegetation can lower the predation risk on ground breeding birds - another piece of evidence for the importance of ground vegetation for a successful conservation of the endangered woodlark in Swiss vineyards.

124-VALUE VERSUS FACT: THE ROLE OF SCIENCE IN IMPLEMENTING THE MITIGATION HIERARCHY AND ACHIEVING 'NO NET LOSS' OF BIODIVERSITY

Joseph Bull

Imperial College London

Astrid VAN TEEFFELLEN, VU University ; Melissa TOLLEY, UNEP-WCMC

To successfully implement policies that seek to achieve 'no net loss' of biodiversity (NNL) or better, alongside economic development, policymakers and practitioners must rely upon a combination of value judgement (values) and scientific research (facts). Conservation biologists will be familiar with this combination. Here, we explore what role values and facts play in the effective delivery of NNL. We outline a general set of value judgements made in developing real-world NNL policy, using examples drawn from this symposium – e.g. whether to allow 'out-of-kind' biodiversity offsets, or permit development within protected areas. To illustrate where subjectivity ends and objectivity begins in implementing NNL policies and designing associated projects, we then give two detailed examples. The first relates to preliminary work undertaken by the UNEP-WCMC in developing an empirical basis for evaluating biodiversity offsets as a mechanism (i.e. asking whether they work, and if so, where and why). This involved mapping the location and type of all biodiversity offsets implemented in Sweden. Second, we describe an exploration of out-of-kind biodiversity offsetting in Victoria, Australia. This required simulation modeling and the implementation of a new policy interrogation framework. Our analysis shows where value judgements are made in allowing offsets to be flexible, and what the ecological outcomes of allowing flexibility might be. Overall, we suggest that important value judgements are made when developing NNL policies and implementing the mitigation hierarchy, but rarely made explicit. We illustrate various means by which conservation biology has contributed to a better understanding of NNL and more robust policymaking – and where it will continue to do so in the future.

SYMPOSIUM 64: USING OPEN INNOVATION FOR CONSERVATION

Paul Bunje

Conservation X Labs[INSTITUTE]XPRIZE Foundation

Global trends in technology and innovation are serving to disrupt industries and fields as diverse as global health and the nature of work. These advances have often led to increasing threats to ecosystems and species. But exponential changes our access to innovation and innovators, specifically through open innovation, also offer the opportunity to harness these changes in order to accelerate conservation efforts. The unprecedented acceleration and democratization of science, technology, and engineering, combined with exponential increase in global connectivity and data, gives us many new powerful tools to address global conservation challenges. Open innovation techniques provide a powerful new toolbox of ways to access the world's best minds and focus them on critical conservation needs. Key tools include prizes and challenges, crowdsourcing, crowdfunding, open analytics, hackathons, and open-source design. By assessing the ways in which tools work and how they can best be applied to different challenges, conservation professionals can rapidly expand both the universe of solutions and the ways in which technology and innovation can rapidly be deployed to counter the destruction of natural systems.

106-THE ROLE OF UNCERTAINTY AND CHANGE IN CONSERVATION CONFLICTS: A GAME THEORETICAL APPROACH

Nils Bunnefeld

University of Stirling

Symposium: NEW AVENUES FOR RESOLVING CONSERVATION CONFLICTS. Conflicts between biodiversity conservation and human livelihoods are increasing in scale and intensity and have been shown to be damaging for both biodiversity and human livelihoods. Research on ecosystem services has shown conclusively that biodiversity underpins ecosystem processes and services to ensure human livelihoods. However, this research fails to address the challenge that arises when stakeholders have competing views on how natural resources (e.g. agricultural crops, wildlife) should be managed. To demonstrate how conservation conflicts can be understood and solved, a game theoretical approach can be applied. For example, in a conflict between farmers interested in protecting their crop from a threatened species and a government agency tasked with providing a favourable conservation status for the species, the outcome of the conflict between these two stakeholders would consistently fall into a prisoner's dilemma situation, in which both gain a smaller benefit than when they both collaborate. Uncertainty in the pay-offs is not usually included in game theory but is common in natural resources and changes the pay-offs of the game. Uncertainty for example



from weather variability could impact both production from agriculture and the population abundance of the threatened species, events that would both reduce food production (crops) and the conservation pay-off (maintaining a viable population of the endangered species) according to some probability of these events happening. Here I show how uncertainty of this situation could shift the game players (farmer, wildlife authority) into a coordination game. Moving interactions between stakeholders with competing objectives from conflict to coordination and eventually collaboration will be a major step towards tackling uncertainty when making decisions in order to improve biodiversity conservation and people's livelihoods.

USING CAMERA TRAPS TO ASSESS POPULATION DENSITY OF TIGER PREY SPECIES

Jenifer Bunty

Clemson University

David TONKYN, Clemson University ; Dale MIQUELLE, Wildlife Conservation Society ; Olga ZAUMYSLOVA, Sikhote-Alin Biosphere Reserve

The conservation of tiger populations is tightly linked to the management and preservation of their prey populations. Prey populations are often elusive and threatened by habitat loss and poaching. We conducted a study to analyze the population density of tiger prey species in the Sikhote-Alin Biosphere Reserve (SABR). The aim of this project was to assess the value of using camera traps to estimate ungulate density. Camera trapping remains a controversial survey method for assessing populations when individuals are not easily identified. When assessing herd animals, the difficulty is compounded by variability in group size and the potential for individuals to be caught in multiple photographs. However, trapping rate (the number of photographs per unit time) has been established as source of information about population density. Rowcliffe et al. (2008) adapted a mechanistic model, which was originally used to describe rates of collision between gas molecules, in order to describe the rates of contact between study animals and camera traps. The adapted model is commonly referred to as the random encounter model (REM). While theoretically sound, this model remains underutilized and undeveloped for many applications. In order to test the utility of the REM on tiger prey species, we compared/contrasted the results with estimates derived from scat analysis. Scat analysis is a widely used and accepted method for studying ungulate population densities and dynamics. Our analysis suggests theoretical and practical adjustments that must be made to the REM when using it to analyze the population density of herd animals. New questions have also arisen which, once answered, will expand the already great potential of using the REM in conservation efforts and as a survey tool.

76-QUANTIFYING SUCCESS FOR BIRD CONSERVATION

Ian Burfield

BirdLife International

Stuart BUTCHART, BirdLife International

Birds are conspicuous, popular, well-known, and consequently are among the most frequent targets for conservation action. In this talk I will highlight three approaches to assessing the impact of such conservation interventions. 1) BirdLife led the development of the Red List Index (RLI) to track trends in the extinction risk of species using data from the IUCN Red List. Calculating the RLI involves determining which species have been downlisted to lower Red List categories owing to genuine improvement in their status. It is then relatively straightforward to identify which of these were driven by conservation action. 2) Conservation action more commonly leads to a species improving in status but insufficiently to qualify for downlisting, or action may avert further declines. We determined examples of the latter by identifying those species that would have gone extinct since 1994 in the absence of conservation action. 3) We also attempted to assess the magnitude of the former phenomenon for one particular type of conservation action: the protection of Important Bird and Biodiversity Areas. We found that among species for which IBAs have been identified, those with a greater proportion of such sites covered by protected areas experienced smaller increases in extinction risk over recent decades: the increase was half as large for species with >50% of the IBAs at which they occur completely covered by protected areas.

FRAGMENTATION, FIRE AND THE POSSUM: SPATIALLY EXPLICIT MODELLING IN NEW ZEALAND'S LARGEST RAMSAR WETLAND

Olivia Burge

University of Canterbury

Dave KELLY, University of Canterbury ; George PERRY, University of Auckland ; Janet WILMSHURST, Landcare Research

New Zealand has lost approximately 90% of its pre-human wetlands and 70% of its pre-human forest cover and legacies of human intervention disrupt natural regeneration even in protected areas. Awarua-Waituna is New Zealand's largest (20,000 ha) Ramsar-recognised wetland and has been subject to clearance, drainage and a heavily modified fire regime. Historically a forested wetland, Awarua-Waituna is considered to be in a stalled succession, with serotinous vegetation and altered abiotic parameters due to the legacy of disturbance. Benefits in favour of reforestation include ameliorating current and historic forest loss both within the site and region-wide, and decreasing the flammability of the wetland, facilitating a return to a more natural fire regime. We used the results of field experiments to parameterise a spatially explicit model of the



interactions between natural and anthropogenic fire regimes, cryptic herbivory, landscape flammability and the surrounding landscape matrix. We then used a combination of the field experiment results and spatially explicit modelling to assess the relative importance of constraints to forest regeneration within the wetland, and assist with management prioritisation. Field experiments revealed cryptic herbivory masquerading as abiotic constraints compounded by fragmentation effects on bird dispersal services. Overall, future wetland scenarios clustered on the key variables of herbivory/predation rates, anthropogenic fire rates and the size and spatial arrangement of seed source. We found herbivory and seed predation was a key parameter of forest regeneration failure within the wetland, affecting both the amount and spatial structure of forest remnants. Field experiments in the study system uncovered previously unappreciated constraints, complementing the ability of spatially explicit models to evaluate succession under multiple management scenarios.

METHODS FOR ELICITING AND COMBINING EXPERT OPINIONS ABOUT FACTS

Mark Burgman

University of Melbourne

Most decisions in conservation biology depend on subjective expert opinion, to some extent. Yet, the methods for acquiring and combining expert judgements are typically naive and untested, creating the potential for unacknowledged biases and inadvertent misunderstandings to cloud decision making. This presentation outlines the latest developments in methods for eliciting judgements from experts about quantities and the outcomes of future events. The performances of approaches are assessed against data and recommendations are presented that lead to generally robust and relatively accurate assessments. The presentation outlines where more work is urgently required.

THE CRANES OF SHANGRI-LA AND THEIR RESPONSE TO SEVENTEEN YEARS OF HABITAT CHANGE IN CHINA'S YUNNAN PROVINCE.

James Burnham

University of Wisconsin-Madison

Matthias BAUMANN, Humboldt University; Heqi WU, Kunming Institute of Zoology

Habitat loss is routinely cited as one of the biggest contributors to the current decline in the world's biodiversity. Wetland loss due to human activities, in particular, is frequently linked threatened or endangered species around the globe. Documented patterns of habitat loss and corresponding declines in biodiversity, however, are often over-simplified and frequently under-represent the nuanced relationships

that exist between human communities and flora and fauna within dynamic wetland ecosystems. Using an alpine wetland in China's northwestern Yunnan Province named Napahai as a case-study, we obtained wintering locations for a threatened waterbird, Black-necked Cranes, over two years with satellite telemetry devices. After creating a land-cover classification map of Napahai from a 2010 SPOT-4 image using a supervised classification method, we determined that wintering Black-necked Cranes used water, wetland vegetation and wetland bare classifications disproportionate to their availability. We then used these methods to classify five Landsat images from 1992-2009 and, using post-classification rules, clumped land-covers into habitat and non-habitat maps. With these maps, we quantified how land-cover and habitat at Napahai changed from 1992-1999 and linked these changes to Black-necked Crane surveys. Contrary to established patterns of human-driven loss of wetlands, our analyses at Napahai show a distinct pattern of habitat increase from 1992-1999, from the construction of water impoundment structures within the wetland. After an airport was built in 1999, impervious urban areas expanded rapidly through 2009. Land-cover patterns are reflected by an increase in cranes from the late 1980's through the late 1990's and then a rapid decline during the early 2000's. These results present a more complete picture of how landscapes change over time and indicate that not all human development equates directly to habitat loss for species of concern.

FORAGING BEHAVIOR OF THREE SYMPATRIC EQUID SPECIES IN THE MONGOLIAN GOBI: A STABLE ISOTOPE APPROACH

Martina Burnik Sturm

Research Institute of Wildlife Ecology

Christian C. VOIGT, Leibniz Institute for Zoo and Wildlife Research (IZW); Ganbaatar OYUNSAIKHAN, Great Gobi B Strictly Protected Area Administration; Petra KACZENSKY, Research Institute of Wildlife Ecology

The conservation and management of threatened and endangered species is increasingly challenged by resource needs of an ever increasing human population. A good understanding of behavioral patterns is an essential element in making better management decisions which may help increase the effectiveness of conservation programs. We studied foraging behavior of three sympatric equid species in the Dzungarian Gobi in southwestern Mongolia: the re-introduced endangered Przewalski's horse (*Equus ferus przewalskii*), the endangered Asiatic wild ass (*Equus hemionus*), and a potential competitor the domestic horse (*Equus caballus*). Using segmentally cut tail hair, a biological archive that contains chemical information about what the animals have been eating in the form of carbon stable isotopes obtained from food, we were able to reveal species specific differences in the



feeding patterns. A stable isotope mixing model revealed that both horse species are hypergrazers that only include higher amount of browse (>20%) in their food under extremely severe environmental conditions. The feeding pattern of the Asiatic wild asses, on the other hand, is highly seasonal switching from being hypergrazers in the summer to mixed-feeders (including up to 65% browse) in the winter when food availability is lowest and competition with other wild and domestic grazers highest. Our results suggest that differences in foraging adaptations facilitate the coexistence of horses and asses in the same habitat, but that competition between Przewalski's horses and domestic horses is likely high, particularly during times of food shortage. Our findings will help optimize resource allocation (grazing permits and winter camp position) between semi-nomadic people and their domestic animals on the one hand and Asiatic wild asses and Przewalski's horses on the other hand and will thus help to improve ongoing conservation strategies.

RESTORING POPULATIONS OF METROSIDEROS ROBUSTA, A ONCE-COMMON NEW ZEALAND HEMIEPIPHYTE

Bruce Burns

University of Auckland

Metrosideros robusta used to be a common emergent tree of many New Zealand forests from which it is today rare; its decline driven by its high palatability to the introduced *Trichosurus vulpecula* brushtail possums. I review evidence of the former abundance of *M. robusta* within New Zealand forests and compare these to its current extent showing its dramatic decline and dieback in many areas. The regeneration ecology of *M. robusta* is complex as it establishes as an epiphytic seedling in natural forests then develops a trunk from roots that reach the ground (i.e., a hemiepiphyte). Natural seedlings occur most commonly on large host trees (> 50 cm diameter) and preferentially on certain host species. I report on an experiment to determine methods to restore hemiepiphytic *M. robusta* populations to forests with limited or no brushtail possums. At Zealandia - Karori Sanctuary, Wellington, New Zealand, in the absence of brushtail possums, the survivorship, and root and stem growth of 200 northern rata seedlings 'planted' on trees as epiphytes were assessed over five years against multiple factors including host species, host diameter, rooting volume, light environment, location on trunk, and aspect. Survivorship was lowest in the summer of the first year due to seedlings drying out, but increased dramatically after this. Survival and root growth were greatest on trees with smooth bark, in seedlings planted with larger rooting volumes, and in intermediate light environments. Stem growth was low in all seedlings until roots had contacted soil, indicating high allocation to root growth at this stage of the life cycle.

Water availability is a key factor limiting growth and survival of juvenile *M. robusta*. Conservation of this formerly key hemiepiphyte species in New Zealand forests will be enabled by controlling brushtail possum populations and strategic location of supplementary seedlings.

A CRASH-COURSE IN CONSERVATION ENTREPRENEURSHIP

Falko Buschke

University of the Free State

Most of us are familiar with the concept of commercial entrepreneurship, which focuses on creating a demand for new products and services. However, there is a newer brand of entrepreneurship – social entrepreneurship – that aims at serving basic, long-standing needs more effectively. Here I briefly introduce the concept of social entrepreneurship within a conservation context. There are several reasons for embracing an entrepreneurial approach to conservation. First, smaller conservation startups can tolerate more risk than conventional conservation organisations and are, therefore, more likely to experiment with innovative solutions to pre-existing problems. Second, some modern conservation problems, such as the need to evaluate, synthesise and summarise the outcomes of past conservation interventions, are amenable to entrepreneurial solutions without needing large organisational structures. Third, novel fundraising tools make launching a conservation startup easier than it has been in the past. Fourth, conventional conservation has traditionally relied on unpaid interns and volunteers, so an entrepreneurial culture offers young conservationists alternative career opportunities. Finally, individuals with certain personality traits, especially those with an internal locus of control, are naturally more suited for entrepreneurial activities. There are already many examples of self-started conservation projects, but these are probably unknown to the broader scientific community. To help embed such startups within mainstream conservation, I introduce an open, online collection of case-studies to inform, and possibly inspire, curious conservation entrepreneurs. Although conservation entrepreneurship will never replace conventional conservation, it may complement existing efforts and ultimately help to protect nature more effectively.

DIFFERENTIAL IMPORTANCE OF PASTURE SIZE AND GRAZING CONTINUITY FOR THE CONSERVATION OF DUNG BEETLES

Joern Buse

University Koblenz-Landau

Martin Slachta, University of South Bohemia ; Frantisek

Sladeczek, University of South Bohemia ; Markus Pung, University



Koblenz-Landau ; Thomas Wagner, University Koblenz-Landau ; Martin Entling, University Koblenz-Landau

Habitat area and continuity are both key issues in conservation biology. Since dung beetles are both functionally important and highly threatened organisms typical of pasture areas, we analyzed how grazing continuity and pasture area affect species richness, functional groups, and threatened species. We used literature and own field data to study a chronosequence of 22 pastures in five Central European countries. Our results show that grazing continuity has a strong positive effect on total species richness especially within the first hundred years of permanent grazing. Richness of habitat specialists increased more strongly with grazing continuity than in generalists. In contrast, the number of red-listed dung beetle species increased strongly with pasture area, leading to higher proportions of red-listed species on large than small pastures. Due to the long time needed for establishment of specialist species, priority should be given to the conservation of existing old pasture areas, and new areas should ideally be connected to source habitats for colonization. To ensure long-term survival of red-listed dung beetles there is a need for relatively large pastures (> 130 ha) or a coherent network of small pastures in a region.

IMPLICATIONS OF PHYSIOLOGICAL TOLERANCES AND EVOLUTIONARY ADAPTATION ON CONSERVATION OF SPECIES AND COMMUNITIES UNDER CLIMATE CHANGE

Alex Bush

CSIRO

Renee CATULLO, CSIRO ; Karel MOKANY, CSIRO ; Simon FERRIER, CSIRO

Species Distribution Models (SDMs) assume that species' occurrences reflect their environmental preferences, but in many cases a species range may not be limited by physiological tolerances, and in addition, those physiological tolerances may change over time. Likewise models that predict turnover in community composition (e.g. Generalised Dissimilarity Modelling: GDM) based on environmental differences in space, may overestimate the rate of change over time. Therefore the capacity for species to tolerate or adapt to climatic shifts has clear implications for our understanding of species potential responses to climate change, and consequently how we evaluate risk and prioritise conservation. We present results from two new methods designed to incorporate estimates of physiological tolerances and adaptive capacity into models of species distributions. To address adaptive capacity for the modified-SDM approach, we used detailed data of the genetics and thermal traits of *Drosophila*, and show how species persistence in the landscape is likely to be affected by the rate of climatic change, the presence of extreme events,

the rate of dispersal, and heritability of traits such as thermal tolerance. A variety of methods can be used to infer adaptive capacity and for large communities like Australian reptiles and plants we used indirect estimates to predict the capacity for diverse assemblages. The modified-GDM approach accounts for such tolerances and highlights where lags in predicted turnover would occur in the future, and therefore where in the landscape there is the least capacity to resist change, and where biodiversity retention may be higher than expected in the future. Under severe climate scenarios change will be inevitable as most species' capacity to resist and adapt is limited. These extended modelling approaches bridge the gap between our knowledge of ecology and physiology, and spatial predictions, to better inform our management actions in the future.

WAVES IN THE FOREST: SPECTRAL ANALYSIS FOR TROPICAL FOREST PHENOLOGY

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Flicking on and off like LED lights at Christmas, the trees of a tropical forest come in and out of flower and fruit in a diverse array of complex cycles. How then in a chaotic natural environment can we recognise and measure these phenological cycles and pull apart the mechanistic and adaptive factors that drive them? Previous work to describe and compare tropical phenology has leaned heavily on qualitative categorisation of phenological behaviour (e.g. continuous, sub-annual, annual, supra-annual), losing information from the raw data and limiting our ability to compare within and between species and detect change. With unique access to thirty years of weather and tree phenology data (750+ trees of 88 species) from Lopé NP, Gabon we are developing spectral time series analyses (based on sine waves) to test links between forest phenology and climatic cycles. Spectral analyses enable efficient use of data to quantitatively identify and assign confidence to dominant cycles. These descriptors (frequency, amplitude and phase) can then be used to test hypotheses of ecological function. Using simulated data and case studies from Gabon we will demonstrate the diversity of cyclic behaviour and synchronisation amongst tropical trees in relation to climate variables, from species whose reproductive cycles are synchronous and ordered around seasonal and annual cycles, to a species that reproduces asynchronously with individuals operating on a 16-18 month cycle. Successful adaptation of forest management to climate change first requires understanding of vulnerability. Current phenology of central African forests is poorly understood and



yet the consequences of change under future climate scenarios will affect animal communities and people depending on the forest. As climate change increases the occurrence of extreme climatic events we show that these tools give us much greater power to identify cascade effects for tree phenology that relies mechanistically on climate signals.

33-NAVIGATING OVERLAPPING AND MULTIPLE ACCOUNTABILITIES IN MULTISCALAR CONSERVATION NETWORKS: LESSONS FROM THE COLLABORATIVE FOREST LANDSCAPE RESTORATION PROGRAM

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This paper examines the interplay between formal and informal accountability in conservation networks through a study of the Collaborative Forest Landscape Restoration Program (CFLRP). Networks are increasingly viewed as preferred avenues for addressing complex environmental problems that cross regional boundaries and operate at multiple scales. CFLRP participants, representing nonprofits, private sector organizations, and public agencies, have developed collaborative networks operating at two scales: landscape scale multistakeholder collaboratives and cross-collaborative networks. Through interviews, field observation, and document analysis, we examine network interactions at both the landscape collaborative scale and at the cross collaborative network scale to gather participant perspectives and explain how network activities are shaping restoration practice on the ground. Utilizing a grounded theory approach, we are especially interested in practitioners' experiences of accountability and responsibility to and with each other. In non-hierarchical network contexts, systems of accountability are less structured and less visible than many contractual intergovernmental or intersectoral relationships. CFLRP participants demonstrate that the principles of felt responsibility and reciprocity afford opportunities for holding themselves and each other accountable. However, individual network participants operate in governmental and regulatory contexts that are constrained by formal monitoring and accountability systems. As a result, when there are competing claims on staff time or resources, it is difficult to prioritize network activities over activities related to regulatory or funder demands. Within this context, we identify how network participants capitalize on the benefits of networks—informality, adaptability, and flexibility—while also maintaining accountability to each other for accomplishing shared goals in conservation and restoration work.

VULNERABILITY OF TURTLE NESTING BEACHES OVER THE NEXT 50-100 YEARS.

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Marine turtles globally are at risk from climate change. We focused on two species that nest across northern Australia, loggerhead *Caretta caretta* and hawksbill *Eretmochelys imbricata*, and parameterized the biophysical characteristics of their nesting beaches in Western Australia, Northern Territory and Queensland. We used climate change projections to identify which beaches may not be suitable for nesting in future. Beaches in all locations are predicted to experience increased maximum temperatures, such that sex ratios will become increasingly female-skewed, and embryo viability will be threatened at beaches in Western Australia and the Northern Territory. Overall, beaches in Queensland are less likely to flood than those in WA and NT, under sea level rise, although all beaches are predicted to experience increases in flooding, and some sites are projected to be below sea level by the end of the current century. Beaches currently not used for nesting, but which may be suitable in future, were also identified, and we suggest that these should come under conservation protection.

RISING TO THE TOP: VOLCANIC AGRO-FOREST PLANTATIONS AND THEIR EFFECT ON THE POPULATION OF JAVAN SLOW LORISES (NYCTICEBUS JAVANICUS)

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Oxford Brookes University

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The latest trend in Java's agricultural landscape is labu (*Sechium edule*). These vegetables grow on a lattice framework made of bamboo. The smallest of labu plantations require 110 bamboo trunks with an annual upkeep of 60 more trunks. An important population of critically endangered Javan slow loris (*Nycticebus javanicus*) is being studied in the agroforests of Cipaganti village on Mt. Papandayan, Java, Indonesia. Labu plantations within the study site have increased from 3 to 24 in 2014, and bamboo cover has been reduced by 85%. Bamboo (various spp.) represents critical habitat for the slow loris as it provides preferred sleeping sites. As a nocturnal primate targeted by the illegal pet trade, safe and cryptic sleeping sites are of the utmost importance for their survival. The agroforest mosaic environment is not well connected for the arboreal lorises which are now routinely recorded walking along the ground from tree to tree. Lorises have also been observed using the labu plantations as a bridge between forest fragments. This



study aims to determine if the loss of sleeping sites outweighs the increased connectivity of fragments throughout the study area. The increase in labu plantations and decrease of bamboo patches have been measured every 3 months for the last year. Radio-collared slow lorises ($n=17$) were followed at night to record their ranging behaviour. All occurrences of ground-walking and labu usage were recorded including bout length, distance covered and observed destination. Sleep site locations were recorded once a week for all individuals. Loris habitat was mapped using ArcGIS to quantify the connecting effect of the labu. Results indicate there is a marked decrease in ground-walking as labu plantations become more prevalent. Slow lorises are vulnerable to predation by dogs, cats and owls while on the ground, therefore, the effects of the labu may increase survival.

181 BALANCE AND TRADE-OFFS IN CLIMATE-ORIENTED CONSERVATION PLANNING IN THE EU

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Conservation is often about trade-offs: trade-offs between biodiversity on the one hand, and economic, social or cultural interests on the other. It often also implies trade-offs between the different biodiversity features we want to protect. Climate change adds yet another dimension to be considered and balanced. This talk will draw on recent studies with a focus on the EU to illustrate a few, often neglected, trade-offs. The impacts of climate change mean that the optimal allocation of conservation resources in the present is likely to be suboptimal for future conservation. Consequently, there is a need for proactive planning given projected climatic changes. Sophisticated methods for spatial conservation planning have been developed to account for the shifting distributions of species under climate change. These approaches often target areas expected to remain climatically suitable for the given species or habitats in question, and/or areas that are expected to receive species tracking climate change, either by functioning as linking corridors or by becoming future distribution cores. Such planning exercises often rely on rather uncertain future projections, giving equal weight to both present distributions and projections. Due to limited resources, this may result in forgoing current conservation needs to preserve uncertain future conservation hotspots. I will present examples of such trade-offs between current and future conservation needs and discuss ways of balancing them while accounting for uncertainties in projections. I will then reflect on whether current EU conservation funding schemes, such as cohesion funds, support near-future conservation needs. I will also discuss additional trade-offs that require consideration when planning for climate change at the EU-level, including mitigation and adaptation trade-offs.

ARE HUMAN-RELATED PROCESSES OR JUST NATURAL PREDISPOSITION THE DRIVERS OF INVASION? AN AUSTRALIAN PERSPECTIVE

Hernan Caceres

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Matthew MCKINNEY, The University of Queensland ; Salit KARK, The University of Queensland

The distribution of introduced species is influenced by both human and natural factors. Understanding the factors that best predict the establishment of invasive species can help us improve the effectiveness of management strategies. We examined the relative importance of anthropogenic and natural factors in shaping the richness of alien mammals across Victoria, New South Wales, and Tasmania. We developed a database of mammal introduction events and occurrence records of exotic mammals for these territories of Australia, beginning in 1775. We used Hierarchical Partitioning on 50 km² grid squares to identify the relative importance of factors in their modern distribution. The strongest predictor for the number of alien mammal species was native mammal richness. This is consistent with the hypothesis that the presence of habitats with high productivity which support more native mammals also enable the establishment of more exotic mammals. In line with this is the second best predictor for alien mammals richness, which is the greenness of an area, as determined the remotely sensed index NDVI. Thus, the establishment of alien species in South-East Australia is best explained by a combination of environmental and biotic factors.

ADDRESSING SOURCES OF UNCERTAINTY IN CONSERVATION DECISION-MAKING UNDER FUTURE FIRE REGIMES

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Fire regimes will change in the future due to global warming. These changes will impact many species across many ecosystems. However, the magnitude and direction of fire regime changes are uncertain. When predicting the impacts of fire regime change on biodiversity, uncertainty about future fire regimes is compounded by a lack of knowledge about species specific responses to fire. Incomplete process knowledge can be characterised as multiple competing models or hypotheses. Unfortunately, it is not common practice to propagate competing process models in population viability analyses nor in evaluating management options. Here we attempt such a feat, analysing the 50-year viability of the



great desert skink (*Liopholis kintorei*) in central Australia. Metapopulation models can suffer from uncertain predictions about population trajectories and extinction risks. However, the real value of these models is in explicitly teasing out the sources and forms of that uncertainty, highlighting what is possible under explicitly stated assumptions. Metapopulation models enable a coarse ranking of options with transparent risk profiling, providing a defensible strategy for prioritizing management decisions. We evaluated the impact of three future fire regimes on the medium-term viability of the great desert skink, under multiple competing hypotheses about the response of the species to fire. The impacts of the different fire regimes outweighed uncertainty in species-fire responses, making the management objective that was most robust to extinction risk clear; to avoid a regime involving frequent, large fires. This will require intensification of efforts by managers to promote patchy, low intensity fires in times of low fire risk, and to suppress large, summer wildfires. We identified the model and scenario assumptions with the greatest influence on the medium-term viability of the great desert skink and the management options most commensurate with its persistence.

ACOUSTIC TELEMTRY REVEALS CRYPTIC RESIDENCY OF WHALE SHARKS IN A COASTAL AGGREGATION

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University of Canterbury

Jesse E M COCHRAN, King Abdullah University of Science and Technology; Christoph A ROHNER, Marine Megafauna Association; Clare E M PREBBLE, Marine Megafauna Association; Tane SINCLAIR-TAYLOR, King Abdullah University of Science and Technology; Simon J PIERCE, Marine Megafauna Association; Michael Lee BERUMEN, King Abdullah University of Science and Technology

Whale sharks, *Rhincodon typus*, the world's largest fish, are considered highly migratory and have been documented to move large distances. They are most frequently observed at a few predictable seasonal aggregation sites in tropical and subtropical seas. Here, in an aggregation site in Mafia Island, Tanzania, we compare two years of *R. typus* visual survey records to concurrent tracking of 30 acoustically tagged individuals. Sightings revealed a clear seasonal pattern with a peak between October and February, and no sharks observed at other times. In contrast, acoustic telemetry showed that *R. typus* stay year-round in the same area, but utilise a different habitat in the off-season, swimming deeper and further away from shore, presumably in response to prey distributions. This behavioural change masks a cryptic residency that was not detected by visual surveys. Management approaches for most marine planktivorous megafauna are based on the assumption that individuals disperse during the long "off-season". However,

here we demonstrate, for the first time, year-round residency of un-provisioned, individual *R. typus* at an aggregation site with residency patterns comparable to those of smaller and more sedentary elasmobranchs like grey reef and blacktip reef sharks. Our results suggest that conservation measures, in particular for charismatic marine megafauna for which citizen science is usually a primary source of information, should not rely on a single technique to infer the movement ecology of the target species.

SYMPOSIUM #20. GORILLAS IN THE CLOUD: INTEGRATING ELECTRONIC DATA COLLECTION AND A WEB-HOSTED DATABASE TO BETTER STUDY AND PROTECT MOUNTAIN GORILLAS

Damien Caillaud

The Dian Fossey Gorilla Fund

Tara STOINSKI, The Dian Fossey Gorilla Fund

A quarter of the critically endangered mountain gorillas living in the Virunga massif is currently studied by the Karisoke Research Center in Rwanda. Every day, a variety of data – demographic, ranging, behavioral, health – are collected on over 120 gorillas living in 8-10 gorilla groups. Due to the time necessary to enter and clean large amounts of data, the delay between data collection and analysis can be substantial. To reduce this delay and increase the quality and volume the data, we developed an integrated electronic data management system. A custom-made application for tablet computers was created to collect data on the social behavior, activity patterns, health and spatial distribution of the animals. Every day the tablets automatically send the new data to an SQL database hosted on a server in Rwanda. This local database is then synchronized with a Cloud database accessible through a user-friendly graphical interface. Statistical software R is also installed on the Cloud server and allows running a set of standard demographic and network analyses within a few days after the collection of the data. This data management system allows researchers to rapidly detect subtle changes in the social structure and demography of the mountain gorillas and is becoming an important tool for gorilla conservation. The data collection software and the structure of the SQL database are available to the community of behavioral scientists and conservationists and can be tuned to suit a large number of study species and protocols.

FRENCH OBSERVATORY OF LITTORAL NATURAL HERITAGE: A COLLABORATION BETWEEN MANAGERS AND SCIENTISTS TO DEVELOP AN EFFICIENT MARINE PROTECTED AREAS MANAGEMENT STRATEGY

Marion Caille

Réserves Naturelles de France



Aurélien BESNARD, CEFE/CNRS/EPHE ; Emmanuel CAILLOT, Réserves Naturelles de France

The coasts of France are prominent in Est-Atlantic flyway for coastal waterbirds as migrating stopover and wintering areas. Since 1977, France contributes to the International Waterbird Census organized in January by "Wetlands International". In parallel, managers of some French Marine Protected Areas (MPAs) developed a monitoring network to extend this census every month over the year. Created in 2000, this network, named "Observatoire du Patrimoine Naturel Littoral" (Observatory of Littoral Natural Heritage), progressively included unprotected areas. This aims at assessing the efficiency of conservation strategy developed in protected area. The monitoring method was co-constructed with scientists, to mix both feasibility on the field and cost-efficiency and scientific rigor. Method of data collection as well of their analysis was validated by an ad-hoc "Scientific and Technical Committee". All collected data are grouped into a unique database and are used to develop indicators of coastal waterbirds population status. They aims at answering managers' questions about the role of protected sites at different spatial scales (local, regional, national, international) and at helping public policy in implementation of the European Marine Strategy Framework Directive. This observatory is now extending to other thematic, such as survey of intertidal benthic habitats or nursery role of salt marshes for fish, to overcome management challenges and understand littoral ecosystems functionalities. The process of this observatory building and the report of its 14 first years will be presented and discussed.

TEMPORARY WETLANDS: CHALLENGES AND SOLUTIONS TO CONSERVING A "DISAPPEARING" RESOURCE

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Fluctuating flood/dry cycles and support of unique, highly specialized species assemblages characterize temporary wetlands, including vernal pools, temporary ponds, gilgais, and prairie potholes. As small aquatic features embedded in a terrestrial landscape, temporary wetlands enhance biodiversity and provide valuable aesthetic, biogeochemical, and hydrologic functions. Primary challenges to conserving temporary wetlands include the need to: (1) integrate freshwater and terrestrial biodiversity priorities; (2) conserve entire "pondscapes" defined by connections to other wetlands and terrestrial systems; (3) mitigate economic impact on

landowners when conserving widely distributed, relatively small features that often fall on private ownerships; and (4) work within limited or non-existent regulatory protections. We propose new paradigms for conserving temporary wetlands in increasingly human-altered landscapes that integrate command and control top-down management and bottom-up, collaborative, relatively local approaches driven by key stakeholders. Because all wetlands function as integral landscape components, not singly as isolated entities, the cumulative loss of wetlands, particularly small natural features, is detrimental to ecosystem functions, but not currently part of the conservation calculus. We postulate that alternative regulatory strategies falling midway between individual pool conservation and conservation of landscapes at scales as large as ecoregions are needed to manage small natural features at scales that are ecologically and economically relevant. Flexible conservation strategies that reduce landowner and manager costs while achieving socio-ecological objectives will have the greatest probability of success in maintaining fully functioning landscapes. We can move toward this paradigm by tailoring conservation to local needs through stakeholder-generated solutions coupled with government engagement at multiple levels.

126. A PARTICIPATORY FRAMEWORK TO ASSESS MULTIFUNCTIONAL AGRICULTURE: CASE STUDY AGROBIODIVERSITY IN AGROFORESTRY SYSTEMS OF TOME ACU IN NORTHERN BRAZIL

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The multifunctionality of agroforestry systems was assessed by applying multicriteria and multivariate analyses to identify ecological, agronomic and administrative proxies and integrate these into factors, and evaluate their effects on the overall system performance. This assessment framework was tested in 70 farms in the municipality of Tomé-Açu in the Brazilian Amazon, an area well known for its long-standing practice of agroforestry. The overall goal was to identify management decisions that ensure sustainable production of goods and the provision of ecosystem services, with special emphasis on agrobiodiversity. Three groups of farmers were considered based on their period of settlement, property size, technological know-how, organization and access to the market. The results show that the determinant factors of multifunctional farming are the farmers' technical qualification, good adaptability, environmental commitment and the search for financial profitability. However, the optimization of these factors leads to trade-offs such as a decrease in biomass and woody species diversity and the decline of by-product production. By considering stakeholders' opinions and being adaptable to various demands, the proposed framework



enhances the legitimacy of the results, and may address both the assessment of complex issues and decision-making advising.

ID124_ CAN WE ACHIEVE THE “NO NET LOSS” OF BIODIVERSITY THROUGH MITIGATION BANK SYSTEM? EMPIRICAL EVIDENCES FROM THE FRENCH EXPERIMENTATION

Coralie Calvet

INRA

Claude NAPOLEONE, INRA ; Thierry DUTOIT, CNRS_IMBE ; Harold LEVREL, AgroParisTech

Biodiversity offsetting is promoted as one of the relevant tools to halt the current ecological crisis. As a way to achieve more effectively the “No Net Loss” of biodiversity, mitigation banks are attracting a growing interest from politics at both national and international scales. Whilst this tool is increasingly being used, its ability to reach conservation targets is still debated. We propose thus to investigate the strengths and weaknesses of mitigation banks mechanism from an institutional economics perspective. We used empirical evidences resulting from the analysis of the first mitigation bank implemented in France in 2008 by “CDC Biodiversité”. We carried out a field research study of this bank focusing on four complementary aspects: i) the role of stakeholders in the implementation of the bank, ii) the actual achievement of ecological restoration plan, iii) the dynamics of biodiversity credits sold by the mitigation bank and iv) the influence of the specific institutional framing of this French case study. Our results showed that, from ecological perspectives, restoration actions were successful on short time scale in allowing the return of targeted birds in restored areas. However, strong uncertainties challenge the durability of this recovery over the long term. The economic analysis revealed failures in the organization of the bank questioning the viability of the mitigation scheme over time. Besides, we found evidences for strong influence of the institutional framing on the bank effectiveness. Indeed, we further revealed that the lack of clear and stabilized offsetting rules led to the emergence of opportunistic behaviours resulting from bargaining between stakeholders that tend to jeopardize the objective of biodiversity protection. This analysis allowed us to draw lessons on the mitigation bank mechanism and to conclude on possible improvements of this tool.

OPTIMIZING THE TRADE-OFF BETWEEN LEARNING AND DOING IN PROTECTING SPECIES’ HABITATS

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Species’ habitats should be identified as accurately as possible to maximize the benefit to conservation and minimize the costs of habitat protection. However, delaying habitat protection to improve accuracy could result in additional habitat loss in the interim. Determining how much time to invest on learning about species’ habitats is therefore important to maximize the accuracy of habitat identification while still allowing for timely protection. To address this question, we expressed the total area of habitats that can be correctly identified as a function of habitat loss and learning over time. We then optimized the trade-off between learning and doing by determining the amount of time spent on research that results in the maximum area of habitat that can be correctly identified and protected. We used linear, hyperbolic, and sigmoid functions to simulate learning over time, and the loss of up to 10% of available habitat area per year to simulate ongoing habitat loss. As predicted, the optimal time to spend learning decreased with increasing rates of habitat loss. When only 1% of habitats are lost per year, the optimal time is determined by the learning rate. For example, given a false positive identification rate of 0.5, the optimal time varied from 15-19 years for sigmoid curves to 5-7 years for hyperbolic curves. However, when habitat loss is 5% per year or greater, the optimal number of years becomes 3 years or less, regardless of the learning rate. This approach to determining the optimal time for learning highlights the need for timely protection when the threat of habitat loss is high, and the benefits of greater accuracy in identification when habitat loss occurs slowly. It can therefore serve as a useful tool for guiding the allocation of conservation resources towards research or habitat protection, for instance, in determining the amount of time to spend on research before designating critical habitats for threatened and endangered species.

EDUCOMMUNICATIVE STRATEGIES FOR THE APPROPRIATION OF THE CONSERVATION OF AMPHIBIANS AND BUTTERFLIES FROM NORTHEASTERN COLOMBIA

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The appropriation of environmental education and the communicative divulgation about fauna in Colombia has gained relevance since the country has been positioned as the second in richness of species of butterflies (3,274) and amphibians (771). Few studies concerning fauna have



been reported in Northeastern Colombia, so there is a lack of information, which results in ignorance among local communities. This scenario motivated us to gather the results of research concerning diurnal butterflies and amphibians from the department Norte de Santander, in order to build plans of environmental education that contribute with the conservation, safeguarding and appropriation of the biodiversity, based on the transformation of communication towards social change. Three rural zones associated to ecosystems of Tropical Dry Forest, Sub Andean forest and Paramo where identified and all available literature and photographic material of amphibians and butterflies was classified for each ecosystem in the study area. From an educative perspective we applied 150 semi structured interviews and invested 240 hours to do direct observations in the rural communities to carry out qualitative descriptions. Results from previous scientific research reported 59 species of amphibians and 245 species of diurnal butterflies; also regarding the perception of rural communities it has been identified a low safeguarding of the natural resources and lack of awareness of the species; however, two species, *Evenus coronatay* *Gastrotheca helenae*, exhibit high acceptance among local communities, facilitating their protection and the consequent sustainability of the forest. Aware of the importance of these species in the study area and taking into account the participation of local communities, we designed an strategic plan of communication that could serve as awareness raising agent, in which local knowledge can be integrated and applied towards the preservation of the environment.

DERIVATION OF A HIGH RESOLUTION LAND-COVER MAP OF THE WESTERN SAHARA-SAHEL TRANSITION ZONE FOR LOCAL BIODIVERSITY CONSERVATION

João Carlos Campos

InBIO-CIBIO

José Carlos BRITO, InBIO-CIBIO

Remote Sensing (RS) has proven to be an important tool for conservation, allowing the detection, mapping and prediction of environmental properties and changes. The Sahara desert and the semi-arid Sahel represent two major African ecoregions, and their limits correspond to the transition between the Palearctic and Afro-Tropical biogeographical realms. The western Sahara-Sahel constitutes a major biodiversity corridor between realms due to the moderate climate influenced by the Atlantic Ocean, thus comprising high biodiversity levels, local endemics and high habitat heterogeneity. Such heterogeneity is usually undetected in habitat-related variables derived by RS at global scales. This represents a major limitation for local biodiversity conservation and management, particularly in areas subjected to growing resource exploitation. This study aims to create a high

resolution land-cover map (30x30m) of the western Sahara-Sahel transition zone. A total of 123.000 GPS-control points and associated habitat-descriptive traits (e.g. soil type, water availability) were collected during four overland expeditions to Mali, Mauritania, and Morocco (2011-2014). 242 points were grouped according to habitat traits by hierarchical cluster analyses (HCA) and further implemented in supervised classifications of Landsat 8 images. Results were validated by a set of 20.000 independent points. The extensive field effort allowed collecting a major dataset that was crucial for classifying and validating a high resolution land-cover map of extensive arid and semi-arid regions. The HCA provided an observer-independent method for a priori selection of habitat classes. The land-cover map provided accurate information on habitat distribution in a region where resource assessment represents a major priority. The Land-cover map derived constitutes framework data for understanding local biodiversity distribution and improving the effectiveness of conservation solutions (e.g. reserve design).

THE USE OF AGROFORESTS OF TEAK BY LARGE AND MIDSIZED BRAZILIAN AMAZONIAN MAMMALS IN THE ARCH OF DEFORESTATION

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Angele OLIVEIRA, UNEMAT

Deforestation of tropical forests is globally known as a priority task to biodiversity conservation. Management of agroforestry systems aims to reconcile economic profit and the ecosystems conservation. Some agroecosystems, however, may be less permeable to the fauna community than others. This study assessed the influence of an agroforest of teak on the abundance of large and midsized Amazonian mammals in Mato Grosso, Brazil. Twelve trails, evenly placed in the forest and in the agroforest of teak, were assessed by linear transects (3.5 to 5 km), totalling 485 km of walked trails. We recorded (sights and tracks) 27 large and midsized mammals, seven Orders and 16 Families, including eight endangered species. Only five species sighted (*Ateles chamek*, *Lagothrix lagotricha*, *Dasyprocta azarae*, *Mazama americana* and *Chiropotes albinasus*) were more abundant in the forest. The vulnerable Woolly monkey (*L. lagotricha*) was the most abundant species in the forest (1.8 group/10km), followed by the white-lipped peccary (*Tayassu peccary*) (1.4 group/10km), both were significantly more abundant in the forest than in the agroforest ($p < 0.05$). The capuchin monkey (*Sapajus apella*) was the most abundant species in the agroforest (1.2 group/10km), while the squirrel monkey (*Saimiri sciureus*) was the only species marginally more abundant in the agroforest (0.6 groups/10km, $p < 0.06$). Excluding singletons and doubletons, the crab-eating fox (*Cerdocyon thous*) was exclusively recorded in the agroforest. All in all, most of the community



of large and midsized mammals used the agroforest of teak to move through the landscape and partially support their ecological needs, foraging and feeding on native plants in the agroforest. This agroecosystem, however, seems to not support populations of some endangered species, such as the spider monkey (*A. chamek*) and the woolly monkey (*L. lagotricha*), exclusively recorded in the forest.

159. STOCHASTIC DOMINANCE TO MAKE DECISIONS ABOUT TRANSLOCATIONS WITH RISKY OUTCOMES

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Species translocations are often a key component of recovery and restoration plans. However, their expected outcomes are typically uncertain, reflecting our incomplete knowledge of complex and variable natural systems. In some cases, there may be concerns that translocations may do more harm than good. Consider for example the risk of spreading novel pathogens when reintroducing captive-bred species, or the ongoing debate about the potential negative impacts of assisted colonisation. Different attitudes toward risk may lead to conflicting views on whether and how to carry out actions. How can decisions be made in such circumstances? We explore the use of stochastic dominance, a widely applied concept in economic decision-making, for decisions about translocations in the face of uncertainty and risk. We use as a case study the recovery plan for a frog species threatened by disease. Here, the choice of carrying out a translocation or not depends on whether managers prefer to ensure good outcomes or to avoid poor ones. The application of stochastic dominance in conservation can help link risk assessments with decision-making, encouraging a transparent assessment of probabilistic uncertainty and of the preferences and attitudes of decision-makers. These in turn can help ensure rational decisions are made and remove potential causes of stakeholder conflict.

TRACKING DIVERSITY: SWEDISH BIRDS RESPOND TO FOREST ROAD OPENINGS

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Road opening is an increasingly recognised threat to biodiversity worldwide. In temperate and sub-arctic forests, however, most of forest management guidelines aim at logging practices themselves (e.g. clear-cutting vs. continuous forestry, green tree retention). An overlooked aspect of forestry is the opening of semi-permanent tracks to allow access to logging sites. In Sweden, forest road openings accounted for 37% of

land-use conversions between 2009 and 2012. Here we assess the impact of road on bird communities in Swedish forested landscapes. Specifically we quantify how changes in road density drive changes in bird abundance and community composition along a latitudinal gradient, accounting for landscape effects and abiotic factors. We develop models within a Bayesian Inference framework that allows flexible model hierarchy and uncertainty quantification. To better account for species habitat requirements we combine several existing land-cover and forest composition layers at 25m resolution, on which is overlaid spatially explicit data on road openings. Bird abundances are derived from a citizen science program, the Swedish Breeding Bird Survey. We show that landscape configuration and road types influence how bird species respond to road openings. Combined with knowledge of the spatial logic underlying road openings, our results allow suggesting road development guidelines to minimize impacts on bird diversity.

SYMPOSIA 188. BARRIERS WITH BENEFITS: THE USE OF IN-STREAM STRUCTURES FOR CONSERVATION OF FRESHWATER BIODIVERSITY UNDER CONDITIONS OF HIGH RISK AND UNCERTAINTY

Samantha Capon

Griffith University

Nick BOND, Griffith University

The detrimental effects of artificial in-stream barriers (e.g. dams, weirs, road crossings, pipelines, etc.) are widely acknowledged. Such structures can prevent fish migration, limit hydrochoric seed dispersal, isolate populations of aquatic fauna and fundamentally alter patterns of hydrologic and biogeochemical connectivity. Removal of barriers is therefore commonly accepted as an appropriate management strategy for the restoration or conservation of freshwater biodiversity in modified systems. Increasing recognition is being given to the potential benefits of in-stream structures, however, particularly in the face of rapid climate change. Through their influence on flows and connectivity, for instance, barriers can create habitats that provide significant refuge from drought or invasive species. The role of artificial barriers in preventing the homogenization of freshwater fauna may also be important where natural barriers (e.g. waterfalls) have been extensively breached by human activities. Additionally, the process of removing in-stream barriers may result in further pressures on already degraded freshwater and riparian ecosystems which could outweigh the likely benefits of barrier removal. Consequently barrier retention, enhancement or construction are now seen, in some situations, as preferable management options. Such actions, however, can be associated with significant costs (e.g. maintenance), considerable risks (e.g. mass failure) and a high probability of perverse outcomes. We present a critical appraisal of the potential benefits of in-stream



barriers in the conservation and restoration of freshwater ecosystems. We assess the risks involved and evaluate a range of case studies to identify the conditions under which artificial barriers are likely to contribute to, rather than threaten, ecological outcomes.

THE BIODIVERSITY AND DEVELOPMENT RESEARCH AGENDA OF THE UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

Sara Carlson

USAID, Forestry and Biodiversity Office

Andres GOMEZ, ICF International ; Diane RUSSELL, USAID, Forestry and Biodiversity Office

The United States Agency for International Development (USAID) is one of the world's major conservation donors. The Agency's recently launched Biodiversity Policy cements its commitment to conservation and articulates a vision of biodiversity as a critically important foundation for human welfare, intricately connected to other development sectors, and fundamental to meeting its development goals. A new Research Policy commits the Agency to evidence-based programming to improve outcomes and contribute to the global knowledge base. In this context, USAID designed a systematic, strategic, operations-focused, and collaborative process to define and prioritize the most critical questions in the area of biodiversity conservation in support of its development objectives. This Agenda seeks to 1) build the evidence base for the links between biodiversity conservation and development outcomes in key sectors; 2) improve the effectiveness of conservation programs and projects; and 3) advise on the generation and use of evidence in conservation project design and adaptive management. While not limited to Agency sources, the Agenda draws on the rich storehouse of data and experience from within the Agency and calls attention to the knowledge resources available therein. We describe the process that led to the Agenda, its conceptual framework, the main themes and priority research questions identified, and suggest avenues for future collaborative engagement by a variety of stakeholders.

WOOD FUNGI DECOMPOSITION INCREASED BY HEAT SHOCK

Fredrik Carlsson

NAT

Mattias EDMAN, NAT ; Bengt Gunnar JONSSON, NAT

Wood fungi are present in the majority of dead wood on the forest floor, and are regarded as the main decomposers in boreal forests. The role of Wood fungi in ecosystem carbon cycling is not fully explored, however as main decomposers they have an impact on Carbon release, from wood to the surrounding air. In this context, it is important to understand

how wood fungi metabolism is regulated in relation to different conditions, since changes in for example temperature and humidity as well as different disturbances can have a significant influence on the release of CO₂. In the present study we investigate the effect of heat shock on decomposition rate in 18 species of wood fungi. Ten of the species can be seen as associated with forest fire while the other eight has no such association. Heat shock time and temperature was calibrated to match the conditions of a forest fire. We found a triggered increase in fungi decay rate after heat shock, and this response was more pronounced in the fire-associated group. In some species the decomposition rate increased by up to 1000%. How relevant this response is on a carbon cycling at a larger scale is not within the scope of the present study, but it shows that decomposition levels can be heavily modified by environmental trigggers, such as in this case, a forest fire.

TOURISM AND CONSERVATION: THE IMPORTANCE OF CONTEXTUAL ANALYSIS AND STAKEHOLDER INVOLVEMENT

Lina Caro

University of Cambridge

Alison GUNN, Fauna & Flora International

Protected areas can face major challenges in achieving a financial sustainability due to economic, politic and legal conditions. Securing long-term funding is one of the most challenging targets to meet, particularly in countries with complexities such as low government investment, supportive law enforcement and corruption. Besides, conventional funding streams often fluctuate impeding the development of sustainable financial strategies. Environmental problems in Ometepe Island Biosphere Reserve, Nicaragua, are largely related with financial shortfalls that impede effective law enforcement, management and conservation planning in the island. Although tourism provides an important source of incomes for the locals, little is invested in conservation and in 2011 only 0.004% of the national budget was invested in all PAs in Nicaragua. Consequently, this expenditure has been inadequate to supply basic needs, including salaries for rangers, environmental education, protection and monitoring activities, and general equipment. It is important to explore innovative funding mechanisms for PAs that can be sustainable in time and independent from government budgets. In particular, tourism user fees (TUFs) are site-based mechanisms that often capture significant revenues necessary for PAs' management and conservation. However, these revenues are not enough on its own to ensure a sustainable financing strategy. Thorough analysis of the contextual factors that may enhance or undermine a sustainable financing strategy in Ometepe revealed that coordination, partnership, leadership, and governance abilities are critical in creating a



sustainable financing niche to ensure stakeholder involvement, cooperation and collaboration.

122 SPATIAL TRADE-OFFS BETWEEN AGRICULTURAL PRODUCTION AND ECOSYSTEM SERVICES IN THE TROPICS

Luis Roman Carrasco

National University of Singapore

Growing global demands for food and biofuels are providing strong economic incentives for deforestation across the tropics. Much of this deforestation is poorly planned due to the lack of information on the spatial distribution of benefits and costs of deforestation. To inform sustainable land-use policies at the landscape level, a spatially explicit analysis of the trade-offs between agricultural benefits, carbon emissions and losses of ecosystem services due to tropical deforestation was performed. The results show that the economic externalities of destroying tropical forests and their associated ecosystem services are at least of a similar magnitude to the direct economic benefits derived from agriculture. The analysis identifies areas that present high potential agricultural gains and low ecosystem services losses, where payment for ecosystem services programs would not be able to halt deforestation, areas that presented low agricultural gains and high ecosystem services and should have not been converted to agriculture. Clarifying the spatial distribution of economic net losses and gains resulting from deforestation can help identify optimal areas for conservation and agriculture thus informing pantropical conservation planning.

SEASONS OBSERVATORY - COLLABORATION BETWEEN CITIZENS AND SCIENTISTS

Jennifer Carré

Associtaion Tela Botanica - GDR PARCS

Isabelle CHUINE, CNRS - GDR PARCS ; Camila LEANDRO, Associtaion Tela Botanica - GDR PARCS

In partnership with Tela Botanica, CNRS has developed the Seasons Observatory program to collect phenology data on the various animals and plants. These data will allow researcher to provide indicators of the effect of climate change and to feed studies in this field. Indeed, climate change is having, and will have, strongly effects on the seasonal rhythms of plants and animals. This changing is having serious consequences in terms of ecosystem functioning, food chains, the survival of certain species, and the geographic distribution of species. Seasons Observatory is a fruit of the collaboration between research teams, citizens, associations and local authorities in advancing climate effects research. This project is a program of participatory science that federates 3160 citizens. This program has two levels: a national level and a local level with 9 relay

observatory. He is a great citizen awareness device through action and is very accessible through collaborative Web tools we are developing. These collaborative Web tools allow us to collect data online and they are free. Also we make an available website to citizens. This website is a true place of resources and exchanges for raise awareness and education of citizens. In this session we will present the results of this project, and open the discussion on the usefulness of these programs in dialogue with civil society.

DIVERSITY OF DIURNAL BUTTERFLIES (PAPILIONOIDEA) IN A HIGH ANDEAN LANDSCAPE FROM NORTHEASTERN COLOMBIA AND ITS IMPORTANCE FOR CONSERVATION

Diego Carrero-Sarmiento

Universidad de Pamplona

Cristobal RIOS-MALAYER, Universidad de Pamplona

Butterflies (Papilionoidea) are functional insects when developing studies of diversity and conservation. Heterogeneity of landscapes and ecosystems position Colombia as the second richest country in terms of species of butterflies with 3274 species reported. Despite of such richness there is a lack of knowledge regarding the diversity patterns of Andean butterflies. Our main aim was to estimate the diversity of butterflies' communities in 8 localities in northeastern Colombia, located at altitudes between 2700 and 3300m. To sample the butterflies we established 7 stations per locality, placed 100m apart from each other in an altitudinal gradient. One transect of 200m x 50m was also established and used to actively search for butterflies from 09:00 to 16:00 hours using an entomological net. In addition we used 6 Van Someren-Rydon traps baited with decomposed fish. Our sampling resulted in a total of 448 hours with entomological net and 1792 with traps. We found 762 individuals, belonging to five families (Nymphalidae, Hesperidae, Pieridae, Lycaenidae and Papilionidae), 30 genera, 55 species, 13 subfamilies and 9 tribes. Twenty five species belonged to the subtribe Pronophilina, the richest and with highest level of endemism including: *Altopedaliodes tamaensis*, *Pedaliodes reyi*, and *Idioneurula erebioides*; the next richer families were Hesperidae, with nine species, and Pieridae, with eight species. Sampling stations located between 2900m and 3100m of altitude where the most diverse, exhibiting diversity order 1D with ranges of species between 22 and 27, represented by genera like: *Pedaliodes*, *Altopedaliodes*, *Corades* and *Idioneurula*, associated to transitional life zones between High Andean Forest and Paramo. Our results show the importance of these Andean Highlands as refuge and reserve of unique species of butterflies, which are key to understand the ecological process that will finally allow us to identify, select and establish priority areas for conservation.



49-ARE SPECIES TRAITS USEFUL FOR PREDICTING PRIMATE SPECIES RESPONSES TO HABITAT LOSS AND FRAGMENTATION? A REVIEW

Xyomara Carretero-Pinzon

The University of Queensland

Thomas DEFLEER, Universidad Nacional de Colombia ; Clive MCALPINE, The University of Queensland ; Jonathan RHODES, The University of Queensland

Habitat loss and fragmentation are the main threats of primate species worldwide. We conducted a review of published literature about the effects of habitat loss and fragmentation to quantify the effect of habitat loss and fragmentation on primates and whether this depended on species' traits. The effect of habitat loss and fragmentation on five response variables (density, parasite prevalence and diversity, presence, genetic diversity and behaviour), were extracted from 130 papers and were compared across six species traits (diet specialization, social organization, body size, home range, group size and dispersal ability). There is no evidence that the effect of habitat loss and fragmentation varies across species traits. Density and parasitic prevalence and diversity were positively correlated with habitat loss and fragmentation. On the other hand, species presence and genetic diversity were negatively correlated with habitat loss and fragmentation. Behavioural responses (time spent in resting, moving and feeding activities) didn't show a detectable effect of habitat loss and fragmentation. Therefore, although some studies hypothesize that species traits can be used as a guide to determine primate species susceptibility to habitat loss and fragmentation, there is little evidence to support this from primate literature at present.

ARE MIXED TROOPS AFFECTED BY HABITAT LOSS AND FRAGMENTATION? AN EXAMPLE FROM COLOMBIAN PRIMATES

Xyomara Carretero-Pinzon

The University of Queensland

Habitat loss and fragmentation are the main threats of biodiversity worldwide. Habitat loss and fragmentation affects the area and resources available to primate species thus affecting their interactions with other sympatrical species. Mixed troops are associations of species, which can be ecologically similar, which associate during long periods of time, moving and feeding together. Several hypotheses have been proposed to explain mixed troops formations in primates, including a parasitic knowledge of spatial resource distribution and reduction of predation rates. Mixed troops formation has not been studied in the context of habitat loss and fragmentation and how these landscape processes can affect

this species type of interaction. The aim of this study was to evaluate the effects of habitat loss and fragmentation on mixed troops formation using the Colombian squirrel monkey (*Saimiri cassiquiarensis albigena*) and black-capped capuchins (*Sapajus apella*) as an example in two areas (one continuous and one fragmented). Mixed troop formation data was collected using scan sampling method every five minutes in both sites, during four months in each site (369 hours in the continuous and 423 hours in the fragmented site). The frequency of mixed troop formation was lower in the fragmented site compared with the continuous site. A higher frequency of mixed troop formation was observed in the dry season for the continuous site, contrary to the findings for the fragmented site for the same season (less frequency of mixed troop formation in the dry season). An exploration of landscape variables and site variables in order to determine the effects of habitat loss and fragmentation in the frequency of mixed troop formation for these species was made.

ASSESSING FUNCTIONAL HOMOGENIZATION OF BIRD COMMUNITIES IN MANAGED AND UNMANAGED FORESTS USING MULTI-SPECIES OCCUPANCY MODELS

Eduardo Carrillo-Rubio

Cornell University

Functional homogenization of biological communities, caused by disproportional population declines and a shift towards domination by generalist taxa, is one of the most ruinous consequences of environmental degradation. Species loss dilutes species-habitat relationships, altering the functionality of ecological systems. As degradation effects are expected to worsen from increasing human pressure and climate change, understanding how biological communities respond and are shaped by disturbances has never been more important. In this study we assessed the effects of logging on habitat relationships and specialization of forest bird communities using occupancy models to estimate species-specific occurrence probabilities as a function of forest stand characteristics while accounting for imperfect detection. We used data from a 2 year breeding bird survey of managed and unmanaged forests in the Sierra Tarahumara region of México. Our findings showed that logging degradation has favored generalist species and a shift towards functional homogenization. Degraded forests dominated by dense stands of small diameter trees (<0.3 m) were species-poor and contained mostly generalists; whereas stands with higher diameter values supported more species and habitat associations. Based on these results, predictions of lower species richness, generalist prevalence, and decreased function from degradation were generally supported. Compared to recent efforts that derived implicit conclusions about



specialization based on the relative apparent occurrence of species among different habitat types, our approach allowed us to develop unbiased species-specific covariate models to formally investigate specialization and quantify the relationships between true species occupancy and habitat gradients. Our findings could be used to inform decision-makers to enhance conservation and management outcomes, and project the consequences of management interventions on biological communities.

171 LEARNING BY DOING: LESSONS LEARNT THROUGH BUILDING CONSERVATION LEADERSHIP VIA PROJECT GRANTS AND AWARDS, INTERNSHIPS AND MENTOR SUPPORT.

Marianne Carter

Fauna & Flora International

Requiring self-initiative, experiential learning is one of the most powerful tools available to build skills and knowledge. 'Having a go' at a complex conservation activity with guided support, and an opportunity for reflecting on that, is a very effective way for building conservation leadership capacity. When an individual shows a spark of initiative, and as a result receives a 'leadership boost' (a training opportunity, a chance to be part of a peer-to-peer network, recognition and profile-raising, or some additional financial or technical resources, for example) we have found this support assists their progression to the point where they are quickly encouraging and inspiring others to join them as they guide and influence positive change. Over time we are developing more ways to better target our limited resources on maximising this effect for conservation gain. FFI has learnt a great deal through support of long-term tailored local and national conservation training and mentoring and also through several global initiatives that target conservation leadership development and aim to scale up our capacity to deliver effective conservation on the ground. Although clearly there is no single magic formula, we believe investing in talented individuals and maintaining strong, effective institutions and networks equals effective and sustained conservation.

THE KEYS TO COEXISTENCE: REALIZING THE POTENTIAL FOR INTEGRATING LARGE CARNIVORES INTO MULTI-USE LANDSCAPES

Neil Carter

University of Maryland

John LINNELL, Norwegian Institute for Nature Research ; Meredith GORE, Michigan State University ; Amy DICKMAN, Oxford University ; J. Baird CALLICOTT, University of North

Texas ; Vidya ATHREYA, Wildlife Conservation Society ; Nicolas LESCUREUX, Norwegian Institute for Nature Research

Many iconic large carnivore species, such as wolves, tigers, and bears rely heavily upon unprotected land as well as reserves. There is therefore a pressing need to integrate large carnivore presence into multi-use landscapes. Sharing landscapes with carnivores can potentially confer many benefits to people, but the negative impacts and conflicts associated with large carnivores often make attaining coexistence challenging. The lack of a clear, consistent, and comprehensive conceptualization of coexistence is among the biggest obstacles. A vague conceptualization of coexistence hinders efforts to implement coexistence strategies and, once implemented, evaluate effectiveness. Furthermore, without a common understanding of coexistence, people with opposing views toward carnivores will be unable to engage in a meaningful dialogue. Here, we explore and clarify important ecological, economic, and societal aspects of human-carnivore coexistence. Examining the coexistence concept from multiple perspectives allowed us to identify three key dimensions: the 1) potential for sharing landscapes based on biophysical and behavioral characteristics of both people and carnivores; (2) societal choice to realize that potential based on norms, attitudes, and knowledge; and (3) implementation of large carnivore conservation in shared landscapes through various institutions, policies, and practices. We also outline an operational framework of human-carnivore coexistence, based on the above three key dimensions and accessible to policy makers and managers. Coexistence is not an automatic consequence of cohabitation; rather, a central and novel theme concerns the extent that coexistence requires mutual adaptations by both wildlife and humans and by different groups of people in those three dimensions. We conclude by discussing ways in which the theory and practice of coexistence can be advanced using our proposed framework.

MODELLING THE COMBINED EFFECTS OF HABITAT HETEROGENEITY AND ROADS ON LANDSCAPE FUNCTIONAL CONNECTIVITY IN A MEDITERRANEAN FOREST CARNIVORE

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Landscape functional connectivity is likely shaped by a combination of factors, including the spatial heterogeneity of habitats and the distribution of infrastructures such as roads networks. These joint effects are poorly understood due to the shortage of empirical information on the environmental features affecting movement behaviour in human-dominated landscapes. We aimed to assess how spatial habitat heterogeneity and roads influence functional connectivity in a forest carnivore, the common genet. We used VHF radiotracking to collect movement data on 22 genets in a mixed forest-agricultural landscape of southern Portugal. We used information-theoretic model building and multimodel inference to develop path selection functions (PathSFs) discriminating between observed and random paths in relation to environmental variables. PathSFs were used together with land cover information to produce conductance surfaces. Genets showed preference for moving within forest patches and close to riparian habitats, and strongly avoided open agricultural land. The probability of movement declined with increasing road density, but increased with the proximity of culverts, viaducts and bridges. Landscape connectivity was favoured by large forest patches, and by the presence of riparian areas providing movement corridors within open agricultural land highly resistant to genet movement. Roads reduced connectivity by dissecting forest patches, but had less effect on riparian corridors due to the presence of crossing structures. Spatial habitat heterogeneity shaped the extent, location and configuration of areas most permeable to genet movement. The road network dissected the forest habitats, creating obstacles in areas otherwise permeable to animal movement.

POPULATION SIZE ESTIMATE AND VEGETATION CORRELATES OF NEST ABUNDANCE OF THE WESTERN CHIMPANZEE IN LAGOAS DE CUFADA NATURAL PARK, GUINEA-BISSAU

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Rapidly growing global demand for natural resources within chimpanzee ranges continues to rise. Chimpanzee depend on effective conservation strategies that mitigate the impacts from the numerous threats they are facing. Among those are harmful anthropogenic activities, including commercial logging, industrial agriculture or mining, all of which contribute to the ongoing reduction of suitable habitat as well as

population sizes for chimpanzees. For Guinea-Bissau, robust estimates of population size and density are lacking, despite the country's importance as a refuge for Pan troglodytes verus at its westernmost margin of distribution. Using distance sampling and nest count methods, we assessed the population density and size of P. t. verus at Lagoas de Cufada Natural Park (LCNP). We further examined how quantitative vegetation characteristics are linked to chimpanzee nest abundance. Chimpanzee density was estimated at 0.22 nest builders/km² (95%CI 0.08-0.62), corresponding to 137 (95%CI 51-390) chimpanzees, the lowest density reported for any protected area in Guinea-Bissau. Zero-altered generalized mixed model showed that nest abundance was negatively correlated with plant species diversity and positively related with availability of smaller-sized trees, both characteristics of dense-canopy forest, the least available suitable habitat. Further, lower nest abundance was associated with greater floristic richness and larger variation in floristic composition, vegetation characteristics of open-canopy forest and savannah-woodland. Given the importance of LCNP as refuge for this flagship species, our findings can help device conservation guidelines for the management of its chimpanzee populations and remaining suitable habitats. Moreover, our population size estimate make a valuable contribution to the urgently needed reassessment of the conservation status of chimpanzees, whose reclassification to critically endangered is overdue (Walsh et al. 2003, Nature).

PERIODICALLY HARVESTED CLOSURES: POTENTIAL OPTIMAL FISHERIES MANAGEMENT STRATEGY

Paul Carvalho

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Periodically harvested closures (PHCs) are a form of community-based fisheries management often implemented within customary fishing grounds throughout the Pacific. Communities, and their co-management partners that advocate the use of PHCs, have broad objectives of fishery sustainability and conservation. However, PHCs are designed more specifically to increase harvest efficiency, and for opportune occasional exploitation of protected stocks to support local social events. Despite their prevalence, the effectiveness of PHCs for simultaneously achieving these objectives remains uncertain. To assess PHC functionality, we developed a bioeconomic fisheries model that included fish behavior, and quantified how PHC open-closed schedule affects harvest efficiency (catch-per-unit-effort), biomass



conservation and sustainable fishery yield. We also compared PHC effects with the effects of non-spatial and no-take marine reserve harvest regulations – forms of conventional management often heralded as optimal in well-managed and over-fished systems, respectively. Optimal PHC design was sensitive to overharvesting; regardless PHCs were more effective at achieving the multiple objectives than either conventional method. Key to the results is the fishers' ability to reduce fish wariness and increase catchability in PHCs targeting finfish using strategic harvest schedules. These findings challenge the dogma that PHCs are simply a cultural legacy to be accommodated by contemporary fisheries science, and instead place PHCs center stage as a potentially optimal fisheries management strategy.

134 USING MARXAN TO INCORPORATE CLIMATE CHANGE IN CONSERVATION PLANNING

Silvia Carvalho

CIBIO/ InBIO

Given the present biodiversity crisis, safeguarding biodiversity in protected area networks and monitoring its change through time, have been established as major international goals. Climate warming challenges our approach to building protected areas' systems and monitoring networks, because it is likely to drive accelerating shifts in species ranges and the projections of those future species distributions are uncertain. Marxan is the most commonly used decision support tool for identifying priority conservation areas. It selects a minimum set of planning units necessary to represent a minimum pre-established amount of conservation features by the minimum cost. In this talk I will exemplify how a modified version of Marxan - Marxan with probabilities – can be used to identify priority conservation areas given uncertain future species distributions. This modified version deals with the inherent uncertainty in probabilistic distribution data, assuring that species' occurrence targets are met with a selected level of confidence. Finally, I will exemplify how Marxan can be used to design biodiversity monitoring networks, optimized to track species range shifts derived by climate change.

BEHAVIORAL AND PHYSIOLOGICAL EVALUATION OF ANTHROPOGENIC EFFECTS ON CANIDS IN THE BRAZILIAN CERRADO

Stacie Castelda

George Mason University

Frederico LEMOS, Universidade Federal de Goiás ; Elizabeth FREEMAN, George Mason University ; Fernanda AZEVEDO,

Cerrado Mammals Conservation Program ; Nucharin SONGSASEN, Smithsonian Conservation Biology Institute

The Brazilian Cerrado is the largest savannah in South America. However, over the past 40 years it has been severely altered and is now a mosaic of cattle ranches, agricultural fields and Cerrado fragments. Three canid species: the hoary fox (*Lycalopex vetulus*), crab-eating fox (*Cerdocyon thous*) and maned wolf (*Chrysocyon brachyurus*) are sympatric in this ecosystem. The objective of our study was to use behavioral and physiological measures to quantify and evaluate how anthropogenic activities are influencing the canid communities. We selected the smallest Cerrado canid, the hoary fox, as our model species. Over 100 hours of continuous focal behavioral observation and 20 serum and 125 fecal samples were collected from a sample population of 24 radio-collared hoary foxes in human modified and fragmented Cerrado habitat in Goiás state, Brazil. Our results indicated that all individuals of our hoary foxes study population were denning and foraging in overgrazed cattle pastures in proximity to human establishments. Interactions between hoary foxes and crab-eating foxes were more common than interactions between hoary foxes and maned wolves. These interactions varied from visual awareness of each other to hoary fox chasing crab-eating fox, crab-eating fox displacing hoary fox from a food resource, hoary fox vocalizing at maned wolf near denning pups, and hoary fox escaping maned wolf predation. More importantly, however, hoary foxes were frequently vigilant for cattle, domestic dogs, trains, and noise from homes. Preliminary analyses suggest that serum and fecal metabolite profiles reflect the frequency of vigilance behavior. Finally, our results indicated that the hoary fox was an ideal model species for advancing our understanding of the impacts of human activities on canid communities and provided the crucial information needed for establishing appropriate conservation plans for the region and sympatric carnivores worldwide.

HUMAN-CANID CONFLICTS ON CATTLE RANCHES IN CENTRAL BRAZIL

Stacie Castelda

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Among the terrestrial mammals, carnivores are the most threatened species and are also the most challenging to conserve. Attitudes towards, experiences with, and economic losses often reflect the degree of conflict between humans



and carnivores. Therefore, assessing attitudes and experiences of people living with wildlife is critical in the development of conservation strategies. We used interviews to assess local knowledge of Cerrado canids, whether predation events affected attitude towards these species and if, in return, local attitudes influence their livestock management practices. An opportunistic sample of 50 ranchers living in and around the Cerrado Mammal Conservation Program study area in the Limoeiro region of southeast Goiás, Brazil participated in structured interviews. Results of our study highlight that many ranchers were not able to differentiate between the crab-eating fox (*Cerdocyon thous*) and hoary fox (*Lycalopex vetulus*) and misidentified when they were active, their social structure, and feeding behaviors. Only half of the respondents liked seeing wild canids on their property and preferred that the animal stayed away from their house. All respondents identified domestic fowl predation by the maned wolf (*Chrysocyon brachyurus*), crab-eating fox, or hoary fox as the main source of conflict. Those who lost domestic fowl were more concerned about the frequency of the attacks rather than the actual number livestock lost. Only half of the properties used some form of enclosure at night to protect against predation. However, all the respondents who sold chickens or eggs as a source of income had some sort of roosting structure or closed them in at night. Finally, most respondents identified a chicken coop as the most expensive form of livestock management practice, but those who used the coop considered them as an investment. Collectively, this information will be used for developing strategies for improving local support for canids.

A CENTURY OF GENETIC CHANGE IN TWO AMERICAN PIKA POPULATIONS IN THE SIERRA NEVADA OF CALIFORNIA

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Oregon State University
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Rapid, contemporary climate change over the past century has already resulted in local extinctions and detectable changes in patterns of occupancy for a number of species. In addition to shaping future habitat suitability, climate change is expected to impact dispersal ability and therefore population connectivity, further complicating predictions of range shifts and species viability. This is particularly true for species with low dispersal ability inhabiting naturally fragmented landscapes. One such species is the American pika (*Ochotona princeps*), which in addition to its reliance on highly specialized, patchy habitat, is also particularly sensitive to relatively small increases in ambient temperature. In this study we characterized historic and contemporary genetic diversity and population structure in two populations of American pikas in California: Lassen Volcanic National Park where the northern Sierra Nevada and

southern Cascade Range meet (1923-1926, and 2010-2011), and Yosemite National Park in the central Sierra Nevada range (1915 and 2012-2014). We found no significant changes in genetic diversity in either study area, suggesting stability in population size over the last century. However, we detected changes in population structure in Yosemite National Park, suggesting increased isolation of particular regions within the study area. Our results provide an important benchmark for long-term genetic monitoring of these populations. Our results also emphasize that maintaining functional connectivity, particularly for populations that are characterized by a metapopulation structure, should be a management priority in the face of rapid climate change.

MEASURING PROTECTED AREAS REPRESENTATIVENESS UNDER CLIMATE CHANGE SCENARIOS: A CASE STUDY OF THE COLOMBIAN CARIBBEAN REGION

Luis Guillermo Castro

Humboldt Institute
Clara Matallana, Humboldt Institute

Climate change is considered one of the main drivers of biodiversity loss at a national and global level. Protected Areas are considered as one of the more effective strategies to adapt to climate change. The objective of this study was to define a methodology that allows to identify the potential of each protected area to preserve species under different climate change scenarios. For doing so we propose to use potential distribution models of species to assess conservation objectives of protected areas, in order to identify which areas can serve as climate refuges for more species inside and outside protected areas. This methodology was applied in a study case in the Colombian Caribbean region, using distribution models for five species (*Aotus lemurinus*, *Leopardus wiedii*, *Synallaxis fuscorufa*, *Basileuterus conspicillatus* and *Pristimantis megalops*.) under current conditions and under the A2 and B1 scenarios defined by Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report. The results allow to analyze how much of the species distribution area will remain inside protected areas, and to define new conservation priorities under climate change scenarios, where most of the species would share its distribution. Our aim is to apply this methodology for the whole country protected area system.

122 PRIORITIZING LEVELS OF ACTION EFFORT TO ACHIEVE COST-EFFECTIVE TRADE-OFFS IN CONSERVATION MANAGEMENT: A FRESHWATER CASE STUDY

Lorenzo Cattarino

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Virgilio HERMOSO, Australian Rivers Institute, Griffith University ; Josie CARWARDINE, CSIRO Ecosystem Sciences ; Mark KENNARD, Australian Rivers Institute, Griffith University ; Simon LINKE, Australian Rivers Institute, Griffith University

In order to protect biodiversity using the limited resources available to conservation, it is critical to identify trade-offs between achieving ecological outcomes and meeting social and economic objectives. Systematic Conservation Planning provides an approach for identifying these trade-offs, by prescribing the nature and spatial location of conservation management actions to address threats to biodiversity, while minimizing costs. Substantial gains in cost-effectiveness can be obtained by prescribing the specific level of effort to allocate to an action to remediate a threat to a species. However, due to the limitations of previous methodological approaches, the spatially-explicit prioritization of levels of conservation effort has received little application. Here, we present the first implementation of a novel approach for prioritizing conservation effort in a cost-effective and spatially-explicit way. We developed an optimization framework to prioritize the specific level of effort to allocate to different actions to improve species persistence. We applied our framework to prioritize the level of effort to allocate to 4 different actions that remediate major threats to freshwater biodiversity, in the Daly River catchment, Northern Australia. We used expert-elicited information on the responses of 140 freshwater species to different levels of effort of the different actions, and the management cost of different actions. Our framework also accounts for river connectivity, by ensuring that levels of action effort are prescribed in sites that are located along the river network. Our analysis reveals the priority areas in the Daly where specific levels of effort, for different actions, are prescribed, to secure the long-term persistence of freshwater biodiversity, at the minimum cost. Sitting at the forefront of systematic conservation planning, our approach represents an innovative and robust way to achieve trade-offs in conservation science.

IS BIRD FRIENDLY® COFFEE ALSO MAMMAL-FRIENDLY? ASSESSMENT OF MAMMAL DIVERSITY IN COFFEE FARMS OF CHIAPAS, MEXICO

S. Amanda Caudill

Smithsonian Institution

Robert Rice, Smithsonian Institution

Biodiversity-friendly coffee certifications, such as the Smithsonian Institution's Bird Friendly® coffee, provide a viable way to protect wildlife habitat while providing a financial incentive to farmers. Most studies related to these certifications focus on avian habitat requirements and it is not known whether these standards also apply to other wildlife, such as mammals, that inhabit the coffee landscapes. We

assessed the non-volant mammalian fauna and their associated habitat requirements in 23 sites representing forest, Bird Friendly® shade, conventional shade, and sun coffee habitats in Chiapas, Mexico. We used Sherman trap-grids to measure small mammal abundance and richness, while camera traps were set for medium-sized and large mammals. We detected 18 species of mammals, representing 11 families. We found the coffee farms in this region to provide an important refuge for mammalian wildlife. Species richness was significantly higher in Bird Friendly® coffee sites than other coffee habitats and was either higher (small mammals) or not significantly different (medium-sized mammals) than forest study sites. No significant difference was found in small mammal abundance among the habitat types. Medium and large mammals were present in sites with larger, more mature shade trees associated with, but not required by Bird Friendly® certification standards. However, lower strata vegetation (5 cm to 1 m tall), the only vegetation parameter found to increase abundance and richness for small mammals, is not specified in the Bird Friendly® standards. Our findings suggest that although the standards devised for avian habitat do benefit mammals, requirements specific for mammals could be included that would enhance the coffee habitat for mammals that inhabit these coffee landscapes.

MAPPING OPPORTUNITIES AND CHALLENGES TO EUROPEAN REWILDING

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Wilderness has evolved into a conservation approach that includes an ecological dimension besides the original ethical and esthetical value. Wilderness areas have been shown to provide important supporting, regulating and cultural services and they are fundamental to the survival of many threatened species. We use wilderness mapping to highlight the opportunities and challenges associated with the restoration of natural habitat in Europe through rewilding. In the context of continuous European farmland abandonment, rewilding has been proposed as a management option for the areas of decreasing human presence. Ecological rewilding is the management of abandonment farmland that aims to minimize human interventions and favor self-regulating ecosystems. The ecosystem trajectories in areas of abandonment depend on the extent of the alterations produced by cultivation and policy responses. We map artificial night light, human accessibility, proportion of harvested primary productivity



and deviation from potential natural vegetation in projected abandonment areas in Europe for 2040. We discuss trajectories of ecological rewilding based on the different wilderness metrics configurations and the current protected area networks in Europe. Areas of disagreement between wilderness metrics are more likely to require management actions to facilitate the return to natural systems. One of the most important metrics that seems to affect rewilding potential is the deviation of current vegetation from natural vegetation patterns. A high proportion of projected abandonment is also located in or around NATURA 2000 sites, which have management goals directed at maintaining many human-managed habitats. Thus rewilding is likely to be slower in these areas though research indicates that recovery of species and vegetation continues despite management interventions. Finally, we discuss European rewilding in the worldwide context of responses to land-use change and anthropogenic modifications.

ACCELERATED MODERN HUMAN INDUCED SPECIES LOSSES: ENTERING THE SIXTH MASS EXTINCTION

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The oft-repeated claim that Earth's biota is entering a sixth "mass extinction" episode depends on clearly demonstrating that current extinction rates are far above the "background" rates prevailing outside of the five previous mass extinctions. We compare a recent background rate for fossil mammals, which is at least twice as high as most previous estimates, with conservative assessments of the number of extinctions in the past five centuries. Even under these extremely restrictive assumptions, the average rate of vertebrate species loss over the last century are up to 70 times higher than the background rate. Extinction rates have increased from the 17th century to present. Depending on the vertebrate taxa, the number of species that became extinct in the last century or so, would have taken from 1,100 to 9,700 years to become extinct under background rates. The exceptionally rapid loss of biodiversity over the last few centuries indicates that the sixth mass extinction is underway. Averting it may be possible through intensified conservation efforts, but that window of opportunity is rapidly closing.

95-CAN SPECIES TRAITS INFLUENCE THEIR VULNERABILITY TO ROAD IMPACTS?

Ana Ceia-Hasse

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Roads are a major threat to global biodiversity. Roads and traffic can affect wildlife populations in three major ways, by: (1) increasing mortality, (2) decreasing habitat amount and quality; and (3) fragmenting populations into smaller subpopulations, which are more vulnerable to local extinction. Species vulnerability to roads and traffic can be influenced by their life history traits and behavior towards roads, e.g., road attraction or road avoidance. Several studies indicate that species with lower reproductive rates and/or higher mobility are more vulnerable to negative road effects. Species that do not avoid roads or that are disturbed by traffic are also negatively affected. For instance, larger mammals with large home ranges, low reproductive rates and low natural densities, birds with larger territories, and all amphibians and reptiles are vulnerable to negative road impacts. Furthermore, simulation models predict that population abundance should not be reduced by roads for species with small territories and movement ranges, and high reproductive rates, such as many small mammals and birds. Explicitly combining extrinsic factors of threat and intrinsic species traits will allow moving from a descriptive to a mechanistic, biologically sound evaluation of threats. For example, modeling studies predict that species with low population growth rates and large minimum area requirements for population persistence can be negatively affected even in regions of low road density. Identifying which traits increase vulnerability to roads and traffic can help direct mitigation efforts towards the species that are most vulnerable. Also, strengthening the link between empirical knowledge and models will help to obtain a refined understanding of the impacts of roads and traffic across species and regions.

DO COMMUNICATION AND INFORMATION PROJECTS MATTER? - EFFECTIVENESS OF

Joanna Cent

Jagiellonian University



Agata PIETRZYK-KASZYŃSKA, Jagiellonian University ;
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Effective conservation requires not only sound biological and conservation science, but also good relationship with stakeholders and their engagement in actual conservation activities. This need is well recognized among both conservation scientists as well as policy makers. For example, European Union's biodiversity policies support financially not only direct conservation activities, but also educating and informing the public about the nature and the need for its protection. Although it is difficult to assess a precise contribution of education and information to the conservation outcomes, there is a need for evaluation of their actual results. Education and information campaigns require vast funding, however the benefits for the conservation are often unclear. We investigated the effectiveness of such campaigns in a case study project funded within LIFE+ INF program. "Natura Mission" LIFE INF project is conducted in Poland comprising several activities aimed at improving environmental awareness on Natura 2000 network among key stakeholders groups, local communities and general public. Special attention is given to conflict mitigation both on local level and in general all over the country. The project has been systematically evaluated at all of its stages (including ex ante, mid-term and ex post evaluation). Evaluation research provided information about stakeholders needs and opinions, used in planning project's activities, such as workshops, media campaign and consultancy. Likewise, assessing success or failure of the project's activities is based on the evaluation research. The evaluation shows differences in reaching stakeholders who are land users or land owners in one or more Natura 2000 areas, local societies and general public. Also, the funding program requirements create inflexibility of project activities that results in allocating time and efforts for less effective activities

HEGGEHOG AS AN ISLAND INVADER: A GENETIC PERSPECTIVE

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The crucial steps in biological invasions, related to the shaping of genetic architecture and the current evolution of adaptations to a novel environment, usually occur in small populations during the phases of introduction and establishment. However, these processes are difficult to track in nature due to invasion lag, large geographic and temporal scales compared with human observation capabilities, the frequent depletion of genetic variance, admixture and other

phenomena. In our study, we used hedgehogs from the genus *Erinaceus* as model taxon for studying genetic background of invasion process. We compared genetic and historical evidence related to the invasion of the West European hedgehog to New Zealand, where they affect many local endemic species. We also included selected European islands with different timing of hedgehog introduction to compare genetic signatures of colonization histories. Historical information from New Zealand indicates that the species was initially established on the South Island. A molecular assay of populations from Great Britain and New Zealand using mitochondrial sequences and nuclear microsatellite loci proposed that the population of the North Island was most similar to that of the native area and showed greatest reduction in genetic variation caused by founder demography and/or drift. This evidence indicated the location of the establishment phase. The hypothesis was corroborated by data on climate and urbanization. The molecular and historical approaches have different explanatory power and the possible biases influencing the description of particular aspects of invasions, and we advocate the integration of the two types of approaches in invasion biology. The work was supported by Charles University grant GAUK 702214.

BIODIVERSITY MONITORING IN MOUNTAIN ECOSYSTEMS: A MULTI-TAXA APPROACH

Cristiana Cerrato

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Elevational gradients are natural laboratories to study species diversity and community level responses along patterns of environmental variation. Understanding how multiple taxa respond to elevation along the same gradient, as well as how the same taxa respond to different elevational gradients, is still an important and urgent task in conservation biology. In this framework, in 2012-2014, 6 Italian Parks (4 National Parks and 2 Regional Parks), located in the Alpine Region and covering its natural variability, shared a common protocol to study animal biodiversity in mountain ecosystems. Along 24 altitudinal transects, for a total of 132 sampling stations, ranging from 550 to 2700 m a.s.l., seven taxonomic groups were monitored (Coleoptera Carabidae, Coleoptera Staphylinidae, Araneae, Formicidae, Orthoptera, Lepidoptera Rhopalocera, Aves), using semi-quantitative standardized, easy to apply and cheap sampling techniques. Such protocol has been developed in order to be repeated every 5 years (2 ys monitoring – 4 ys stop; next session 2018-2019). We focused on recognizing



common points and differences between geographic areas and altitudinal zones. In this framework, we decomposed β -diversity into its nestedness and turnover components and we quantified the proportion of variation due to different factors (climate, habitat, altitude, spatial component). We observed that both climate and altitude have a fundamental role in shaping the observed communities, but at the same time a well-defined proportion of the variation depends on the geographical position of each protected areas, showing how each of them has its peculiar faunistic composition. We also identified the (group of) species characteristic of different areas and habitat types. To identify the parameters influencing species' distribution across large spatial scales represent an important tool for estimating current conservation value and obtaining a baseline against which measure future changes.

WETLAND RESTORATION AND AQUATIC BEETLES: COMMUNITY AND SPECIES LEVEL RESPONSES

Cristiana Cerrato

National Research Council

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Alpine wetlands represent a rare and fragile biotope in the European Alps, often altered by human activities, which strongly modify the water table, with negative effects on the biota. In 2013-2014, Gran Paradiso National Park (NW Italy) begun a restoration project in a transitional peat bog (6 ha, 2100 m a.s.l.), impacted by grazing and drainage channels. The restoration project consists of the exclusion of grazing and the positioning of small mobile dams, to reduce the channels effect and whose height can be manually regulated depending on the seasonal water table level. The effects of these activities have been tested, using aquatic beetles (Coleoptera Dytiscidae, Coleoptera Hydrophiloidea) as a target group. A sample of 23 ponds has been selected and each of them characterised measuring the amount of water, its seasonality and the water chemistry. The responses of aquatic beetles have been tested at two levels. At first, we evaluated if the ponds host communities with different faunal composition and which ponds' characteristics are the most influential one. We observed big differences in community composition, suggesting the importance of micro-habitat management. Secondly, we measured seasonal population dynamic and movements of two selected species (*Agabus congener* and *Agabus solieri*, Coleoptera Dytiscidae). A mark-release-recapture protocol has been developed. During each bi-monthly session, the captured specimens were permanently marked with an alphanumeric code, printed on water-proof paper and pasted over one elytra, and then immediately released in field. Such mark didn't reduce the flight ability of the specimens and allowed us to follow their movement through the humid area, during all the

season. We marked more than 600 specimens but we observed a low amount of movements, mainly executed by walking through the mud. Our results can offer important suggestions for the management of alpine humid areas.

SOCIAL PERCEPTION OF ALIEN SPECIES IN THE TUSCAN ARCHIPELAGO NATIONAL PARK (ITALY)

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Game and Wildlife Conservation Trust

Francesca GIANNINI, Tuscan Archipelago National Park ; Michele GIUNTI, NEMO society ; Elena TRICARICO, University of Florence

Biological invasions are worldwide recognized as one of the most relevant threats to biodiversity and ecosystem services. Islands are particularly vulnerable to this phenomenon, and several heavy invasions were reported in these ecosystems. Being humans the first cause of introductions, an understanding of the social perception is critical to effectively tackle the problems associated with invasive alien species (IAS). The Tuscan Archipelago National Park, composed by seven main islands, was established in 1996. It is located in Central Italy, between the Ligurian and Tyrrhenian Sea, and several projects were conducted to preserve the local biodiversity and control the IAS, particularly alien plants. During 2012, within the Strategic project Co.R.E.M. ("Cooperation of ecological networks in the Mediterranean area", cooperation program Italy-France 2007/2013), we interviewed 237 local people to evaluate their knowledge and social perception on IAS present in Park. The majority of the people (90%) knew the term alien species, but they were not able to indicate an invasive one or did not consider invasive some well-known invasive species. Most local people (93%) bought alien plants because they are beautiful and more resistant than native ones, and did not know that some are highly invasive. They mostly stood up for managing IAS through eradication programs, controlling their trade, and establishing a sort of "black list" (95%), but, oddly, they were not willing to attend dissemination events on the topic (62%). Overall, they did not think IAS are the most important environmental problem for the Park (63%). It thus emerges that more dissemination programs are needed to increase the local awareness on the topic, and make proactive the people on IAS management.

185: ADAPTIVE STRATEGIES FOR MANAGING A METAPOPULATION OF CRYPTIC SUMATRAN TIGERS WITH DECLINING CONNECTIVITY

Iadine Chades

CSIRO

Yann DUJARDIN, CSIRO ; Arthur LE RHUN, CSIRO ; Guillaume CHAPRON, Swedish University of Agricultural Sciences ; Eve



MCDONALD-MADDEN, University of Queensland ; Sam NICOL, CSIRO

Threatened species are difficult to detect, with the consequence that many populations go extinct without us noticing. Deciding whether to continue investing in the protection of a threatened population that is already extinct could lead to a waste of scarce resources, while giving up too soon could lead to species' extinction. Finding the best strategy becomes even more difficult when managing metapopulations of cryptic threatened species with uncertain and changing connectivity over time, because with the right connectivity, individuals might have a chance of recolonising a declining population and saving it from extinction, but with poor connectivity, that population is unlikely to persist. Using a case study of Sumatran tigers, we study when uncertain and changing connectivity between sub-populations warrants implementing an adaptive management strategy. We solve this decision problem using a novel tool from Artificial Intelligence. While decision tools are often criticized for the complexity of their solutions and inaccessibility to stakeholders, our approach makes it possible to find the simplest adaptive management strategy that also maximises the chance of persistence of threatened species. By avoiding overly-complex adaptive management strategies, whilst still accounting for uncertainties, decision-makers can ensure that limited conservation funds are spent adequately. In doing, so we hope to contribute to bridging the gap between conservation decision science and practitioners.

DIVERSITY OF RHIZOBIA ASSOCIATED WITH LOCAL LUCERNE IN THE OASIS ECOSYSTEMS OF TUNISIA

Oumaima Chaieb

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Abstract In arid ecosystems of Tunisia, oases are faced to high levels of land degradation exacerbated by climate change impacts. Alfalfa (*Medicago sativa* L.), the most important forage crop of oasis ecosystem can contribute to the improvement of soil fertility and soil conservation. As well, it can contribute to the maintenance and regeneration of the crops through a symbiotic nitrogen fixation. Both alfalfa and its nitrogen fixing symbiotic bacteria are affected by different abiotic stresses such as salinity, drought and high temperatures. Improvements in biological nitrogen fixation could be achieved through selection of native tolerant strains of nitrogen-fixing bacteria Rhizobia to these abiotic stresses. The study of natural nodulation showed that it depends of physicochemical factors

of soil and agricultural practices. Phenotypic characterization of 68 bacteria isolated from root nodules of local *Medicago sativa* plants growing in 28 soils of arid oases was studied. All strains can resist in high and low temperatures. 90% of strains were able to grow at pH ranging from 5 to 9, tolerate a high salt concentration 500 mM of NaCl and grew at a maximum temperature between 35 and 45° C. The rhizobia were very diverse with respect to their cross-nodulation patterns, as well as their physiological and biochemical properties. Almost all isolates shared the ability to nodulate with alfalfa. 10% of the strains were highly effective. The R38 stain claimed that was the highly efficient and classified astolerant to osmotic stress and moderately tolerant to nitrate stress. The strains which were highly effective in nitrogen fixation at the same time could intensively solubilize phosphates. The results obtained suggest that the phenotype of these rhizobia might have evolved to adapt to the local arid conditions. Keywords: Alfalfa, Rhizobia, Diversity, Nitrogen fixation, Abiotic stress, Phosphate solubilization

SPATIAL PRIORITIZATION IN COASTAL ECOSYSTEMS RESPONDING TO CLIMATE CHANGE

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Hugh POSSINGHAM, University of Queensland ; Stuart PHINN, University of Queensland

In the design of marine protected areas we need to not only incorporate both the influence of connectivity and climate change, but also the effect of climate change on connectivity. We use a structured decision-making approach to determine suitable development and management options to safeguard a productive near shore fishery while accommodating climate change and the associated human responses. Most ectothermic marine species are operating at or near their thermal limits. Ontogenetic ecosystem connectivity has important consequences for reef and coastal organisms that have nursery habitats detached from reproductive populations. Increased ocean temperatures are expected to accelerate larval development, potentially leading to reduced pelagic durations and earlier settlement behaviour. The spatial scale of connectivity for planktivorous larval movement is predicted to be reduced leading to a convergence in dispersal distances. To develop robust plans for conservation, species-specific analyses explicitly defining responses to environmental change are incorporated into prioritization. Candidate areas are identified and by applying complementarity, areas are selected among the candidates. By incorporating demography and dispersal, mechanistic modelling and time-series analysis in remote sensing, we are developing a spatially coherent network for species dispersal and persistence under changed climatic conditions by maximizing the conservation benefit for the lowest cost. We use the Zonation spatial



prioritization software framework and apply our plan to the Mackay/Whitsunday NRM Region of Central Queensland employing feature specific connectivity. Parametisation is with environmental and physiological data using the iconic species *Lates calcarifer* an economically important species in near shore tropical regions.

WATER RESERVOIRS AND THEIR IMPLICATIONS IN THE CINEGETIC MAMMALS DISTRIBUTION IN THE SEMI-ARID: CONTRIBUTIONS TO THE CONSERVATION OF THE SERRA DA CAPIVARA NATIONAL PARK, SOUTHEASTERN PIAUÍ, BRAZIL

Marcia Chame

Oswaldo Cruz Foundation

Luiz Flamarion OLIVEIRA, Rio de Janeiro Federal University

The Serra da Capivara National Park (PNSC) - a World Heritage Site, is a 130,000ha area at the Caatinga Northeastern Brazil. There are no perennial watercourses at the PNSC and water is available only in man-made or natural reservoirs. We study the implications of water reservoirs over 20 cinegetic mammal species. All 443 reservoirs in the park area were classified by the species use, landscape and habitat components. The animals' use of the reservoirs was evaluated by ordination analysis, NMS, MRPP, Indicator Species Analysis. The presence or absence of each sample, species and land cover classes was transformed in occurrence favorability index by "Beals Smoothing". These values were transposed to the polygons of land cover classes, generating maps of occurrence favorability of all 20 studied species. The analysis identified three different groups related to the distinct environment conditions: i) *Mazama gouazoubira*, *Puma yagouaroundi*, *Leopardus tigrinus*, *Dasyprocta aff. nigriclunis* and *Cerdocyon thous* are distributed throughout the high dense scrubby Caatinga of the plateau area of the Park; ii) *Alouatta caraya* e *Sapajus libidinosus* are restricted to the forests of the interior of the deep canyons and; iii) *Panthera onca*, *Dasyopus spp.*, *Euphractus sexcinctus*, *Conepatus semistriatus*, *Tamandua tetradactyla* and *Kerodon rupestris* are distributed in corridors formed by a set of land cover patches. *Tolypeutes tricinctus*, *Callithrix jacchus*, *Procyon cancrivorus*, *Pecari tayassu*, *Mazama americana* showed no preferences. Great predators overlapped distribution, excluded small carnivores and short distance between the reservoirs is more important than the size of them, especially for the jaguar, while the large reservoirs are important points for the deer. These highlights the efforts made by the Foundation Museum of American Man (FUMDHAM), in and out of the park, since this is the most significant area for conservation in the region, specially the most targeted by hunters.

SISS-GEO: A PLATFORM FOR COLLABORATIVE CITIZEN-DRIVEN MONITORING OF WILDLIFE HEALTH

Marcia Chame

Fiocruz

Douglas Augusto, Fiocruz ; Eduardo KREMPSE, LNCC ; Livia ABDALLA, Fiocruz ; Helio BARBOSA, LNCC ; Luiz GADELHA, LNCC

SISS-Geo, a georeferenced information system on wildlife health, is a Brazilian initiative for prevention and prediction of threats to animal and--by consequence--human healths. Recruiting a group of professionals to track events concerning wildlife is expensive and clearly does not scale to large areas like the vast Brazilian territory. Aware of that, SISS-Geo takes the modern and increasingly popular approach of leveraging the collaborative effort of citizens to help monitoring wildlife health. Uncommon or abnormal wildlife occurrences observed by the volunteers can be promptly informed to SISS-Geo through a mobile application. Occurrences describe the observed situation, such as locality, involved animals and their conditions, and once received by the system they are grouped according to whether or not they represent the same event--for instance, when the occurrences are spatially and temporally connected. The next phase relies on a previously built regression model, which will process the just characterized wildlife event and predict its severity. High-severity events represent potential threats and therefore are immediately communicated to specialists for close inspection and confirmation. Roughly speaking, a prediction model works by evaluating linear and non-linear rules and relationships among variables derived from the event's occurrences. As one can guess, the effectiveness of SISS-Geo strongly depends on how accurate the model is. In order to obtain highly accurate models, SISS-Geo employs state-of-the-art machine learning techniques to automatically train and update the model, based on the growing data from the confirmation of past predictions. The prediction models, in particular the symbolic ones, also serve to the purpose of giving insights on what makes an event more or less severe. This can aid specialists to come up with more effective measures to preserve wildlife health and biodiversity.

FEATHERED FRIEND OR FEATHERED FOE? BIRDS LOVED AND HATED BY URBAN RESIDENTS

Brendan Champness

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Little is known about urban residents' opinions of the birds with which they share their streets and gardens. As urbanisation increases, this information could predict future conflicts between birds and humans in suburbia. In south-



eastern Australia, urban bird communities are comprised of numerous conspicuous generalist species and some woodland species where suburban and urban fringe habitat is suitable. Twenty participants from an Australian city were shown photographs of local bird species and asked to separate the photographs according to whether they liked or disliked the bird. The photographs included local urban and woodland birds which each participant had previously indicated were familiar to them. Greater than 75% of participants liked nine species of birds, including the Laughing Kookaburra, Australian Pelican, Crimson Rosella, Rainbow Lorikeet and Superb Fairy-wren. Many of these species are prominent and easily sighted within the suburbs of south-eastern Australian cities. Behaviour and colour seemed to be primary factors in these decisions. No species were disliked to such a degree, however half or more of participants disliked the Australian Magpie and Australian Raven, citing swooping, scavenging or "pest" status as reasons for disliking a species. Overall, colour, behaviour and personal experience with a species seemed to drive residents' reactions to local birds. These results suggest species which are useful for promoting community engagement in urban conservation programs, and those which are less useful. However, the lack of reaction to small woodland passerines (those in urban fringe habitats susceptible to population declines), suggests that despite awareness of their presence, local residents know relatively little about these species. Conservation agencies and scientists, it seems, can do much more to inform suburban residents of these birds and promote their conservation.

147 ESSENTIAL BIODIVERSITY VARIABLES FOR CONSERVATION NEEDS - OPPORTUNITIES FOR CITIZEN SCIENCE

Mark Chandler

Earthwatch Institute

With recent changes in technology and the ability to reach and interact with much wider audiences than ever before, Citizen Science is becoming an increasingly trusted and integral part of future scientific research, particularly in terms of data collection. With limited budgets for paying scientists and government-sponsored environmental monitoring, engaging citizens to help with ground-based monitoring efforts and reporting of rare events will be the only way of covering much of the planet's environments. This talk will examine how CS can contribute to ongoing efforts in biodiversity monitoring, e.g. through increased monitoring of data on key species and systems in a standardized manner, collection of information on Essential Biodiversity Variables (EBVs), or in reaching key constituencies who would benefit biodiversity observation networks through their involvement.

RECENT RANGE CONTRACTION OF THE ENDANGERED PYRENEAN DESMAN (GALEMYS PYRENAICUS) IN THE FRENCH PYRENEES

Anaïs Charbonnel

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The Pyrenean desman (*Galemys pyrenaicus*) is a threatened semi-aquatic mammal endemic to the mountain streams of the Pyrenees and the Iberian Peninsula. We compared an historical (1985-1992; 637 sites) and a current (2011-2013; 1222 sites) sampling conducted in the French Pyrenees to update the distribution of this species and highlight potential range shifts. After simulating the river flow across the entire stream network using the hydrological model Soil and Water Assessment Tool, we applied a consensus of Species Distribution Models to predict habitat suitability both in the historical and current periods while accounting for climatic (i.e., rainfall and temperature), hydrological (i.e., river flow) and land-use changes between the two periods. The Pyrenean desman range has strongly contracted all over the French Pyrenees with mean occurrence probabilities shifting from 0.70 (\pm 0.27) to 0.32 (\pm 0.17) for historical and current periods, respectively. We showed that the distribution of the Pyrenean desman is mainly constrained by climatic and hydrological factors, suggesting that this species is sensitive to modifications of these environmental factors. As climate change in the French Pyrenees is associated with warmer temperature and lower annual rainfall, this appears as a severe threat for the Pyrenean desman as streams with high temperature and low rainfall were highlighted not to be suitable for this species. Additionally, the place left to move to new climatically suitable habitats is strongly limited for this mountain species. However, the observed range contraction was much higher than the one projected when including only land-use, climatic and hydrological changes that have occurred during the two time



periods. This finding thus suggests that other factors, such as stream local habitat or biotic interactions (e.g. recent range expansion of invasive and native predators) may play an important role in the recent reported decline of this threatened species.

A TREE-RING PERSPECTIVE ON THE IMPACT OF CLIMATE CHANGE ON NORTH AMERICAN TREE GROWTH

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The fate of forests in a warming world is of major ecological, societal, and economic concern. Forests play a key role in the combined carbon-water-nutrient cycle, including important ecosystem services and feedbacks to the climate system. Historically, forests have been an important carbon sink because of an excess of net primary production (NPP) compared to ecosystem respiration, but the future of this carbon sink is increasingly in question, as NPP may decline in a warming world. We assessed how climate change will affect growth in North American forests, using an extensive network of tree-ring observations to calibrate the relationship between tree growth and climate. In particular, we parsed the effect of changing climate ("exposure") from changing sensitivity to climate ("sensitivity"). The effect of shifting climate sensitivity offsets much of the growth increase that would otherwise be projected for northern latitude forests due to warming. That is, much of the positive effect of 21st century warming on growth rates in temperature-limited forests is counteracted by the degree to which those forests become precipitation-limited in the future. All else being equal (i.e., assuming constant species composition, stand structure), we forecast the net effect of changing climate on North American tree growth rates to be a reduction between -5% and -17% by the second half of the 21st century, with the strongest reduction of growth rates associated with the most carbon-intensive emissions scenario. Geographically, the strongest reduction of growth rates is forecast for interior western parts of the U. S. and Canada, highlighting the vulnerability of these forests to climate change. Our gridded forecasts, based on empirically-determined climate-growth relationships, adds to the emerging evidence questioning the ability of future forests to mitigate global carbon emissions.

194 BEST AVAILABLE SOCIAL SCIENCE FOR ENVIRONMENTAL DECISION-MAKING

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A number of laws, rules, and policies direct federal natural resource managers in the United States and other countries to consider the "best available science" in natural resource management decision-making. Yet rarely do these laws, rules, and policies provide managers and others with guidance on how to define or evaluate what the "best available science" is, or how to use it. Attempts to fill this gap have focused on the best available natural science. This paper provides insights for natural resource managers and others on how to assess and integrate the best available social science (BASS) into environmental decision-making to comply with best available science mandates, based on the experience of authors that have been involved in such efforts. We offer some definitions and standards for BASS, and compare and contrast them with those for natural science. We comment on how qualitative data, and traditional and local ecological knowledge, might be considered in best available science efforts – both sources of social science information that natural resource managers may have difficulty evaluating and using. We then provide two case examples – one from the U.S. Forest Service, one from the National Marine Fisheries Service – of how these federal agencies have attempted to integrate best available social science into natural resource management decision-making. Insights for improving best available science efforts drawn from these cases include: the need to identify at the outset what the key management questions are for which best available science is needed; to consider the social dimensions of the questions (rather than assume there aren't any) and assemble a team from the start that includes social scientists having the appropriate expertise; to determine how natural and social science will be integrated early on; and to work closely with decision-makers to deliver the scientific information needed in a meaningful and usable way.

TIGERS OF INDIA ARE AT RISK OF GETTING DISEASES FROM DOGS

Vratika Chaudhary

Clemson university

David TONKYN, Clemson university

In highly populated countries like India dogs thrive on human leftovers and live in densely packed human habitations and breed successfully multiple times a year. They are reservoirs for diseases like rabies, canine distemper virus (CDV), canine



parvovirus, canine adeno virus, tuberculosis etc. Apart from public health concern free ranging/ semi owned dogs, which are often unvaccinated, pose a serious threat to health of livestock and wild carnivores. CDV is the second most common cause of death due to infectious disease in domestic dogs and is emerging as a global health concern for endangered wild carnivores. In 1990s in Serengeti National Park, there was a steep decline in African lion (*Panthera leo*) population caused by CDV epidemic that was later found to be caused by spillover from domestic dogs. My study site is in Kanha Tiger Reserve, a deciduous protected area for endangered species such as tigers (*Panthera tigris*) in central Indian highlands. Most of the dogs that are found in Kanha Tiger Reserve are of communal ownership. They are seen to frequent the tiger reserve and they come in frequent contact of the wild carnivores. There is very little information available on the demography or population size of these dogs. Based on our surveys it was determined that these dogs are largely unvaccinated and suffer from general poor health conditions. In this study we conducted seropositivity surveillance of feral dogs and wild carnivores of the region. We have also studied odds ratio of infection at carnivore metacommunity level, genetic composition of the pathogens that jump species and are found both in feral and wild carnivores. Based on our ongoing study we can conclude that tigers and other wild carnivores of the region are at a risk as feral dogs act as reservoir communities for these infectious diseases.

INFECTION FROM DOGS: EMERGING THREAT TO WILD CARNIVORES

Vratika Chaudhary

Clemson university

David TONKYN, Clemson university; A.b. SHRIVASTAVA, CWFH

In many parts of the world, domestic dogs pose a significant though often overlooked threat to protected wildlife. In countries such as India, dogs thrive on human leftovers and can form large populations that move freely among towns, agricultural fields and protected areas. These free-ranging or semi-owned dogs are generally unvaccinated and can serve as reservoirs for rabies, canine distemper virus (CDV), canine parvovirus (CPV), canine adenovirus (CAV), and tuberculosis, which threaten humans, livestock and wildlife. For example, domestic dogs are believed to have been the source of a CDV epidemic that ravaged lions in the Serengeti National Park in the 1990s. More generally, CDV is the most common cause of death from infectious diseases in domestic dogs, and is emerging as a global health concern for endangered wild carnivores. We are studying the role of semi-owned dogs around the Kanha Tiger Reserve in central India as reservoirs of CDV and other diseases that threaten protected carnivores including tigers (*Panthera tigris*). Our surveys found that most of these dogs are communally owned, largely unvaccinated,

and in poor health. Still, they reach high densities and frequently enter the Reserve where they come in contact with wild carnivores. Our preliminary studies found that 85% of the dogs were sero-positive for CPV, 43% were positive for CDV and 52% were positive for, CAV representing past infections and not necessarily current infectivity. None were sero-positive for rabies, though infected individuals would be expected to die quickly and not be detected. We opportunistically examined samples from various wild carnivores, and are comparing the genetic composition of pathogens that jump species and calculating the odds ratio of infection at the carnivore metacommunity level. Our work to date suggests that tigers and other wild carnivores are at a risk from diseases carried by these feral dogs.

BEYOND TRADITIONAL PROTECTED AREAS: CONSERVATION LANDSCAPES TO ENSURE ECOLOGICALLY-RELEVANT AND COST-EFFICIENT LAND PROTECTION

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Protected areas (PAs) play a key role in global biodiversity conservation, being generally thought to safeguard biodiversity and help support local and regional ecosystem functions. Yet, an overwhelming majority of PAs are <5km², limiting their ability to prevent further biodiversity loss and to contribute towards securing key ecological processes and the provisioning of ecosystem services at scales relevant to dependent human communities. Here we propose a new approach to halting biodiversity loss, which could be achieved through multiple-use landscapes rather than strict protection. This paradigm shift in land protection and management relies on the identification of Conservation Landscapes (CLs), which are defined as areas able to sustain viable populations of the widest-ranging terrestrial species and help secure ecological processes. We describe a cost-benefit approach to identifying CLs to maximise biodiversity conservation outputs while minimising the long-term costs. Specifically, benefits are defined in terms of richness and representativeness of all species and threatened species; we index long-term costs using the Human Footprint as a proxy for opportunity cost, and the potential for climate to change as a measure of increases in future costs and pressure. We show through a case study in East Africa that the current reserve system does not encompass



all the most cost-effective conservation areas. In the light of the recommendations from 2014 IUCN World Parks Congress, we believe such options should be considered by wildlife management authorities when deciding on how to expand the current conservation areas network.

EVALUATING THE IMPACTS OF A SEAGRASS CONSERVATION EDUCATION PROGRAMME ON THE COMMUNITY'S ECOLOGICAL UNDERSTANDING AND PERSPECTIVES OF SEAGRASS CONSERVATION: A CASE STUDY IN PENANG, MALAYSIA.

Jiun Xiang Cheah

UNIVERSITI SAINS MALAYSIA

Leela RAJAMANI, UNIVERSITI SAINS MALAYSIA

Community-based approaches in marine conservation has been increasing in importance especially in developing countries where conservation funds are limited. However, information on the effectiveness of community participation in conservation education is also limited. This paper presents a case study of community involvement in a seagrass education programme in Penang, Malaysia. The education programme consists of two components, seagrass education and seagrass monitoring. The seagrass education uses diagrams, seagrass photos and informal conversations to disseminate information of seagrass biology, seagrass ecology, threats to seagrass and its conservation to the local community. To improve further their understanding, the community are invited to participate in a six-months seagrass monitoring using photo-library method. This method was adopted using Kutser et al (2007) to visually estimate seagrass dry weight using a photo-library of classes of different seagrass biomass. A catalogue of photo-library consisting seagrass photos and its corresponding biomass will be developed for the reference of the community during the fieldwork. Individual semi-structured interview surveys will be conducted before and after the seagrass education programme. Both the interview surveys will ask questions on general understanding on seagrasses, seagrass monitoring method, and perspectives towards seagrass conservation. The post interview surveys will also include questions on community opinions towards the seagrass education programme and lifestyles changes. The programme targets local fishermen, boat operators and university students. This study aims to assess the impacts of a seagrass education programme on the community's ecological understanding and perspectives of seagrass conservation.

HUMAN-WILDLIFE COEXISTENCE IN QOMOLANGMA (MT. EVEREST) NATURE RESERVE: CONFLICT AND RECOMMENDATIONS

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Livestock depredation by large carnivores is increasing in Qomolangma (Mt. Everest) Nature Reserve, Tibet Autonomous Region of China. We conducted an assessment of local resident's interactions with wildlife, and evaluated the compensation scheme adopted by local authorities. We collected quantitative and qualitative data using multi-methods. We gathered 9,193 conflict records over 2011-2013 to analyze predation patterns. We interviewed government officials and local residents to understand perceptions about causes of conflict and effectiveness of the compensation program, including community participatory mapping to get local knowledge and perspective. We found snow leopards (*Panther uncia*), lynxes (*Lynx lynx*), dholes (*Cuon alpinus*), and wolves (*Canis lupus*) were major predators. The snow leopard tended to take yak and cattle, whereas lynx and dhole selected sheep and goat. Conflicts showed spatial and temporal patterns as different towns were impacted by different predators, mostly from March to July. Most respondents (68%) attributed causes to wildlife population growth, and only 6% blamed improper herding practices, while 7% said it was due to livestock population increase. The compensation scheme was flawed in virtually all aspects - evidence collection and verification, public involvement and communication, standards and procedures setting, resources allocation, implementation, monitoring and evaluation, and in its inability to terminate unsuccessful activities. Local residents and government officials highlighted different weaknesses of the management problem, due to their different identities, demands and expectations. We showed that human-wildlife conflict management can greatly benefit from an integrated, adaptive approach that targets the key aspects of the complex, interconnected social and management process at based in the conflict. Our recommendations sought to offer reduced conflict, improved conservation, and open, more effective management.

133 HOW BUDDHIST VALUES DRIVE ORGANIC FARMING IN TAIWAN

Li-Yi Cheng

Tse-Xin Organic Agriculture Foundation

Through organic farming, adapting a vegetarian diet, and planting trees, the Buddhist concepts of love and compassion are applied as part of our daily life by Tse-Xin Organic Agriculture Foundation (TOAF). The development of organic farming is the earliest and the most comprehensive of TOAF's efforts which began by introducing the purpose for organic farming through various educational camps and encouraging



farmers to convert to organic farming. TOAF also helps consumers and farmers understand why eating and planting organic food is healthy for people while promoting care for the many other living entities in agricultural fields. Through organic farming, the Buddhist disciple can practice love and compassion that builds a co-existing and cooperative relationship between people, other species, and the natural environment. TOAF involves the participation of not only Buddhists but also many others in the society to become healthier, to enrich their spirituality, and to demonstrate love and compassion which are shared universal values. Case studies of organic farmers and consumer behaviors will be discussed with the hope of drawing upon this shared value and inspiring love and compassion for all.

BEHAVIORAL CROWDING: IMPACT OF PROVISION OF EXTRINSIC BENEFITS ON ENVIRONMENTAL BEHAVIOR

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Indian School of Business

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We provide evidence that the foundational assumption motivating conservation interventions that seek to simultaneously address rural poverty and resource or habitat degradation is flawed – namely that providing material benefits to local residents shall persuade them to change behavior deemed to improve conservation outcomes. Evaluating the impact of a prototypical Integrated Conservation and Development intervention in the Indian Himalayas, we find that households who received material benefits through the program changed their behavior in environmentally unsustainable ways compared to matched counterparts who did not receive benefits. We use data on grazing and firewood use on 1432 households from before the start of the program in 2006 and at the end of in 2011, distributed equally across villages that received the program and those that did not. We further find that providing private material benefits to support rural livelihoods has the worst impact on behaviors related to open grazing of cattle in local forests and use of firewood for domestic energy also collected from local forests. On the other hand, households participating in creating public goods through the program reported slightly positive change in behaviors, though this is not statistically significant. In a related finding, we also report an adverse effect of the program and its activities on the intrinsic motivations of participating individuals to protect the environment. Our results not only corroborate existing critiques of ICDPs, but provide quantitative evidence about their adverse effects under certain conditions. This manuscript is part of a set of contributed papers organized by L. Glew, M. Mascia, and D. Miller. If accepted, please include this presentation in the program at the end.

A TREE IS A TREE? EFFECTS OF DIFFERENT TREES ON VEGETATION IN AGROFORESTRY STRIPS

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Technische Universität München

Harald SCHMID, Technische Universität München ; Sebastian WOLFRUM, Technische Universität München ; Kurt-Jürgen HÜLSBERGEN, Technische Universität München

High future demand for biomass will likely enhance fast growing tree plantations. Agroforestry, a corresponding sustainable agriculture practice, has many favourable properties. However, effects on biodiversity are little known. The aim of this study was to evaluate richness and composition of vascular plants in relation to different tree species in agroforestry strips. Data was collected at Scheyern research station located in southern Germany. In 2009 four short-rotation coppice systems comprising three 8.25 m wide tree strips were planted. Each strip consists of three double rows spaced 1.5 m apart. After first harvest in February 2013, vegetation was recorded in May 2013 and September 2014 in 140 plots (0.75 x 1.5 m). Sampled tree species included black alder (*Alnus glutinosa*), black locust (*Robinia pseudoacacia*), poplar Max 3 (*Populus maximowiczii* x *Populus nigra*), willow Inger (*Salix triandra* x *Salix viminalis*) and a mixture of regionally common hedge trees. Sites with different trees showed different plant species composition and richness. In 2013, 36 species belonging to 19 families were recorded. The most frequent families were Poaceae, Fabaceae and Polygonaceae. In 2014, the number of species increased to 40 from 21 families, mostly Asteraceae, Poaceae, Rosaceae and Fabaceae. The highest species richness was recorded in willow for 2013 and black locust for 2014. In both years, poplar showed lowest species richness. Legumes and forest species, which were not present at sites with black locust and black alder, favoured few nutrients in soil and low light availability. The most species were hemicryptophytes. Weed species, annual species and species with ruderal strategy disappeared with time. Six years after plantation typical species for natural hedgerows appeared. Plant species richness and composition thus suggested little limitation by nutrient availability, but more by light conditions due to tree species characteristics and location within strips.

GIVE THEM DESSERT: INCREASING BENEFICIAL INVERTEBRATES IN WHEAT AGROECOSYSTEMS

Beth Choate

Allegheny College

Jonathan LUNDGREN, USDA-ARS, North Central Agricultural Research Station

Wheat is grown worldwide on approximately 520 million acres and provides 20% of calories and protein consumed across the globe. Sustainable and efficient management of wheat



is essential to reduce negative environmental impacts and ensure necessary food supplies. Cereal aphids are responsible for reducing wheat yields; however, management against these species is rare, particularly in North America. Generalist predators may contribute to reducing cereal aphid numbers and prevent significant damage to crops. A two-year field study was conducted in South Dakota spring wheat aimed at identifying the arthropod communities throughout wheat fields and the role of non-prey foods in enhancing these communities. Plots of spring wheat were planted and surrounded by alfalfa borders to evaluate the effects of diverse cropping systems. Borders were treated with high and low inputs of sucrose to mimic plants with extrafloral nectaries. The arthropod complex in wheat was diverse with 103 taxa identified. Sentinel bird cherry-oat aphids were placed on wheat plants and predator gut-content analysis employed to identify specific predators. The role of a sugar in enhancing predator communities and the role of predators in reducing aphid communities provides important guidelines toward creating a self-sustaining wheat agroecosystem.

BIOLOG & BIOLIB, MOBILE & WEB SPECIES MAPPING APPLICATIONS AIMING AT PUBLIC

Karel Chobot

Nature Conservation Agency CZ

BioLog and BioLib are two species occurrence mapping applications in the Czech Republic. BioLog is an Android app replacing the field notepad by using the advantages of mobile technologies (mapping, location, time, and media) for gathering the species observations by public. The app has been originally developed by Nature Conservation Agency of CZ as a mobile device for their experts, but it is open to public use. The data collected via BioLog are public, and after validation procedure imported to the central Species Occurrence Database, the official instrument of nature conservation authorities, but also as a source of data for research purposes. BioLib is a web page originally intended as taxonomically structured photo gallery of all species, but the branch of citizen science: mapping of species of mammals, amphibians, reptiles, dragonflies and selected species of beetles and spiders has evolved. Although created as an independent project, the data flows are recently also connected to the Species Occurrence Database. Both applications are examples of good practice of use of citizen science in both nature conservation practice and research. <http://biolog.nature.cz> <http://www.biolib.cz/>

PREDICTING THE IMPACTS OF SEA LEVEL RISE ON SEA TURTLE ROOKERIES IN LOW-LAYING ISLANDS: A CASE OF CONDAO ARCHIPELAGO (VIETNAM)

Cuong Chu

Vietnam Academy of Science and Technology

Martin DAHL, Department of Ecology, Environment and Plant Sciences, Stockholm University

Vietnam is the most vulnerable country in Southeast Asia to sea level rise, which is expected to be 0.5–1.4 m through 2100. Approximately 80% of green turtle (*Chelonia mydas*) nesting in Vietnam is on the Con Dao Islands. In this study, we used three climate change scenarios to estimate the loss of nesting area on the Con Dao Islands beaches (n = 5) in relation to predicted sea level rise through 2100. Previous studies have not considered the seasonal nature of turtle nesting and monthly tidal fluctuations. To address this gap, we estimated the impact of sea level rise for each month separately during the nesting season. Beach profile measurements and digital elevation models were used for simulation of sea level rise. The nests in 2011 defined the nesting area. Our results showed that the period June–August would experience the lowest impact (17–36% loss of nesting area by 2100), and October–November the highest impact (43–56% loss by 2100). This result matches with the nesting activity in 2011, which was highest between June and August when the beach is at its maximum width. Tide data showed that June to August also had the lowest tidal impact during 1980–2009. We concluded that rising sea levels today and in the future have the potential to reduce nesting space, lower breeding success, and cause an increase in conspecific nest destruction on the Con Dao Islands. To predict the impact of sea level rise, monthly variations must be considered because nesting activity is seasonal.

133. IDEA TO ACTION: THE EMERGENCE OF FAITH-BASED CONSERVATION IN THE EASTERN HIMALAYAS AND EAST AFRICA

Dekila Chungyalpa

Yale University

The results of qualitative and quantitative research on faith-based conservation projects established by Tibetan Buddhist leaders in the Eastern Himalayas and the Catholic Church in East Africa that were supported by the Sacred Earth Program at WWF between the period of 2009 and 2014 are the focus of this presentation. Two different sets of questions are explored: (1) Does environmental advocacy from senior faith leaders lead to measurable pro-environmental behavior change at the institutional level and (2) is there also a comparable attitude change among individual monastics? Findings from the two case studies demonstrate that an environmental call to action from senior faith leaders can result in pro-environmental behavior among their religious institutions and communities. The more specific the call, the more efficacious and tangible the pro-environmental behavior is. At the same time, distinguishing between individual attitude change and



institutional behavior change is important because regulations at an institutional level do not necessarily lead to or imply an attitude shift at the individual level. Without the engagement and support of middle-tier monastic managers, the initial faith-based environmental effort can be unsustainable as a management model. The religious institutions with strong physically present leadership and that receive consistent capacity building efforts are the most successful in reaching their own environmental goals and engaging their wider communities.

AUGMENTATION OF THE CRITICALLY ENDANGERED SPECIES, *ALOE SAUNDERSIAE*

Brigitte Church

Ezemvelo KZN Wildlife

Sharon LOUW, Ezemvelo KZN Wildlife

Aloe saundersiae which occurs in Kwazulu-Natal South Africa is an endemic, critically endangered plant with a very restricted range and very specific habitat requirements. The species was not afforded any formal protection and the area of occurrence fell below the conservation target. At the initiation of this project in 2003 there was only one extant population with two subpopulations. As introduction to a protected area was one of the recommended interventions in the recovery plan, a modelled distribution of the species was used to select three sites in a protected area for a trial introduction. Adult plants grown *ex situ* from seed collected from the natural site were planted in suitable microsites within the three selected sites. The quantitative measures of success at each site are based on the number of surviving introduced plants, the number of progeny that reach reproductive maturity, the number of inflorescences produced per year and the number of new seedlings per year. Results after 10 years of monitoring show varied success at the three sites. Adult survival rate varied from 74% to 43%. Although flowers, seeds and seedlings have been produced at all sites only one site has completed a full life history cycle in which progeny have flowered and produced seeds and seedlings. Despite this, current interventions including this introduction programme have improved the status of the species through an increase in area of occurrence from 0.76km² to 9.58km² and an increase in area of occupancy from 0.75km² to 2.25km². Recommendations for ongoing monitoring and management to secure this species are made.

HUMAN-WILDLIFE CONFLICT IN EASTERN TURKEY: GAINING PERSPECTIVE FROM COMMUNITY SURVEYS

Mark Chynoweth

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Emrah COBAN, KuzeyDoga Society ; Cagatay ALTIN, Celal Bayar University ; Cagan SEKERCIOGLU, University of Utah

Human dimensions of wildlife management are critical to the success of a wildlife management program. The input of stakeholders at the local level can help determine how a conservation organization can mitigate potential human-wildlife conflicts. In the Sarikamis-Allahuekber Mountains National Park and surrounding forests in eastern Turkey's Kars province, large carnivores are facing increasing threats due to human activity. Villagers in this area have an integral relationship with the forest, which provides firewood, grazing areas and recreational opportunities. The main threats to large carnivores in the region include unchecked development, habitat loss and fragmentation, illegal resource extraction, and direct persecution. To provide a comprehensive conservation and management plan, the KuzeyDoga Society is conducting long-term monitoring of large carnivores, including a community outreach program. As part of this program, we are conducting community surveys in villages surrounding the national park to understand the opinion of local villagers concerning large carnivore presence, wildlife management, and designation of protected areas. We conducted 682 surveys in 2010 and 267 surveys in 2014 at 29 villages surrounding the national park. Seventy-seven percent of respondents see wildlife on a regular basis in the area immediately surrounding their village, and 53% of these people consider these interactions harmful. However, the majority of survey respondents are aware of ecotourism as an economic opportunity (63%) and have a desire to participate in future wildlife ecotourism opportunities (74%). These and other results of this survey provide guidance for the KuzeyDoga Society to further develop their community outreach program and sustain populations of brown bears, gray wolves, Caucasian lynx and other wildlife species in eastern Turkey.

CONSERVATION IN A COMPLEX WORLD: MODELLING THE BOREAL FOREST-CARIBOU COMPLEX SYSTEM, A CASE FOR ABM SIMULATION

Fabian Cid Yañez

UBC

Lael PARROTT, UBC ; Frédéric RAULIER, Université Laval ; Daniel FORTIN, Université Laval ; Guillaume LATOMBE, Monash University

Conserving populations of boreal caribou (*Rangifer tarandus caribou*) in Canada is of paramount ecological and cultural importance. Caribou can be considered a fine filter for the ecological integrity of the boreal forest, also culturally important as many communities rely on caribou as symbol or source of food. Additionally, the ultimate cause of caribou's threatened status is the human encroachment and habitat loss caused by recreational, industrial and forest activities.



Therefore, connecting the social and ecological systems to help manage caribou conservation becomes a key aspect for defining conservation strategies. In this case, our objective is to provide forest planning decision makers with a decision support tool that could help them assess the viability of forest management strategies under caribou conservation goals. For doing so, an Agent-based model (ABM) of caribou movement and interactions is setup to test forest planning strategies. The model captures movement data from telemetry observations for two other species: moose (*Alces americanus*) and wolves (*Canis lupus*). The resulting movement sub-models allow the species to interact in a fairly dynamic environment for a given period of time. Functional responses and population dynamics can emerge from these interactions. Some difficulties for the model arise when fitting scales of different ecological processes. To overcome these challenges, landscape structure is quantified and movement sub-models derived accordingly. A prototype model will be presented and the validation process discussed to simulate movement and dynamics in future managed landscapes. The goal is to derive process-pattern relationships to facilitate caribou self-sustainability and estimate trade-offs between the management production and conservation objectives.

A BEFORE-AFTER-CONTROL-IMPACT (BACI) STUDY OF THE SAPODILLA CAYES MARINE RESERVE IN BELIZE

John Cigliano

Cedar Crest College

Richard KLIMAN, Cedar Crest College

The Sapodilla Cayes Marine Reserve (SCMR) was established in 1996 at the southern end of the Mesoamerican barrier reef to protect and replenish local fisheries. The SCMR is divided into three zones of varying levels of protection: a General Use Zone (GUZ), where commercial extractive activities are allowed but managed; two Conservation Zones (CZ), where no commercial extractive activities are allowed (subsistence harvesting is allowed in one of the zones); and a Preservation Zone (PZ), where entry is prohibited except with a special permit. Enforcement began in April 2010. The goal of this project was to conduct a before-after-control-impact (BACI) study to determine if the conservation goal of the reserve was being fulfilled for queen conch (*Strombus gigas*). We collected pre- and post-enforcement data (n=3 yrs each) on density, size (total length), and age (lip thickness; queen conch are considered subadults with lips <5mm and adults with lips ≥5mm) of conch in shallow-water (<3m) aggregations in both control/unprotected (GUZ, n=3) and impacted/protected (CZ, n=6) sites. We found no significant BACI effect for density (P=0.6724), size (P=0.2910), or age (P=0.5817) with all sites included. We also found no significant effect when single impacted sites were compared to control sites. However, there

are signs of recovery. Conch returned to one site that did not have conch within 5 months of enforcement and we observed for the first time conch laying eggs in shallow water. The lack of a BACI effect is likely due to the parallel response of control and impacted sites. This likely occurred because the few fishers that regularly fished the SCMR left once enforcement began, essentially turning the entire reserve, including the GUZ, into a protected area. We conclude that enforcement is likely having a positive effect but additional and regular monitoring is required to confirm this conclusion.

A PLAYBACK EXPERIMENT ON THE EFFECTS OF NATURAL ENERGY EXTRACTION NOISE ON WILDLIFE: THE PHANTOM NATURAL GAS FIELD.

Elizeth Cinto Mejia

Boise State University

Christopher J.w. MCCLURE, Peregrine Fund ; Jesse Rex BARBER, Boise State University

Energy infrastructure and related extraction activities are expected to more than double in the western US in the next few decades. Gas extraction activities negatively impact wildlife abundance and diversity. For instance, avian abundance and species richness are reduced near gas compressor stations. No work has experimentally parsed the role that compressor station noise alone plays in these impacts. We have recreated the noise component of natural gas compressor stations, a prominent element of extraction fields, using speaker arrays at four sites in a shrub steppe habitat and simultaneously monitored four control sites. We present preliminary results demonstrating that noise affects the distribution of birds, bats, and insects. Ongoing work is focusing on how noise might impact trophic relationships in sage steppe ecosystems

TRANSITION TO SUSTAINABILITY: AN ECOSYSTEMS-BASED APPROACH TO MODELING URBAN METABOLISM

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Urban systems embody, as a human community scale, the current contradiction between development and nature conservation goals at planetary scale. According to the systemic understanding of sustainability, any economic system is a sub-system of a social system which is itself a subsystem of a natural system in which is embedded and on which is dependent. This nested inclusion relationship means



that sustainable development requires that ecological issues must be given priority in policy and management, followed by social issues and then by economic issues. However, the public opinion favors an opposite order: it demands that economic problems are solved first, followed by social issues, with environmental issues being left at the end. In this communication, we propose a way forward through a holistic eco-city reference model (ECRM) that reviews and extends the notion of urban metabolism to include ecological, social and economic aspects. The model is formulated as a composite algorithm that aggregates information and knowledge from various fields of science (starting with environmental quality parameters) into a set of holistic parameters that policy-oriented, the most important being the city resilience, city footprint and city livability. System complexities and limitation of knowledge are being addressed through recently developed concepts in sustainability studies. A set of sustainability filters (SF) – environmental, social and economic – accounts for the systemic order of priorities. The notion of Urban Sustainability Nexus (USN) is used to manage the interdependencies between landscape, water, energy and transport within cities. Using this model, we show that, in the pursuit of better and sustainable living in cities, citizens can assimilate better principles of nature conservation. We anticipate that urban ecosystems and biodiversity are key themes in the transition to sustainable development, because they facilitate interaction between experts and public.

SYMPOSIUM 188: BARRIERS TO BIODIVERSITY IN FLUVIAL ECOSYSTEMS” RELYING ON HISTORICAL ECOLOGY TO PLAN THE RECOVERY OF THE EUROPEAN EEL

Miguel Clavero

Estación Biológica de Doñana-CSIC

Virgilio HEMOSO, CEMFOR-CTFC Forest Sciences Center of Catalonia

Energy infrastructure and related extraction activities are expected to more than double in the western US in the next few decades. Gas extraction activities negatively impact wildlife abundance and diversity. For instance, avian abundance and species richness are reduced near gas compressor stations. No work has experimentally parsed the role that compressor station noise alone plays in these impacts. We have recreated the noise component of natural gas compressor stations, a prominent element of extraction fields, using speaker arrays at four sites in a shrub steppe habitat and simultaneously monitored four control sites. We present preliminary results demonstrating that noise affects the distribution of birds, bats, and insects. Ongoing work is focusing on how noise might impact trophic relationships in sage steppe ecosystems

ARE AUSTRALIAN'S JUST OBSERVERS TO SHOREBIRD POPULATION DECLINES BEING DRIVEN FROM OVERSEAS?

Robert S. Clemens

University of Queensland

Greg A. SKILLETER, University of Queensland ; Richard A. FULLER, University of Queensland

The conservation of non-breeding habitats for migratory species is critical for the long-term viability of populations. However, for highly mobile or migratory species, population increases or decreases at a local scale may or may not be related to local conditions. Local conservation efforts, monitoring effectiveness, and our understanding of the costs and benefits of taking conservation actions at local habitats are confounded when species populations may have declined due to factors outside those local habitats. Migratory shorebirds that visit Australia during the non-breeding season are declining rapidly, and by analysing count data we discover three more species that can be added to the list of those showing widespread declines. Local shorebird population declines are most rapid at both ephemeral wetlands, which are filling more intermittently or disappearing altogether, and many large wetlands reliant on freshwater flows which are decreasing in water quality or increasing in salinity. Using a continental citizen science count data set we investigated why some local populations are faring better or worse than others, and find important geographic variation including greater declines in the south for some species. We also discover a strong negative correlation between predicted inland suitability and coastal abundance of four shorebird species, suggesting a combination of markedly different habitats is used during the non-breeding season further confounding local scale analyses. Finally, we explore whether this dynamic habitat suitability is related to population changes as management increasingly dampens the pattern of wetland availability. With growing evidence that shorebird population declines are driven by habitat loss in East Asia, we show here that variation in conditions in the non-breeding areas in Australia also may play a role.

SYMPOSIUM ID: 76. CAN PAYMENTS FOR ENVIRONMENTAL SERVICES CONSERVE HABITATS AND ALLEVIATE POVERTY AT THE SAME TIME? A CASE STUDY FROM NORTHERN CAMBODIA.

Tom Clements

Wildlife Conservation Society

E.j. MILNER-GULLAND, Imperial College London

The potential impacts of Payments for Environmental Services (PES) and Protected Areas (PAs) on environmental outcomes and local livelihoods in developing countries are



contentious and have been widely debated. The available evidence is sparse, with few rigorous evaluations of the environmental and social impacts of PAs and particularly PES. We measured the impacts on forests and human wellbeing of three different PES programs instituted within two PAs in northern Cambodia, using a panel of intervention villages and matched controls. Both PES and PAs delivered additional environmental outcomes: reducing deforestation rates significantly in comparison with controls. PAs increased security of access to land and forest resources for local households, benefiting forest resource users, but restricting households' ability to expand and diversify their agriculture. PES impacts on household wellbeing were related to the magnitude of the payments provided: the two higher-paying market-linked PES programs had significant positive impacts, whereas a lower-paying program that targeted biodiversity protection had no detectable effect on livelihoods, despite its positive environmental outcomes. Households that signed up to the higher-paying PES programs, however, typically needed more capital assets and hence they were less poor and more food secure than other villagers. Therefore, whereas the impacts of PAs on household wellbeing were limited overall and varied between livelihood strategies, the PES programs had significant positive impacts on livelihoods for those that could afford to participate. Our results confirm theories that PES, when designed appropriately, can be a powerful new tool for delivering conservation goals whilst benefiting local people.

MAKING A DIFFERENCE: THE IMPACT OF SEED CONSERVATION AND TRANSLOCATION ON THREATENED PLANT RECOVERY

Anne Cochrane

Department of Parks and Wildlife

Leonie MONKS, Department of Parks and Wildlife ; Andrew CRAWFORD, Department of Parks and Wildlife

Implementing effective conservation strategies is essential to stem the loss of global biodiversity. Seed banks deliver one of a number of important strategies for supporting the conservation of threatened plant species. Seed banks collect, evaluate and store seeds under conditions that minimise seed deterioration as an insurance against species or population loss. Adequate collections of viable seed with a broad genetic base are required to provide effective support for conservation activities such as threatened species translocation. The goals of translocation are to increase plant numbers, create or maintain self-sustaining populations and ideally down-grade a species from its threatened ranking, thereby positively affecting the conservation status of the species. Evaluating the success of each step of the translocation process, from seed germination through to survival of reproducing adults on the ground, can help prioritise and set targets for future seed collection. Here we highlight the benefits of integrating ex situ seed storage

and plant translocation programs to help provide for better conservation outcomes. We use Western Australian examples to illustrate how translocation supported by seed conservation is making an important contribution towards improving conservation status of a wide range of threatened species across this unique global biodiversity hotspot.

THRESHOLDS OF CHANGE IN A MULTI-USE CONSERVATION LANDSCAPE OF SOUTH AFRICA: HISTORICAL LAND-COVER, FUTURE TRANSFORMATION AND ENVIRONMENTAL DECISION-MAKING IN THE KRUGER TO CANYONS BIOSPHERE RESERVE

Kaera Coetzer

University of the Witwatersrand

Edward T F WITKOWSKI, University of the Witwatersrand ; Barend F N ERASMUS, University of the Witwatersrand

Biosphere Reserves (BRs), as multi-use conservation landscapes, exemplify the landscape mosaic approach to environmental decision-making. With dual biodiversity conservation and sustainable development objectives, they provide a long-term perspective that aims to improve the relationship between traditional conservation and sustainable use; providing local communities with options to sustainably manage environmental resources into the future. South Africa has six BRs listed with UNESCO's Man and the Biosphere Programme (MaB), with the Kruger to Canyons Biosphere Reserve (K2C) in north-eastern South Africa, one of the largest globally. K2C is a spatially structured socio-ecological system, with important economic sectors and world-renowned protected areas proximal to extensive, mostly rural, human populations engaged in informal livelihood practices. In this study, time-series remotely-sensed data (1993 – 2006 – 2012) was used to track landscape transformation across the subregion, analysing spatial changes in cover relative to the theoretical MaB concept. The focus is on changes in the scale of land-cover change (spatial extent, rate, intensity of change) across the analysis period, simulating future changes to 2018 and 2024. Results indicate that the spatial distribution of these land-cover changes bear little regard for the prescriptive BR zonation and the relative limitations on 'use' that typifies successful BR implementation. The increased rate of change in the recent observation period (2.3% versus 5.7%) poses challenges for landscape management, with future predictions of escalating transformation likely to undermine BR sustainability long-term. Consequently, the thresholds for scheduling proactive management action have been identified, allowing for timely detection of unfavourable transformations while practical options for intervention remain.



159 - AN ANALYSIS OF PLANT CONSERVATION TRANSLOCATIONS IN EUROPE

Bruno Colas

Université Paris Sud [INSTITUTE] Univ. Paris Diderot
Juan FERNANDEZ-MANJARRES, CNRS - Univ. Paris Sud 11

Alternative views for managing biodiversity oppose on the one hand the conservation of extant biodiversity at all costs, and on the other hand, the management of landscapes to allow evolution continue while accepting extinctions. These views question our conception of wilderness, but they are not mutually exclusive although tools for reconciling them are not easily available. One management option that seeks to manage endangered populations and may also target landscape restoration is species translocation. We focus here on conservation translocation which consists in the deliberate movement of organisms from one site for release into another, for a conservation benefit at the levels of a population, species or ecosystem (cf. IUCN). We have set up a database of more than 800 conservation translocations of plants and animals in Europe over the last 150 years. Parallel to the presentation of Thévenin et al. (this symposium), which focuses on animals, we present here some results on plants from the database. First, we compared translocated species with all plant species in Europe to see whether translocated species consist of a particular subset of taxonomic groups (genera and families), life forms (herbs, shrubs, trees...), and other life history traits (pollination syndromes). We also identified the types of translocations that have been undertaken, according to the IUCN typology for conservation translocations (reinforcement, reintroduction, assisted migration). We compared the frequencies of the different translocation types in plants and examined possible differences with animals in the light of differences in dispersal abilities. Lastly, we discuss the demographic survey and the viability of translocated plant populations, and the need for more long-term demographic data.

99. URBANISATION AND GREEN-SPACE - INFLUENCES ON HUMAN WELL-BEING, BIODIVERSITY KNOWLEDGE AND CONSERVATION SUPPORT.

Debbie Coldwell

University of Sheffield
Karl EVANS, University of Sheffield

There is a vast amount of literature on the well-being benefits people get from spending time in nature. It is also widely assumed that greater nature engagement may lead to increased biodiversity knowledge and willingness to protect it. There is thus rising concern that urbanisation will increasingly disconnect people from nature, reducing the benefits delivered by green-spaces as well as conservation support.

This talk presents results of household surveys conducted in six urban areas across England across the full range of the socio-economic spectrum present in each area. These data inform understanding of how people perceive urbanisation and green-space, and how at a local scale these influence human well-being, biodiversity knowledge and interest in environmental protection.

GENETIC DIVERSITY IN RINGED SEALS (*PUSA HISPIDA*) FROM THE BALTIC SEA AND THE ADJACENT LAKES

Bethany Cole

University of Lincoln
P UKKONEN, University of Helsinki; O KARLSSON, Swedish Museum of Natural History; Malgorzata PILOT, University of Lincoln

Ringed seals (*Pusa hispida*) rely on ice for breeding and foraging, so winter ice cover is vital. The southern location of the Baltic, Lakes Ladoga and Saimaa ringed seals may render them vulnerable to climate change effects, combined with human disturbance from ships, fisheries, and pollution, which may affect their recovery from the 1970's bottleneck. Modern ring seal populations from Ladoga and Saimaa lakes, landlocked for nearly 10,000 years, have reduced genetic diversity, which may be due to both long-term genetic drift and the recent bottleneck. Mitochondrial DNA was sequenced from ancient and modern ringed seal samples, and aligned with published sequences. Nucleotide diversity of Baltic ringed seals decreased from 0.037-0.038 in 1850-1925 to 0.032 in 2000-2012. Ancient ringed seals (14,000-3,000 BP) had lower nucleotide diversity (0.029) compared to modern Baltic populations. This could be an underestimation due to the small sample size (N=11), but may also suggest that initial colonisation of the Baltic was followed by subsequent gene flow from genetically diverse sources. Spatial analysis showed high nucleotide diversity (0.044-0.049) in different parts of the Baltic Sea: Bay of Finland, Bay of Bothnia and Archipelago Sea; 8.6% of haplotypes were shared among these colonies. Comparatively low nucleotide diversity was found in Lake Ladoga: 0.028 and Lake Saimaa: 0.027, reflecting strong genetic drift. Lake Saimaa shared 2 haplotypes (9.5%) with Lake Ladoga and the Baltic, while Lake Ladoga shared 5 with the Baltic and 1 with Lake Saimaa (19% altogether). Some shared haplotypes were only found in museum specimens, implying recent bottlenecks further increased levels of genetic differentiation among these populations. Overall, these results suggest recent bottlenecks could have caused a larger loss of genetic diversity in the Baltic and adjacent lake populations than genetic drift acting on these populations since their founding in early Holocene.



134 MARXAN'S ROLE IN PARTICIPATORY PLANNING PROCESSES

Heather Coleman

PacMARA

Norma SERRA-SOGAS, PacMARA ; Jeff ARDRON, PacMARA

Marxan spatial planning software supports systematic conservation and resource use planning. It is best known as a decision support tool to aid the development of marine protected area networks, but is just as applicable to other systems and scales. Using Marxan or Marxan with Zones, planners can identify an efficient system of management areas that represents a suite of targets for a minimal socioeconomic "cost." Many challenging decisions are inherent to solving this problem, including setting targets for each feature, determining appropriate socio-economic input values, and working with stakeholders to understand the role and outputs of a decision support tool. Technical considerations for successful Marxan use in participatory planning processes are also under-discussed, considering the popularity and wide usage of the tool, and good practices in both areas deserve more attention. Teaching managerial-level and technical Marxan courses internationally has provided us with insight into challenges and problems faced by Marxan users in any context. This presentation will include current good practice considerations for Marxan as part of a participatory planning process.

WHICH NATURAL AREAS DO WE MOSTLY VISIT? IMPLICATIONS ON CONNECTEDNESS WITH NATURE AND RESTORATION

Agathe Colléony

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Much research effort has been done to explore the effects of natural areas on human health, well-being and environmental concern. However, with urbanization, biodiversity crises and western way of life, the opportunities to experience nature rarefy, and the growing disconnection of people with nature jeopardizes global conservation efforts. It is therefore extremely important to know which kind of nature are mostly preferred and used by individuals, before building sustainable conservation and pro-nature managements. In this paper, we present results on nature connectedness and nature habits of 2744 French adults, based on the exploration of questionnaires coming from three complementary data sets: 1126 students from various disciplines, 1172 adults from a virtual game community, and 446 zoo visitors. We explored the type and

frequency of natural areas they visit mostly, the place they have grown up, and their connectedness with nature, i.e. the extent to which an individual feels being part of the natural environment. We found significant differences between the three groups in the type of natural areas they visit mostly. For instance, gamers mentioned significantly more their personal natural areas (e.g. their own garden), and zoo visitors were more concerned with animal presence in natural areas (e.g. zoos). However, in all the three groups, the forested areas are largely more mentioned than other natural areas, suggesting a common appealing for forests in these populations. Mediation effects of connectedness with nature on the relationship between place of childhood and natural areas' visits are clarified. These results are discussed in light of restorative aspects of nature, the potential of nature to reduce cognitive fatigue and other sources of stress. Finally, consequences of this result in terms of landscape management and education are examined.

TENSION, CELEBRATION AND FAIRNESS OF HUNTING PRACTICE IN THE ETHNOZOOLOGY OF NEWFOUNDLAND MOOSE

Cory Collins

Memorial University of Newfoundland

The Eurasian elk or moose is an invasive species on the island of Newfoundland, having been introduced via extremely small founder populations in 1878 and 1904. Moose create problems for the regeneration of balsam fir and hardwoods and appear to have negative affects on certain birds and lichens in Newfoundland, and reduce its hopes for a sustainable forestry industry. At the same time, however, moose and their hunting have been meaningfully integrated into Newfoundlanders' cultural identities and a system of traditional knowledge, centred in part around notions of 'fairness' of relations between species, has developed in tandem. I examine the dynamics of these relationships and knowledges using interviews with moose hunters, moose meat consumers, moose-vehicle collision victims and their families as well as secondary literature. I find that this ethic of hunting and the entrenchment of moose as a cultural identifier in Newfoundland exist in uneasy tension with increasing moose-vehicle collisions but are also reinforced by amused interest in episodes where moose wander into urban centres.

SNAPPING TURTLE (CHELYDRA SERPENTINA) HOME RANGE ANALYSIS IN AN OPEN RIVER SYSTEM: IMPLICATIONS FOR CONSERVATION AND HARVEST REGULATIONS

Benjamin Colteaux

Virginia Commonwealth University



Derek JOHNSON, Virginia Commonwealth University

The snapping turtle is an iconic large-bodied reptile native to freshwater lakes and rivers in the eastern United States. Increased commercial harvest pressure on these turtles has raised concern about the sustainability of the species. Understanding the movement patterns and home range of snapping turtles is critical for making informed conservation decisions. In particular, a snapping turtle's home range can be used to infer size- and sex-specific movement patterns, habitat use, conspecific interactions, and population density. Historical accounts of snapping turtle demography is based almost exclusively on lake habitats, yet the majority of commercial harvest pressure is exerted on river and estuarine systems, which offer greater public access to trappers. Here we estimate seasonal home range sizes for 23 snapping turtles within the Chickahominy watershed, Virginia, USA. We found that average home range size was larger during the summer (1.04 ha), than during the spring (0.25 ha) or autumn (0.44 ha) sessions. On average males had larger home ranges than females, both overall (4.22 to 3.50 ha) and seasonally (ranging between 18 – 38% larger). Home range size was not correlated with body mass. Additionally, we found that home ranges were unexpectedly smaller, but overlapped more, in this open river system compared to findings from lake environments. Their sedentary nature may expose this riverine snapping turtle population to increased risk of overharvest as a large number of turtles can be more easily trapped in congregations over a relatively small area. Repopulation following a commercial harvest event may also be difficult due to the limited dispersal ability shown by this population. These results suggest that effective snapping turtle management should include the prevention of extirpating local populations as a conservation priority.

THE ROLE OF ZOOS IN ATTITUDES TOWARDS BIODIVERSITY AND THE REINTRODUCTION OF NATIVE WILD CARNIVORES TO THE UK: RESULTS FROM A PILOT STUDY

Adriana Consorte-McCrea

Canterbury Christ Church University

Ana FERNADEZ, Canterbury Christ Church University ; Alan BAINBRIDGE, Canterbury Christ Church University ; Dennis NIGBUR, Canterbury Christ Church University

Our research investigates the role of zoos in forming attitudes towards biodiversity and towards wild carnivores (European lynx *Lynx lynx*, and pine marten *Martes martes*), native to the UK within historical times, which have been considered for reintroduction, to inform species conservation strategies in the UK and Europe. The project being developed by an interdisciplinary team (wildlife conservation, psychology, education) employs a mixed methods approach, based on an

expanded version of the Theory of Planned Behaviour and on personal narratives. Research suggests that experiences with animals in zoos encourage empathy, through personal connection, which facilitates greater concern towards biodiversity. IUCN guidelines state the need for public support to establish viable, free-ranging populations in the wild, therefore, carnivore restoration benefits from an understanding of human dimensions. The reintroduction of carnivores to their native habitats may help regulate ecosystem dynamics. Carnivores carry a rich cultural and historical heritage that makes their reintroduction even more relevant. The first of the pilot studies taking place in Kent (Spring 2015) uses focus groups and interviews. Results will be discussed in the light of findings about attitudes towards lynx and pine marten and their conservation and potential reintroduction in the UK; how attitudes relate to knowledge, to socio-demographic variables (age, gender, place of residence), and to zoo membership. Results will inform the design of questionnaires and interviews to be carried out in north-west England and Scotland. A nuanced understanding of local people's attitudes towards native carnivores allows for a cost-effective way to identify and address points of conflict between them and wildlife, and saves time. A baseline survey of attitudes will enable the evaluation of the effect of the deployment of future plans for environmental education on attitudes of interest groups.

91-GETTING SCIENTIFIC EVIDENCE USED IN PRACTICE: PROGRESS, BARRIERS AND SOLUTIONS.

TITLE: ACHIEVING CONSERVATION SCIENCE THAT BRIDGES THE KNOWLEDGE-ACTION BOUNDARY

Carly N Cook

Monash University

Michael B MASCIA, Conservation International ; Mark W SCHWARTZ, University of California ; Hugh P POSSINGHAM, University of Queensland ; Richard A FULLER, University of Queensland

There are many barriers to using science to inform conservation policy and practice. Conservation scientists wishing to produce management-relevant research must balance this goal with the imperative of demonstrating novelty and rigor in their science. Decision makers seeking to make evidence-based decisions must balance a desire for knowledge with the need to act despite uncertainty. Generating science that will effectively inform management decisions requires that the knowledge created be salient (relevant and timely), credible (authoritative, believable, and trusted), and legitimate (developed via a process that considers the values and perspectives of all relevant actors) to both researchers and decision makers. This paper outlines some of the challenges for those hoping to generate conservation science that achieves all three of these information characteristics, and highlights some of the



successful ways creative scientists and decision makers have found to facilitate science that will inform management. We discuss examples of effective solutions to generating science that crosses the knowledge-action boundary including: boundary organizations (environmental organizations that span the boundary between science and management), embedding research scientists in resource management agencies, creating formal links between decision makers and scientists at research-focused institutions, and innovative training programs for conservation professionals. The success of these, and other, approaches to generating boundary-spanning science hinge on incorporating mechanisms for promoting communication, translation, and mediation across the knowledge-action boundary. Learning from current successes can help conservation science become a more effective boundary science, which both advances scientific understanding and contributes to decision making.

USING THE POLICY SCIENCES ANALYTICAL FRAMEWORK IN THE ASSESSMENT, IMPLEMENTATION AND MONITORING OF ADAPTIVE ECOSYSTEM-BASED APPROACHES TO RESOURCE MANAGEMENT

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Biological diversity and ecosystem resilience are undoubtedly eroding and the deterioration of ecosystem functions is likely accelerating at a global scale, with potentially catastrophic social consequences if current trends are not significantly mitigated. There is a growing sense that traditional scientific management approaches are failing, and may in fact be making the problems worse. Despite growing popularity of various iterations of adaptive management there is little sign that stress on ecosystem function is abating. While many continue to cite the need for adaptive management, there exist few real-world examples of institutional arrangements designed for the sustainable regulation of natural resource protection and use. Absent the capacity to implement and monitor an ecosystem approach to restore ecological integrity and human sustainability, environmental policy decision makers and managers will not succeed in addressing critical environmental problems. We propose a tool that has the capability of assessing existing governance while fostering a successful adaptive approach. We rely upon the analytical framework of the Policy Sciences to derive characteristics that would be representative of an "ideal" adaptive, ecosystem-based approach to management. We argue that management

regimes that most closely resemble the ideal governance characteristics proposed in this study will show greater progress toward restoration and goal achievement than projects that differ greatly from the ideal. Our proposal fosters an intelligence system derived from the use of monitoring indicators that will trigger adaptive responses if trends for critical functions are moving away from goals. The governance regime that existed in the Great Lakes Basin during the early years of the Great Lakes Water Quality Agreement efforts of the 1970's and 1980's and a more recent regime in the Bay of Fundy/Gulf of Maine watershed are then compared with the ideal characteristics.

97. CAN CITIZEN SCIENCE MOTIVATE SCIENCE-BASED RATHER THAN EMOTION-BASED MANAGEMENT DECISIONS FOR SONGBIRDS IN A RESIDENTIAL LANDSCAPE?

Caren Cooper

North Carolina Museum of Natural Sciences

Larson LINCOLN, Clemson University; Mark HAUBER, Hunter College

Citizen science has the potential to coordinate and inform public stewardship of songbirds for a positive cumulative impact. We focused on public efforts to enhance nesting by native passerines and control invasive competitors. In the United States, many people try to prevent the non-native house sparrows' attempts to breed. Given insufficient data to directly assess the efficacy of management options, and the clear need for citizen science participation to fill the data gap, we created The House Sparrow Project to assess the decision-making process of citizen scientists. Using web-based surveys, we investigated two questions: (1) What are the primary factors influencing citizen scientists' choice of management actions for minimizing sparrow breeding? (2) Does citizen science participation increase the likelihood that management decisions are guided by scientific evidence (science-based) rather than personal experience and affect (emotion-based)? We found that emotions and personal experience matter tremendously in this system. The best predictors of lethal management were firsthand contact with House Sparrow damage, antipathy associated with specific House Sparrow encounters, and general feelings about House Sparrows. Using pre-post surveys we found changes in management orientation varied with level of project engagement. Support for emotion-based management decreased during the project among participants who engaged at medium or high levels, and increased among low-level participants. We characterize changes among participants with low engagement as counterproductive "onlooker effects," potentially important given the ubiquity of skewed engagement of citizen science programs. Insights from this study deepen understanding of the affective and cognitive drivers of backyard management



and highlight the complexity of using citizen science to fill a data gap and support participants in achieving desired conservation outcomes.

CLIMATE REFUGIA AND BIODIVERSITY CONSERVATION IN AN ERA OF ANTHROPOGENIC CLIMATE CHANGE

Laura Coristine

University of Ottawa

Paul GALPERN, University of Calgary ; Andrew PLOWRIGHT, University of British Columbia ; Juan ZULOAGA, University of Ottawa ; Cassandra ROBILLARD, University of Ottawa ; Emily ACHESON, University of Ottawa ; Rosanna SOARES, University of Ottawa ; Jeremy KERR, University of Ottawa

Climate refugia maintained populations of some species during periods of paleoclimatic change and could mitigate extinction risks during anthropogenic climate changes. Because both climatic variability and rates of change can cause species' populations to shift or disappear, the rate of climate change and the magnitude of climatic variability within refugia should be lower than in surrounding areas if climate refugia are to provide biologically significant shelter for species. Using long term, high resolution climate data across the most intensively observed regions of North America, we identify areas where relative variability and rates of change are low despite the substantial climatic shifts observed subsequent to 1975. Rate and interannual variability of climate are assessed, at multiple spatial scales (ranging from 2800 to 230,000 km²) using mean annual temperature and precipitation seasonality data from 1975-2010. There are significant areas distributed across much of continental North America that have, to date, shown potential as climatic refugia. However, the utility of these refugia hinges on whether they are distributed across areas with high species diversity or coincide with existing or potential protected areas. Climate refugia overlap with such areas is limited, suggesting that species vulnerabilities may be greatest where refugia are most limited in their extent.

INDICATORS OF ECOLOGICAL CHANGE: AN INTER-SITE COMPARISON OF A CONCURRENT MONITORING OF WILDLIFE OCCURRENCE AND HUNTING ACTIVITY IN CENTRAL AFRICA

Daniel Cornelis

Cirad

Nathalie VAN VLIET, CIFOR ; Nicolas GAIDET, Cirad ; Jean-Claude N'GUINGUIRI, FAO ; Robert NASI, CIFOR ; Alain BILLAND, Cirad ; Sébastien LE BEL, Cirad

Choosing and adapting wildlife management options ideally requires appropriate and affordable information on trends in animal populations and offtakes over several years. In

African tropical forests, most studies have been documenting separately wildlife abundance, offtake and consumption of bushmeat. In addition, most site-level assessments were so far implemented using different methodologies, thus limiting the potential for meta-analysis at inter-site level. Yet, measuring concurrently spatial patterns of wildlife occurrence and hunting activities at different sites along gradients of human pressure (land conversion, human density) may provide a useful basis to identify indicators of non-sustainability of hunting, and to help predict temporal trends at site level. In this study, we implemented a standard protocol aiming at assessing bushmeat use and availability over 6 hunting grounds located in the Congo Basin (Gabon, Congo, and Democratic Republic of Congo). This preliminary diagnostic was conducted to evaluate the feasibility of testing community-based hunting approaches in the framework of a FAO/GEF project. For this purpose, we mapped the contours and the principal features of every hunting ground, and characterized the management rules, wildlife resources, hunting practices, offtakes and consumption. Results of the comparison between sites show how indicators of game species availability (e.g. species diversity, abundance indices, etc.) and resource use (e.g. catch per unit effort, ratio between small and large body-sized species, composition of the catch, etc.) vary in contexts of contrasted hunting pressure. We discuss their respective relevance as a basis for implementing evidence-based wildlife management strategies through adaptive management.

49-HABITAT FRAGMENTATION EFFECTS ON BIODIVERSITY SERVICES REVISITED- EFFECTS OF FOREST EDGE FORMATION ON INSECTS AND PLANTS

Tatiana Cornelissen

Universidade Federal de Sao Joao del Rei

Insects and plants are major components of terrestrial ecosystems and insects have the potential to alter plant population dynamics, community structure and ecosystem functioning through their effects as herbivores. Recently, habitat fragmentation has turned into one of the most important threats to biological diversity and a common feature of habitat fragmentation is a sharp increase in the amount of induced or artificial edges, exposing plant and animal populations in fragmented habitats to ecological changes associated to edge formation. We reviewed the evidence for the effects of fragmentation on insects and plants by conducting a meta-analysis for the effects of artificial forest edge formation on insect herbivore abundance, herbivore richness and plant herbivory, with data pooled from 31 studies and 159 independent comparisons. Edge formation exhibited strong effects on plant herbivory rates, as plants on edges exhibited about 70% more damage than plants in



interior patches. Edges also increased herbivore abundance by 14% and herbivore richness by almost 65%. Effects of edge formation were stronger for Lepidoptera (mainly caterpillars were evaluated) and Orthoptera. Edge effects were also stronger for forested ecosystems compared to open habitats and for temperate regions. Because the studies here evaluated did not simultaneously evaluate bottom-up and/or top-down factors, the mechanisms responsible for the patterns found cannot be properly addressed, although variation in host plant chemistry and/or relaxation of pressure exerted by natural enemies can be suggested as potential factors explaining variation in herbivory between edge and interior habitats. Higher herbivory rates on edge habitats, as shown by our meta-analytical review, have the potential to alter community composition and should be studied in detail to unravel its effects on ecosystem functioning.

COMMUNITY RESILIENCE AND ADAPTION IN A CHANGING ARCTIC: POLICY CHALLENGES AND OPPORTUNITIES FOR MARINE MAMMAL SUBSISTENCE USERS

Leslie Cornick

Alaska Pacific University

The Arctic is the sentinel for climate change on several fronts – tangible changes to ecosystems are observable in real time, including the opening of the Northwest Passage, the loss of seasonal sea ice and shore fast ice, and increased interest in off-shore oil and gas development, shipping and tourism. Indigenous communities in several Arctic nations (e.g., United States, Canada, Norway) rely on the subsistence hunting of marine mammals as a significant component of their food security and cultural life ways. Changes in ocean temperatures and ocean acidification may alter the timing and distribution of marine mammal prey, which may then alter migration and residence patterns. Changes in seasonal sea ice and shore fast ice have already altered behavior and accessibility of ice seals, walrus and polar bears, and make large whale hunting from shore more dangerous. Increased development of offshore oil and gas and shipping increase the risk of oil and other contaminant spills and ship strikes. In order to continue to harvest these resources safely and reliably, indigenous communities must consider how to adapt to the shifts that climate change continues to bring to the region. In order to preserve coastal communities, policy makers in Arctic nations must consider indigenous rights as they develop policies for sustainable Arctic development and conservation. Treaty rights, co-management agreements, and regular and genuine stakeholder engagement are critical for these communities to adapt to a changing Arctic climate and maintain the subsistence practices that sustain them, for both food security and cultural preservation. Using Alaska as a case

study, this presentation will address the current challenges and opportunities for coastal communities that rely on marine mammal subsistence, define the current state of relevant Arctic policy, and make recommendations for policy makers and communities to preserve access to these critical resources.

SYMPOSIUM 65: CITIZEN SCIENCES FOR MONITORING BIODIVERSITY IN HABITAT STRUCTURED SPACES

Camille Coron

Université Paris Sud

Christophe GIRAUD, Université Paris Sud ; Clément CALENGE, Office National de la Chasse et de la Faune Sauvage ; Romain JULLIARD, Museum National d'Histoire Naturelle

Our aim is to estimate the abundance of a common species, using data coming from different citizen science programs. Space is divided into sites and we estimate relative abundances of several species between any two sites by combining standardized and opportunistic datasets. Species detecting probability, and site observation intensity are also estimated for each dataset. More practically, a second step consists in considering space habitat structure and taking into account the respective preferences of observers and of each observed species for each habitat. The model for the behavior of observers is different for each dataset. We estimate abundances, habitat preferences and observation efforts, and study the role of opportunistic data in improving the accuracy of these estimations.

POTENTIAL BENEFITS AND TRADE-OFFS BETWEEN BIODIVERSITY CONSERVATION AND BIOFUEL PRODUCTION WHEN USING MICROALGAE PRODUCTION FARMS

Diego Felipe Correa

University of Queensland

Hugh POSSINGHAM, University of Queensland ; Hawthorne BEYER, University of Queensland ; Skye THOMAS-HALL, University of Queensland ; Peer SCHENK, University of Queensland

Ongoing population growth and increasing energy demands pose further pressures on resource consumption and on biodiversity conservation. Biofuel production systems have been proposed as a more sustainable alternative for energy production in comparison to the use of fossil fuels. However, several studies discuss the potential negative environmental effects of biofuel production; which include loss of biodiversity in areas where native ecosystems, cropland and pasture mosaics are transformed for extensive monocultures. Recent advances in production technologies have shown that microalgae cropping can be a suitable



alternative for biofuel production, as result of its high yield potential per unit area. This could result in better optimization of land use for biofuel production, increasing the potential of biodiversity conservation. Additionally, algal cultivation is possible in areas with low precipitation levels, which have been negatively related to areas with high biodiversity values. Here, we review the potential benefits and trade-offs between biofuel production and biodiversity conservation when using microalgae production farms, comparing the environmental impacts between microalgae production ponds and extensive crops for biofuel production, taking into account differences on land use change. This research could lead to a better understanding on how the production of biofuel in smaller areas can relate to the conservation of native biodiversity at regional scales.

MEASURING AND MAPPING THE DIGITAL SALIENCY OF BIODIVERSITY

Ricardo Correia

Universidade Federal de Alagoas[INSTITUTE]University of Oxford

Peter LONG, University of Oxford ; Ana MALHADO, Universidade Federal de Alagoas ; Richard LADLE, Universidade Federal de Alagoas[INSTITUTE]University of Oxford ; Paul JEPSON, University of Oxford

The success of nature and biodiversity conservation efforts often depends on public support. Understanding and monitoring changes in conservation values over space and time and identifying the causes of these changes are therefore essential for a wide variety of conservation actions. The emerging field of 'culturomics' potentially provides new analytical techniques for studying social change and opens new possibilities to explore the interactions between social and natural sciences. Here, we briefly review the conceptual and methodological frameworks for mapping the saliency of biodiversity across space with a first example of its application to a case study using Brazilian birds. Specifically, we applied innovative 'culturomic' techniques to measure and map the digital saliency of Brazilian birds in national and international contexts. Our results clearly illustrate the potential of 'culturomics' for metricizing, measuring and mapping the digital saliency of conservation issues. In the example shown, bird assemblages of more populated and/or visited regions (where local people/international visitors see and engage with birds) tend to show a higher cultural saliency. Beyond their intrinsic interest, such results have the potential to inform macro-geographic conservation policy: for example, the choice of flagship species, PA designation or the focus of national and international awareness raising initiatives.

ASSESSING PUBLIC SALIENCY AND AWARENESS OF PROTECTED AREAS USING DIGITAL TOOLS

Ricardo Correia

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Ana MALHADO, Universidade Federal de Alagoas ; Paul JEPSON, University of Oxford ; Richard LADLE, Universidade Federal de Alagoas[INSTITUTE]University of Oxford

Protected areas (PAs) were originally created as strongholds for the conservation of iconic landscapes and endangered wildlife, but are nowadays expected to serve a much wider range of conservation and social goals. Despite their conservation importance, PAs are under increasing threat from development and economic interests due to competition for land and natural resources. While the increase in the extent of PAs (terrestrial and marine) over the last few decades has been remarkable, there is also evidence for an increasing number of degazettement, downgrading and downsizing events (usually referred to as PADDD). This is the case in Brazil, with its world-renowned PA network undergoing major PADDD events over the last decade. Under this scenario of increasing threats to PAs, public support is essential to avert further PADDD events. Here, we make a first attempt to assess the saliency and awareness of PAs within Brazilian society using an innovative set of digital tools. Our results demonstrate clear patterns of variation in public awareness for both different PA categories and individual protected areas. National Parks have the highest levels of saliency and, presumably, public support. However, other PA types garner comparatively less attention and may therefore be at increased risk of PADDD. Our results demonstrate the enormous potential of new digital tools to generate insights into public awareness of conservation issues. In the specific case of Brazilian PAs, measurements of digital saliency could be used to identify deficits in public awareness that can form the basis of future campaigns.

ENHANCING LEADERSHIP SKILLS FOR OUR NEXT GENERATION OF CONSERVATION LEADERS

Colleen Corrigan

University of Queensland

The skills required to be a successful conservation leader are underexplored and there is a significant role for the higher education sector to play in training and producing strong leaders (Dietz et al 2004). A review of conservation science leadership literature identified eight core principles associated with conservation leadership and recommendations for adhering to these principles (Manolis et al 2008). While self-development was found to be a critical mechanism for leadership enhancement, several of the recommendations suggested roles for education in delivering instruction in



leadership theory and skills development. These included actions such as facilitating networking opportunities between students and local conservation leaders and the provision of placements for first-hand engagement with professionals in the workplace (Manolis et al 2008). In a separate study, results using in-depth interviews of ten conservation leaders also indicated that education programs on the topics of economics and environmental policy, as well as exposure to a network of professional contacts, were important factors in success (Dietz et al 2004). While these studies provide some evidence for how to build environmental leadership, our collective understanding about skills that effective leaders require, as well as the approaches to acquire them, is limited, especially for professionals faced with current and future environmental issues. While conservation leadership programs are not new, their effectiveness has not been systematically evaluated and there is much to be learned from past experiences in these tailored programs as well as from other sectors that can provide innovation in resolving complex issues. This poster explores the development of a new leadership program in the Centre of Excellence for Environmental Decisions at the University of Queensland and insights gained on how institutions can collaborate through joint learning from past and current experiences.

SYMPOSIUM ID # 193. - FROM ABANDONED TO WILD LANDSCAPES: PRACTICES, CONSEQUENCES AND PERCEPTIONS OF REWILDING IN EUROPE.
TITLE : TOP SCAVENGERS IN A WILDER AND MORE UNPREDICTABLE EUROPE

Ainara Cortés Avizanda
CIBIO-InBIO

Avian scavengers are the target of restoration programs linked to the manipulation of food resources but we lack of a general approach to understanding how scavengers and the ecosystem services they provide will fit into a rewilded Europe. Carcasses play a key role in ecosystem functioning and energy-flux within food webs. Large ungulate carcass availability has through the course of evolution, given way to the appearance of true scavenger strategies displayed by vultures whose guilds are structured by complex interspecific relationships. Traditional agro-grazing systems have historically replaced wild ungulates as food source for vultures. In Europe this fact was exacerbated by modern farm intensification join to a stricter EU legislation that banned the abandonment of carcasses in parallel with arising human-vulture conflicts leading vulture populations to an unprecedented crisis. Consequently, supplementary feeding became a worldwide management recovery tool. Vulture restaurants, however, alter the spatial-temporal nature of food with strong consequences at individual, population,

community and ecosystem levels. The conservation of avian scavengers in rewilding European landscapes should rely on wild ungulate expansion, the recovery of large carnivore populations and, in humanized areas, the promotion of traditional extensive agro-grazing systems limiting artificial feeding activities. So, it may be possible to combine both the historically recognized ecosystem services provided by vultures (elimination of remains, nutrient cycling) with new recreational (aesthetical) while providing economic benefits to local societies. Vultures and other scavengers, because they exploit space at a huge scale, are singular actors within a rewilded Europe. Their conservation, and that of the ecological processes in which they are involved, requires large-scale approaches surpassing those limits imposed by administrations, habitats and even biomes.

LONG TERM MORTALITY PATTERNS IN THE ENDANGERED HUEMUL DEER (HIPPOCAMELUS BISULCUS) OF PATAGONIA

Paulo Corti

Instituto de Ciencia Animal & Programa de Investigacion Aplicada en Fauna Silvestre, Facultad de Ciencias Veterinarias, Universidad Austral de Chile
Achaz VON HARDENBERG, Alpine Wildlife Research Centre, Gran Paradiso National Park, Degioz 11

Conservation of endangered ungulates requires high quality data and long term monitoring of their populations. Most populations of threatened ungulates lack this information, which affects recovery and management plans. We conducted a 7-year study in Chilean Patagonia, from April 2005 to June 2012, to assess mortality patters in one huemul deer population. This endangered deer is endemic to the southern Andes of Chile and Argentina with a total population of less than 2,000 individuals. We identified 151 deer of all sex-age classes with ear tags, radiocollars, radio ear tags, or natural marks, recording a total of 62 mortality events. We recognized three main causes of mortality during the study period: predation from cougars (*Puma concolor*; 23% of all mortality), culpeo foxes (*Lycalopex culpaeus*; 29%), and domestic dogs (18%). In addition, we recorded isolated mortality events due to poaching, accidents, senescence, or undetermined causes of death (31%). On average, cougars preyed on 2 ± 1.91 huemul/year, culpeo foxes 2.57 ± 2.64 deer/year, and dogs killed 1.57 ± 1.27 huemul/year. Foxes only preyed on fawns, but cougars and dogs killed all age and sex classes. Here we model the implications of the predation by different predators on the dynamics of this huemul population. Management plans for the conservation of huemul should focus in monitoring populations in a long-term setting to account for predation variability and its real effects on population growth. In addition, a plan to control dogs, which are an anthropogenic cause of relevant loss in the huemul population, is urgently needed.



HOW WIDE SHOULD A CORRIDOR BE? USING RADIO-TRACKING DATA TO ESTIMATE WIDTH OF AMPHIBIAN MOVEMENT

Stephanie Coster

West Virginia University

Jessica VEYSEY POWELL, University of New Hampshire ;

Kimberly BABBITT, University of New Hampshire

A common question in the design of conservation corridors is: how wide should a corridor be? We used radio-tracking data from wood frogs (*Lithobates sylvaticus*) and spotted salamanders (*Ambystoma maculatum*) in a managed forest in Maine (U.S.A.) to characterize movement patterns of populations, and thus inform planning for the width of wildlife corridors. For each individual, we calculated the polar coordinates of all locations, estimated the vector sum of the polar coordinates, and measured the distance from each location to the vector sum. We created a population-level probability density function and estimated 95th percentiles to determine the width of lateral movement as individuals progressed from the pond to upland habitat. We found 95% of wood frog movements were ≤ 51 m wide and 95% of spotted salamander movements were ≤ 39 m wide. We have gathered movement data from other amphibian studies and are conducting a meta-analysis to explore how path width varies by location and species and to discuss the conservation implications.

INVASIVE PREDATORS DISRUPT A KEY ECOLOGICAL PROCESS ON CORAL REEFS

Isabelle Cote

Simon Fraser University

Jocelyn CURTIS-QUICK, Cape Eleuthera Institute ; Emily DARLING, University of North Carolina ; Fiona FRANCIS, Simon Fraser University ; Luis MALPICA-CRUZ, Simon Fraser University ; Nicola SMITH, Simon Fraser University

Predatory invaders can have substantial direct effects on the communities they invade. However, their impacts can extend far beyond reductions in prey abundance, particularly when the prey they remove play important roles in ecosystem processes and functions. Red lionfish (*Pterois volitans/miles*) were introduced from the Indo-Pacific region to Florida in the mid-1980s and have since spread throughout the Caribbean basin. They prey on many native reef fish species, including some responsible for providing the grazing pressure necessary to prevent algal proliferation and maintain coral health on coral reefs. We quantified the extent to which lionfish impair the key process of herbivory through a combination of fish population surveys, behavioural observations, and algal settlement experiments on Bahamian patch reefs, half of which have been regularly cleared of lionfish for 3+ years. The abundance

and biomass of herbivorous fishes was significantly higher on patches with few lionfish than on unmanipulated patches with more lionfish. As a result, herbivory rates were higher and algal biomass accumulation on settlement plates lower on reef patches without the invasive predators. This study provides the first empirical test of the indirect effects of lionfish on essential coral reef processes.

PASTORAL AND WOODCUTTING ACTIVITIES IN THE MOROCCAN MIDDLE ATLAS CEDRUS ATLANTICA FORESTS: IMPACTS ON ECOSYSTEM STRUCTURES AND MODES OF SOCIAL REGULATION

Marc Coudel

AgroParisTech

Pierre-Marie AUBERT, AgroParisTech ; Mohammed ADERGHAL, Faculté de lettres et sciences humaines ; Christelle HÉLY, Institut des sciences de l'évolution

Southern Mediterranean forests, their biodiversity and the livelihoods that rely on them are at risk from resource over-extraction. To produce the knowledge necessary for sustainable conservation, research faces methodological problems that must be overcome: gather information in contexts with many uncertainties about systems to understand their socio-ecological dynamics. This is true in the symbolical Moroccan Middle Atlas *Cedrus atlantica* forests. These ecosystems are critical ecologically and economically: they are North Africa's largest continuous forests and produce nationally important wood and sheep commodities. In the work to be presented, we sought to understand how the cedar forest socio-ecosystems behave and why resource extraction has so far been resistant to conservation efforts. We focused on pastoral and woodcutting activities as an interface between social and ecological dynamics. Ecologically, the patterns of activity intensities within the forests are linked to clear changes in ecosystem structures and dynamics. Cedar forests do not appear to be threatened regionally. However, cedar logging has reduced the standing forest capital. Locally, cedar populations may be vulnerable in one third of the forest due to pastoral activities and to unfavorable environmental conditions. Socially, the intensification of human activities is linked to low prospects for livelihoods that don't use forests and to the low cost resources they offer due to inadequate law enforcement. Reacting to ecosystem changes, users and managers regulate activities. Users individually try to lead less destructive methods. Community and extra-community based dynamics have also been successful to regulate resource extraction. Management has however not achieved its participative objectives. These results can direct future research and management needs for a better protection of Mediterranean forests and parklands and their biodiversity that also respects local population's livelihoods.



CORPORATE CITIZEN SCIENCE; A NOVEL TOOL FOR TACKLING ENVIRONMENTAL SUSTAINABILITY?

Jenny Cousins

Earthwatch Institute

Societies globally face unprecedented challenges, via climate change and unsustainable land use which degrade water quality and biological systems. The complex and contested nature of environmental sustainability requires collaboration between stakeholders and societal willingness to respond. As significant influencers of global environmental change, the private sector has a critical role in taking action towards sustainable solutions. Citizen science (CS) offers potential to engage employees in environmental data collection whilst empowering engagement in local and global sustainability issues. Corporate CS can foster new ways of thinking within businesses and connect scientists and business leaders towards informed decision-making and long-term solutions. This paper examines two different CS programmes, which engage employees of major multi-national companies. Freshwater Watch is a mass CS programme, connecting local scientists and corporate citizens in 32 cities worldwide, with research aimed at meeting local challenges in water management whilst developing a global database on water quality. The programme offers a limited training experience and uses mobile applications and online resources to support repeated data collection. In contrast, an intensive and immersive 5-day residential programme (the Sustainability Leadership Program) involves a global network of climate change-related experiments, with 100 senior business managers each year completing fieldwork alongside learning sessions. We explore the value of linking corporate engagement with CS to enhance environmental sustainability within business and personally. We consider the benefits and limitations of these programmes (each with a range of cultural and engagement challenges) via a unique dataset of corporate citizen scientists. The effectiveness of each programme is examined against data quality, enhanced awareness of environmental issues, behavioural change and changes in company culture.

MAXIMIZING MANGROVE FOREST CONSERVATION THROUGH MULTI-SCALE STAKEHOLDER ENGAGEMENT IN CITIZEN SCIENCE

Jenny Cousins

Earthwatch Institute

This poster takes a case-study approach to illustrate how effective engagement of stakeholders and communication of science at multiple scales has maximized the conservation and community outcomes of a mangrove research project in Kenya. For coastal communities, such as those living around Gazi Bay,

mangrove ecosystems provide firewood and building poles, nursery provision for fish, and coastal protection. They also play an important role in climate stabilization due to their ability to trap and sequester carbon. As one of the most severely threatened and undervalued ecosystems, their extractive use presents not only a threat to community livelihoods, but also an opportunity for stakeholder involvement in their conservation. Through partnership with Earthwatch this project is helping to sustain the supply of mangrove goods and services by engaging a range of participants in pioneering plantation experiments that measure a range of ecosystem functions in replanted mangrove stands. In particular, the project is pioneering the use of carbon credits as a new way to fund mangrove conservation and social development in the area. Participants include school children, the village committee, the local government, students, and international volunteers, whose learning around ecosystem services at different levels supports a range of impacts from individual, to project, to community - each level critical to long term project success and resilience of these ecological and social systems.

FROM ONE TO MANY: WHEN TO INCLUDE COMPLEX MANAGEMENT STRUCTURES IN CONSERVATION

Shaun R. Coutts

School of Biological Sciences, University of Queensland and School of Natural Sciences, Trinity College Dublin.

Jonathan RHODES, School of Geography, Planning and Environmental Management, University of Queensland ; David PANNELL, Centre for Environmental Economics and Policy, The University of Western Australia ; Sarah BEKESSY, Global, Urban and Social Studies, RMIT University ; Yvonne M. BUCKLEY, School of Natural Sciences, Trinity College Dublin.

It takes more than ecologically correct decisions to make good conservation decisions. Many populations of concern are embedded in landscapes with multiple decision makers and institutions, often with competing motivations or goals. How management is structured to deal with that complexity can be crucial to the success of a management program. To address this issue ecologists have often called for greater integration of ecological and social sciences. However, such integration can easily lead to more complex models and conceptual frameworks. This extra complexity will incur unavoidable and non-trivial costs. The relative benefits and costs of developing social or ecological components of population management models has received very little attention in the literature. Here we review the current conservation science and applied ecological literature to see how social complexity in decision making is included. We also examine when and why more complicated social scenarios are included. A simple single decision maker was the most commonly assumed management structure. Studies that assumed a single decision maker were often limited in scope and focused on cases where



a single organization undertakes the management at relatively small scales. Studies that assumed more complicated multi-decision maker management structures tended to heavily simplify the ecology and focus on problems at larger landscape scales. We assert that the blanket use of more complex models in population management is not necessarily the best solution, rather we need conceptual and mathematical models fitted to the problems at hand, not necessarily more complex ones. To aid in this we propose a framework to classify management structures and relate them to different conservation problem types.

STRUCTURE AND DYNAMICS OF AN UNEXPLOITED POPULATION OF THE REEF MANTA RAY *MANTA ALFREDI*

Lydie Couturier

School of Biomedical Sciences, The University of Queensland
Chirstine DUDGEON, School of Veterinary Science, The University of Queensland ; Kenneth POLLOCK, Department of Biology, North Carolina State University ; Fabrice JAINE, Marine Megafauna Foundation ; Michael BENNETT, School of Biomedical Sciences, The University of Queensland ; Kathy TOWNSEND, School of Biological Sciences, The University of Queensland ; Scarla WEEKS, Biophysical Oceanography Group, School of Geography, Planning and Environmental Management, The University of Queensland ; Anthony RICHARDSON, CSIRO Climate Adaptation Flagship, Marine and Atmospheric Research

Reliable abundance assessments are essential to the study of population dynamics and underpin conservation biology and management of a species. Although fishing pressure is a major threat to *Manta* spp., information on the trends and status of many of the species' subpopulations is lacking. Here we use photographic identification and mark-recapture methods to report on the site affinity, size and structure of an unexploited subpopulation of *Manta alfredi* in eastern Australian waters. A total of 716 individuals were identified between 2007 and 2012, including 636 at Lady Elliot Island (LEI), southern Great Barrier Reef. Over 60% of individuals were resighted at least once during the study period. Multiple resightings within and among years imply a high degree of site affinity to aggregation sites by individuals. One individual was sighted 11 times at LEI within a 27-year period. The sex ratio of this manta ray subpopulation was significantly biased toward females with an overall 1.3:1 female-to-male ratio. Overall, females were more likely to be resighted than males, however, site visitation at LEI varied between sexes. Robust design population models were used to estimate the population size of the winter aggregation at LEI over a 4-year period. The model estimated up to 532 individuals in the population within one winter season and that survivorship of *M. alfredi* between consecutive years

was exceptionally high ($\Phi \sim 1$). Our findings highlighted the importance of aggregation sites for *M. alfredi* subpopulations, and provide a valuable baseline to assist in the status assessment of exploited manta ray subpopulations.

99: GARDEN BIRD FEEDING: OUR DESIRE FOR CONNECTION

Daniel Cox

University of Exeter

Kevin GASTON, University of Exeter

Interacting with nature is now widely recognized as providing a range of health and well-being benefits to people living in urban areas. There is evidence that having more bird species, or at least the perception of more species, along with watching birds and listening to their songs has positive effects for our psychological well-being. As cities continue to grow and people live increasingly urbanized lifestyles the provision of food for garden birds may provide an important link by which people connect with nature. Indeed, garden bird feeding is a global phenomenon and one that continues to grow, with up to 75% of people in some urban areas regularly putting out food. Previous studies have examined the demographics of who is feeding garden birds and what they are feeding them, however there is no clear understanding behind why so many people put out food for birds. We quantitatively surveyed the bird feeding habits of urban households in the UK to investigate people's motivations behind garden bird feeding together with their perceptions and preferences of what they prefer to see at their feeders. Although these motivations are likely to be complex, we explore how they may stem from three core drivers; the pleasure benefits that people gain from watching avian behaviour at their feeders, a concern about bird welfare, and/or as a way for people to express their natural orientation towards interacting with nature. A person's desire to connect with their garden birds and the benefits that they receive from doing so may be motivated more through wanting to target specific bird species and communities, than just attracting birds per se. Understanding the role that species diversity and individual abundance play in these motivations has important implications both for harnessing the conservation potential of bird feeding and in urban planning for maximizing the ecosystem services that birds provide.

SYNTHESIZING THEORIES OF ENVIRONMENTAL GOVERNANCE

Michael Cox

Dartmouth College

There are several research communities that have dedicated themselves to the analysis of human-environment interactions and to similar themes (e.g. resilience, environmental



governance, common-pool resources, and conservation). Each of these communities has established the importance of a set of factors in affecting outcomes of social and ecological importance. To a slightly lesser extent, these communities have also established a set of theories that link these different factors up to each other and to important outcomes. For the most part, however, communities have not established a common protocol for consistently measuring theoretically important concepts. Moreover, no common method has been developed for consistently expressing the different theories that relate such concepts to each other. Without this common language for concepts and theories, the accumulation of scientific knowledge across study sites and related disciplines is stymied. In this presentation I will discuss one project that has attempted to address these challenges. This project is known as the Social-ecological Systems Meta-analysis Database (SESMAD) project. This project is a highly collaborative, interdisciplinary effort involving scholars from environmental social science, resilience science, and conservation science. Two primary goals of this project have been to develop an online relational database to store (1) an encyclopedia of variables of established importance across a range of disciplines, and (2) a companion encyclopedia of theories from multiple disciplines, each of which associates two or more variables together via a mechanistic account of their relationship to each other. In this presentation I will discuss these two encyclopedias, their relationship to the larger SESMAD project, and how they may help scholars focusing on different conservation contexts to determine what the most relevant concepts and theories are for their particular cases and research questions.

MARINE MAMMAL AND SEABIRD FORAGING AROUND A SHELF SEA FRONT AS REVEALED THROUGH A COMBINATION OF PASSIVE ACOUSTIC, SHIPBOARD SURVEY AND TRACKING DATA.

Samantha L Cox

Plymouth University

Clare EMBLING, Plymouth University ; Phil HOSEGOOD, Plymouth University ; Matt WITT, Exeter university ; Peter MILLER, Plymouth Marine Laboratory ; Brendan GODLEY, Exeter university ; Simon INGRAM, Exeter university ; Stephen VOTIER, Exeter university

Oceanic fronts have been linked to a diverse range of marine top predators. Increased productivity and biomass entrainment have been predicted to attract higher trophic level consumers but direct tests of this are lacking. Here, results are presented from three studies centred on understanding the small scale processes that underlie predator-prey interactions around a seasonally forming shelf sea front off the North Cornwall coast (UK). We first show, using passive acoustic data, that dolphin sp, associate with the presence of the

front during the summer months. Second we present results from two summer shipboard surveys where simultaneous measurements of oceanography and animal observations show both common dolphins, *Delphinus delphis*, and northern gannets, *Morus bassanus*, associate with patches of sub-surface chlorophyll present around the front. An in-depth analysis of the oceanographic data shows that these patches of productivity are mediated with the movement of the front with the spring-neap tidal cycle. Finally we suggest, using tracking data from gannets equipped with GPS and time-depth recorders (TDRs) at Grassholm Island (Wales), that fronts induce a behavioural shift in foraging strategy. Gannets were shown to make shorter shallower dives around fronts, suggesting prey availability is altered sufficiently to allow for a, presumably, more efficient dive strategy. As such, fronts appear to constitute enhanced foraging habitat and this should be considered in spatial management and the mitigation of the effects of anthropogenic activities including fisheries and marine renewable developments.

THE USE OF TIDALLY DRIVEN, HYDRODYNAMIC FEATURES BY FORAGING COASTAL BOTTLENOSE DOLPHINS

Samantha L Cox

Plymouth University

Phil HOSEGOOD, Plymouth University ; Anneli ENGLUND, University College Cork ; Stephen VOTIER, Exeter university ; Sophia BUTLER-COWDRY, National Oceanographic Centre ; Clare EMBLING, Plymouth University ; Emer ROGAN, University College Cork ; Simon INGRAM, Plymouth University

Understanding the distributions, movements and foraging behaviours of coastal top predators, such as the bottlenose dolphin *Tursiops truncatus*, is critical for effective marine planning and conservation management. Optimal foraging is likely a main driver of habitat use and whilst predator behaviours are often linked to the availability of their prey, gaining meaningful measurements of mobile prey distributions in complex marine habitats is often impracticable. Dolphin encounter locations, collected over 11 years (1997-2007 inclusive) during standardised surveys of the Shannon estuary SAC in western Ireland, were modelled using tidal temporal variables and benthic habitat descriptors. The Shannon estuary is a tidally dominated system with currents of up to 2.5ms⁻¹ at the estuary mouth and in the central channel. Dolphins were found to use different areas of the estuary dependent on the tide. This relationship was most prominent in a narrow channel in the centre of the estuary, where concentrated foraging activity occurred almost exclusively during the flood tide. In this study we use an acoustic current Doppler profiler (ADCP) to measure and characterise hydrodynamic features in the central channel, where we drove a repeat circuit mini-survey throughout a 12 hour tidal cycle. These surveys revealed high



levels of shear and strong down-welling between convergent fast flowing water during flood tides. We suggest the presence of these features aid animals in capturing their prey and so constitute important foraging habitat features within the estuary environment. Incorporating detailed measurements of the dynamic hydrography of a site such as the Shannon together with fine scale animal distribution provides an insight into drivers of habitat selection and the mechanisms of foraging behaviour which increases our understanding of the potential interactions of coastal dolphins with human activities in tidally dominant coastal systems.

CONSERVING GOD'S OWN COUNTRY: BIODIVERSITY IN AGROFORESTRY LANDSCAPES OF KERALA, INDIA

Theraesa Coyle

McGill University

Jeanine RHEMTULLA, The University of British Columbia ; Peter ARCESE, The University of British Columbia ; T K KUNHAMU, Kerala Agricultural University ; Navin RAMANKUTTY, The University of British Columbia ; Sarah TURNER, McGill University

The traditional home gardens of Kerala, India, may offer a sustainable balance between food production and ecosystem conservation. These complex agroforestry systems, situated within the Western Ghats biodiversity hotspot, may provide refuge for species threatened by habitat destruction, while still supplying food, fuel, medicines and income to local families. Despite their potential value, these ancient and diverse gardens are quickly disappearing with the rapid expansion of housing developments and monoculture plantations of non-edible cash crops, threatening both biodiversity and food security. This project explores the potential of home gardens to support wild biodiversity, and the attitudes of local home owners towards agriculture, wildlife and the environment. We used a combination of sociological and biological field surveys, as well as remote sensing and GIS, to examine 1) the diversity of birds, amphibians, insects and trees in home gardens; 2) the biotic and abiotic landscape features which influence this diversity; and 3) the correlations among home owner dependence upon agriculture, land management decisions, and attitudes towards environmental issues. We found substantial variation in the structure and composition of individual home gardens, as well as their landscape context, and significant correlations between these attributes and the richness and abundance of animal taxa residing within. We also found strong links between home owner perspectives and the management decisions which determine the structure of home gardens. Our results illustrate the importance of landscape and vegetation features when assessing wildlife habitat in human-dominated systems, as well as the need for interdisciplinary approaches to account for human management influences. This project highlights the value of maintaining traditional farming methods in rural landscapes, and aids our

understanding of land-use decisions and their importance for conserving biodiversity.

DETERMINANTS OF FOREST BIODIVERSITY VALUE IN A RAPIDLY URBANIZING AREA OF UPSTATE SOUTH CAROLINA

Melanie Cozad

Furman University

Jenny WARNKEN, Furman University ; John QUINN, Furman University

Rapid growth of communities in rural and peri-urban areas such as the southern Piedmont ecoregion of the United States is driving declining biodiversity and rapid forest loss; with the latter faster than any other region in the eastern United States. The subsequent decline in ecosystem services has given rise to concerns among stakeholders who express interest in restoring lost forest cover to reduce future loss of services. Yet, despite this interest, data on resource abundance and their value do not exist to help conservationists and planners in land management efforts. Using contingent valuation survey methodology, we value residents' willingness to pay (WTP) for forest preservation. WTP was assessed using a multiple-bounded discrete choice elicitation question that allows respondents to value forest preservation across a wide-range of monetary thresholds in addition to incorporating varying levels of uncertainty within responses. Tax and donation collection mechanisms were considered. For a 5% increase in forest cover over 10 years, we find WTP values of approximately 20 dollars per year across donation and tax bid vehicles. The WTP values increase as respondents' uncertainty across responses is allowed to vary demonstrating that the estimated value represents a lower bound. Perceptions regarding the reduction of society's current use of the environment for the benefit of future generations played a large role in determining WTP across both bid vehicles, while respondents' level of familiarization with biodiversity was significant in the donation vehicle where larger amounts of respondents' uncertainty was accounted for. Results suggest that it would possible to reach a conservation target of reversing forest cover loss from the last 40 years but that conservation efforts may need to focus on biodiversity education efforts.

EFFECTS OF HUMAN ACTIVITIES ON CARNIVORE BEHAVIOR AT THE INDIVIDUAL, POPULATION AND COMMUNITY LEVEL AND THEIR IMPLICATIONS FOR CONSERVATION

Gabriele Cozzi

Zurich University



Due to expanding human population into wildlife habitats, human wildlife interactions and subsequent conflicts have increased over the past decades. Understanding and predicting how wildlife species, particularly large mammals with cognitive and behavioral complexity, respond to human activities is needed to sustain coexistence. Here I present empirical evidence from three different systems and show how human activities and interventions influence the behavior of large carnivores at three different levels. 1) I discuss the effect of leftovers from elephant trophy hunting on the ranging behavior of spotted hyenas. While, on average, hyenas visit carcasses for 10-15 days, some individuals do so for > 50 days, indicating important impact of this surplus food source on their behavior and emphasizing individualities. 2) I illustrate how access to extra food from an open-sky garbage dump influences brown bear ranging and feeding behavior and is responsible for a behavioral dichotomy in life history strategies within the study population. Half of the monitored bears remain sedentary throughout the year and feed on garbage, whereas the other half migrates up to 100 km before hibernation to search for natural food sources. 3) Using African top predators, I show that, by differentially influencing competing species, human interventions can alter interactions and thus coexistence within an entire guild. The observed difficulty of lions to cross a veterinary fence results in a relatively lion-free zone, which in turn, provides refuge for those species competitively inferior, like the African wild dog. By showcasing these three different systems, I demonstrate how human activities can profoundly influence animal behavior and population dynamics. Quantifying the consequences of such activities on wildlife at different levels of organization is essential for implementing sound, evidence-based conservation action and promoting coexistence between humans and wildlife.

QUANTIFYING THE IMPACT OF BILLIONS OF DOLLARS OF GEF SUPPORT TO CONSERVATION IN PROTECTED AREAS

Ian Craigie

James Cook University

Megan BARNES, Australian Research Council Centre of Excellence for Environmental Decisions, the University of Queensland; Jonas GELDMANN, Center for Macroecology, Evolution and Climate, Natural History Museum of Denmark, University of Copenhagen; Stephen WOODLEY, IUCN World Commission on Protected Areas

Over the past 20 years the Global Environment Facility (GEF) of the World Bank has provided billions of dollars of support to protected areas and protected area systems in developing countries. However there is a poor understanding of what this

investment has achieved. We carried out a comprehensive impact assessment of GEF support to protected areas using three different conservation-relevant measures: management effectiveness scores, rates of forest loss and changes in abundance of wildlife populations. These outcomes were measured at each of the ~1800 protected areas the GEF is known to have supported in over 100 countries. Several different methods were used to assess GEF impact: before-after comparisons, difference in difference comparisons and propensity-score matched comparisons to protected areas without GEF support. Several of the methods used were unable to detect meaningful impact of GEF support. However it was found that management effectiveness scores increased more at GEF supported protected areas than those without support. A marginal decrease in the rate of forest loss was found in some regions. And increases in abundance of some threatened species in protected areas could be reasonably attributed to GEF projects. The difficulty in demonstrating significant impacts of GEF support to protected areas is concerning, especially given the levels of investment involved. This talk will highlight a number of improvements that could be made in GEF processes to allow future impact assessments to be more conclusive. This would allow improved targeting of funds to increase biodiversity benefits in future and create a body of evidence about what makes a project more likely to succeed. Given important role of the GEF and it's high public profile, it is imperative that projects are able to quantify their conservation-relevant outcomes in a more meaningful manner to provide lessons for future investments.

FORMALIZED CONSERVATION STRATEGIES TO ARREST AND REVERSE RAPID DECLINES AND RANGE CONTRACTIONS OF TWO ENDANGERED ENDEMIC PASSERINES ON KAUAI, HAWAII

Lisa H. Crampton

Hawaii Division of Forestry and Wildlife

Eben H. PAXTON, United States Geological Survey; Lucas BEHNKE, The Nature Conservancy; John VETTER, Hawaii Division of Forestry and Wildlife; Megan LAUT, US Fish and Wildlife Service; Liba PEJCHAR, Colorado State University; Steve MOREY, US Fish and Wildlife Service

Hawaii is one of the extinction capitals of the world, having lost at least half of its native avifauna in the 1000 years since colonization by humans, and with all but a few extant species listed as critically endangered. On Kauai Island, two critically endangered endemic honeycreepers, Akikiki (*Oreomystis bairdi*) and Akekee (*Loxops caeruleirostris*) are particularly imperiled. Largely restricted to the forests of the high elevation Alakai Plateau (>1000 m) these species face numerous threats: hurricanes; non-native, invasive plants and animals (both predators and ungulates), and deadly introduced



diseases. Bird density surveys carried out from 1981 to 2012 indicate rapidly declining numbers and contracting ranges for both species. Populations in 2012 were estimated at 468 birds for Akikiki (95% CI: 231 to 916) and 945 individuals for Akekee (95% CI: 460 to 1,547), down 71% and 48% respectively since 1981. Occupancy surveys in 2012 confirmed range contractions, with occupancy rates for both species increasing from west to east along the Plateau (Akikiki: $\psi = 0.02 \pm 0.07$ to 0.55 ± 0.21 Akekee: $\psi = 0.03 \pm 0.10$ to 0.53 ± 0.33), which reflects canopy height differences and a gradient of invasive species on the Plateau. In 2013, 14 experts used a Structured Decision Making format to analyze available information, and develop and rank alternatives to create a management plan to address these trends. Fifteen actions were evaluated on the likelihood that the action would prevent immediate extinction of each species; set the foundation for having a genetically-viable, reproducing, and stable population in 10 years; and allow for the long-term persistence of each species in the wild. Probability of success of each action was weighed against the constraints and costs of its implementation. The group recommended a combination of captive propagation and in situ threat management as the best strategy to save these species.

IN DEFENSE OF SMALL RESERVES: A CASE STUDY ON THE ROLE OF ENVIRONMENTAL EDUCATION PROGRAMS IN PROTECTED AREA DESIGN AND PLANNING

Matthew Crane

Suranaree University of Technology
Colin STRINE, Suranaree University of Technology ; Inês SILVA, Centre for Ecology, Evolution and Environmental Changes, University of Lisbon ; Taksin ARTCHAWAKOM, Sakaerat Environmental Research Station, Thailand Institute of Scientific and Technological Research

Small-scale reserves can provide real conservation benefits alongside large protected areas; however, they are often overlooked and underfunded, leaving them unprotected. We present a case study of a small reserve in Northeastern Thailand, as a model for incorporating environmental education into protected area planning as a means of supporting conservation, research activities, and local development in small protected areas. To compensate for limited government funding, Sakaerat Environmental Research Station (SERS) has developed a sustainable science camp for schools that incorporates conservation and local cultural knowledge. From its inception in 2002 until 2012, the Science Camp has generated 5,138,624 Thai Baht (138,593 €) in supplementary budget. The science camp profits have provided a constant source of income for the reserve while facilitating the main objectives for the Man and Biosphere

Reserve (MBR) Program: conservation, economic development, and logistical research support. The ranger corps has garnered a more substantial budget to deter poaching and illegal logging, increasing with the advent of the science camp program. Three major sustainable development projects have been supported through the Science Camps to provide alternative income to poaching for the local community. The SERS infrastructure developed for the Science Camp also provides logistical support for conservation research compared to the other small MBRs in Thailand. The SERS science camp is already fully booked through 2016, hosting roughly 17,000 students per annum providing sustainable long term income. The potential for small reserves to act as outdoor classrooms should be considered when assessing the costs in designing or reinventing small protected areas.

CONSERVATION PSYCHOLOGY IN ACTION: FOSTERING AND EVALUATING DURABLE MOTIVATION IN CAPACITY BUILDING PROGRAMS

Kayla A. Cranston

Antioch University New England

Conservation psychology is increasingly cited as offering essential insight to programs that aim to both conserve biodiversity and foster the wellbeing of humans involved in that conservation. This presentation contributes to this conversation by applying a psychological perspective to the field of capacity building for biodiversity conservation. I begin with an analysis of the conservation literature on capacity building at the institutional, community, and individual level. Through this analysis, I argue that conservation psychology is primed to offer a deeper investigation of the definition and development of individual capacity in this context. I review theoretical insight from the field of community and positive psychology to help supplement our current understanding of individual capacity for biodiversity conservation. Based on this investigation, I propose a psychological measurement for evaluating aspects of empowerment and long-term motivation for biodiversity conservation in people responsible for the continuation of these efforts within each region. I describe the results of research I've conducted with this instrument and discuss suggestions for its use in the field of capacity building for biodiversity conservation. Together, this presentation explores the development and use of a conservation psychology-based instrument that supports a novel approach to effectively sustaining human action toward the goal of biodiversity conservation.



USING CITIZEN SCIENCE TO MAP GEOSPATIAL AND TEMPORAL TRENDS IN HUMAN-ELEPHANT INTERACTIONS IN ASIA

Cheli Cresswell

University of Oxford

Paul JEPSON, University of Oxford

As elephant habitat becomes increasingly fragmented and human populations continue to rise, the frequency with which humans and elephants are coming into contact - and conflict - is on the rise. At the same time, the rapid spread of internet access and social media usage across Asia, combined with the rapid adoption of mobile devices with cameras and GIS means that people in these areas are sharing a wealth of information about their encounters online. Currently, however, that data is largely inaccessible to scientists who might be able to use it to help understand patterns and trends and to create more effective conservation strategies. The data is also too complex for the current state-of-the-art computer-automated processes alone. Our tool takes advantage of the affordances of the social machine - humans and computers working together to achieve more than can be done by either alone - and uses citizen scientists to process and extract relevant details about human-elephant interactions throughout the Asian elephant habitat range, which can then be visualized on a multi-layered map. The tool will promote a decentralized approach to conservation and can be used by contributors physically located anywhere in the world. It is also an exploration of the neogeographical space and the challenges - technological, ethical, and logistical - that come with a multi-stakeholder international citizen science project. As the project moves forward, we hope to explore how the interaction of VGI, big data, and non-traditional geographers interplay with the temporalities and the geographies of conservation.

USING UNMARKED COUNTS OF MIGRATING BIRDS TO ESTIMATE POPULATION CHANGE WHEN A LONG-TERM BIAS IN STOPOVER DURATION HAS OCCURRED

Tara Crewe

Western University

Philip TAYLOR, Acadia University; Denis LEPAGE, Bird Studies Canada

The use of unmarked counts of migrating animals to monitor long term population change assumes independence of daily counts and a constant rate of detection. However, migratory stopovers often last days or weeks, violating the assumption of count independence. Further, a temporal bias in stopover duration will result in a change in the probability of detecting individuals once, but also in the probability of detecting individuals on more than one occasion. We tested

how variation in stopover duration influenced accuracy and precision of population trends by simulating migration count data with known constant rate of population change and by allowing daily probability of survival (probability of remaining at the count site) to remain constant, or to vary randomly, cyclically, or increase linearly over time by various levels. Using simulated datasets with a linear bias in survival, we also tested whether any resulting bias in population trend could be reduced by modeling variation in survival, or by subsampling data to every three or five days to reduce the incidence of recounting. Mean bias in population trend did not differ significantly from zero when survival remained constant or varied randomly over time, but bias and the detection of false trends increased significantly with a linear increase in survival. Importantly, a linear bias in survival resulted in a compounding effect on counts due to the increased probability of detection and recounting. Under this scenario, bias in population trend could not be modeled using a covariate for survival alone. Rather, to improve inference drawn about long term population change using unmarked migration counts, analyses must include a covariate for the bias in detection, as well as incorporate sampling modifications (e.g., subsampling) to reduce the probability that individuals will be detected on more than one occasion.

DETERMINING THE PRIMARY DRIVERS OF NEST FAILURE IN OPEN-CUP NESTING SONGBIRDS

Merle Crombie

University of British Columbia

Peter ARCESE, University of British Columbia

Determining the factors that influence natality and mortality and their relative contribution to fitness is fundamental to understanding the dynamics of animal populations. In birds, nest fate is a key component of natality and is commonly used to quantify productivity, model population dynamics, and to develop habitat management plans. Prior research suggests that nest fate may be driven by (1) intrinsic qualities of the bird(s) caring for the nest, (2) nesting habitat characteristics, and/or (3) environmental factors related to weather events or predation. However, while individual drivers of nest fate have been identified, few are able to critically assess the combined influence of multiple drivers, leaving a substantial gap in our knowledge of their relative contribution to nest fate. Based on >3200 song sparrow (*Melospiza melodia*) nest monitoring records and detailed nest-site habitat characteristics, a 40-year social and genetic pedigree, and local climate data, I will take an information theoretic approach to ask how intrinsic qualities of the female (age¹, inbreeding coefficient², lifetime reproductive success³), nest-site habitat characteristics (percentage of thorny shrub cover surrounding nests⁴, nest micro-climate⁵), and environmental effects (cumulative inclement weather⁶, and predation risk as annual cowbird



parasitism rate) influence nest fate, as well as how they may interact and/or vary temporally. By using a dataset that includes marked variation in key drivers shown to affect nest fate in this and other bird populations, my work will be among the first to assess these drivers simultaneously, thus identifying key determinants of population fitness and growth that can be applied toward successful conservation efforts.

49-GLOBAL PATTERNS OF HABITAT LOSS AND FRAGMENTATION FOR THE WORLD'S MAMMALS

Kevin Crooks

Colorado State University

Christopher BURDETT, Colorado State University ; David THEOBALD, Conservation Science Partners ; Sarah KING, United States Geological Survey ; Moreno DI MARCO, Sapienza Università di Roma ; Carlo RONDININI, Sapienza Università di Roma ; Luigi BOITANI, Colorado State University

Habitat destruction is a primary threat to biological diversity and the world's mammals are particularly sensitive to habitat loss. Nevertheless, global assessments of degree of habitat loss and fragmentation for mammals are absent. We used high-resolution habitat-suitability models to conduct comparative analyses and to identify global hotspots of fragmentation and core habitat for the world's mammals. A database of 4148 mammal species from 26 taxonomic Orders was compiled from an extant mammalian phylogeny and the IUCN Red List of Threatened Species. We described the degree of fragmentation of high-quality habitat for each species with the GISfrag metric, which measures the average distance of all cells within a high-quality habitat patch to the nearest edge of the patch. Results demonstrate that species with less fragmentation (i.e., more interior high-quality habitat) had larger geographic ranges, a greater proportion of habitat within their range, and a lower risk of extinction. Body mass was not associated with degree of habitat fragmentation. On average, less than 50% of a species geographic range was comprised of high-quality habitat, and, more troubling, less than 4% of the range was comprised of such habitat within protected areas. Identification of hotspots of fragmentation and core habitat will help guide strategic priorities for global mammal conservation.

CORAL REEF CONNECTIVITY IN PALAU: A POPULATION GENETICS APPROACH TO CORAL REEF MANAGEMENT IN WARMING SEAS.

Annick Cros

Hawaii Institute of Marine Biology

Stephen A. KARL, Hawaii Institute of Marine Biology

Coral reefs are under increasing threats from climate change and human impacts. In response, scientists and managers are designing and implementing resilient marine protected area (MPA) networks to increase the chances of reef recovery

following disturbance. One of the key attributes in the design of a resilient MPA network is connectivity. Understanding patterns of population connectivity within a MPA network, however, remains a difficult task. In the marine environment, population genetics is becoming a promising tool to measure the relatedness of individuals and determine the connectivity of MPA networks. In this work, we use Palau's barrier reef as a case study to explore coral connectivity and provide advice for the design of their existing MPA network. Fifty colonies of *Acropora hyacinthus* were sampled at each of 25 sites around Palau's reef including in existing MPAs. We amplified 16 microsatellites with forward primers designed with an individual index for each colony (n=50). Samples were then pooled by site and given an additional site index using the Illumina TruSeq kit, creating a site ID. Once the colony and site indices were attached, all 25 sites were sequenced using Illumina MiSeq genome sequencer. A bioinformatics pipeline was created to assign each colony a genotype based on the 16 distinct microsatellites from which we could analyze nucleotide variants such as SNPs. The sequences will be analyzed and results presented providing an insight on the relatedness of the colonies of *Acropora hyacinthus* around Palau's reef and information on coral connectivity at an island scale. This will be useful at the management level providing guidelines on the design of resilient MPA networks.

73. DO THEORETICAL AND EMPIRICAL ESTIMATES OF CONNECTIVITY MATCH? A CASE STUDY IN THE SOUTH-WEST LAGOON OF NEW CALEDONIA.

Marion Cuif

Direction des pêches maritimes et de l'aquaculture

Christophe LETT, Institut de Recherche pour le Développement ; Laurent VIGLIOLA, Institut de Recherche pour le Développement ; David Mickaël KAPLAN, Virginia Institute of Marine Science ; Pascal DOUILLET, Institut de Recherche pour le Développement ; Cécile FAUVELOT, Institut de Recherche pour le Développement

Understanding marine populations' dynamics is critical to their effective management, and requires information on patterns of dispersal and connectivity that are still poorly known. Many marine organisms have a bipartite life history with a pelagic larval stage that often represents the only opportunity for dispersal. In the last decade, new empirical and simulation approaches to measuring larval dispersal have been developed, but results from these two different approaches have rarely been compared in the context of a single marine system, impeding the use of larval dispersal models in metapopulation models supporting decision making. We used both approaches to investigate larval connectivity for a coral reef fish, *Dascyllus aruanus*, in the South-West Lagoon of New Caledonia. Our biophysical dispersal model shows that larval retention exhibits considerable temporal variability at both lagoon and patch reef scales and periodically reaches large



values despite low average water residence time. Artificial transgenerational marking of embryonic otoliths in the wild also showed relatively low self-recruitment rates indicating high population openness at the reproductive season scale, with considerable monthly variability of self-recruitment. Large quantitative discrepancies between simulations and empirical results emphasize the need to better understand processes that facilitate local retention, such as homing behavior and very small scale circulation patterns.

NEW FRAMEWORKS FOR ASSESSING THE SPATIAL RESILIENCE OF PROTECTED AREAS

Graeme Cumming

James Cook University

Protected areas remain one of conservation biology's core approaches for conserving ecosystems and their associated functions and services. As the human population grows, protected areas are experiencing an unusual combination of increasing demand and increasing pressure. One outcome of these antagonistic forces is that protected areas in developing countries are increasingly expected to justify their own existence in competition with alternative land uses in a political and socioeconomic forum. In this presentation I consider protected areas as social-ecological elements in a multifunctional landscape. I present an extension of Ostrom's social-ecological systems framework that takes better account of issues of scale and function by explicit analysis of the hierarchical arrangement and alignment of ecological scales and socioeconomic/sociopolitical levels of organization relating to protected areas. A preliminary analysis of three case studies suggests that at broader scales, anthropogenic influences and socioeconomic decisions – such as climate change and governance – dominate ecological variables as influences on protected area sustainability and resilience. I then extend the framework further to consider scale mismatches in protected area management and present a new, semi-quantitative index that provides a potentially useful way of thinking about and diagnosing scale mismatches. If scale mismatches are hardest to resolve when ecological extent and organizational levels are furthest apart (maximally misaligned), then our analysis of a larger set of case studies suggests that there may exist a predictable relationship between ecological extent, sociopolitical level, and protected area resilience.

MAN VS CAT: THE CASE OF HUMAN-BIG CAT INTERACTIONS IN GUYANA

Anthony Cummings

University of Texas at Dallas

The status of big cats, in particular jaguars, within Latin America has gained much attention recently. Our understanding of these cats, and cat-human interactions have been shaped by studies within the context and spaces occupied by cattle ranchers, and other farmers. While such studies provide valuable knowledge on cats, the impacts of global processes such as economic collapse on human intrusion into cat habitats have been missed. As an agent of change, gold mining intensity is strongly linked to changes in global gold demand and offers a new perspective for viewing human-big cats interactions. In this study I postulated that the movement of gold miners into forested regions of Guyana will present a different dynamic for big cat-human interactions than those currently offered by cattle ranchers. Following a respondent driven sampling design, I examine the views of gold miners, cattle ranchers, indigenous peoples, resource managers, and loggers, towards jaguars and other big cats. Stakeholders were asked to relate whether they feared cats, whether they had heard of cats being killed or killed cats themselves. Overwhelmingly, respondents expressed fear towards cats, jaguars and pumas in particular, while most persons suggested they had heard of big cats being killed. The various groups of stakeholders offered different positions on how they responded to cats within their spaces of work. Gold miners are more likely to pursue strategies to eliminate cats from within their locale because of the perceived threat to their personal safety, while cattle ranchers are more concerned about the safety of their herd. While conventional methods for preventing human-cat conflicts are applicable to cattle ranchers and other farmers, the mobile nature of gold miners and cats alike, present multiple opportunities for conflicts to arise, demanding the development of more innovative conflict management solutions.

ETHNIC VARIATION IN THE VALUATION OF ECOSYSTEM SERVICES

Aida Cuni Sanchez

University of Copenhagen

Marion PFEIFER, Imperial College London ; Rob MARCHANT, University of York ; Nd BURGESS, University of Copenhagen

Forest islands in the desert provide key ecosystem services to surrounding communities, which completely depend on them for their livelihoods. With increasing human pressure and droughts, conserving these fragile ecosystems is not easy. We focused our work on three isolated forest mountains in northern Kenya, Mt Marsabit, Mt Kulal and Mt Nyiru. We aimed at determining if ethnic group and/or livelihood strategy affected the way local populations perceive and use these forests, so that better management strategies can be suggested. We used focus-groups (FG), semi-structured



interviews, observations on plant abundance and population structure in/outside the forests and observations on medicinal plant and fuelwood in local markets. Water was found to be the most important ecosystem service (ES) in all study sites and amongst all ethnic groups. However, the second most important ES differed: while the Boran (farmers) mentioned fuelwood, the Samburu (pastoralists) in Marsabit mentioned fodder and the Samburu in Kula mentioned medicine. Differences in other important ES and most important plant species were also observed, which were related to ethnic group and access to markets. Information from the FG was in agreement with field and market observations. Results highlight that local perceptions and use is affected by ethnic group (cultural aspects and livelihood strategy) and these should be considered not only when ES rating but also when finding alternative livelihood strategies for forest edge communities. Top-down approaches have often been justified in multi-cultural ecosystems providing a one size fits all solution to complex problems. However, our findings highlight the need to understand and address cultural diversity if targeted conservation actions at the local scale are to be successful.

TIME DISCOUNTING IN BIODIVERSITY OFFSETS AND ECOLOGICAL EQUIVALENCY ANALYSIS-APING ECONOMICS, OR ECONOMIZING BIODIVERSITY LOSS?

Michael Curran
ETH Zürich

Biodiversity offsets (and related compensation policies) are expanding globally. Offsets attempt to compensate the local, "residual" biodiversity impacts of development projects with a goal of "no net loss" of biodiversity. A common means of compensation is the restoration of degraded ecosystems, which leads to a mismatch between the instantaneous loss of biodiversity and the delayed gain of biodiversity (which is gradual and may require centuries or even millennia). To address this "time lag" in the delivery of biodiversity value, time discounting has been suggested as a means of bridging the gap. Time discounting penalizes distant gains in biodiversity by expressing them in "net present" terms to be directly compared to present losses. The justifications for this practice are drawn from "utility discounting" in neoclassical economics, which is the subject of considerable debate, particularly surrounding economic assessments of climate change. In offsets, recommendations for choosing a rate/function are scarce. In this talk, I clarify what discounting is and assumes. I recap the economics literature on discounting (functions, choice of rates, empirical evidence), and identify which justifications may be useful in ecology. I suggest possible ecological variables that could be used as a basis for the discount rate/function

and illustrate the influence of the discount rate with global, spatially differentiated models of habitat restoration based on a published meta-analysis of the restoration literature (expressing recovery of species similarity in degraded ecosystems). In a case study region, I use these predictions to calculate basic offset ratios and show that current ratios in existing policy are far from what is required to achieve a "no net loss" of biodiversity. Concluding, I consider the alternative "rights-based" (Kantian) view, which rejects temporal trades, as a potentially superior option for offsets.

DIVERSITY AND DISTRIBUTION OF THE LION (PANTHERA LEO) ACROSS ZAMBIA

Caitlin Curry

Texas A&M University

Paula WHITE, Center for Tropical Research, University of California ; James DERR, Texas A&M University

The true conservation status of the African lion (*Panthera leo*) is in question due to a lack of knowledge regarding genetic diversity and conflicting estimates of population size. For example, in Zambia, although the lion has a large distribution spanning over 167,000 km² of habitat in managed areas, there are limited estimates of both population size and genetic sub-structure. This lack of reliable information compromises conservation decisions, some of which, such as the banning of trophy hunting, could have a profound impact on both the long-term security of the species as well as Zambia's economy. Analysis of the 12S and 16S mitochondrial genes of 165 lions found in five main areas in Zambia shows gene diversity throughout the population is high (0.7319 +/- 0.0174) with eight haplotypes found; three haplotypes previously described and five previously unseen haplotypes. Bayesian analysis shows haplotypes present in the Zambian population which link the Southern Africa lineage with the Southern/East Africa lineage suggesting the Zambian population may act as a bridge connecting the lions in southern Africa to eastern Africa. AMOVA analysis, however, suggests there is little to no gene flow between the populations within Zambia ($F_{ST}=0.44$) when separated into regional populations. The determination of regional sub-populations, such as that of eastern and western Zambia, could be the first step to the creation of conservation programs and proper legislation to focus on saving specific, at risk populations.

BEHAVIOURAL RESPONSE OF TWO GRASSLAND SONGBIRDS TO NOISE POLLUTION FROM ENERGY DEVELOPMENT IN THE CANADIAN PRAIRIE

Claire Curry

University of Manitoba

Bridget ANTZE, University of Manitoba ; Paulson DES BRISAY, University of Manitoba ; Heather NENNINGER, University of



Manitoba ; Miya WARRINGTON, University of Manitoba ; Nicola KOPER, University of Manitoba

Anthropogenic noise, created by roads, urbanization, and energy development, may influence wildlife in both protected areas and multi-use landscapes. Some species alter amplitude, frequency, or structure of songs or calls to avoid masking by noise. Species that cannot alter their vocalizations may be at greater risk from anthropogenic noise. Baird's sparrows are a declining grassland songbird (a species of special concern in Canada, with 25% decline in the past decade) with few studies on their vocal behavior. Species with highly variable songs, such as the more common Savannah Sparrow may be able to adjust more easily to noise pollution. We demonstrated that Baird's sparrows avoid sites with noisy infrastructure, whereas the more common Savannah Sparrows do not avoid noisy infrastructure. We hypothesized that these differing abundance patterns around development are a result of differing ability to communicate in noisy habitats. To test this hypothesis, we recorded songs from 47 Baird's Sparrows and 142 Savannah Sparrows in 26 mixed-grass prairies with varying types and abundances of energy infrastructure in southeastern Alberta and from 3 sites before and during playbacks of well drilling noise. Preliminary analyses show Baird's Sparrows do not alter minimum frequency or amplitude during control silence versus noise playback. In contrast, Savannah Sparrow minimum frequency and amplitude positively correlate with louder ambient noise at infrastructure sites. Understanding effects of anthropogenic noise on at-risk and common species will help us develop appropriate habitat management strategies for conservation in areas with increasing energy development. If species of concern are only sensitive to noise and not to the infrastructure, noise mitigation could allow for both conservation and economic development in the same prairies.

INFERRING OPPORTUNITIES FOR SPECIES INTERACTION FROM CAMERA TRAP DATA

Jeremy Cusack

University of Oxford [INSTITUTE] Institute of Zoology ZSL
Amy DICKMAN, University of Oxford ; Marcus ROWCLIFFE, Institute of Zoology ZSL ; Chris CARBONE, Institute of Zoology ZSL ; David MACDONALD, University of Oxford ; Tim COULSON, University of Oxford

Remotely triggered camera traps are being used worldwide to gather information on species occurrence, density, activity patterns, habitat use and behaviour. Recently, the spatiotemporal information contained in camera trap images has been used to characterise species interactions, i.e. estimating whether two species avoid or attract each other more than expected by chance. We review, test and compare proposed methods to infer species interactions from camera traps (occupancy models, activity patterns, spatiotemporal

point processes), using simulations and empirical data on large mammals collected in southern Tanzania's Ruaha landscape. We find that the extent to which camera trap data can provide meaningful and robust insights into species interactions depends largely on the strength of the interaction, sampling effort and landscape heterogeneity. In most cases, however, camera trap data can reveal "opportunities for interaction" between pairs of species, and we discuss how these may be useful for conservation ecology.

DUALLY IMPROVING BIODIVERSITY AND POLLINATION SERVICES FOR ENHANCED COTTON YIELDS AND SUSTAINABILITY

Sarah Cusser

University of Texas, Austin
Shalene JHA, University of Texas, Austin

Cotton is an economically and culturally important crop worldwide. Although self-fertile, cotton benefits from pollination service, producing larger bolls with more seeds with outcross pollen. However, cotton growers do not manage domesticated pollinators or employ land management practices that promote the establishment or long-term stability of wild pollinator communities. To determine best management techniques for dually increasing cotton yield while promoting important biodiversity, we sought to investigate the relationship between pollen limitation, pollinator community composition, and aspects of land management in South Texas Cotton, one of the largest US cotton producing regions. Our study had three objectives: 1) determine the extent of pollen limitation, 2) establish the relationship between pollen limitation and aspects of the pollinator community, and 3) identify which aspects of land use promote diverse and abundant pollinator communities. To answer these questions, we used a combination pollen limitation experiments, pollinator community surveys, and GIS analysis in 12 large-scale cotton fields. Overall, we found that cotton is indeed pollen limited, producing significantly larger bolls with the addition of outcross pollen. Despite this general finding, we found enormous variation in the degree of pollen limitation between sites. The degree of pollen limitation was negatively related to aspects of pollinator community composition, including pollinator abundance and richness. Pollinator community composition, in turn, was closely related to aspects of land use. Surprisingly, no particular land use type was associated with rich, abundant communities, but rather land use heterogeneity at both local and regional scales had a strong positive influence. This relationship between land-use, pollination service, and crop yield in cotton, presents a unique opportunity to increase cotton yield while dually engaging in pollinator conservation on a large scale.



ENGAGING LOCAL COMMUNITIES IN CONSERVATION IN PAPUA NEW GUINEA: CASE STUDIES FROM THE ONE OF THE WORLD'S MOST BIOLOGICALLY AND CULTURALLY DIVERSE COUNTRIES

Richard Cuthbert

Wildlife Conservation Society

The interaction between biological and cultural diversity is nowhere more apparent than in Papua New Guinea (PNG), where the country's diversity of animals and plants – around 8% of the world's terrestrial biodiversity in 1% of global land area – is matched by the diversity of cultures with more than 840 recognized languages in the country. This diversity is facing a wide and growing range of threats; from large-scale extractive industries to climate change, along with a growing human population that is moving from a traditional subsistence lifestyle to the market economy. The challenge of implementing effective conservation measures in PNG is further complicated by the traditional ownership of land and coastal resources (around 97% of land and near-shore marine areas are under customary tenure) and because around 85% of the population gain a significant portion of their nutrition from terrestrial and marine wildlife. This complex situation poses challenges and also opportunities: as the communities with the biggest vested interest in the conservation of wildlife and their environment are the customary landowners who utilise, control and depend on their own natural resources. We discuss three varied conservation initiatives – forest protection in Manus Province, sustainable small-scale fisheries in New Ireland, and the use of fur and feathers in traditional outfits in the Highlands – as case studies for working in PNG. Experience gained from these projects demonstrates that the active engagement of local communities in the design, implementation and enforcement of conservation activities is essential for projects to be supported and that projects can also benefit if customary knowledge can be incorporated alongside modern techniques and conservation science. Strengthening community initiatives along with local and national policies is essential if PNG's diverse wildlife and cultures are to survive against the country's ever growing conservation threats.

A NEW IUCN STANDARD FOR THE IDENTIFICATION OF KEY BIODIVERSITY AREAS

Annabelle Cuttelod

Penny LANGHAMMER, Terraconsilium ; Fishpool LINCOLN, BirdLife International

Biodiversity loss is accelerating at genetic, species, and ecosystem levels with serious negative consequences for the

delivery of ecosystem services and human well-being. There is great demand from across society to know, with precision, where places that contribute significantly to the global persistence of biodiversity occur so that conservation efforts can be targeted effectively. The Convention for Biological Diversity, in its Aichi Target 11, recognized the necessity of ensuring that protected areas networks include, among other characteristics, "...areas of particular importance for biodiversity..." Addressing the challenge of how to identify such areas has been a primary objective of the IUCN WCPA/SSC Joint Taskforce on Biodiversity and Protected Areas. Over recent years, in response to a request from IUCN members, the Joint Taskforce has led a global consultation process involving conservation organizations, academics, national decision-makers, donors and the private sector to develop a globally-agreed standard for the identification of Key Biodiversity Areas (KBAs) as sites that contribute significantly to the global persistence of biodiversity. Building on existing approaches, such as Important Bird and Biodiversity Areas, the KBA Standard broadens the scope to address genetic and ecosystem levels of biodiversity in addition to species and is applicable across taxonomic groups in freshwater, terrestrial and marine systems. This presentation will introduce the criteria in the new KBA Standard, including efforts to test and calibrate the thresholds using data on various taxa and techniques from systematic conservation planning; guidelines for site delineation; and the process to propose a site as a Key Biodiversity Area.

MISSION TREE KANGAROO: A COMMUNITY-BASED APPROACH TO CONSERVATION IN PAPUA NEW GUINEA

Lisa Dabek

Woodland Park Zoo

Matschie's tree kangaroos are listed as endangered (IUCN Red List 2014). They are important to the indigenous landowners of the cloud forest of Yopno-Uruwa-Som (YUS), Morobe Province, Papua New Guinea (PNG) for food and cultural purposes. This species is only found on the Huon Peninsula in Morobe Province. There is a customary land tenure system in PNG and local villagers own over 90% of the land. Since 1996 the Tree Kangaroo Conservation Program (TKCP) has utilized a community-based interdisciplinary approach for both protecting this endangered species and for integrating support for the local communities in the areas of health, education, land-use planning, and sustainable livelihoods. The work of TKCP in partnership with the local landowners resulted in the first and only Conservation Area in Papua New Guinea, which is managed on a local level. This presentation will share TKCP's innovative and groundbreaking approaches to conservation in Papua New Guinea that has resulted in TKCP being a model for



the PNG government for protected areas policy and a model for community conservation in remote areas of Papua New Guinea. Our work adds to the body of knowledge and practice of community driven conservation that can be shared globally. The discussion will specifically include our YUS Landscape Plan; Healthy Village, Healthy Forest project; YUS Conservation Ranger program for monitoring the YUS Conservation Area; tree kangaroo ecological research; Conservation Coffee project with Caffè Vita; and capacity building of staff in the local NGO, Tree Kangaroo Conservation Program - PNG.

POPULATION GROWTH RATE OF TARGET BIRD SPECIES SHOWS POSITIVE ASSOCIATIONS WITH A HIGHER-LEVEL AGRI-ENVIRONMENT SCHEME IN WALES.

Daria Dadam

British Trust for Ornithology

Gavin SIRIWARDENA, British Trust for Ornithology

Declines in farmland biodiversity have been extensively reported across Europe and agri-environment schemes (AES) have been the main geographically-widespread mechanism utilised to address this decline. Their deployment has involved the extensive investment of taxpayers' money, so testing their efficacy is of paramount importance. Previous studies have successfully tested the impacts of English AESs on birds using national-scale survey data. Here we present a similar approach to test the effect of the recently-ceased Welsh higher-level AES, Tir Gofal, on birds. We were able to utilise data from the entire implementation of Tir Gofal, from 1999 to 2013, and use bird data from 300 1km-squares of the long-term BTO/JNCC/RSPB Breeding Bird Survey (BBS). Tir Gofal options were grouped between those providing woodland creation and stock exclusion, scrub management, grassland habitat, arable winter seed, arable invertebrates, heathland, and hedgerow management. Population growth rate of target species in areas with AES was compared to that in the wider countryside outside AES by modelling bird population growth rates with respect to spatio-temporal covariates, namely AES option quantities and appropriate control variables. Grassland and heathland options did not show a clear pattern but woodland and scrub management options were associated with positive population growth rate of several species, including red-listed habitat specialists, a novel pattern that had not emerged from previous work on AES in the UK. Other key results included positive associations of arable winter seed and hedgerow management on a number of target species. In this study we showed a strong association between a number of AES higher-level options and population growth rate of target species, reinforcing the evidence for the need of targeted mechanisms to tackle species decline at habitat level.

POSITIVE AND UNFORESEEN NEGATIVE EFFECTS OF AGRI-ENVIRONMENT MANAGEMENT ON BIRDS

Daria Dadam

British Trust for Ornithology

Gavin Siriwardena, British Trust for Ornithology ; Phil GRICE, Natural England

Environmental Stewardship (ES) was the major agri-environment scheme in England between 2005 and 2014 and included a range of management options designed wholly or partly to help to reverse long-term declines in farmland bird populations. National bird monitoring data were used to test the effects of eight years of ES management on bird population growth rates to inform scheme revisions under the new European Union Common Agricultural Policy (CAP). Analyses were conducted by management option type on all individual species that the management might plausibly benefit. There were broad, positive effects of crop stubble management on granivorous species, reflecting population-limiting factors, but the patterns were less clear for other option types. Considering the results by each of a number of key, farmland-dependent species (as opposed to looking for general patterns by option), there were also net positive associations between population growth rates and ES management for several species. This provides good evidence that ES management has contributed to an ongoing reversal of the population declines of several key species, sometimes operating via the effects of multiple option types. However, there were mixed or negative effects of sacrificial seed crops, suggesting that new ecological relationships involving predation, competition or disease transmission may be developing and overriding positive effects of the management option. Further monitoring and management option development is needed if modified agri-environment management is to succeed in reversing bird declines under the new CAP. This is particularly challenging both because funding is being reduced and because this study shows that responses to management in practice may be modified from those found during developmental or initial monitoring studies.

MARINE PROTECTED AREAS LAG BEHIND WILDERNESS IN THE CONSERVATION OF FUNCTIONAL ROLES

Stéphanie D'agata

University Montpellier

David MOUILLOT, University Montpellier ; Laurent WANTIEZ, Université de Nouvelle-Calédonie ; Alan FRIEDLANDER, University Hawaii Manoa ; Michel KULBICKI, Institut de



Recherche pour le Développement ; Laurent VIGLIOLA, Institut de Recherche pour le Développement

Marine Protected Areas (MPAs) represent one of the most effective management responses to the pervasive human impacts on the world's oceans. However, due to their limited age, size and regulation or their location in regions with deep and long-lasting human footprints, MPAs may fail to provide their full potential benefits and thus appropriate ecological targets for measuring conservation effectiveness. A fair comparison with areas isolated from human activities but located in the same region, while controlling for environmental factors, would reveal the real ecological performance of MPAs with different key conservation features. Here we show that the biomass of apex predators and the breadth of functional roles are significantly higher in fish communities of coral reefs far from the market (>20 hours of travel time) than even in the oldest (38 years old), largest (17,500 ha) and most restricting (no-entry) MPA of New Caledonia (South-Pacific). The release from fish market pressure is dependent of the community aspect, and begins at 7.5 and 12 hours travel for the biomass of herbivores and apex predators, respectively, and at 16.5 hours for the recovery of functional roles. Overall our results suggest that beyond a threshold of 20 hours travel, considered as a delimitation for wilderness, ecological values saturate at levels that are neither reached in MPAs nor in traditionally managed areas. More specifically, apex predators have 3.5 more biomass in wilderness areas than in the most efficient MPA, while some key functional roles (mobile predators) are critically missing in MPAs. We thus demonstrate that wilderness areas support unique ecological values with no equivalency as one gets closer to human activities even in MPAs cumulating key conservation features. Wilderness areas may serve as benchmarks for management efficiency and act as the last sanctuaries for the most vulnerable functional roles, potentially mitigating their decline.

SURVEYS MAKE ME FEEL GOOD: A MULTI-NATIONAL EVALUATION OF SOCIAL DESIRABILITY BIAS WHEN VALUING ENVIRONMENTAL PUBLIC GOODS

Martin Dallimer

University of Leeds

Jette BREHDAHL JACOBSEN, University of Copenhagen ; Thomas HEDEMARK LUNDHEDE, University of Copenhagen ; Bo JELLESMARK THORSEN, University of Copenhagen

Conservation biologists generally accept that the general public value biodiversity and other non-market goods associated with the natural world. This is illustrated by the

large number of survey-based estimates of willingness to pay (WTP) for environmental goods. However, evidence from psychology suggests that a component of any stated value is associated with a social desirability bias (SDB) as respondents seek to feel better about themselves through over-stating their good intentions. This could lead to inflated estimates of WTP. Here we test for the presence of a SDB by comparing personal WTP with the amounts respondents say their peers would pay. We do this within a stated preference survey to elicit WTP for the conservation of semi-natural grassland in 3 European countries (Denmark, Poland, Estonia). Respondents (2122 out of 2900) were personally willing to pay for conservation to enhance environmental goods. They also reported a positive WTP for their peers. An SDB was present, with mean personal WTP of €24.38, some €12.84 (95% CI: 11.21-14.46) higher than that for their peers. Using a hurdle model we investigated socio-demographic drivers of the SDB. The propensity to state different individual and peer WTP amounts was positively related to income and involvement with environmental organisations, while respondents from Poland and Estonia were significantly less likely to report a SDB than people in Denmark. The magnitude of the SDB was not related to any socio-demographic variables, apart from nationality. Here, the presence of an SDB has led to an over-estimate of the values that the general public attribute to the conservation of the natural world. If widespread, such an overestimation could alter what conservationists have come to accept as the strength of the relationship between people and environmental goods. We must therefore develop appropriate methods that control and correct for SDB when valuing the natural world.

INTEGRATING BIODIVERSITY RESEARCH FOR IMPACT MITIGATION ON A TRANS-ANDEAN MEGAPROJECT: CASE STUDY FROM PERU

Francisco Dallmeier

Smithsonian Conservation Biology Institute

Catherine SAHLEY, Smithsonian Conservation Biology Institute ; Bruno VILDOSO, PERU LNG ; Reynaldo LINARES, Smithsonian Conservation Biology Institute ; Pablo TABORGA, PERU LNG ; Karim LEDESMA, Smithsonian Conservation Biology Institute ; Carolina CASARETTO, PERU LNG ; Alfonso ALONSO, Smithsonian Conservation Biology Institute

The PERU LNG Project consists of a 408 km natural gas pipeline that transverses 14 ecological landscape units (ELUs) through the eastern Andes, inter-Andean valleys and Pacific coastline desert. Because of the region's diversity, the Project developed a Biodiversity Action Plan to conserve biodiversity during construction and operation of the pipeline and marine terminal. The Project implemented a Biodiversity Monitoring and Assessment Program (BMAP) to understand the status and trends of species and habitats in the area of influence (Aoi), to assess the effectiveness of mitigation, and to contribute to the



knowledge, management and conservation of biodiversity. The Project used the Mitigation Hierarchy (MH) framework to quantify impacts, assess the effectiveness of mitigation and restoration strategies and align management objectives with best practices for conservation. High-resolution satellite images and field analysis of habitats and vegetation cover of the Aol were used to estimate hectares of habitat avoided during pipeline micro-rerouting and impact minimization efforts. Potential impacts were quantified as quality hectares impacted with and without micro-routing, minimization, or biorecovery for all ELUs. Minimization was quantified by the reduction of right-of-way width in the ELUs and habitats. Biorecovery was also quantified and ground truthed by the BMAP. Residual impacts were calculated by subtracting avoidance, minimization and restoration values from the estimated potential impact, allowing for the design of conservation initiatives aimed at achieving no net loss of biodiversity. A positive restoration trajectory for some ELUs has been reached, indicating that no net loss objectives may be reached. Implementing a BMAP and a MH quantification process contributed to best practices to document, quantify and implement impact mitigation while contributing to innovative approaches to integrate development needs with conservation priorities.

73-LARGE SCALE CONNECTIVITY: ADVANCING OUR KNOWLEDGE IN THE MEDITERRANEAN SEA

Alicia Dalongeville

CEFE, CNRS

Marco ANDRELLO, CEFE, CNRS ; Stéphanie MANEL, CEFE, EPHE

Marine ecosystems are threatened by multiple stressors such as fishing, pollution and climate change, which affect the functioning of ecosystems and their capacity to provide services to society. In particular, commercial fish species suffer important decreases of density and biomass. In that context, Marine Protected Areas (MPAs) have been promoted as a powerful tool to mitigate threats to oceans, but also benefit fisheries by increasing stock levels in fishing areas through adult spillover and larval supply. Up to now, MPAs have been generally set up according to independent local decisions instead of regional management plans. Hence, the spatial design of the actual MPA network is mainly the results of socio-economic factors rather than ecological considerations. Thus, a macroecological perspective on the connectivity of MPA network and its ability to sustain populations is surprisingly lacking. Arguably, this gap of knowledge may be largely due to the lack of detailed and spatially explicit datasets needed for such analyses, the improvement of genetic technologies can provide such datasets by estimating the level of gene flow between populations. We will present here an integrated view of genetic connectivity at the scale of Mediterranean Sea combining results obtained from biophysical modelling

(Andrello et al., 2013, 2015), a quantitative review of fish genetic diversity (Dalongeville et al. submitted) and we will illustrate the project SEACONNECT, which aims to estimate genetic connectivity of fishes from a large spatial sampling at the scale of the Mediterranean Sea using 'Next Generation Sequencing' technology.

MANAGEMENT RESPONSES TO HYBRIDISATION: THE SOUTH AFRICAN PERSPECTIVE

Desire Dalton

National Zoological Gardens of South Africa

Anri VAN WYK, National Zoological Gardens of South Africa ; J. Paul GROBLER, University of the Free State ; Coral BIRSS, Cape Nature ; Antoinette KOTZE, National Zoological Gardens of South Africa

Hybridisation between introduced and endemic ungulates in South Africa resulting from anthropogenic actions has been reported for several species. Hybridization resulting in fertile offspring has been reported in the blue and black wildebeest, black-faced impala (and common impala, grevy's zebra and plains zebra and bontebok and blesbok. Conservation authorities and game farmers supported the development of a set of markers for the routine identification of pure and hybrid individuals in herds. Diagnostic markers for bontebok and blesbok have been developed. Genetic analysis of hybridisation is conducted routinely on bontebok samples collected under chain of custody and these markers have sufficient power to identify fixed genetic differences. In an attempt to acknowledge ancestral polymorphisms and to address concerns related to the low genetic diversity present in bontebok populations, the methods for defining hybrid bontebok incorporates the implementation of a threshold of 90% based on acceptable limits of variability aimed at ensuring the maintenance of the majority of pure bontebok and associated allelic diversity to counter the loss of heterozygosity within bontebok populations. Due to the development of the marker set, national policy and provincial legislation on biodiversity conservation has been adapted and permits for translocation can only be obtained if a genetic certificate is issued. The developed test is of benefit to the private game farmer and nature conservation. Presently there is a huge economic incentive for game farmers to have pure certified animals. In addition, the test supports nature conservation as their current policy states that they do not support the crossbreeding of species, subspecies or ecotypes. Thus, the genetic integrity of the bontebok will be maintained due to a combination of genetic research and the implementation of management responses.



IMPACT OF SOIL PROPERTIES ON THE DISTRIBUTION AND ABUNDANCE OF ISOBERLINIA DOKA IN NIGERIA

Olayinka Daodu

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Distribution ranges of plant species are related to physical variables of ecosystems that limit plant growth. This study examined the impact of soil properties on the distribution and abundance of *Isoperlinia doka* Craib & Stapf, a hardwood West African tropical timber tree in Kamuku National Park, Birnin Gwari, Kaduna State. A total of 60 sample plots measuring 1000 m² with twenty quadrats of 10 m × 5 m in each of the sampling plots was used to measure and record the floristic and structural vegetation data such as density, species composition, diameter at breast height (dbh), vegetation/crown cover, species richness and diversity index of woody species (≥ 3m high). Frequencies and tree basal areas were also measured, while the percentage litter cover, grass cover as well as bare ground were estimated by sight. Soil samples were also collected from three 10 m x 5 m quadrats in each of the major plots using a cylindrical core and samples were taken to the laboratory for further analysis. Woody species abundance was higher in the mixed species woodlands than inside the *Isoperlinia doka* woodlands (1,542 and 905 respectively) but species richness was higher in the *Isoperlinia doka* woodland than in the mixed species woodlands (65 and 53 respectively). Woody plant species belonging to the family Combretaceae, Euphorbiaceae and Rubiaceae were dominant in the mixed species woodlands while woody plant species belonging to Fabaceae, Annonaceae and Combretaceae dominated the *Isoperlinia doka* woodlands. Woodlands dominated by *Isoperlinia doka* differ markedly in soil features from those in the mixed species: pH, organic Carbon, total Nitrogen, available Phosphorus, exchangeable Calcium, exchangeable Potassium, exchangeable Sodium and Cation Exchange Capacity all showed significant differences. However, the soils of both woodland types were similar in exchangeable Acidity (H+Al) and exchangeable Magnesium.

124 GERMAN IMPACT MITIGATION REGULATION - AN EXAMPLE TOWARDS NO NET LOSS OF BIODIVERSITY?

Marianne Darbi

Leibniz Institute of Ecological Urban and Regional Development

Wolfgang WENDE, Leibniz Institute of Ecological Urban and Regional Development

Germany has an impact mitigation regulation (IMR) procedure since 1976 legally based in the Federal Nature Conservation

Act. The planning and assessment instrument accompanies the environmental impact assessment, and results in legally binding no net loss (NNL) and biodiversity offset requirements. We present real-world experiences with IMR and with the establishment and use of habitat banks, as demonstrated through the Burgberg Zschaitz Habitat Bank in Saxony. Both key factors to success and obstacles under the German IMR are identified, providing valuable lessons learned: 1. Successful offsets are backed by clear regulation and policy guidance, while unclear and uncertain administrative action and sometimes lacking engagement of government agencies may be an obstacle. 2. Cooperation with stakeholders at regional level, including land owners and farmers, is crucial, ensuring public acceptance through clear conservation goals (including socioecological aspects, e.g. environmental education, aesthetic and recreational values). 3. The implementation of larger, complex and high quality measures not only adds to reaching state-wide nature conservation goals and strengthen biotope networks and connectivity, but is also more cost-efficient to plan and implement. 4. To ensure this delivers best outcomes, compensation services providers (i.e. habitat banks) need trained personnel and a sound methodology. 5. Problems of uncertainty and advance financing as well as the negative effects of competition (i.e. price dumping) are best addressed by a stable, independent and not profit-oriented compensation services provider who should also guarantee the maintenance and safeguarding of the measures in perpetuity. In addition, we share experiences on metrics as applied in Saxony and illustrate how biodiversity offset measures around an EU Natura 2000 site provide an actual 'add-on' of measures beyond the currently required Habitats Directive management measures.

181 - DATA-DRIVEN PORTFOLIOS OF CLIMATE ADAPTATION STRATEGIES FOR INDO-PACIFIC CORAL REEFS

Emily Darling

Wildlife Conservation Society

Joseph MAINA, University of Queensland; David MOUILLOT, Université Montpellier; Tim MCCLANAHAN, Wildlife Conservation Society

Climate change is an unprecedented threat to global coral reefs. There is mounting evidence that conventional marine conservation cannot prevent wholesale losses in the face of climate change. Urgently, innovative regional approaches to are needed to tackle climate change through portfolios of local conservation and management actions, such as strategically establishing marine reserves within natural climate refuges or promoting climate-tolerant fisheries. I will present a multi-stakeholder project that involves 90+ international researchers, NGOs and government agencies to identify climate adaptation options for 2200+ coral reefs throughout the Indo-Pacific. This data-driven approach combines coral reef surveys with climate



models to identify portfolios of adaptation actions across gradients of climate exposure and functional diversity. I will also address the practical realities of coordinating multiple, complementary conservation actions for coral reefs and the communities that depend on these valuable ecosystems across the Indo-Pacific.

CROPS, COMMUNITY AND CONFLICT

Jyoti Das

AARANYAK

Bibhuti LAHKAR, AARANYAK ; Bibhab TALUKDAR, AARANYAK

Human elephant conflict is a major issue in Golaghat district of Assam and it is one of the most affected areas in entire India. The district has witnessed loss of enormous forest cover owing to deforestation, encroachment, tea cultivation and construction of an oil refinery in last two decades. Keeping this in view, we initiated this study to mitigate human elephant conflict by using multi dimensional approach for driving away elephants. The ultimate aim was to create an environment for co-existence of elephants and people in harmony. We selected a village named Sundarpur (found to be the most affected by elephants) and decided to work with the communities. We recorded a total of 245 conflict incidents (n=245) during the study period (2012-13). This included 53 incidents of house damage, 8 incidents of physical injury or death and 184 incidents of crop-raiding. We implemented community based crop protection measures in the model village of Sundarpur. Initially, three groups of local youths were formed and trained. Trial plots were established to investigate the potential of different methods like trip wire and chilli fencing to drive the elephants. Further, chilli cultivation was carried out to look at the potential as cash crop for the locals. Both the methods were tried separately and showed a 60 - 70 % success rates in driving away the elephants. Out of 18 occasions when the elephants visited the trial plots, the trip wire and chilli fencing method successfully driven away the elephants for 13 and 14 times respectively. We recommend chilli fencing method to be implemented in this locality which is cost effective and also income generating for the local farmers. Human and elephant can co-exist in harmony with this initiative in this area.

SECURING THE CONSERVATION OF BENGAL SLOW LORIS; APPROACHING INTERDISCIPLINARY CONSERVATION ACTION PLAN (ICAP)

Nabajit Das

Primate Research Centre NE India

K. A. I. NEKARIS, Oxford Brookes University ; Jihosuo BISWAS, Primate Research Centre NE India ; P. C. BHATTACHARJEE, Gauhati University

Endemic to Southeast Asia, including Northeast India, the Bengal slow loris *Nycticebus bengalensis*, a nocturnal primate, draws less attention from conservationists. The combination of being strictly nocturnal makes the species sensitive to any changes in their habitat. Hunting for medicinal beliefs, combined with habitat loss and fragmentation are the major threats. Status of Bengal slow loris is currently listed as Vulnerable on the IUCN Red List, basis of habitat loss alone. From 2009 to 2013, we carried out a detailed survey to estimate the population status in protected areas of Assam and Arunachal Pradesh, Northeast India. Line transect methods were used to estimate loris encounter rates. A team of 3-4 individuals conducted surveys at night (1800 – 0300h) on foot, detecting lorises visually. During first phase of survey we covered 370 km and in second phase of survey covered 71 km only in Namdapha National Park, Arunachal Pradesh. The abundance estimate of this species was calculated at 0.06 to 0.42 loris / km, which is relatively low when compared to estimates of slow lorises throughout their distribution range in Southeast Asia. Combined with ongoing anthropogenic threats and very likely listing of the Indo-Burmese form as a distinct taxon, the species should be regarded in a crisis situation in Northeast India. An action plan should be implemented including planned management, habitat protection, management of people and their activities, legislation and its enforcement and training of manpower to implement key actions. A more comprehensive, interdisciplinary approach to action planning will result a plans that effectively assisting decision makers responsible for allocating resources and authorizing action, as well as implementers of species conservation.

ID 7 : CAN ZONOTIC DISEASE RISK HELP CURB THE WILDLIFE TRADE IN CHINA?

Peter Daszak

EcoHealth Alliance

Maureen MILLER, EcoHealth Alliance ; Aleksei CHMURA, EcoHealth Alliance ; James DESMOND, EcoHealth Alliance ; Parviez HOSSEINI, EcoHealth Alliance ; Jon EPSTEIN, EcoHealth Alliance ; Kevin OLIVAL, EcoHealth Alliance ; Zhengli SHI, Wuhan Institute of Virology ; Guangjian ZHU, EcoHealth Alliance

The unsustainable consumption of wildlife for food in China is a significant conservation concern. Despite international pressure, and interventions from the Chinese government, the trade in wildlife within southern China, and neighboring countries appears to be expanding. The consumption of wildlife for food has been linked to the emergence of a range



of highly lethal emerging diseases, including Ebola virus disease, SARS and others. In this talk, we describe a strategy to quantify the risk of the wildlife trade in southeast Asia to human health. This involves a combination of human behavioral risk surveillance, characterization of market 'value chains', economic analysis of emerging disease costs, and identification of novel and known viruses in animals traded within markets. In addition, we are sampling captive raised wildlife to examine whether farming wildlife reduces the risk of disease emergence. Demonstrating that this is a more healthy alternative to consumption of wild-caught animals, reduces conservation impact, and remains economically viable, could lead to this becoming an acceptable alternative to an unsustainable and risky trade.

ID#151 : HOW BIODIVERSITY CONSERVATION CAN PREVENT PANDEMICS

Peter Daszak

EcoHealth Alliance

Carlos ZAMBRANA-TORRELIO, EcoHealth Alliance ; Kevin J. OLIVAL, EcoHealth Alliance ; Kris A. MURRAY, Imperial College ; Toph ALLEN, EcoHealth Alliance ; Tom HUGHES, EcoHealth Alliance ; Dan SCHAR, USAID RDMA ; Katherine D. LEE, University of Wyoming ; Elizabeth H. LOH, EcoHealth Alliance ; David C. FINNOFF, University of Wyoming ; Parvies Rana HOSSEINI, EcoHealth Alliance ; Jamie PIKE, EcoHealth Alliance ; Catherine MACHALABA, EcoHealth Alliance ; Jon H. EPSTEIN, EcoHealth Alliance ; William B. KARESH, EcoHealth Alliance

Policy efforts to conserve biodiversity are often given short shrift when balanced against the realities of lives lost due to pandemic zoonotic disease emergence (e.g. H1N1, SARS, Ebola), or the high profits of land conversion, agricultural intensification and trade. However, we propose that there are hidden and highly valuable health benefits in protecting biodiverse landscapes from exploitation, specifically linked to disease emergence. In this talk, we lay out a framework to leverage health impacts and economic costs of emerging diseases to help promote biodiversity conservation. First, we present a new analysis of Emerging Infectious Disease (EID) hotspots using new underlying data and a new modeling framework. Our results confirm that, while human population density (and population change) and mammalian species richness are correlated with zoonotic EID risk, so also are measures of land use change. Secondly, we present data from economic modeling of disease risk in the Amazon and in Borneo that demonstrate if the economic costs of disease emergence from these highly biodiverse regions are taken into account, the rate of deforestation is demonstrably unsustainable from an ecosystem services perspective. Finally, we show that strategies to prevent pandemic emergence by dealing with the underlying drivers of emergence (e.g. land use change, wildlife trade) are more cost effective in the

long term than business-as-usual. Our work demonstrates the health benefits of conserving wildlife biodiversity, and specifically promotes biodiversity conservation as a strategy to prevent the most high-profile health threats: emerging zoonoses. We propose that highlighting these specific health benefits of conservation will be a useful tool in efforts to reduce deforestation and the global wildlife trade in the age of pandemics.

FALLOW HUNTERS: SPATIO-TEMPORAL DYNAMICS OF LARGE MAMMAL HUNTING IN A SHIFTING CULTIVATION LANDSCAPE IN ARUNACHAL PRADESH, INDIA

Anirban Datta-Roy

Ashoka Trust for Research in Ecology and the Environment (ATREE)

Nitin Rai, Ashoka Trust for Research in Ecology and the Environment (ATREE)

Subsistence hunting and shifting cultivation have been traditional practices of indigenous people of upland areas across parts of the world including the Himalayan biodiversity hotspot areas. In northeast India, although these practices are discouraged through policies and laws, they continue to play an important role in the cultural and socio-economic lives of indigenous people. An understanding of such systems has been hampered by the lack of detailed studies. We used participatory methods to document subsistence hunting based on a self reporting offtake monitoring system. We present spatial and temporal dynamics of large mammal hunting over 22 months in an eastern Himalayan village inhabited by the Adi tribe, who practice traditional shifting cultivation and subsistence hunting. Preliminary analysis of the spatio-temporal patterns of hunting indicate that 45% of the hunts occur in the shifting cultivation fallows around the village while temporal intensity of hunting appears to be influenced by the timing of the agricultural calendar. 47% of wild meat biomass is procured from hunts that occur in a matrix of cultivation and differently aged fallows. Hunting in the fallows is characterised by short hunting trips. Results are consistent with observations by previous authors of 'garden hunting' among indigenous shifting cultivators in central and south America. This study provides first documentation of actual hunting yields for the region. While the results indicate the importance of these mixed-use landscapes as an important source of food and sustenance for the villagers, these landscapes are currently under threat. Government policies have been largely intolerant of shifting cultivation and are attempting to replace them with permanent cultivation in the form of terraces and horticultural orchards. Our study suggests there is much merit in maintaining these landscapes for subsistence practices and simultaneously reducing hunting pressure on the adjoining forests



CONSERVATION OF AFRICAN RAIN FORESTS: A RAPID ASSESSMENT OF THREAT USING A META-DATASET OF PLANT OCCURRENCES RECORDS

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Africa hosts the second largest extent of tropical rain forest (TRF) in the world. Even though they represent one of the most species-rich places on Earth, African TRFs are being depleted of their biodiversity resulting mainly from global changes. Species with small ranges are particularly vulnerable to extinction. Identifying areas with high concentration of such microendemic and threatened species is therefore of crucial importance for conservation planning. Despite considerable efforts to improve our knowledge on biodiversity patterns across African TRF, estimates of levels of threat are largely lacking. Indeed, published IUCN assessments are only available for ca. 1,500 plant species whereas the total number of species in African TRF probably exceeds 15,000. This is explained mainly by the time-consuming species by species process of properly assessing and publishing conservation status using IUCN Red List criteria and categories, but also by the poor knowledge of plant distributions. Here, we undertake a rapid risk of extinction assessment of more than 5,000 African TRF plant species based on the unique RAINBIO database representing over half a million occurrences of sub-Saharan vascular plant species. Using an R routine that calculates the EOO, AOO and number of localities, we used the criteria B to identify threatened species and provide their conservation status following the Red List categories. We use these results to generate various maps of risk for the region's flora using the different Red List categories. To assess the robustness of our approach, results are compared to available IUCN assessment for Cameroon and Gabon. Even though this approach might seem rudimentary, it provides a quick but necessary approach of exploring current threats for a large number of species and identifying potentially high-priority areas for future conservation efforts while providing preliminary data for assessments of Red List index in the region.

POPULATION DYNAMICS FOR THE VULNERABLE POPULATION OF SOUTHERN RIGHT WHALES (EUBALAENA AUSTRALIS) IN NEW ZEALAND WATERS

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The analysis of population dynamics is key in the conservation for endangered and vulnerable species. Southern right whales (*Eubalaena australis*) were nearly extirpated from New Zealand (NZ) waters by commercial whaling in the 19th century but are now thought to be recovering. Here we present the first matrix model for right whales in NZ to assess population dynamics. Parameters used in the matrix model incorporated new estimates of life history traits from data collected in Port Ross, Auckland Islands (2006-2012), and conspecific parameters. A three-stage, female only, matrix population model was used to estimate growth rate, stage distribution and sensitivity/elasticity. The estimated growth rate is $\lambda=1.056$ (95% bootstrapped CI: 1.019-1.130). Sensitivity analysis suggests the survival rate of the mature female stage had the highest proportional effect on population growth rate. This population growth, coupled with recent re-colonization of former habitats around mainland, and evidence from congeneric populations, suggest that southern right whales in New Zealand may become exposed to impacts in the future, e.g. from fishing and shipping. Conservation management aimed at maximizing mature female survival (e.g. MPAs, shipping restrictions) will be important for continued population recovery.

AN ECOSYSTEMS APPROACH TO MANAGING VEGETATION ALONG BRITAIN'S TRANSPORT CORRIDORS

Helen Davies

ADAS UK Ltd

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The study set out to investigate how vegetation adjacent to railway lines and motorways (the 'soft estate') could be managed to maximise biodiversity gain, ecological connectivity, ecosystem services provision, and resilience of transport infrastructure to climate change. This involved a review of literature to identify existing good practice in the UK and beyond; engagement with stakeholders within the two Nature Improvement Areas (NIAs) of Morecambe Bay and the Humberhead Levels; interviews with regional Network Rail and Highways Agency staff covering these two areas; and the development of a GIS-based multi-criteria decision aid to



identify vegetation management options for those sections of the transport network with the greatest opportunity or need. The options identified vary according to the existing habitat within the transport corridor (based on 100m segments), the surrounding land use (e.g. agricultural) and land cover (woodland, grassland or wetland), and the nearby presence of hazards (such as flood risk or leaf fall) and biodiversity designations. The project has shown that management strategies for transport soft estate can deliver multiple ecosystem services, for example pollination, water regulation and provision of biomass. This novel study brought together a wealth of previously disparate literature, providing a scientific basis to discussions between land managers/owners and wider environmental stakeholders who jointly attended meetings in order to better understand the opportunities and constraints. Over the next three years, Network Rail, the Highways Agency, Natural England and the Wildlife Trusts of Cumbria and Yorkshire will invest millions of pounds implementing these management options in up to six opportunity areas identified in each of the two NIAs. If successful, this innovative yet simple approach could be rolled out on a wider scale, potentially covering transport and other linear corridors across the UK.

NURSING STUDENTS WALKING IN URBAN AREAS TO DEVELOP AN UNDERSTANDING OF OPEN SPACES AS A RESOURCE FOR HEALTH

Jacqueline Davies

City University London

Student nurses walk in urban streets and parks to observe ecological concerns such as energy pollution and human-wildlife conflicts; and reflect on how they will communicate the benefits of outdoor activities for a range of individuals. While the socially advantaged may readily embrace outdoor activities, those from less advantaged backgrounds often view public spaces as high risk environments. On their walk students meet and talk to the people they will care for when they are in practice. They learn about the space where they will later encourage people to walk. And they get to walk and meet each other. Some reports from these urban walks view nature as dirty and dangerous. The teaching innovation that which requires students to step out into the real three dimensional world and use all five senses to observe has won a prestigious quality award from the local health education board and been evaluated positively by students. The method draws on the health worker's long established practice of 'walking the patch' and their need to observe and write a report of what was noticed in a given time and area. The walk provides an opportunity to observe both old and new public health challenges and initiatives, from drainage systems upwards. The instructions given to the student to walk about in a group, observing, notice and conversing have been

developed from the psychogeography 'dérive' developed by Guy Debord in Paris in the 1950s, which we first used successfully with business studies students to disrupt traditional transmissive learning. The educational initiative is valuable for healthcare professionals to learning about their area of practice and reflecting on how to develop strategies and manage challenges of using the natural environment as a space for developing healthy living.

DIAGNOSING LARGE-SCALE MARINE PROTECTED AREAS: A COMPARATIVE ANALYSIS OF THE SOCIAL, ECOLOGICAL AND INSTITUTIONAL DRIVERS OF SUCCESSFUL CONSERVATION

Tammy Davies

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To meet global conservation targets and secure sustainable resource use, governments and NGOs are increasingly establishing large marine protected areas (MPAs). Large MPAs face unique management challenges, yet we know little about what affects their performance. To identify pathways to effective management, we systematically investigated the ecological, social and governance characteristics that contribute to effective management of large MPAs. We used the MPA global database (www.mpaglobal.org) to identify large MPAs (marine portion larger than 10,000km²) with governance arrangements in place for at least five years. There were 15 MPAs globally that fulfilled these criteria and that had sufficient secondary data to enable reliable and accurate coding. Cases were entered in the Social-Ecological Systems Meta-analysis Database (<http://sesmad.dartmouth.edu/>), which enables consistent measurement of key variables related to the ecological and social components of social-ecological systems, as well as the governance system that influence the ways in which people interact with the environment and each other. Our comparative analysis combines the quantitative rigor of formal statistical meta-analysis with some of the flexibility of qualitative and primary data collection to address critical research areas concerning: 1) the applicability of knowledge developed in small-scale systems to large scale systems, and 2) the extent to which success factors proposed in conservation biology and MPA design apply across cases. By drawing upon multiple perspectives, our analysis highlights key lessons for MPA success at large scales, while also suggesting important future research priorities for this field.



101 SPRINGS: CONSERVING PERENNIAL WATER CRITICAL IN ARID LANDSCAPES

Jenny Davis

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Charles FOLEY, Wildlife Conservation Society

Arid landscapes are highly water-limited environments and all water (surface and groundwater) is environmentally, culturally and economically important. Springs, sites where groundwater discharges at the Earth's surface, are often the only long lasting, or perennial aquatic habitats in arid regions. Accordingly, they provide habitats for aquatic biota, as well being an essential water resource for terrestrial species and human settlements. Small spring-fed aquatic habitats often contain the greatest concentration of endemic species of plants, fishes and invertebrates within a region. They are increasingly being recognized as globally important biodiversity hotspots and evolutionary and ecological refugia. However, water resource development represents a major threat to spring ecosystems. Increasing groundwater withdrawal for direct human consumption and the production of food, fibre and energy, all driven by global population growth, is a major management issue for many spring habitats. Predictions from global climate models that suggest that drier regions will become drier and extreme events (extended droughts) more common. This will increase the pressure to extract groundwater for human use and result in the loss of spring habitats and the endemic and dispersal-limited species they support. Additional management challenges include impacts of exotic and invasive species and unmanaged recreational activities. The isolation and small size of spring habitats makes them extremely vulnerable to anthropogenic impacts. However, it also means that important conservation actions may be more feasible and cost effective for springs than for larger aquatic ecosystems. Conservation measures include fencing to exclude feral herbivores, removal of alien aquatic species and assisted re-colonisation of dispersal-limited, endemic species. However, the protection of the groundwater resource on which desert springs depend must be a fundamental protection priority.

ACCOUNTING FOR ENFORCEMENT COSTS IN THE SPATIAL ALLOCATION OF MARINE ZONES

Katrina Davis

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Marit KRAGT, University of Western Australia; Stefan GELCICH,

Pontificia Universidad Catolica de Chile; Steven SCHILLIZI,

University of Western Australia; David PANNELL, University of Western Australia

Marine fish stocks are in many cases extracted above sustainable levels, but they may be protected through restricted-use zoning systems. The effectiveness of these

systems typically depends on support from coastal fishing communities. High management costs including those of enforcement may, however, deter fishers from supporting marine management. We incorporated enforcement costs into a spatial optimization model that identified how conservation targets can be met while maximizing fishers' revenue. Our model identified the optimal allocation of the study area among different zones: no-take, territorial user rights for fisheries (TURFs), or open access. The analysis demonstrated that enforcing no-take and TURF zones incurs a cost, but results in higher species abundance by preventing poaching and overfishing. We analyzed how different enforcement scenarios affected fishers' revenue. Fisher revenue was approximately 50% higher when territorial user rights were enforced than when they were not. The model preferentially allocated area to the enforced-TURF zone over other zones, demonstrating that the financial benefits of enforcement (derived from higher species abundance) exceeded the costs. These findings were robust to increases in enforcement costs but sensitive to changes in species' market price. We also found that revenue under the existing zoning regime in the study area was 13-30% lower than under an optimal solution. Our results highlight the importance of accounting for both the benefits and costs of enforcement in marine conservation, particularly when incurred by fishers.

ELASTICITY IN ECOSYSTEM SERVICES: ANALYSING VARIABLE RELATIONSHIPS BETWEEN ECOSYSTEMS AND HUMAN WELLBEING

Tim Daw

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The Millennium Ecosystem Assessment highlighted the role of ecosystem services for human wellbeing, suggesting a positive relationship between ecosystem health and human wellbeing. Yet improvements in human wellbeing have coincided with ecosystem degradation, suggesting a more complex relationship. To investigate this relationship, the NERC/



ESPA funded Sustainable Poverty Alleviation from Coastal Ecosystem Services (SPACES) project has applied an extensive ecological and social dataset from rapidly transforming coastal areas of Kenya and Mozambique to a heuristic framework to conceptualise and assess the processes linking ecosystems to human wellbeing. The SPACES framework uses multiple interlinked chains of ecosystem services that encompass multiple provisioning, regulating and cultural services. For each service we assess the elements of the ecosystem underpinning the services and goods obtained, how these are given value through access and markets, and the distribution of wellbeing benefits among groups of people. Here, we show how fishery catch data, Ecopath modelling, reef carbonate budget censuses, household and community surveys can be used to populate this framework. The framework describes the “elasticity” of each service, (how human wellbeing responds to incremental changes in ecosystem quality), and the linkages, conflicts and inequalities within and between ecosystem services. Further, this framework will allow us to investigate which links in the chains are most sensitive to changes in the levels, access or value of goods and services provided by the ecosystem and how human needs and wellbeing can drive feedbacks within chains. By exploring “elasticities” under different future scenarios the framework can be used to identify where policy and management tools for promoting both human wellbeing and ecosystem health are likely to have the greatest impact.

118 POVERTY, WELLBEING AND EQUITABLE CONSERVATION - EMPIRICAL INSIGHTS FROM RWANDA AND LAOS

Neil Dawson

University of East Anglia

This talk presents social studies from forest-adjacent villages in Rwanda and Laos, funded through the Ecosystem Services for Poverty Alleviation programme. In summary, tradeoffs and synergies between the wellbeing of local populations and conservation goals were extremely context specific and variable, suggesting prescriptive one-size-fits-all conservation and development initiatives are unlikely to result in win-wins. Fine-scale studies discussed here sought to interpret perspectives of those living alongside the world’s biodiversity hotspots, their own priorities and values, as well as evaluate their standard of living. In line with more comprehensive definitions of equity, concerns of local populations rest not only on distribution of material resources but also procedures through which decisions are made plus recognition of context-specific needs and socio-cultural values. This has important implications: For example attempts to restrict traditional, ‘unproductive’ modes of farming in both countries were viewed quite differently based on how alternatives were introduced,

choices afforded to smallholders and compatibility with local culture and aspirations (not simply profitability). While equity research reveals perceptions of governance, wellbeing enhances understanding of local values and behaviour. Poverty research can then complement this, but here mainstream poverty indicators are shown to be of limited value, for example taking no account of land tenure, so often a major factor in perceptions of conservation initiatives. The common assumption that poverty leads to resource exploitation was, currently, unfounded in these case studies. Moreover the importance placed on different habitats in the wider landscape (not only forests) revealed opportunities for meeting joint social and ecological goals through integrated landscape management, opportunities so far unrealised due to lack of community engagement.

ENVIRONMENTAL FLOWS AT WORK; RESTORING FLOODPLAIN WETLANDS THROUGH RETURN OF HISTORICAL CONDITIONS

Samantha K. Dawson

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Wetlands are among the most degraded ecosystems worldwide, demanding effective restoration. In an effort to ameliorate ecological degradation from upstream water diversions, environmental and managed flows (E-flows) are increasingly used to help restore vegetation communities. Understanding of factors affecting the success and efficacy, however, remains limited. We investigated the capacity of flooding, including E-flows, to restore wetland flora across areas varying in disturbance intensity from historic land-use (land-use intensity). We predicted that increasing land-use intensity would decrease restoration effectiveness, while more frequent and increased duration flooding should improve restoration outcomes. A case study was used to assess vegetation restoration: a floodplain wetland with a land-use intensity chronosequence, flooded through E-flows, in the Macquarie Marshes in the Murray-Darling Basin of south-eastern Australia. We examined extant vegetation, soil seedbanks, plant trait distributions and historical vegetation change through surveys of plant community composition, greenhouse seedbank



germination, trait modelling approaches and Landsat imagery analysis. Composition of extant herbaceous vegetation correlated with land-use intensity and flooding, while extant shrub and woody species were more strongly correlated with land-use. Within seedbanks, exotic and disturbance-adapted species were associated with higher land-use intensity and native wetland species were associated with lower land-use intensity and increased frequency and duration of flooding. Trait analyses showed similar results to the seedbank with respect to disturbance and wetland traits. Imagery analysis showed regular flooding coincided with restoration success. In conclusion, flooding was critical to achieving restoration objectives, with higher frequencies increasing efficacy, but increased land-use intensity compromises restoration rates.

CONSIDERATIONS OF SCALE IN JAGUAR AND PUMA RESOURCE SELECTION MODELS BASED ON SCAT LOCATIONS IN SOUTHERN MEXICO

Jennifer Day

University of Washington

Jurgi CRISTOBAL-AZKARATE, University of Cambridge ; Brenda SOLORZANO, National Autonomous University of Mexico ; Samuel WASSER, University of Washington

Mexico's Isthmus of Tehuantepec is a critical bridge between Central and North American populations of jaguar (*Panthera onca*) and puma (*Puma concolor*). The goal of our study is to develop species-specific landscape connectivity models of southern Mexico as tools for conservation. We collected 126 putative felid scat samples in the Uxpanapa valley of Veracruz, Mexico with the aid of wildlife detection dogs. Of those, 56 samples contained sufficient quality DNA for species confirmation based on mtDNA sequences (28 jaguar locations, 8 puma, 20 small felid). Resource selection probability functions (RSPFs) were fit using scat locations as used sites and generated points within the surveyed track zone as available sites. Here, we focus on the consideration of geographic scale when evaluating covariates, such as terrain ruggedness or road density, for building RSPF models along with the consequences of scale-selection on downstream construction of connectivity models of the Uxpanapa valley.

USING ECO-EVOLUTIONARY INDIVIDUAL-BASED MODELS TO INVESTIGATE SPATIALLY-DEPENDENT PROCESSES IN CONSERVATION GENETICS

Jennifer Day

University of Washington

Nathan SCHUMAKER, US Environmental Protection Agency

Eco-evolutionary individual-based models (IBMs) are powerful new forecasting tools for exploring management strategies for climate change and other dynamic disturbance regimes. Additionally, eco-evo IBMs are useful for investigating

theoretical feedbacks between evolutionary dynamics and wildlife population dynamics. We designed a series of theoretical simulation models within the software platform HexSim, to investigate how spatial landscape pattern influence eco-evo processes relevant to conservation. Our simulation uses a changing landscape to drive changes in isolation by distance (IBD), drift, migration, and selection, incorporating both demographic and genetic metrics to track eco-evolutionary responses. Our series of simulations addresses the following questions: 1. In well-connected landscapes exhibiting little genetic drift, how does isolation by distance (IBD) affect inferences of genetic structure? 2. In disconnected landscapes, how does drift interact with IBD, and thus affect inferences of genetic structure? 3. In poorly-connected landscapes, how effective is dispersal at homogenizing population structure resulting from both IBD and drift? 4. In poorly-connected landscapes, how does dispersal ability influence genetic structure when populations are subjected to IBD, drift, and selective pressure? We demonstrate how the results of our simulations lay the groundwork for applying eco-evo spatial IBMs to specific conservation applications with a simulation investigating jaguar habitat connectivity and landscape genetics in southern Mexico.

LIGHT POLLUTION AND BATS: IS IT TIME TO SWITCH OFF THE LIGHTS?

Julie Day

University of Exeter

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Artificial nighttime lighting is a growing conservation concern, affecting many groups of organisms. Most bats are nocturnal and so particularly vulnerable to light pollution. A proposed mitigation option to reduce negative environmental impacts of street lighting is to reduce exposures by switching off streetlights for part of the night. These schemes often retain lighting during the hours of most human activity. We assessed the potential benefits of part-night lighting on a photophobic bat species, *Rhinolophus ferrumequinum* and explored the extent to which periods of peak bat activity in roadside environments close to roosts coincided with the proposed switch-off times for streetlights. Following this we then monitored the activity of multiple bat species activity at seventeen sites before and after the implementation of part-night lighting. For *R. ferrumequinum*, a large primary peak in activity was observed one hour after sunset with a smaller secondary peak before sunrise. Due to the large proportion of activity early in the night, we conclude that the potential for part-night lighting schemes to benefit this species is very limited. In our observational study of part-night lighting,



switching off the lights after 2am affected species composition and abundance to varying degrees, depending on habitat. Sites with poor habitat showed little increase in bat activity when streetlights were switched off, whilst sites with better quality habitat saw increases in bat activity and species diversity. Part-night lighting may therefore provide some benefits for bats in certain environments.

NEW PROSPECTS FOR STANDARDIZED MICROSATELLITE GENOTYPING USING HIGH THROUGHPUT SEQUENCING

Marta De Barba

Univ. Joseph Fourier

Christian MIQUEL, Univ. Joseph Fourier ; Stephan LOBREAUX, Univ. Joseph Fourier ; Frederic BOYER, Univ. Joseph Fourier ; Jon SWENSON, Norwegian University of Life Sciences ; Pierre TABERLET, Univ. Joseph Fourier

Individual identification based on microsatellite genotyping using DNA extracted from biological samples has played a major role in wildlife research during the past 20 years. Molecular individual identification has been the basis for demographic, genetic, and ecological studies of wild animals, including applications for population estimation and monitoring, movement tracking, pedigree reconstruction, assessing genetic diversity, structure and gene flow, and forensics. This information contributed to increase knowledge of species biology and has been key for conservation. Currently, microsatellites are genotyped by scoring alleles on electropherograms resulting from running PCR products on a capillary sequencer. However, this method poses limitations on the number of samples that can be run in parallel and for complete automation and standardization of the genotyping process. We present a new genotyping approach based on the use of high throughput sequencing (HTS). With this method, multilocus genotypes are scored by analyzing directly the sequence of the alleles. This feature provides greater accuracy of allele determination because alleles are unambiguously identified by their sequences. This will also permit to easily share genotype data generated in different labs without need of calibrating allele sizes, which will represent an important advantage for effective monitoring of populations across countries and the creation of transboundary databases. In addition, due to the ability of HTS to produce huge amount of sequence data, large sample sizes could be processed for many markers in parallel, allowing to reduce time and costs of large scale projects and analyses requiring a greater number of loci than just for individual identification. We will present the technical basis of the method and discuss aspects of its implementation in comparison to the traditional method. In addition, we will provide results of its application for genotyping wild carnivore samples.

“HOTSPOTS” TO “REDDSPOTS”: OPTIMISING CARBON, JAGUARS AND BIODIVERSITY CONSERVATION

Alan Eduardo De Barros

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A major question in global environmental policy is whether schemes to reduce carbon pollution through forest management, such as Reducing Emissions from Deforestation and Degradation (REDD+), can deliver co-benefits for biodiversity conservation in tropical countries. Here, we identify municipalities in Brazil that are priorities for reducing rates of deforestation and thus preserving carbon stocks, while simultaneously being conservation targets for the endangered jaguar, *Panthera onca*, and wider biodiversity. We used a multi-criteria decision analysis to identify municipalities that offered the best opportunities for co-benefits under a range of scenarios for varying rates of deforestation and carbon values. These areas were then further refined on the basis of their representativeness of the country as a whole (on measures such as percent forest cover), and an indirect measure of cost (number of municipalities). The areas that are identified as offering optimal co-benefits are termed “REDDspots” and their spatial distribution is compared with that of current and proposed REDD projects. We conclude that REDD+ strategies could be an efficient tool for biodiversity conservation in key locations, especially in Amazonian and Atlantic Forest biomes.

CONSTRUCTING BAT HOUSES MATCHING THE THERMAL CHARACTERISTICS OF NATURAL ROOSTS IN TREE CAVITIES

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The availability of suitable roost sites is essential for the survival of bats. Roosts are used for mating, hibernation, and rearing the young; they offer protection from adverse weather and predators. Selection of specific roost sites by breeding female bats has consequences for survival and reproductive success. Tree cavities are scarce in most intensively managed Western European forests. In the past, several attempts were made to provide forest dwelling bats with alternative roosts with variable results. In general, these experiments failed to



attract reproduction colonies of typical tree cavity-dwelling bats, which seriously limits the potential of bat houses as a mitigation measure. Previous research yielded that the internal temperature regime of tree cavities, previously used by bats, are seriously buffered compared to external temperature and temperature peaks inside the cavity show a 6 to 8 hours delay compared to the external peaks. Slight differences in wall thickness had significant influence on the internal temperatures. Therefore, the influence of wall thickness, external color and material (wood or woodcrete) used on the thermal characteristics of bat houses was further investigated. The objective of this project was to investigate the relationships between wall thickness, material used and internal temperature regimes of artificial bat roosts. Based on those relationships, a type of bat house is suggested that approaches the thermal characteristics of natural tree cavities, but combines ease of manufacture, ease of control and relatively low cost.

JAGUARS IN THE GREATER LACANDONA ECOSYSTEM, MEXICO: CONSERVATION STRATEGY AND LONG TERM MONITORING.

Antonio De La Torre

National Autonomous University of Mexico
*Valeria TOWNS, National Autonomous University of Mexico ;
Rodrigo MEDELLIN, National Autonomous University of Mexico*

The Greater Lacandona Ecosystem is the last remnant of tropical rainforest in Mexico. This region, together with Calakmul in Campeche and the Peten in Guatemala and Belize, represents the greatest portion of tropical forest in Central America (The Mayan Forest). In this region inhabits the second biggest population of jaguars (*Panthera onca*) in the continent. Jaguar conservation in Mexico faces great difficulties because natural resources in the country are rapidly deteriorating. This is why a great effort in monitoring wildlife populations along with maintaining connectivity inside the country and between borders must be done. We have been studying the jaguar population in the Grater Lacandona Ecosystem, since 2007. By using camera traps and telemetry techniques, we have estimated jaguar population densities, home ranges sizes and occurrence patterns. Besides, after seven years of monitoring, we have been able to understand behavioural aspects and life history traits that give us a deeper insight into jaguar ecology. By now, we have identified that the northern portion of the Greater Lacandona Ecosystem, is a critical area to maintain the population connectivity between Mexico and Guatemala. Therefore, we are strengthening together with local authorities, academic institutions, government agencies and national and international NGO's; a collaborative strategy for the conservation and management of jaguars and its habitat. As part of this initiative, local inhabitants and students are becoming part of the monitoring program of the species and

will take advantages of this results by using the information for the management and environmental services payment, eco-tourism and environmental education activities. Our main goal is to generate information enough to improve jaguar conservation initiatives and to minimise the human causes that are threatening their survival.

ASSESSING THE SUSTAINABILITY OF WILDLIFE HARVESTING: COMMERCIAL AND SUBSISTENCE HUNTING OF ENDEMIC PIGEONS IN THE TROPICAL ISLAND OF SÃO TOMÉ

Ricardo De Lima

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The harvest of wildlife for human consumption threatens species and may disrupt ecosystem functioning. Determining the sustainability of wildlife harvest is therefore paramount to defining conservation strategies, but it is also notoriously difficult to achieve because sustainability models require data that is hard to obtain. Here, we assess the sustainability of hunting of four endemic pigeon species in the tropical island of São Tomé (Democratic Republic of São Tomé and Príncipe, central Africa). For each species, we estimated population size using distance sampling along transects, and obtained extraction data from interviews to commercial hunters, who supply urban areas, and to rural inhabitants, who practice subsistence hunting. To assess the sustainability of hunting, we applied these data to three commonly used sustainability models. Our results indicated that the endangered Maroon pigeon *Columba thomensis*, and the vulnerable São Tomé green pigeon *Treron sanctithomae* are harvested unsustainably, while the São Tomé lemon dove *Columba simplex* and bronze-naped pigeon *Columba malherbii* are within safe hunting boundaries. The relative contribution made by subsistence and commercial hunting to total extraction varies markedly between species. This study is an important contribution to guide the conservation of São Tomé's endemic pigeons, which are key species to ensure the long-term functioning of the island's forest ecosystems. Because the endemic pigeons of São Tomé differ in their ecological requirements and are subject to varying hunting pressure, they offer an interesting system to test the performance of different sustainability models. Therefore, we also hope to revive the debate around the need for testing and creating better sustainability models.



RECOMMENDATIONS FOR PROMOTING BIODIVERSITY IN EXTENSIVELY MANAGED MEADOWS: EVALUATING MOWING REGIMES IN A FIELD SCALE EXPERIMENT

Davide De Masi

University of Bern

Jean-Yves HUMBERT, University of Bern ; Raphaël ARLETTAZ, University of Bern

In the latter half of the 20th century, mixed-used farming gave way to highly intensive forms of agricultural production in the developed world in order to increase production efficiency and yield. Semi-natural grasslands are becoming less and less common in agricultural regions in Europe and North America. Consequently, many species that were able to tolerate more traditional farming practices have become endangered or extinct. Mowing is an agricultural practice to collect grass and hay and is thought to affect biodiversity by altering habitat heterogeneity and temporal resource availability. To understand the effects of mowing on biodiversity, we investigated the effects of four different mowing regimes on plant and insect biodiversity: (1) control meadow with first cut not before 15 June; (2) delayed meadow (first cut not before 15 July); (3) eight weeks, (first cut not before 15 June and second cut not earlier than 8 weeks from the first cut); (4) refuge meadow, first cut not before 15 June but 10-20% of the meadow area is left uncut. Data on orthopterans, plants, wild bees and butterflies were collected 1-4 years after the implementation of the mowing regime. Positive effects on orthopterans were found in delayed (species density) and refuge (species density and richness) meadows and on pollinators as well as butterflies in refuge treatments. Preliminary results after four years suggest an altered plant community biodiversity as well as an increase in parasitoid wasps in delayed meadows. These results suggest that modified mowing regimes can drastically alter overall biodiversity on a timescale of just a few years and can have important implications for grassland restoration efforts and conservation. We therefore develop a precise set of recommendations based on our experimental evidence to promote grassland biodiversity in specific case study in mid-elevation prairies of the Western United States.

ARTIFICIAL SALINES AS ALTERNATIVE HABITATS FOR SHOREBIRD CONSERVATION IN THE NORTHEASTERN BRAZIL

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Shorebird populations have declined around the world primarily due to the loss and conversion of natural habitats. The identification of anthropic alternative habitats that ensures essential resources is currently a key conservation strategy for this animal group. This study presents for the first time data on the use of alternative habitats for shorebirds in one of the largest saline wetland complex in the northeastern Brazil: the Apodi-Mossoró estuary. This estuary was originally characterized by mangrove associated with natural hypersaline supratidal flats and today it is completely fragmented and converted primarily to artificial salt ponds by the salt industry. We have performed bird counts fortnightly from August 2012 to December 2014 on a ~35ha area, covering approximately 10% of the estuary. For each bird registered, we identified the species, the behavioral state and the microhabitat where it was registered. A total of approximately 17,400 birds of 18 species of Charadriiformes were registered, with 68.1% of those records belonging to Nearctic migratory species. In relation to habitat use, 87.3% of the records were in salt evaporation ponds, 8.6% in pumping ponds and 4.1% in salt crystallization ponds. The behavioral state more frequently were foraging (75.1% of the registers) and resting (20.6%). In addition to these results, we registered during the censuses a colony of reproduction of *Himantopus mexicanus* (Recurvirostridae) in salt evaporation ponds between May and August of 2013 and 2014. We registered a total of 35 nests in 2013 and 41 nests in 2014. The nest predation rate in 2013 was 74% and in 2014 was 41%. Domestic dogs footprints were found near the predated nests. The results of this study show that salines represent alternative habitats for shorebirds in Apodi-Mossoró estuary. Salines of the northeastern Brazil should prioritize the conservation and management of evaporation ponds to ensure food, resting and breeding opportunities to shorebirds.

INVESTIGATING THE FLORAL PREFERENCES OF POLLINATING INSECTS USING POLLEN DNA METABARCODING

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Insect pollination is a key regulating ecosystem service so there is considerable concern worldwide about declines in both wild pollinators and honeybees due to habitat loss, agricultural intensification, pests and disease and climate



change. Understanding the reasons for declines and providing conservation guidance requires detailed information on the habitat requirements and foraging preferences of pollinating insects. DNA metabarcoding of pollen collected by insects provides a powerful method for tracking floral visitation. Pollen can be retrieved from the bodies of insects, or from pollen loads or honey from honeybees. DNA is extracted and amplified using the *rbcL* and *ITS2* DNA barcode markers. Resulting amplicons are sequenced using the Illumina MiSeq platform and identified by matching them to GenBank. Key to ability to identify unknown DNA samples is a comprehensive DNA barcode reference library. We have DNA barcoded all of the native flowering plants of the UK (1479 species) along with non-native, horticultural and agricultural plants likely to be important for pollinators. Here we present three case studies that illustrate the use of pollen DNA metabarcoding.

1: Pollen loads and honey samples have been collected from six hives situated within the National Botanic Garden of Wales and Waun Las National Nature Reserve. The vegetation of the botanic garden and nature reserve has been mapped so that honeybee foraging can be shown in a spatially explicit way. The importance of different plant taxonomic groups and relative use of native versus non-native flora is being investigated.

2: Honey samples have been collected from beekeepers throughout the UK to investigate the floral range of honeybees in different geographic areas.

3: Hoverflies of the genera *Eristalis*, *Sericomyia*, *Rhingia*, and *Cheilosia* have been sampled from four *Cirsio-Molinietum* grasslands of varying plant species diversity. Floral constancy will be compared across individuals, species and sites.

GENETIC AND ECOLOGICAL STUDIES ON THE COASTAL PLANT *MALCOLMIA LITTOREA* (L.) R. BR. (BRASSICACEAE) ACROSS EUROPE: IDENTIFICATION OF PRIORITIES FOR ITS CONSERVATION

Marcello De Vitis

Tuscia University
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Malcolmia littorea is a plant which occurs on the coasts of Portugal, Spain, France, Italy, Algeria and Morocco. The continuous fragmentation and degradation of the coastal dunes are threatening the persistence of this species, reducing the abundance of its populations together with their genetic variability. In the present study, results of both genetic and

ecophysiological analysis, conducted on a set of European populations, are discussed. In particular, five chloroplast and four nuclear microsatellite loci were analysed and the genetic parameters were estimated and compared. The genetic structure of the species was also investigated, and a spatial analysis was performed. An ecophysiological study on seed germination was conducted, incubating the seeds of the several populations at eight constant temperatures (0-27°C). Then, germination data were compared among populations and tested for correlation with independent variables like population's area of occupancy, latitude and climatic variables, to understand which are the driving forces of differences in germination responses. From the genetic standpoint, it was not detected any significant difference among populations in the within-population genetic diversity, even if they showed significant ($P < 0.05$) differentiation values of Φ_{PT} (chloroplast) and *FST* (nuclear), forming two main gene pools. Based on the allelic composition and richness, three populations were identified as priority conservation spots. Two of them occur in very small areas ($AOO < 0.1$ ha) and showed the lowest germination percentages. The study on seed ecology revealed that the AOO was highly correlated to the germination percentage, indicating a reduced vigour in small populations. The results of this study provide useful information for the development of a conservation strategy for *M. littorea* in Europe, identifying specific populations with high conservation priority.

CULTURAL MONUMENTS AND NATURE CONSERVATION: THE ROLE OF KURGANS IN MAINTAINING STEPPE VEGETATION

Balázs Deák

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Steppe is among the most endangered biome in the world. Steppes have been destroyed in the last centuries due to agricultural intensification and afforestation. Nowadays steppe vegetation is often restricted to small fragments generally inadequate for arable farming like ancient soil monuments of the steppe region called 'kurgans'. We collected existing



knowledge on kurgans, focusing on their distribution, vegetation and threatening factors, and to highlight the necessity of their effective protection. Despite their small size (generally up to a few hectares) kurgans are characterised by a high microhabitat diversity and play a crucial role in preserving steppe vegetation, especially in intensively managed agricultural landscapes. Kurgans hold endangered desert-, grass-, herb-grass- and forest steppe habitats. They harbour red listed species such as *Adonis vernalis*, *Amygdalus nana*, *Echium russicum* and *Tulipa schrenkii* which are extinct in the surrounding areas. Kurgans represent a unique nature conservation and historical value, but their protection is not guaranteed in most regions. According to our estimations 250,000 kurgans remained in the whole steppe and forest steppe zone, which is only 20% of their original number. Kurgans are essential for maintaining landscape-scale habitat- and species diversity, and can act as stepping stones and potential core areas for habitat restoration projects.

185- BIODIVERSITY AND ECOSYSTEM SERVICES: HOW DOES BETTER INFORMATION AFFECT MANAGEMENT DECISIONS AND VALUE?

Laura Dee

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The 'new conservation' focuses increasingly on managing nature explicitly for ecosystem services that provide benefits to humans, rather than for its intrinsic value. Though often debated, the consequences of conserving ecosystems for their services rather than for the explicit goal of biodiversity protection are not clear. Biodiversity is thought to be essential to ecosystem services at some level, but the number and identity of species that must be protected to secure services remain unresolved. Further, this uncertainty is only compounded by global change and market dynamics. These sources of uncertainty are crucial both to managers optimizing service value and the resulting consequences for biodiversity protection. Recent theory (Dee et al) and the precautionary principle suggest that uncertainty over how biodiversity produces services can provide an economic incentive to protect more species than are presumed directly critical to a service. However, resolving such uncertainty, such as via investments in scientific research, can improve knowledge about which species are critical or which species will be lost given a particular management choice. We ask: how valuable would such reduced uncertainty be to ecosystem service objectives? How could reducing uncertainty alter biodiversity outcomes that result from managing solely for services? We use dynamic programming techniques to compute the value

of several types of information and to understand the impact that the reduction of uncertainty has on optimal management choices. The results shed light on potential tensions between managing for ecosystem services and conserving biodiversity and may help inform and prioritize monitoring efforts and management of ecosystems.

(ID 64 CONSERVATION 3.0) ACCELERATING THE SPEED, SCALE & IMPACT OF CONSERVATION SOLUTIONS THROUGH INNOVATION

Alex Dehgan

Conservation X Labs & Duke University

The current extinction crisis, which will become worse as emerging middle classes around the world put exponential new demands on natural systems. This requires us to dramatically increase the speed, scale, efficacy of our understanding of the rate and scale of the environmental changes under way and our ability to engineer new solutions to address these threats. The existing research infrastructure and set of conservation tools we are increasingly insufficient to match the speed at which these pathogens emerge, and the risks they pose. However, the democratization of science and technology, exponential increases in global connectivity, new low cost technologies like arduino sensors, nanosatellites, and drones, and greater availability of data has provided us a new set of tools and approaches that reveal the state of the world in unprecedented detail to improve the knowledge about species status and prognosis, and, second, operationalize that data to improve global conservation efforts, including generating new solutions. The most critical innovation however, has been through the ability of harnessing the power of the crowd through open source approaches for collection, analysis, and funding of data and research. This movement towards open source or networked includes approaches such as prizes and challenges, hackathons, citizen science and gamification of science, and crowdfunding and crowdsourcing. This approach is useful where the distribution of the species or the scale of the change is large (continental scale sensing) or changing, such as for studies of macro-ecology, biogeography or climate change, or where there is a need for rapid assessment or collection of data, such as a response to an environmental emergency, could not be financially feasible otherwise. Finally, open source conservation serves to not only revolutionize conservation, but to bring the public into science.

(ID 64 CONSERVATION 3.0) CONSERVATION FINANCE: RETHINKING HOW WE FUND CONSERVATION

Alex Dehgan

Conservation X Labs & Duke University



John TOBIN-DE LA PUENTE, *Credit Suisse*

To preserve the health of natural ecosystems, a significantly larger amount of capital investment is required than the sums currently being allocated to conservation. Private sector investment is needed, not to replace but to supplement traditional sources of conservation capital such as public funding or philanthropy, which have been impacted by the global economic downturn. Against this backdrop, Credit Suisse, WWF and McKinsey joined forces in the area of conservation finance to identify the conditions needed to attract and redirect private capital toward conservation. Our research has shown that there are many unexploited private sector investment opportunities to increase conservation finance and deliver maximum conservation impacts while, at the same time, generating returns for investors.

(ID 64: CONSERVATION 3.0) THE ART OF THE WILD: THINKING ABOUT MESSAGING IN CONSERVATION

Alex Dehgan

Conservation X Labs & Duke University

Asher JAY, *National Geographic*

The consumer demand for wildlife products, exotic meats and pets to produce snake oil cures for human ailments and assert status, and individuality for the elite have created profit markets that bank on extinctions in the Anthropocene. This has resulted in a global market place that illegally capitalizes on the exploitation of our planet's finite natural resources to cater the myopic vested interests of a few at the cost of many. More recently, this demand has trebled with a rise in the purchasing power of a burgeoning middle class, which has implied the inevitable demise of various species, unless public education seeds shifts in cultural consciousness. In the digital age, where public engagement in global concerns that affect collective welfare is incited by pithy sound-bytes that are 140 characters or less, it is vital not only to condense and collate data sets but translate them into a vernacular that is familiar to the masses. Unless academic research is made accessible to the layperson in simple, mainstream vocabulary, the long-term conservation of wildlife and wilderness areas will remain a marginalized interest of an exclusive community. The work I produce bridges the hiatus between science and storytelling, it utilizes advertising and marketing tactics to galvanize community involvement.

MATRIX INTENSIFICATION AFFECTS BODY AND PHYSIOLOGICAL CONDITION OF TROPICAL FOREST-DEPENDENT PASSERINES

Justus Deikumah

University of Cape Coast

Matrix land-use intensification is a relatively recent and novel landscape change that can have important influences on the biota within adjacent remnant habitats. Anthropogenically-mediated chronic stress from the effects of high-intensity land use could affect individuals in nearby remnants, leading ultimately to population declines. We investigated how physiological indicators and body condition measures of tropical forest-dependent birds differ between native remnants adjacent to surface mining sites and those near farmlands at two distances from remnant edge in southwest Ghana. We used mixed effects models of several condition indices including residual body mass and heterophil to lymphocyte (H/L) ratios (an indicator of elevated chronic stress) to explore the effect of landscape change and matrix intensification on two contrasting categories of tropical forest-dependent passerines (sedentary area-sensitive habitat specialists vs. nomadic highly mobile generalists). Individual birds occupying tropical forest remnants near surface mining sites were in poorer condition, as indicated by lower residual body mass and elevated chronic stress, compared to those in remnants near agricultural lands. The condition of the sedentary forest habitat specialists *Alethe diademata* and *Cyanomitra obscura* was most negatively affected by high-intensity surface mining land-use adjacent to remnants, whereas generalist species were not affected. The carrying capacity of a landscape is likely to be affected not only by habitat extent, but also by the hospitability of the matrix, which is in turn influenced by intensity of land use. Land use intensification may set in train a new trajectory of faunal relaxation beyond that expected based on habitat loss alone. Patterns of individual condition may be useful in identifying habitats where species population declines may occur before faunal relaxation has concluded.

MAPPING ECOSYSTEM GOODS AND SERVICES TO INFORM CORAL REEF ECOSYSTEM-BASED MANAGEMENT IN MAUI NUI, HAWAII

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University of Hawai'i at Manoa

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Coral reefs provide diverse goods and services critical to human wellbeing. In Hawaii, direct human activities and climate change threaten coral reefs. Observed declines in



reef state jeopardize the delivery of these critical goods and services. To support policy-making, we are constructing a decision support tool linking coral reef ecological properties to ecosystem service provisioning. We used remote sensing and spatial predictive modeling techniques to map the current ecological properties of Maui Nui (Maui, Molokai, Lanai) coral reefs. We adapted ecological production functions to convert ecological properties into ecosystem services metrics. More specifically, those functions quantify the potential supply of three types of reef services: reef health (supporting), seafood supply (provisioning), and biocultural resource abundance (cultural). We linked those functions to a spatially explicit dynamic ecological coral reef model (Coral Reef Scenario Evaluation Tool – CORSET) to create a scenario-based decision support tool. The tool can model the impact of alternative land and marine management scenarios on reef services delivery, enabling trade-offs and opportunities assessment in service delivery. Preliminary results include identifying key ecological attributes that make up important reef services and then spatially characterizing and estimating potential supply of those services. Our results can inform the shift towards spatial planning and ecosystem-based management of coral reefs by identifying areas to optimize management, and/or identify locations where potential conflicts may arise. By employing an ecosystem services approach, our results express management targets in ecological terms, while being grounded in the local socio-cultural context relevant to the policy realm. This place-based approach can promote adaptive management by accounting for critical linkages and feedbacks connecting people and reefs.

210-NEVER A ROAD HAS GONE: NORTH AMERICA ROADLESS AREAS AS “NO GO” ZONES

Dominick Dellasala
Geos Institute

Roadless areas play a pivotal role in preparing large landscapes for climate change. In the USA, the Roadless Conservation Rule protected >23 million ha of inventoried roadless areas (IRAs >2,000 ha) that may provide refugia for climate-forced wildlife migrations, are a buffer against weed invasions, and contain carbon-dense ecosystems important to climate stabilization. IRAs also are source areas for municipalities that treat and distribute drinking water; the cost-savings to water treatment plants and highway departments from avoiding sedimentation caused by logging and road building is estimated at ~ \$18 billion annually. IRAs also provide \$490 million annually in waste treatment, services that will only increase in value as climate change triggers regional droughts. Although there is no national roadless policy in Canada, an inventory of intact areas by Global Forest Watch-Canada shows them concentrated in boreal and coastal rainforests. Canada's boreal region, in

particular, contains one-quarter of the world's wetlands, more surface water than any other continental-scale landscape, and stores an estimated 147 billion tonnes of carbon, equivalent to >25 years of current emissions. Road building and development compound stressors to ecosystems already dealing with accelerated climate change and degradation of critical ecosystem services. Climate change policies need to treat roadless areas as “no go” zones for industrial activities, especially new roads.

NON-TARGET MORTALITY OF ENDEMIC LESSER SHORT-TAILED BATS FROM TOXIC BAITING TO CONTROL EXOTIC MAMMALS IN A NEW ZEALAND CONSERVATION RESERVE

Gillian Dennis

Massey University

Brett GARTRELL, Massey University; Doug ARMSTRONG, Massey University; Colin O'DONNELL, Department of Conservation; Alastair ROBERTSON, Massey University

The use of toxic baits to control introduced mammals is essential for wildlife conservation in New Zealand, but also involves risks to non-target species, including the lesser short-tailed bat (*Mystacina tuberculata*). Due to its terrestrial foraging behaviour and broad diet this species has been considered at risk of primary or secondary poisoning. In 2009, 115 lesser short-tailed bats were found dead during a rodent control operation in Pureora Forest Park. Post-mortem examination of bats confirmed poisoning with the anticoagulant rodenticide diphacinone. This was the first recorded non-target mass mortality of this species. To determine the route of exposure of the bats to diphacinone, we used infra-red cameras to record whether bats consumed similar non-toxic bait in captive and wild settings, and to record whether bait was consumed in the wild by arthropods known to be prey items for the bats. Our results suggest that the bats are more at risk through secondary ingestion of toxicants via arthropod consumption than through direct ingestion of bait. Adjustments to bait presentation and delivery in bat habitat did not completely prevent exposure of wild bats, as revealed by detection of diphacinone in guano, but there were no obvious mortalities. To determine the effect of this level of exposure on wild bats we assessed population survival and physiological measures of fitness in individuals before, during and after a rodent control operation using the modified baiting practices. Our results suggest that exposure of bats to diphacinone was sub-clinical. However, while the pathway of secondary poisoning remains intact we propose that the risk of adverse affects on bats could vary annually depending on the abundance of certain arthropod populations and prey switching by the bats. We recommend further review of toxicant choice and bait delivery methods in lesser short-tailed bat habitat.



**DISENTANGLING THE RATIONALE OF
DEFORESTATION TO UNDERSTAND BETTER THE
PARTIAL EFFECTIVENESS OF PROTECTED AREAS.
A CASE STUDY FOR MADAGASCAR'S EASTERN
RAINFOREST CORRIDOR (2001-12)**

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Madagascar's notoriously high level of biodiversity is currently threatened by deforestation. Protected Areas (hereafter "PAs") remain until now the central instrument to protect it whilst little is known about their environmental effectiveness in the country. With a matching approach in a quasi-natural experiment setting, we demonstrate for the entire island's rainforest that PAs' additionality has been limited from 2001 to 2012. PAs have made it possible for deforestation to be stabilized in a trend and has restricted the upsurge of deforestation resulting from the country's late political instability. Nonetheless, post-matching analyzes reveal that PAs have only contained some of the causes of deforestation. Effectively stopping the latter will require further ambitious policies to trigger the necessary agricultural transition for the country.

**THE GENETIC DIVERSITY AND SPATIAL GENETIC
STRUCTURE OF THE FERULA COMMUNIS COMPLEX
(APIACEAE) IN THE TYRRHENIAN AREA.**

Caterina Angela Dettori

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The giant fennel is a circum-Mediterranean complex characterized by a great morphological variability and comprising several species and subspecies. The focus of our work is on the taxa inhabiting the Tyrrhenian islands and coasts, namely *Ferula arrigonii* Bocchieri, a Corso-Sardinian endemic located in a few coastal sites and on small islands, *F. tunetana* Pomel ex Batt., endemic to Tunisia, and the widespread *F. communis* s.l. AFLP markers and a population genetic approach were used to investigate these taxa, with the following main aims: i) gaining insight into the patterns of molecular variation of the *F. communis* complex in the Tyrrhenian area and verifying how they are related with geographic boundaries and the current taxonomic treatments; ii) assessing the species-wide spatial genetic

structure and diversity of the previously unstudied endemic *F. arrigonii* and provide suggestions for its conservation; and iii) comparing levels of genetic diversity between *F. arrigonii* and its widespread congener *F. communis*. Results indicate that the *F. communis* complex constitutes a relatively heterogeneous group whose genetic structure is organized in multiple hierarchical levels and is only partially coherent with the geographic provenance of the populations, previous findings and current taxonomic treatments. All the investigated populations are characterized by high levels of genetic diversity, with no significant differences between *F. communis* and *F. arrigonii*. Three genetically distinct groups were detected within this latter taxon, although with considerable overlap between populations. Our data therefore suggests that in situ actions are not urgently needed for this species, and that a geographic criterion aimed at conserving it in its whole distributional range should be adopted when planning germplasm collections for long-term ex situ conservation.

**CONSERVATION OF GENTIANA LUTEA L.
(GENTIANACEAE) IN SARDINIA THROUGH A
MULTIDISCIPLINARY APPROACH.**

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Gentiana lutea L. s.l. (Gentianaceae) is an orophyte plant which occurs in Southern European mountains. It has a long-standing history of human exploitation, mainly for liqueurs preparation and in the pharmaceutical industry and it is currently listed in the EU Habitat Directive 92/43/EEC Annex V. Its distribution range in Sardinia consists of only a few groups of individuals limited to small areas of the Gennargentu massif (Central-Eastern part of the island). A conservation project is being carried out at the CCB (Centre for the Conservation of Biodiversity) with the aims of assessing the conservation status of this taxon and actively plan and carry out subsequent ex situ and in situ conservation measures, with a particular focus on its possible reintroduction in areas where it has gone extinct. A multidisciplinary approach is being undertaken, which involves the following activities: i) assessment of the



actual distribution range of the taxon in Sardinia through the analysis of the available historical data, environmental modelling and extensive field surveys; ii) in situ studies, including the investigation of the species' phenology and reproductive biology, the analysis of the demographic trends and the identification of the main threatening factors; iii) implementation of the existing ex situ conservation measures, investigation of the requirements for seed germination by testing different protocols and environmental factors, and comparison with the optimal germination conditions in the field; and iv) population genetic analyses using AFLP markers to investigate the genetic diversity at both the intra- and inter-population levels and the spatial genetic structure. We hereby present the preliminary results of the project and the utility of our integrative approach for the conservation of this plant. This research is supported by the Regione Autonoma della Sardegna (Rep. 27512-91 del 9-XII-2013 RAS).

MITOCHONDRIAL DNA-BASED IDENTIFICATION OF FRESHWATER EELS OF NORTHEAST INDIA

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Freshwater habitats provide the occurrence of various species of freshwater eels – a fish with an elongated snake like structure. Populations of these eel species are declining due to loss of habitat, overfishing, barriers to migration, pollution and changes to water currents. A Mitochondrial DNA-based system for the identification of eel species found in Northeast India has been established in the present study based on the following criteria: adequate molecular variation, comprehensive specimen sampling, explicit morphological species identification and phylogenetic analysis. Nucleotide sequence analysis of mitochondrial COI gene and D-loop region of seven eel shaped fishes belonging to three families Synbranchidae (*Monopterusuchia* and *Monopterus albus*), Anguillidae (*Anguilla bengalensis*) and Mastacembelidae (*Mastacembelus armatus*, *Macrogathus pancalus*, *Macrogathus aral*, *Macrogathus aculeatus*) have been performed in the present study. The study provides a comparative account of the taxonomic differences among the eel like species of freshwater habitats in Northeast India. Several interesting differences between *M. albus* and *M. cuchia* at molecular level have been established, which clarifies their genetic distinctness rather than species complex as suggested by earlier conventional morphometric studies. **Key words:** eels, molecular, morphology, phylogeny

116. WHERE ARE WE? 15 YEARS OF BAD AND GOOD NEWS IN CONSERVATION SCIENCE

Vincent Devictor

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Conservation science is a mission discipline meant to produce knowledge on the fate of biodiversity and relevant guidelines for action to halt the biodiversity crisis. But what kind of knowledge and what kind of actions is actually produced? To what extent conservationists document warnings and hopes? Do we read any signs of improvement or degradation in the fate of nature from conservationists themselves? Here, we explored all papers (~13,000) published in conservation journals during the last 15 years to assess the distribution of studies documenting effective and potential improvement or degradation in the status of species and habitats. We show that, surprisingly, only few papers propose concrete assessments and conservation implications. Among those papers with concrete results on the fate of biodiversity, we identify a majority of bad or potential bad news. However many papers also reflect that many conservation actions have actually worked and that a considerable useful knowledge is available to improve many situations. We further reveal how the distribution of bad and good news has changed through time, among countries and taxonomic groups. Overall, this study suggests that before choosing new paths for conservation we should better understand what has already been accomplished in this discipline.

APPLYING AN INTEGRATIVE MODEL OF BEHAVIOR CHANGE TO IMPROVE GLOBAL CONSERVATION OUTCOMES

Amielle Dewan

IFAW

Kevin GREEN, RARE ; Brian CRAWFORD, UNIVERSITY OF GEORGIA

Recent studies predict that current species extinction rates are 100 to 1,000 times pre-human background rates, and some species have lost over 50 percent of their historic range. This rapidly increasing rate of biodiversity and habitat loss is largely the result of human behavior. Scientists and practitioners increasingly agree that achieving conservation outcomes is fundamentally about changing behaviors. Although many initiatives have addressed human behavior-driven threats, particularly through education, little evidence supports their success. The field of public health has recognized the need to move beyond traditional awareness-raising, applying targeted campaigns grounded in theory from the behavioral sciences. The conservation field has made less progress in this direction, but some advances have been made in applying models of human behavior to conservation problems. We evaluated the



impact of 84 such projects that target destructive behaviors such as illegal hunting and overfishing using the same integrative model of behavior change. Across interventions, all behavior change model variables demonstrated significant increases ($p < 0.001$) ranging from 16.1 - 25.0 percentage points. Most importantly, our results demonstrate large overall changes in behavior across interventions (95% confidence interval: 12.1 – 24.0 pp), providing new evidence that interventions that apply this model can be effective for addressing challenging and widespread conservation problems. Based on an unprecedented sample of systematic interventions, our results highlight the importance of integrating behavioral theory into traditional conservation programs. Our study offers hope that applying such a model can be a powerful tool for improving global conservation outcomes.

SYMPOSIA 129 - AN OVERVIEW OF THE OPEN STANDARDS FOR THE PRACTICE OF CONSERVATION

Amielle Dewan

IFAW

Nick SALAFSKY, Foundations of Success

The Open Standards for the Practice of Conservation (OS) synthesizes common concepts of and approaches to good project design, management, and monitoring, to provide a common framework for project cycle management/adaptive management for conservation. Numerous conservation organizations have come together in a collaborative partnership to develop, operationalize, and improve the OS since its development and first release in 2004. In 2014, the community commissioned an evaluation of the extent to which the OS, and the associated partnerships, have strengthened Results Based Management (RBM) in the conservation sector from 2002 - 2013. Results demonstrated widespread adoption of the OS, with 71% of web survey respondents using the OS for program management ($n=231$) with an additional 11.3% using a different RBM approach. The study also suggests that adoption of the OS has led to increased conservation funding, stakeholder participation, effective project management, and investment in learning. Here we provide an overview of Open Standards for the Practice of Conservation, as well as key results and lessons learned from the comprehensive evaluation

WECARE: A LOCAL HUMAN NETWORKING APPROACH TOWARDS BIODIVERSITY CONSERVATION & SUSTAINABLE DEVELOPMENT POST UTTARAKHAND DISASTER

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WeCare-a local approach to global concern, is a platform aimed to conglomerate people from all strata of society towards biodiversity conservation and sustainable development. Still in its preliminary stage, it is an initiative of research scholars of the department conceptualised aftermath tragic Uttarakhand disaster in June 2013. It is foreseen as a vibrant tool to address the issue of conservation by active participation of local mass. In less than a year, we have entwined a network of more than 1500 local people comprising school kids, house wives, farmers, shopkeepers in around 20 villages, who wilfully dedicate whatever little time they can to issues of biodiversity threat & conservation. Their efforts include contributing to biodiversity data-basing of this region through their collected species photos or verbal descriptions, assessment of local population of a species using basic tutorials prepared by our scholars, reporting local threats to us, creating forums & discussion panels at village level, where every one has an equal say and can come up with their own idea of conservation. To our surprise, locals now feel free to unravel the atrocities being committed to nature by catching the real site images, they identify the lacunae in local policies and even suggest ways to rectify them. With time more people are volunteering to form physical groups & coming up with concrete recommendations which could be forwarded to policy makers. This platform is running without any capital investment or government funds, yet it has helped us in strengthening the unexplored species database of the region, in identifying the local threats as well as species population decline due to unplanned anthropogenic activities and was followed up by actual field visits by the scholars and subsequent scientific investigations; however the full credit goes to that reporting commoners.

PLACE VULNERABILITY OF HUMAN ELEPHANT CONFLICT: A CASE OF EASTERN NEPAL

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University of Florida

Nepal's elephant is largely represented by the migrating population that traverses frequently between India and Nepal. Jhapa district of Eastern Nepal borders with the West Bengal of India and lies on the historical route for migrating elephants from Assam, West Bengal to Chitwan, Central Nepal. With the increased human population and decreased habitat, the migratory route has been blocked, and now about 200 elephants are confined within and around the forests of



Mahananda Wildlife Sanctuary in West Bengal. In the crop harvesting season (May-July, and Oct-Dec), these elephants migrate to Eastern Nepal, through Bahundangi village of Jhapa district, every night looking for corn and paddy. In Bahundangi village only, they destroy hundreds of hectares of farmland and harvest ready products worth USD 150 per family. Further, there are human and elephant casualties. Given the problem, the government has failed to develop and implement an effective policy for the region. The complexity of the problem has escalated as there is no protected area in Nepal side, and hence no mechanism for dealing the problem. This study accounts the degree of vulnerability faced by the people in Bahundangi because of elephant attacks. By taking into the account of the place vulnerability, this study identifies the high, medium and least vulnerable areas. Both geographic and social vulnerabilities are taken into account. This is a noble approach of understanding human-wildlife conflict, as there is the lack of studies carried out from the hazard perspectives in the context of Human Wildlife Conflict. We believe such kind of approaches will help the management and policy makers find innovative ways of solving the problem.

BIODIVERSITY LOSS ASSOCIATED WITH OIL PALM PLANTATIONS IN MALAYSIA: SERVING THE NEED VERSUS SAVING THE NATURE

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Oil palm is considered as one of the most important crops for the future in serving the global food and biodiesel needs. Oil palm also serves as the important source for rural employment and plays a major role in poverty alleviation in Malaysia. The increasing need for palm oil has resulted in the rapid expansion of oil palm plantations in the last few decades, which has become the biggest cause for deforestation in Malaysia. The google deforestation map for the year 2000-2012 shows that Malaysia has the highest deforestation rate of all the countries in the world. This research assessed the biodiversity value of oil palm in comparison with primary forests and secondary forests. The biodiversity value of secondary forests are overly underestimated and are readily converted into plantations. Using species richness data of vertebrates and invertebrates from previous publications, this research argues that conversion of either primary or secondary forest to oil palm plantation would adversely affect biodiversity. The oil palm plantations are filled with non-native invasive species or generalist species of low conservation interest. The review results compiling numerous species richness surveys in Malaysia show that there is a 34.9% net reduction in species richness in oil palm compared to forest habitats, and 79.6% of the species found in forest habitats were not found

in oil palm habitats. The primary causes for the reduction of species richness is found to be poor ground vegetation, lack of structural complexity and poor microclimate in oil palm plantations. In order to sustain the biodiversity in Malaysia, It is recommended that future expansion of plantations in primary or secondary forests should be strictly prohibited. It is also recommended that the oil palm management regime should focus on improving the structural complexity and ground vegetation of oil palm plantations.

SETTING CONSERVATION PRIORITIES IN DYNAMIC MIGRATORY NETWORKS

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University of Queensland

Marcel KLAASSEN, Deakin University ; Hugh POSSINGHAM, University of Queensland ; Sam NICOL, CSIRO ; Iadine CHADES, CSIRO ; Richard FULLER, University of Queensland

Many migratory species have been found to alter their migratory pathways as a result of threats at stopover sites. However current conservation plans assume that migratory networks are static and that if stopover sites are lost, migrants will be unable to adapt and will therefore go locally extinct. Here we use a measure of irreplaceability to identify conservation priorities within a migratory network. We create an individual-based model which uses potential connectivity between stopover sites to model population flow through the migratory network. We parameterise this model using satellite tracking data. We show that the portfolio of sites needed to conserve migrants differs markedly if the underlying pattern of migratory connectivity is assumed to be static versus dynamic. We also find that for migratory species usually traveling short distances, the best strategy is to conserve many inter-connected sites. For species making a small number of long distance journeys, the best approach is to conserve a handful of strategically placed stopover sites. Setting priorities for multi-species migratory systems must therefore explore the trade-offs between priority sites for different species, and explicitly decide whether to assume a dynamics migratory network or not.

OPTIMIZING DISTURBANCE MANAGEMENT FOR WILDLIFE PROTECTION

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Karen MUSTIN, University of Queensland ; Hugh POSSINGHAM, University of Queensland ; Richard FULLER, University of Queensland

To ensure public compliance with regulations designed to protect wildlife, many protected areas need to be patrolled. However, there have been few attempts to determine how to deploy enforcement effort to get the best return



on investment. This is particularly complex where species experience spatially heterogeneous threats. Furthermore, repeated enforcement visits may result in diminishing returns on investment and simple quantitative methods to solve such problems are not available to conservation practitioners. We use a decision science approach to find the most cost-effective allocation of patrol effort among sites with a limited budget. We use the case study of declining migratory shorebirds threatened by disturbance in Moreton Bay, Australia, to determine where and when Marine Park personnel could manage for disturbance using two different scenarios: (i) where a fixed subset of sites is chosen for management each year, and (ii) where different sites are visited during each patrol. We show that by prioritizing enforcement based on cost-effectiveness, it is possible to avoid inefficient allocation of resources. Indeed, 90% of the maximum possible benefit can be achieved with only 25% of the total available budget. In addition, visiting a range of enforcement sites at varying rates yields a greater return on investment than visiting only a fixed number of sites. The choice of patrol location and frequency is therefore not a trivial problem, and prudent investment can substantially improve conservation outcomes. Our research demonstrates a simple and objective method of allocating enforcement effort while accounting for diminishing returns on investment over multiple visits to the same sites. Our method is transferable to many other enforcement problems, and provides solutions that are cost-effective and easily communicable to managers.

BIODIVERSITY CONSERVATION OF WILD, ENDEMIC AND MEDICINAL PLANTS OF HIGH ALTITUDE REGION AT MT. EVEREST NATIONAL PARK IN NEPAL

Deepa Dhital

Nepal Academy of Science and Technology (NAST)
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Nepal harbors many globally significant wild, endemic, medicinal and aromatic plant species; hence it is rich in floral biodiversity in the world. The high Himalayan regions of Nepal remain one of the most important storehouses for them, although valuable plants are distributed from low land Terai to high mountains. These plants are at great risk due to various anthropogenic activities, overexploitation for national and international trade, and consequences of prevailing climate change, causing massive loss of biodiversity. The plant biodiversity from Himalayan region are conserved through the seeds in seed bank for their ex-situ conservation. The seeds are being researched not only to understand their future reactions to climate change but also to preserve them from extinction in the long run, hoping that these seeds and their embryos can survive outside their natural environment in high tech structures like seed bank. The seeds of most plant species can

be dried and stored from year-to-year and they remain viable for tens/hundreds of years. The need of conservation of these plant biodiversity is very important; hence Himalayan Seed Bank (HSB) and seed research facility has been established at Nepal Academy of Science and Technology (NAST). This is a joint initiative of NAST and EvK2CNR-University of Pavia, Italy. Initiation of activities of seed conservation, characterization and seed biological research have been started from the Sagarmatha National Park (SNP) region, and 325 accessions have already been conserved at HSB. Key words: Plant biodiversity Ę Himalayan Seed Bank (HSB) Ę Seed biology Ę Climate change

EFFECT OF CLIMATE CHANGE ON RICHNESS AND DIVERSITY OF BIRD COMMUNITIES IN MEDITERRANEAN BASIN: AN IMPLEMENTATION OF THE SESAM FRAMEWORK

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Climate change is expected to threaten biodiversity in plenty of ways. The impacts are predicted to be particularly relevant in the Mediterranean region, considered as one of the major biodiversity hotspot. Although birds have been the topic of many investigations, few studies investigated the potential impacts of climate change on bird community and diversity patterns in this highly sensitive area. Here, we use bird community data to predict the current and future patterns of species richness and composition in a heterogeneous area of Southern Italy. We apply two modelling strategies: the classic sum of binary predictions from species distribution models (bS-SDM) and other more advanced options of the recently developed "SESAM" modelling framework. In particular, we implemented the following steps: i) we used species distribution models (SDMs) to model the suitability to the abiotic habitat for single species, under current and future climate; ii) we predicted the distribution of species richness through macroecological models (MEMs) to control the number of species expected to co-occur within each site, in current and future conditions; iii) we used a biotic rule to select which species could coexist in each site, conditional to the richness value defined in Step iii. SDMs showed good to excellent predictive performance, whereas MEM proved less accurate. SESAM accurately predicted the current spatial patterns of the analysed communities and allowed highlighting a potential loss of species in the area, a reduction of γ -diversity and alterations in community composition under future conditions. In the simplest implementation, bS-SDM



only predicted a reduction of species richness at site-level. Applying bs-SDM or the full SESAM framework predicted different degrees of climate change impacts, rising interesting questions about the use of simple versus more complex modelling approaches for conservation applications under climate change.

122 ARE “ONE-SIZE-FITS-ALL” TARGETS FOR POPULATION SIZE SENSIBLE UNDER LIMITED CONSERVATION RESOURCES?

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“One-size-fits-all” targets have great appeal in conservation biology, acting as short-cuts for management decisions where suitable data are lacking. The concept of a universal minimum viable population (MVP) size is an example of a population target advocated to ensure species persistence. As with most rules-of-thumb, the underlying theory and empirical accuracy of a universal MVP size has provoked extensive debate, with the decision to apply a general MVP rule commonly traded-off against a manager’s uncertainty in its effectiveness. Although already widely discussed, this debate has yet to acknowledge the importance of constraints such as time, resources and competing values in the decision of whether to recover a population. Here, we examine this issue using a formal decision theoretic framework for setting population size targets that is explicit about budget constraints, costs of management, and uncertainty in MVP estimates. We illustrate our framework with a case-study based on the setting of targets across several charismatic mammals, each with a range of MVP size estimates and corresponding level of uncertainty. We demonstrate that even when we are highly uncertain about MVP sizes for each species, setting a universal target is always sub-optimal when we have constraints on conservation resources. This has broad reaching implications for the debate about how to set population targets based on MVP sizes.

130-HISTORICAL DRIVERS OF EXTINCTION RISK: USING PAST EVIDENCE TO DIRECT FUTURE MONITORING

Moreno Di Marco

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Global commitments to halt biodiversity decline mean that it is essential to monitor species’ extinction risk. However, the work involved in extinction risk assessment is currently intensive, and it may be unsustainable without substantial increase in funding. We demonstrate an alternative approach to monitor changes in extinction risk, based on the response of species to external conditions, and validated using historical information. We defined transitions in the extinction risk of ca. 500 species of mammalian carnivores and ungulates, and modelled the probability that these transitions occurred between 1975-today. A set of 24 predictor variables was used, including intrinsic traits (i.e. species biology) and external conditions (human pressure, distribution state, conservation interventions). The models correctly classified up to 90% of all observed extinction risk transitions and revealed complex interactions between variables, e.g. protected areas and human impact. We found that a small number of predictors can successfully explain transitions in species’ extinction risk. The most important predictors were: initial extinction risk, protected areas extent, geographical range size, body size, taxonomic family, human impact. Including more than a handful of variables increased the model complexity but not its performance in terms of classification ability. Monitoring a targeted set of metrics, such as those included in our analyses, would allow to anticipate future escalations in species’ extinction risk. There is great potential for the application of our approach to other taxa, especially considering the increasing availability of retrospective extinction risk assessments for groups such as birds, amphibians and corals. Our approach can also guide efficient allocation of resources between monitoring of species’ extinction risk and monitoring of external pressures.

HUMAN PRESSURES PREDICT SPECIES’ GEOGRAPHIC RANGE SIZE BETTER THAN BIOLOGICAL TRAITS

Moreno Di Marco

Sapienza University

Luca SANTINI, Sapienza University

Geographic range size is the manifestation of complex interactions between intrinsic species’ traits and extrinsic environmental conditions. It is a fundamental ecological attribute of species and a key extinction risk correlate. Past research has primarily focused on the role of biological and environmental predictors of range size, but macroecological patterns can be distorted by human activities. Here we analyse the role of extrinsic (biogeography, habitat state, climate, human pressure) and intrinsic (biology) variables in predicting range size of the world’s terrestrial mammals. Our



aim is to compare the predictive ability of human pressure vs species biology. We evaluated the ability of 19 intrinsic and extrinsic variables in predicting range size for 4,867 terrestrial mammals. We repeated the analyses after excluding restricted-range species and performed separate analyses for species in different biogeographic realms and taxonomic groups. Our model had high predictive ability, and showed that climatic variables and human pressures are the most influential predictors of range size. Interestingly, human pressures predict current geographic range size better than biological traits. These findings were confirmed when repeating the analyses on large-ranged species, individual biogeographic regions and individual taxonomic groups. Climatic and human impacts have determined the extinction of mammal species in the past, and are the main factors shaping their present distribution. These factors also affect other vertebrate groups globally, and their influence on range size may be similar as well. Measuring climatic and human variables can allow to obtain approximate range size estimations for data deficient and newly discovered species (e.g. hundreds of mammal species worldwide). Our results support the need for a more careful consideration of the role of climate change and human impact - as opposed to species biological traits - in shaping species ranges.

A LEGAL TRADE IN HORN FOR IMPROVED RHINO PROTECTION AND SUSTAINABLE DEVELOPMENT

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University of Helsinki

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Illegal killing of both southern white (*Ceratotherium simum simum*) and black (*Diceros bicornis*) rhinoceros for their horn has escalated in South Africa since 2007, even though international trade in rhino products has been banned since 1977. Consequently, we provide an ecological-economic analysis to understand whether a legal trade in horn could be useful to address the emerging rhino 'crisis'. Our results suggest that the southern white rhino population will be at high risk of extinction in the wild unless law enforcement is enhanced. Legalizing the trade without enhancing law enforcement will not change the status quo. Without legalizing the trade, enhancing the protection of the rhino population would require raising many millions of dollars year after year to protect rhinos from poaching. However, the funding generated by selling an effective quota every year could be used to enhance the protection of the rhino population to levels that will undermine illegal poaching activities and allow the rhino population to increase in size. Hence, an important contribution

that the legal trade could make is to cover such costs, at least in the short term, until other measures over some longer period lead to a reduction in demand from users in the Far East. We suggest the recent escalation in illegal killing within South Africa, the country most effective at conserving its rhinos, makes it timely to consider alternative options.

SPATIAL PRIORITIES FOR CARNIVORE CONSERVATION UNDER LAND USE CHANGE

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Carnivores are among the most iconic and charismatic species that help generate millions of dollars of funding for biodiversity conservation every year. Yet, they have suffered the biggest range contraction among all biodiversity and include some of the most persecuted species by humans. We used newly developed spatial conservation prioritization tools in combination with global high-resolution distribution maps and global land use change scenarios to identify global spatial priorities for the conservation of placental and marsupial carnivores. Our results suggest that the current global biodiversity target to protect 17% of terrestrial land area is insufficient to adequately protect carnivores. In addition, the risk of human-carnivore conflict is high in countries where spatial priorities for carnivore conservation were identified. We discuss how innovative interventions will be needed to mitigate human-carnivore conflict outside protected areas.

HUMAN IMPACT AND THE SUSTAINABLE CONSERVATION OF LARGE MAMMALS IN THE DENG DENG NATIONAL PARK

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In view of the roles played by humans in structuring biological resources, research was conducted in the Deng Deng National Park with the aim to assess the effects of human influences on large mammals. Specifically, the study aimed at identifying human factors threatening the park, determine where threats are occurring, their corresponding intensity, and analyse the relationship and variation between identified threats and the



encounter rates and distribution of large mammals in the park's landscape. Historical topographic and land use maps, and satellite images detailing land use such as settlement and presence of infrastructural features within the park were important secondary sources used for the determination of human factors threatening the park. Field surveys along transects and reconnaissance walks were also elucidated to complement and update the types of human threats occurring in the park. Kilometric index analyses approach was applied to determine threats frequency and encounter rates in the study area. More than 300 observations of eight categories of threats were recorded. Using a spatial analysis approach in geographic information system, distribution of threat categories was analysed. Results revealed that the park is experiencing threats that are changing the physical environment in simple and reversible manner but also threats that have changed the park's environment in permanent ways; all from impacts of adjacent human settlements and development activities. Generally species abundance was significantly high ($p = 0.03$) in habitats where threats encounter rates were low and vice versa. This is a clear indication that human activities have created depressing effects on the habitats of large mammal species in the park. Efforts to limit human activities around the park, to sustain the large mammals and their habitats especially within threat hotspots identified in this study are proposed, to ensure a sustainable future for large mammals in the park.

EFFECT OF TOURISM ON THE MANATEE PRESENCE, IN THE NORTH OF QUINTANA ROO, MEXICO, AFTER 15TH YEARS

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The manatee is an endangered species protected throughout its range. In Mexico, manatees are present in the Gulf coast and Caribbean Sea. Annually five millions of tourists visit beaches and inlets of the Mexican Caribbean, but the effects of this high influx of tourism on manatee are still unknown. Forty-eight interviews were conducted to local people to assess areas with manatee presence and knowledge about the species. The main areas reported of presence were the inlets of Xel-Ha and Xpu-Ha, on the north of the Yucatan Peninsula, in the tourist corridor Cancun-Tulum. All interviewees know what a manatee is and can describe it sometimes in great detail. 45.4% believe that the population is declining. From June to December 2013, 227.27 hours of observation ad libitum were conducted, to detect the presence of manatees in Xel-Ha and Xpu-Ha. Four different manatees in the estuary of Xpu-Ha (Relative Abundance Index = 0.82 manatees/hr) were detected. Manatees were present in 96.6% of the survey days and, during 66.6 % of the time a cow-calf pair was observed. Behaviors

such as feeding, playing and breathing were recorded, among others. In Xel-Ha no manatee was observed. These results differ from those obtained by a study 15 years ago, in which eight manatees were observed in Xel-Ha and two in Xpu-Ha. They suggest that the change in presence and use of inlets by manatees is related to the number of tourists using the area. Xel-Ha receives on average 2184 visitors per day, while Xpu-Ha only 22. In Mexico, manatees still used areas heavily impacted by tourism, such as north of Playa del Carmen and Holbox, probably moving from protected areas. The tourist corridor Cancun-Tulum is especially important for manatees as it is the contact area of the two manatee populations in Mexico and could be essential to ensure connectivity between them. It is necessary to implement management strategies and environmental education to mitigate the effect of tourism in these areas.

124 MONEY TALKS: THE DRIVERS OF CORPORATE BIODIVERSITY COMMITMENTS

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TOTAL/Cross-sector Biodiversity Initiative

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Companies that manage biodiversity risks and impacts effectively often benefit from a competitive advantage in accessing resources, capital or markets, and suffer fewer project and permitting delays. Greater understanding of the costs to business of poor biodiversity management - and opportunities from good management - has driven increasingly quantified commitments at both the project and corporate level. This new world of No Net Loss and Net Gain commitments has been particularly driven and shaped by Multilateral Financial Institution lending standards. Many companies obtain project finance from these institutions, or from commercial banks that follow their standards (such as the 80 Equator Principles Financial Institutions). Even when companies do not seek external finance, many large projects are part-owned by host country governments, which often borrow their project equity from these financial institutions. Such is the cumulative momentum behind these financial institution standards that they are rapidly becoming best practice globally. They are being voluntarily incorporated into corporate or project strategies, and even into national government legislation. Conservation biologists who understand financial lending standards are finding huge new opportunities to achieve conservation goals that align with emerging corporate best practice.



91-GETTING SCIENTIFIC EVIDENCE USED IN PRACTICE: PROGRESS, BARRIERS AND SOLUTIONS. ORGANISING EVIDENCE FOR ENVIRONMENTAL MANAGEMENT DECISIONS: A '4S' HIERARCHY

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Making decisions informed by the best-available science is an objective for many organisations managing the environment or natural resources. Yet, available science is still not widely used in environmental policy and practice. We describe a '4S' hierarchy for organising relevant science to inform decisions. Primary Studies are collated into Systematic Reviews, both Studies and Systematic Reviews are presented in Summaries, and Decision Support Systems place the evidence into a decision-making context. At each stage of ascent, the original scientific information is condensed, summarised, and becomes more accessible to decision-makers. This hierarchy has already revolutionised clinical practice. It is beginning to emerge for environmental management, although all four levels need substantial development before environmental decision-makers can reliably and efficiently find the evidence they need. We expose common bypass routes that currently lead to poor or biased representation of scientific knowledge. We argue that the least developed level of the hierarchy is that closest to decision-makers, placing synthesised scientific knowledge into environmental decision support systems.

NEW APPROACHES TO INFORM THE CONNECTION AND PROTECTION OF THE LAST VAST PLACES IN THE UNITED STATES.

Brett Dickson

Conservation Science Partners, Inc.

Luke ZACHMANN, Conservation Science Partners, Inc. ; Christine ALBANO, Conservation Science Partners, Inc.

In the face of global change, there is a pressing need to strategically design, connect, and conserve new landscapes that more effectively capture biodiversity and ecological processes at relevant spatial scales. In the United States, extensive areas of public land, including those administered by the Bureau of Land Management (BLM), present substantial opportunities to protect well-connected areas of conservation concern. For 12 western states, we used a novel multiple-criteria analysis to map contiguous areas of roadless BLM land that possessed important ecological indicators of high biodiversity, resilience to climate change, and connectivity. We leveraged new and existing spatial datasets to implement a systematic and statistically robust analysis of eight key indicators at several spatial scales, and to identify areas

with high conservation value across 41-million hectares of roadless BLM land. We identified 13-million hectares of land with relatively high conservation value mostly located in Alaska, Utah, Colorado, Arizona, Oregon, and Nevada. Highest value lands exhibited greater species richness, vegetation community diversity, topographic complexity, and surface water availability than existing BLM protected areas. These lands also encompass vast areas of ecological importance relative to other federal lands, and serve as critical linkages between already protected public lands in the West. Analyses based on circuit theory indicated high likelihood of ecological connectivity from southern Nevada through Utah and into western Colorado. Connectivity was facilitated by a network of existing protected areas, and across multiple jurisdictions. Our results provide a timely decision-making tool as the BLM and other federal agencies engage in large landscape analyses and planning efforts. Our methodological framework can integrate among variables at multiple spatial scales and is readily applicable to other jurisdictions and regions within the U.S. and beyond.

218 EU CONSERVATION DIRECTIVES - A SCIENCE PERSPECTIVE

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The EU Habitats Directive can be considered one of the most advanced legal foundations for nature conservation worldwide. In article 18 (Research), the Habitats Directive attributes a particular role to science in identifying effective species and habitat specific measures, integration of regional stakeholders, and devising sound monitoring programs. Not surprisingly, criticism and suggestions for improvements of the Habitats Directive have been raised. Criticism includes ineffective choice of protected target species and habitats, insufficient protection of ecosystem processes, lack of a truly coherent network of protected sites, lack of sufficient flexibility in light of climate change. The EU Habitats and Birds Directives have not prevented the EU's failure to meet the 2010 targets. However, there is scientific evidence to conclude that the EU conservation directives and the Natura 2000 network established under the directives have at least slowed biodiversity loss in the EU. The EU conservation directives have increased the engagement of civil society. Both the EU Habitats and Birds Directives have provided conservationists with new legal opportunities requiring industry and the agriculture sector to adapt relevant projects and management to conservation needs. Numerous court decisions have upheld conservation as an overriding public interest against development or unsustainable resource exploitation. This seems to yield some delicate balances



between conservationists, industry and land-users, albeit with many remaining conflicts. Currently, the Habitats and Birds Directives are undergoing an audit (refit) that may yield considerable change and weakening. The EU conservation directives maintain much potential for further subsidiarity in allowing regional adjustments and optimisations. Apart from some adaptations, from a scientific perspective we can mostly suggest strengthening of the EU conservation directives and their implementation across policy sectors.

SCALING THE DIVIDE: SOCIAL VALUES AND BIODIVERSITY CONSERVATION IN A DYNAMIC WORLD

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Humans are increasingly represented in social-ecological systems as active agents that influence and are affected by their surroundings in complex relationships of adaptation and change. These relationships (i.e., feedback loops) necessitate an increased understanding of the social, biological, and ecological components of systems. Less understood is exactly how to address these phenomena when they operate across different levels and scales. Our work supports the notion that studies explicitly testing for cross-scale and cross-level dynamics can improve the efficacy of conservation solutions and allow for better explanation of factors that influence social values. In response to this desire to understand system dynamics and inform conservation decision-making, we explicate the relationship between indicators of social change and values at different levels within spatial (county and individual levels) and cognitive (values-attitudes-behaviors) scales. Using multilevel modeling, we show that individuals' fundamental values are influenced by characteristics, including demographics (e.g., education, income and urbanization), of the place in which they live independent of their own sociodemographics. We then show how these values influence individual-level support for various conservation actions. Finally, we provide a case study examination of human responses to wolf (*Canis lupis*) recovery in Washington state (U.S.) to illustrate how our findings apply in a particular social-ecological system. Results suggest that linkages between spatial and cognitive scales have important implications for the success of conservation actions and, specifically, for the social-ecological benefits anticipated as resulting from endangered species recovery.

MARINE ECOSYSTEMS FUNCTION FOR DEVELOPMENT OF SUSTAINABLE ANCIENT SHIPWRECK SITES IN NATUNA SEA, INDONESIA

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Natuna is a group of small islands in Indonesia located in South China Sea. It's directly adjacent with Singapore and Malaysia Country. Based on historical records, Natuna Sea had being passed by many ships from Asian and European Country for trading to spices archipelago in Indonesia. Their destination were Banten and Sunda Kelapa (Java), Celebes (Sulawesi), Borneo (Kalimantan), Moluccas (Maluku). Some of them never arrived at their destination and lost in Natuna Sea. Then, as the second world war happened, the battles between Japan and allied forces took place at South China Sea in Natuna and This was the caused many of warplane and warship crashed on Natuna Sea. Nowadays, these phenomenon are a reason for existence the ancient shipwreck sites buried in Natuna Sea. The distribution of sites are located in 8 areas of Natuna Sea with different depths. Integration between the historical values of the ancient shipwrecks and marine ecosystems living on the sites give fascinating for the people visiting them. Furthermore, marine ecosystems give influence of the sites physical stability. They protect the sites from diving activities impact and unstable water condition. On the contrary, excessive sites exploitation for archaeological research will destroy of the ancient shipwreck sites and their marine ecosystems. This paper will first discuss about the ancient shipwreck sites problem related by marine ecosystems function for their sustainability in Natuna sea. Then this paper also describe about the kind of marine ecosystems giving impact for the sites sustainability. Finally, this paper will give a marine conservation model for the ancient shipwreck sites based on ecosystems of Natuna Sea, with using marine ecological approach and marine archaeological research method.

KEYWORDS: ancient shipwreck, ecosystems, Natuna Sea

CLIMATIC DRIVERS OF BIODIVERSITY IN THE TIME OF THE GREEN SAHARA

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Scattered across the Sahara is a rich collection of rock art that depicts thriving fauna, fossils of savannah and water dependent species, and animal populations that are restricted to mountain tops and oases. These are relicts of the most recent period of high humidity in the Sahara which persisted throughout the first half of the Holocene. Periods of high humidity in the Sahara are the result of orbitally induced



enhancement of summer rainfall and positive feedbacks between vegetation and precipitation. I used paleoclimate snapshots and palynological data held in the African Pollen Database in order to model the effect of paleoclimate and soil properties on the beta diversity of fossil pollen using Generalised Dissimilarity Modelling (GDM). I found that paleoclimate and soil properties explain a modest proportion of compositional dissimilarity during the African Humid Period and that this is strongest when species of modern Saharan affinity are examined in isolation of those now found at tropical latitudes. This result is consistent with studies showing a strong affinity of tropical trees to water bodies even as they may have been expected to exist across the landscape at large. Climate change is expected to bring increased rainfall in the Sahara and may see a renewed expansion of savannah ecosystems and northward migration of tropical plant species along reactivated lakes and water bodies.

SYMPOSIUM 91: THE ART OF CONSERVATION SCIENCE IN THE FIELD: BARRIERS TO THE USE OF EVIDENCE

Alex Diment
WCS

Conservation science is a complex and multi-disciplinary field, which aims to address pressing issues of extinction and biodiversity loss. In many cases 'field' conservation can often be more art than science, working with governments, civil society, and local communities to negotiate trade-offs and collaborative solutions to achieve positive outcomes. This can be especially true when working in developing countries undergoing rapid transitions and with weak governance. However, despite the inherent challenges of researching complex and dynamic socio-political situations, there remains a crucial role for collecting and disseminating of evidence for the impacts of conservation interventions. Assumptions are commonplace in field projects, and substantial resources are regularly expended with seemingly no learning from the experience of others, and no monitoring of project impacts. Numerous barriers remain for the uptake and application of science in conservation projects, including education and language, cultural and political, logistical and financial, and plain old 'human nature'. Here I describe some of the key barriers to the use of evidence to guide field conservation projects, and to the collection of evidence for adaptive management. I highlight several case studies and discuss a range of potential solutions, including the evidence for their effectiveness.

PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF CILIATE MODEL PARAMECIUM SP. TO DITHIOCARBAMATES AND TRIAZOLES FUNGICIDES

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The last decade witnessed a dramatic increase in the use of fungicides. Such compounds affect the aquatic populations and may disturb their metabolism. In this study, we investigated the physiological and biochemical effects of two fungicides, thiram and tebuconazole, to a freshwater ciliate *Paramecium* sp. After exposing the cultures of the ciliates to the fungicides at several selected concentrations, the growth kinetics was followed for 96h. The results showed a significant decrease in the growth rate and a disruption in the motion of the protist. The monitoring of respiratory metabolism showed a significant decrease in oxygen consumption in the cultures treated by thiram. On another level, biochemical assays revealed the existence of oxidative stress generated by the xenobiotics tested, resulting in a disruption of the enzymatic activity of Catalase and Glutathione S-transferase in treated cells. Keywords: *Paramecium* sp., thiram, tebuconazole, CAT, GST.

HABITAT AMOUNT DETERMINES SPECIES' EXTINCTION RISK THRESHOLD

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Species' extinction risk is determined by intrinsic and extrinsic factors. Among extrinsic factors, habitat destruction is the main threat to biodiversity. Here we combined information on habitat amount and intrinsic extinction risk of terrestrial mammal species to predict their threat status. We calculated the amount of natural habitat by overlaying the species' geographic distribution with a global land cover map. Intrinsic extinction risk was calculated from species' functional traits and phylogenetic information. We found that intrinsic extinction risk was able to predict threatened species with 60% of accuracy. When we included information on habitat amount information, accuracy raised up to 100%, showing a threshold response around the value of 15-30% of natural habitat remaining within their range. The value of this threshold was higher for species with higher intrinsic extinction risk. Applying this framework to predict threatened species among data deficient ones, we found that 37% of them are



threatened to extinction, considering a precision of 90%. This finding reinforces the effect of habitat destruction as a central mechanism responsible for extirpating biodiversity from our planet. Also, our approach has a potential application for predicting the future dimension of the global biodiversity crisis, considering available scenarios of global land cover change.

THE INFLUENCE OF FIRE ON AVIAN DIVERSITY AND COMMUNITY COMPOSITION IN SOUTH AFRICAN SAVANNA

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With its exceptional diversity of wildlife, the South African savanna is recognized worldwide as an important priority for conservation. Savannas are one of the most threatened biomes on earth as a result of limited land protection combined with habitat loss and degradation from human encroachment, unsustainable agricultural activities, and inappropriate fire regimes. Savannas are fire-prone ecosystems and burning is an important driver of landscape change. As a result, many protected areas, including national parks and private reserves, use prescribed burning to simultaneously mimic natural savanna fire regimes and mitigate fuel loads. The impact of fire on grazing mammals has been well documented. Recently however, researchers and managers have begun to focus on the rest of the savanna community. In this study, we documented patterns of avian diversity across a landscape of different burn ages. Further, we tested two alternative hypotheses, food availability and vegetation structure, as potential mechanisms influencing avian diversity. We conducted avian point counts, sampled invertebrates and measured vegetation structure at 150 sampling points across a gradient of time since burn in North West Province, South Africa. No differences were detected in avian diversity across burn ages, however, species composition shifted after five months. Invertebrate abundance and richness peaked a year following burning and declined in subsequent years. Simultaneously, avian diversity was associated with a number of characteristics of vegetation structure. Ongoing work will attempt to disentangle the relative influence of food availability versus vegetation on avian diversity. With the continued use of fires in South Africa and the potential increase in fires due to climate change, the identification of specific mechanisms influencing avian diversity is a critical next step in developing management strategies for birds in savanna ecosystems and protected areas.

DIVERGENT RESPONSES OF BIRDS, MAMMALS AND REPTILES TO LANDSCAPE-SCALE WILDFIRE

Tim Doherty

Edith Cowan University

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Fire is a strong determinant of animal communities in fire-prone regions. We measured the response of birds, mammals and reptiles to a history of landscape-scale wildfire in semi-arid shrublands in south-western Australia. Using pitfall trapping, we surveyed small mammals and reptiles at 13 'young' sites (8-13 years since last fire), and 14 'old' sites (25-50 years since last fire). We also surveyed birds at 32 sites in a chronosequence ranging from 12 to >50 years since last fire. Small mammals and reptiles showed divergent responses to shrubland fire history. Five species were associated with young shrublands and four with old shrublands. No bird species were associated with young shrublands, although three species were most abundant in areas 34 to >50 years since last fire. These older shrublands also had the highest bird species richness and insectivore abundance. These results suggest that landscape-scale fire management is needed to maintain diverse animal communities. In particular, management should aim to preserve areas of long unburnt shrubland.

CITIZEN SCIENCE IN RURAL AFRICA: THE CONSERVATION AND MONITORING OF A THREATENED CARNIVORE BY MAASAI HUNTERS

Stephanie Dolrenry

Lion Guardians

Charles T.t. EDWARDS, National Institute of Water and Atmospheric Research ; Leela HAZZAH, Lion Guardians ; Laurence FRANK, Living with Lions, University of California-Berkeley

Although developing countries across Africa have high concentrations of threatened species and biological hot spots, there are few citizen science schemes currently running, particularly in the rural communities, with limited evaluation of these programs. We explore the convergence between citizen science and the conservation biology of threatened African lion (*Panthera leo*) populations. Specifically by using the traditional knowledge of Maasai hunters to have them engage in the broad-scale monitoring of lions. We investigate how participation in biodiversity conservation can transform hunters into citizen scientists. We examine, with empirical data, whether a citizen-science approach, with non-literate Maasai warriors, can produce quality data on an elusive carnivore.



Our study analyzes the accuracy of more than 350 verified reports from the hunters, as well as examining the increase in knowledge of the lions, both preceding and during the citizen science program. We model data collected by the hunters on transects to determine whether their data can accurately predict lion density from reported track density; a relatively simple technique to quickly estimate wildlife populations by community members. Our results show that data quality and quantity improved substantially with the engagement of the Maasai hunters. Engaging local community members in biodiversity conservation and monitoring can be a powerful approach, particularly in human-altered systems of rural Africa.

MICROBIAL DIVERSITY, INSECT EXTINCTION AND ECOSYSTEM FUNCTION IN BIRD'S NEST FERNS

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Microbes are the dark matter of ecology. Although fundamental to nutrient cycling and energy transfer within ecosystems, little is known of the precise relationship between microbial diversity and ecosystem function. By using the bird's nest fern (*Asplenium nidus*) and its associated invertebrate community as a model ecosystem, we aim to quantify the process of decomposition in canopy soils, in response to simulated insect extinctions. For the first time, we will trace nutrients through an entire ecosystem, allowing us to elucidate the precise relationship between biodiversity and nutrient transformation. Sets of ferns were installed into replicate tree crowns within the rainforest biome at the Eden Project (UK), supported by a novel canopy-level irrigation system. The chemical composition of host tree leaves (the primary route for nutrients entering the system) were analysed using gas chromatography-mass spectrometry, before the microbial composition and activity of the fern soils were analysed using MicroResp plates, extracellular enzyme assays and phospholipid fatty acid analysis. Preliminary results reveal that the trees which host bird's nest ferns have leaves of significantly different chemical composition, and that the soil at their bases contain significantly different levels of organic matter. These differences highlight the importance of the host tree in determining the nutrient inputs of bird's nest ferns. Future steps will examine how suspended soil nutrient content changes when invertebrate decomposer communities are modified through simulated extinctions. This developmental research to reveal novel patterns in insect diversity and soil microbial activity paves the way for further unique studies of ecosystem function within the Eden Project and, eventually, for

transferring similar manipulation experiments to the rainforests of Borneo.

163-MONITORING AND EVALUATION OF ECOSYSTEM-BASED ADAPTATION PROJECTS

Camila Donatti

Conservation International

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Ecosystem-based adaptation (EbA) is receiving growing attention from the conservation and development communities, given the significant overlap between people's dependence on ecosystems and their vulnerability to the impacts of climate change, coupled with the potential to provide significant biodiversity co-benefits alongside societal adaptation. However, there is still limited information on the effectiveness of EbA, in terms of its ability to reduce specific vulnerabilities or increase the overall resilience of people to climate change impacts. Specific challenges include the complexity of multi-objective strategies which encompass social and biophysical goals, the long time horizons required to observe social and environmental change, and the level of uncertainty surrounding current tools and approaches. We examined how two tools, Theory of change models and evidence synthesis, can be used in EbA monitoring through characterizing pathways to impact, identifying causal mechanisms, distinguishing relevant indicators, and recognizing areas of uncertainty, particularly in data poor environments where assumptions often substitute for evidence. We applied those tools in EbA case studies to address the merits of combining program theory and evidence synthesis in order to inform monitoring of EbA. Interventions from those case studies ranged from mangrove restoration and rehabilitation to reduce the vulnerability of coastal communities to projected increases in the power of tropical cyclones, to local capacity building and technology transfer to support livelihood security under climate change. We concluded that, when together, Theory of change models and evidence synthesis have the potential to expedite learning on which interventions are most effective, what indicators to measure, and how to deal with uncertainty in decision making, and argued that such an approach is essential for EbA projects to foster a culture of adaptive management and enable rapid learning.



INFORMATION NEEDED FOR DECISION MAKERS TO TAKE ACTION ON CLIMATE CHANGE ADAPTATION FOR SMALLHOLDER FARMERS-THE CASE OF CENTRAL AMERICA AND MEXICO

Camila I. Donatti

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Even though it has been assumed that highly detailed information is key for policy makers to make strategic, improved and informed decisions, few studies to date have addressed if the lack of scientific or technical information is in fact one of the barriers that need to be overcome for decision makers to design and implement climate change adaptation policies. Here, we look at this issue regarding the climate change adaptation of smallholder farmers in Central America and Mexico. We implemented an online survey with policy makers from this region to answer the following questions: a) Is the lack of information a barrier for policy makers to take action on climate change adaptation for smallholder farmers? , b) How important are particular types of information to support policy makers to successfully implement adaptation plans for smallholder farmers?, c) To what extent have this information been used to develop or implement adaptation policies or programs for smallholder farmers? and e) What gaps exist in the information? Our survey with 105 policy makers from Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama shows that the lack of technical information is one of the most important barriers for policy makers to take action on adaptation for smallholder farmers. Participants identified the types of information that they consider to be very important to support policy makers to successfully implement climate change adaptation plans for smallholder farmers. Although specific types of Information were identified as very important to successfully implement climate change adaptation plans for smallholder farmers, they are rarely used by them, even when some of them are available. Therefore, there is a need to not only fill existing gaps, but also to ensure that decision makers are aware of the available or technical information and to deliver the information in a format that is relevant to existing decision-making procedures.

ROLE OF FIRE AND CONTINUOUS BROWSING IN CONTROLLING BUSH ENCROACHMENT IN THE ARID SAVANNAS OF THE EASTERN CAPE PROVINCE

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University of Venda

The study investigated the long-term effects of fire and herbivory on bush encroachment (1982-2001) in the arid savannas of the Eastern Cape Province of South Africa. Fire and herbivory were chosen as possible solutions because of their ecological recognition as factors of the environment in African Savannas and these methods are economically suitable for rehabilitation of veld which has inherent economic potential. Data collected using vegetation surveys were analysed using an Analysis of Variance where the treatment effects were first tested for significant differences using an F-Test. If the F-Test showed significant treatment differences then these individual treatment effects were determined using a t-Test in the form of Least Significant Differences (LSD's). The long-term effects of the treatments on the woody vegetation were investigated in terms of their effects on the density, phytomass and browsing potential of the bush, botanical composition of the dominant tree and shrub species. The long-term effects of fire and herbivory on the herbaceous component were investigated as botanical composition, basal cover and productivity of the grass sward. The long-term effects of the treatments on the grass sward were investigated in terms of their effects on veld condition, botanical composition of the dominant grass species and the basal cover of the grass sward. The general conclusion from the investigation into the effect of continuous browsing and application of fire on the bush indicated that this treatment successfully controlled bush encroachment and caused varying degrees of mortality amongst the different bush species. The effects on the bush density (plant per hectare-P/HA) showed Significant Difference ($P < 0.05$) = 148.650, while the bush phytomass (tree equivalents per hectare-TE/HA) showed Significant Difference ($P < 0.05$) = 448. The effects on the browsing potential (browsing units per hectare-BU/HA) illustrated Significant Difference ($P < 0.05$) = 22 as well as the effects on the Veld condition (percentage-%) showed Significant Difference ($P < 0.05$) = 1.738. If a livestock farmer or game rancher has a problem with bush encroachment in the arid savannas the application of fire and browsing can be effectively used to maintain high basal cover indices for grazing purposes and accessible bush for browsing.

#151_A TICKING TIME BOMB? LYME DISEASE IMPLICATIONS FOR CONSERVATIONISTS

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Lyme disease is a bacterial infection transmitted through the bite of an infected tick carrying one of several *Borrelia* pathogens. In humans, symptoms begin days to weeks after infection and while early symptoms include fever, muscle and joint pain, headache and chills, infection is often marked by the distinct erythema migrans or bull's eye rash that appears



on the skin. If left untreated, the pathogen can spread to the brain, heart, and joints causing cognitive impairment, stroke, paralysis, cardiac problems, and in some cases death. In the decades proceeding its identification and subsequent epidemiological tracking, Lyme disease has become the most common vector-borne disease in North America and the most common tick-borne disease in Europe. The geospatial reach of the pathogenic agent, the ticks that carry it and the reported cases of human and animal infection have expanded beyond biological endemic regions of the US and Europe and it has now been reported in over 40 countries worldwide. The scientific literature indicates that working in rural or natural environments, working in proximity to wild and domestic animals, participating in outdoor recreation activities (hiking, camping) and visiting Lyme endemic areas for touristic experiences (e.g. ecotourism) are the most significant human risk factors for infection. Ominously, the very nature of the conservation profession presents an occupational risk for contracting Lyme disease. Through the personal narratives of environmental and conservation researchers who contracted the infection while conducting field work in endemic areas, this presentation will provide an overview of Lyme disease etiology, the occupational risks for conservation professionals, the prophylactics available to guard against infection, as well as the research that is needed to better understand the human ecology of this infectious disease.

MANAGING WATER FOR THE ENVIRONMENT IN AUSTRALIA - A POLICY FRAMEWORK FOR ALL SEASONS

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Under its National Water Initiative, Australia has made significant advances in providing water for the environment to maintain and improve the environmental condition of rivers and wetlands. Environmental water provisions are now in place for all major water systems considered to be at risk. In a number of over-allocated systems, Governments have made investments to recover water for the environment and improve the balance between environmental and consumptive use. The most notable of these is in the Murray- Darling system where programs are in place to recover the equivalent of 2750GL of water, with these water entitlements held by environmental water managers. As a result of these initiatives, environmental water managers now hold significant volumes of water entitlements which are highly valuable public assets. For environmental water managers, the challenge is now to use this water effectively to achieve the desired environmental outcomes, efficiently to show that investment levels were justified and transparently to ensure there is public confidence in their management. This paper describes the governance

arrangements and the policy framework for the management of environmental water in Victoria and the Murray-Darling Basin. The governance arrangements were developed to be robust, transparent and appropriate for the level of public investment and asset ownership. The policy framework for the management of environmental water is scientifically based, logical, easily understood by the community and is designed to work under all climatic scenarios. The approach was used both during and after the Millennium Drought in Australia and was ultimately accepted by the community even in times of extreme water scarcity.

THE OLD MEN AND THE SEA - UTILIZING HISTORICAL DATA AND LOCAL KNOWLEDGE OF FISHERMEN TOWARD SHARK CONSERVATION

Mareike Dornhege

Sophia University

Anne MCDONALD, Sophia University

While long accepted in various disciplines including terrestrial conservation management, historical data is still not commonly applied in marine conservation and fisheries management. Yet, management based on recent data alone, ignoring historical information, typically results in too optimistic conservation statuses and fisheries quotas that are higher than if long-term data were considered. Japan manages the 8th largest shark fishery in the world. Until 1993, shark catches were recorded in logbooks under the single general category "shark", including both coastal and pelagic sharks, making prior stock assessments impossible. Currently, historical data is not utilized and the fisheries are managed top-down through international, local and regional bodies based on recent stock assessments. In Japan's biggest landing port for sharks, Kesenuma in Miyagi Prefecture, interviews with captains of long line vessels with at least 20 to over 60 years of experience were conducted, recording observations of stock changes and local knowledge of shark populations. Additionally, shark landing data for the past 20 years were analyzed. Results showed a clear divide: While younger fishermen reported no observed change, fishermen with more than 40 years of experience reported that stocks have been reduced up two thirds. Several fishers proposed management measures, suggesting MPA locations, catch limits and seasonal fishing regulations. Ignoring historical information on past population sizes and species composition can lead to shifting baselines and includes a risk of ineffective management of ecosystems. While collecting anecdotal historical data and local knowledge has its limitations, the study suggests that conservation management based on stock assessments post 1993 alone may be misleading. The study can further give valuable impulses for scientific investigation to confirm the potential of the proposed conservation measures.



WAYS OF PLANT CONSERVATION AND RECOVERY OF SIBERIAN ENDANGERED SPECIES (RUSSIA)

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Central Siberian Botanical garden

Tatyana NOVIKOVA, Central Siberian Botanical garden ;

Alexandra NABIEVA, Central Siberian Botanical garden

Since the 1970s many botanic gardens in Russia have been collecting rare and endangered species. Central Siberian Botanical Garden contains considerable gene pools of rare species ex situ including field gene bank (208 species), seed bank - 161 species and in vitro bank of germplasm. The goal of our work is to develop the methodology of plant conservation and recovery of endangered species of Siberian flora. Material for conservation and ex situ reproduction (seeds, rhizomes, roots and whole plants) was collected during in situ study. Proper sampling ensured the maximum preservation of existing genetic variation. An analysis of variability using storage proteins and DNA – markers was proved to be of great importance when studying the genetic structure of populations. We have developed a method of express - assessment of natural and introduction populations of rare and endangered species of plants in order to determine their current ecological state using morphological, biochemical (storage proteins), molecular - genetic (DNA) characteristics as markers. In the nursery of Botanic Garden (field gene bank) 208 species from 68 self-preserving populations (33%) and 139 small populations (67%) which are close to extinction are grown. Artificial populations through planting seeds collected in endangered populations of rare species *Hedysarum theinum* Krasnob. and *Viola incise* Turcz. were created in 2009 and 2011, respectively at Red Mountain and the Seminsky Pass in the Altai Republic in collaboration with researchers of the Altai Botanical garden. As a result, recommendations to restore some endangered species of Siberia were given. Thus, Central Siberian Botanical Garden is close to reaching main goal as stated by the Global Strategy of Plant Conservation to preserve ex situ 60% of threatened species nationwide and including 10% of them in recovery and restoration programs.

LESSONS IN CONSERVATION: TEACHING AND TRAINING MATERIALS FOR CAPACITY DEVELOPMENT IN CONSERVATION

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The Network of Conservation Educators and Practitioners (NCEP), a collaborative project of the American Museum of Natural History's Center for Biodiversity and Conservation (CBC), works to enhance conservation capacity worldwide. As one of our strategies, NCEP produces peer-reviewed, open-access teaching and learning resources (or "modules") on a range of conservation topics tailored to local contexts. To date, we have a collection of over 140 training modules in eight languages freely available online (<http://ncep.amnh.org>) and published selectively through NCEP's official journal, *Lessons in Conservation*. This journal is designed to introduce NCEP modules to a broad audience, and each issue focuses on a topical theme, such as selected NCEP syntheses and case studies on freshwater ecosystems, or conservation challenges and solutions in the Southern Tropical Andes. In our current issue, we feature selected resources developed with our partners in Madagascar, including "Characteristics of endangered species of Madagascar" and "Community natural resource management." Developed in the French language and adapted to the Malagasy context, these modules reflect our efforts over ten years to improve the breadth and quality of conservation training available in Madagascar, and worldwide. All module components can be used in a variety of academic or training courses and include questions designed to promote use of effective teaching practices in the classroom, such as active learning techniques, and the development of critical thinking skills. By supporting long-term planning for capacity building and targeting the teachers of conservation professionals, NCEP expects to have an amplified and sustained impact, as students become the researchers, managers, and decision-makers of the future.

ID7- CRAVING FOR MEAT: PSYCHOCULTURAL DISORDERS INDUCED BY A DEPLETION OF BUSHMEAT IN THE DIETS OF CONGO BASIN FOREST DWELLERS

Edmond Dounias

IRD-CIFOR

Unlike the situations occurring in the Sudano-sahelian region, which are characterized by severe periodic depletions in food availability causing drastic hypocaloric diets, tropical rainforests are known to provide a constant supply of diverse potential foods that mitigates the risk of food shortage. Nevertheless, forest dwellers undergo what they perceive as 'lean periods' in food supply. Although game is vanishing in certain forest areas, it remains a food of paramount importance. In several forest dweller languages, specific terms are used to distinguish various forms of hunger induced by food shortage: one of



these terms refers to a 'lack of meat'. The craving for meat corresponds to a pronounced decrease in animal protein intake, but does not necessarily translate into acute nutritional deficiencies. The temporary rarefaction of meat consumption is generally compensated by vegetal sources of protein and fat. However this meat hunger is perceived dramatically and constitutes a definite stress. The meat hunger is a cultural form of hunger that can be interpreted as a psychological disorder to be linked to a qualitative variation in diet: a reduced availability of the most culturally valued food. Based on first hand studies carried out in Cameroon and DRC, this communication stresses that this psychological unrest may in turn have negative biological consequences, such as cardiovascular ailments, vulnerability to infection or low growth rates among children. Even in the absence of concrete dietary insufficiencies, meat is locally perceived as essential for health, and meat hunger is said to bring about tiredness, loss of vital strength and induced illness resulting from effects expressed at very diverse levels with a blending of material and symbolic aspects. The impact of seasonality, which appears moderate in the tropical forests, may in fact far exceed the biological incidence of the variations in food availability.

LANDSCAPE CHANGE, HUMAN POPULATION GROWTH AND OIL DEVELOPMENT IN A UGANDAN PROTECTED AREA LANDSCAPE: A CASE-STUDY FROM MURCHISON FALLS CONSERVATION AREA

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Protected areas in Sub-Saharan Africa are sanctuaries for rich biodiversity and are important economic engines for African nations, but they are becoming increasingly threatened by discoveries of mineral deposits within and nearby their boundaries. In 2006, viable oil reserves were discovered in Murchison Falls Conservation Area (MFCA) in northern Uganda. Exploratory and appraisal activities concluded in 2014, and production is expected to begin in 2016. The oil development is associated with a substantial increase in human population outside MFCA, with people seeking jobs, land, and economic opportunity. Concomitant with this change is increased truck traffic, a sprawling and denser road network, and infrastructure within the park, which could have large impacts on both the flora and fauna. We examined the broader protected area landscape and the potential feedbacks from resource development on the ecosystem and local livelihoods. Our analysis combines a land cover analysis using Object Based Image Analysis of Landsat data (2002 and 2014), migration patterns and population change (1959-2014), and qualitative interview data. Our results suggest that most of the larger-

scale impacts on the landscape and people are occurring in the western and northern sections, both inside and outside of the park. Additionally, oil development is not the only factor in the region influencing population growth and landscape change. Post conflict regrowth in the north, sugarcane production in the south, and migration to this region from conflict-ridden neighboring countries are also playing a vital role in human migration shaping the MFCA Landscape. Understanding the social and environmental changes and impacts in the MFCA and its surrounding areas will add to limited literature on the impacts of resource extraction on local, subsistence communities and landscape level change, which will be important as access and pressure for oil and minerals within protected areas continues to rise.

ID (117) LAND SHARING NOT SPARING IN THE "GREEN ECONOMY": THE ROLE OF LIVELIHOOD BRICOLAGE IN CONSERVATION AND DEVELOPMENT

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In Southeast Asia's green economy, conservation interventions intensify the production of resources as commodities through land sparing activities and zoning in extensively used landscapes. Such initiatives encounter problems where poor resource users diversify livelihoods in multi-functional landscapes over time. In terms of 'livelihood bricolage' – the mixing, matching and building of portfolios– we describe how forest users enhance security by spreading risk across livelihood portfolios. Philippine case studies show how disrupting livelihood bricolage in multi-functional landscapes with 'intensifying interventions' constrains livelihood security and conservation objectives. We conclude that more equitable forest governance supports land sharing with diverse, extensive livelihoods in varied landscapes.

HOW BIODIVERSITY INDICATORS SHAPE THE BIODIVERSITY/FOOD PRODUCTION RELATIONSHIP

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The land sharing/sparing framework has been proposed as a strategy to reconcile food production and biodiversity. The relative utility of sparing vs. sharing depends on the shape of the biodiversity/food production relationship. Yet numerous studies show that the shape and the direction of the relationship are themselves highly dependent on the biodiversity indicator used. Biodiversity indicators can differ because they focus on different taxa. They can also carry information about different characteristics of the observed individuals, such their taxonomy, their phylogeny or different



functional traits. Finally they can differ in the metrics used to aggregate these characteristics into a group level quantity, such as species richness, phylogenetic or functional diversity. Focusing on common birds, our objective was to determine whether the relationship between food production and biodiversity depended on the metric used, or only on the underlying choice of the considered characteristic. We computed food energy production on a nation-wide gradient covering French agroecosystems. Biodiversity data were provided by the French Breeding Bird Survey (FBBS). Several indicators describing bird biodiversity from the point of view of phylogeny, taxonomy, habitat specialization and diet composition were computed in 849 different sites of the FBBS. Both data sets were combined using generalized mixed models. Most of the indicators tested exhibited a negative relationship with energy production. Indicators based on habitat specialization, however, exhibited a positive relationship with energy production. When significant, the direction of the relationship depended only on the underlying choice of the considered characteristic and not on the metric. Significativity depended on both. Our results suggest that conserving different characteristics of biodiversity may entail different land-use strategies.

THE EFFECTS OF SMALL LIVESTOCK FARMING ON THE DIVERSITY, DISTRIBUTION AND ACTIVITY PATTERNS OF WILDLIFE IN A SEMI-ARID REGION OF SOUTH AFRICA

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M. Justin O'RIAIN, University of Cape Town ; Nicoli NATTRASS, University of Cape Town

Human activities are known to impact adversely on wildlife and may manifest as chronic conflict between humans and wildlife for critical resources. In South Africa, small-livestock farming in the semi-arid region of the Karoo is reported to impact adversely on biodiversity in general and predators in particular. Here we attempt to quantify the potential impacts of small livestock farming by comparing biodiversity and predator presence on farmland and protected areas within the Karoo. We used camera-traps established within a grid (0.5 camera/km²) to sample medium and large terrestrial mammals and large species of ground birds. We deployed cameras at 379 locations – 191 in the farms and 188 in the protected area and used the photographs taken during this period to estimate richness, occupancy and activity patterns of medium to large sized fauna. We obtained more than 12 000 independent images with a total sampling effort of 23 796 camera trap nights. Biodiversity on farmlands was higher than expected. Large predators were absent and there was a higher abundance of small to medium-size prey species. Predictably sheep were the most commonly detected species on farmland followed by

two medium-sized ungulates (common duiker and steenbok). In the protected area chacma baboon and oryx were the most common species and surprisingly two carnivores common on farmland were not detected. Activity of jackals and caracals on farmlands was mostly nocturnal while in the protected area it was cathemeral. Both species showed a habitat preference. Together our results show that biodiversity conservation can be achieved outside protected area, with small-livestock farms hosting a significant proportion of mammal and large ground bird communities.

ESTIMATING TRUE ABUNDANCE OF A NILE CROCODILE POPULATION USING A BINOMIAL MIXTURE MODEL FROM REPLICATED COUNTS: A CASE STUDY IN THE KUNENE RIVER SYSTEM, NAMIBIA.

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The Nile crocodile *Crocodylus niloticus* is found throughout sub-Saharan Africa, including in countries such as Namibia, Botswana and Angola. The species was transferred from CITES Appendix I to Appendix II in 2004, although it is recognised as peripherally endangered in Namibia due to diminishing habitat availability from human encroachment. In 2014 a species management plan was approved in Namibia to assess the management of the Namibian Nile crocodile populations, as the species plays an important role within the ecosystems that it occupies in the form of tourism and trophy hunting. The Nile crocodile population in the Kunene river system needs to be assessed as there are no previously published data available primarily due to the logistical difficulty in accessing large parts of the river system. An aerial survey was conducted to provide a true population estimate, making use of a recently developed N-mixture model for estimation of abundance and spatial variation. Detection of crocodiles from the air can be difficult and is also animal-size dependent, however an estimated 806 individuals were counted along the 352 km of the Kunene river system with a naïve estimate of 562 crocodiles regardless of size. The parameter estimates generated by the analysis demonstrated that the class-structured model can produce precise, unbiased estimates of total abundance and reliable estimates of local abundance for this population in the Kunene river system.



THE PEATLANDS OF THE HIGHLANDS OF LESOTHO - A UNIQUE AQUATIC SYSTEM UNDER THREAT

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Numerous hill-slope seeps and valley-bottom peatlands occur in the high-altitude headwaters of the Senqu River in Lesotho. These peatlands deliver important ecosystem services such as water retention, purification and slow release of water as well to sustain a unique plant and animal diversity. Due to the high altitude (mostly above 2 000m above sea level), a slow process of peat formation occur. On these peatlands a very unique plant community exists. Several plant species are peatland endemics. A communal grazing system exists in the highlands of Lesotho and these peatlands are one of the main sources of pasture for domestic stock. In order to describe the vegetation and species composition of these peatlands sample plots were randomly placed within these peatlands. All species were noted and their cover-abundance values were assessed according to the Braun-Blanquet scale. Environmental data such as slope, aspect, grazing, degree of erosion of the peatland were noted, while average height of plants were also noted. Data analysis was done using TWINSPLAN classification as well as CANOCO. The results reveal that the thurfur (elevated humps of peat) on the peatland supports a different plant association in comparison to the surrounding water-logged areas. Environmental factors such as wetland hydrology, drainage, erosion and biotic impact are playing important roles in the distribution of wetland-associated species. Several impacts are threatening to destroy these high-altitude wetlands and drastic conservation measures are needed to protect these unique ecosystems from total destruction.

A.P.E.S.: MERGING LOCAL SURVEY EFFORTS AND A GLOBAL PERSPECTIVE ON GREAT APES

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All great ape species are endangered according to the IUCN Red List. Global and regional information on population abundance, distribution, and spatio-temporal trends are key to informing conservation policy-making and buffering against emerging threats. Despite the many efforts in collecting great ape population data at numerous locations across Africa over the past 30 years, comparable country-, ape-range- and eco-region-wide information remains scarce. Together with partners of the ape conservation community, we initiated the

IUCN SSC A.P.E.S. (Ape Populations, Environments and Surveys) Portal (<http://apesportal.eva.mpg.de>), a platform that serves to centralize and standardize all existing ape survey information and provide access to extensive spatial and non-spatial information and analytical tools to assess ape population status, threats to their survival and conservation initiatives for their protection. Since its official launch in 2012, uses of the almost 300 data sets currently stored in the database have included the identification of important research and conservation gaps in Africa, the development of a model to predict range-wide ape distributions, regional threats and population changes over the past 20 years, an assessment of conservation effectiveness at all African great ape sites and site-specific risks of population extinctions. Furthermore, we investigated the effects of socio-economic constraints on great ape abundance to propose effective conservation strategies across increasingly human-dominated landscapes. Current projects include the development of a world-wide abundance model for all great ape species, the evaluation of co-benefits of carbon credits for climate, great apes and biodiversity protection, and the further development of web-based, interactive tools that allow scientists, stakeholders, and managers to analyze pressures impacting species within important ape sites and to support broad-scale site comparisons.

MANAGING EUROPEAN LARGE CARNIVORES AT THE TRANSBOUNDARY POPULATION LEVEL: THE ADDED VALUE OF THE ALPINE CONVENTION AND CARPATHIAN CONVENTION REGIMES

Jennifer Dubrulle

Tilburg University

Most European populations of brown bear (*Ursus arctos*), wolf (*Canis lupus*) and Eurasian lynx (*Lynx lynx*) are shared by two or more countries (8 of 10 bear populations; 8/10 for wolves; 10/11 for lynx). Most European states cannot host viable populations on their own. It is thus widely accepted that conservation planning for these species should be adjusted to the biological unit of each population, rather than to international frontiers. Detailed criteria for such transboundary population level management (TPLM) are set out in the Guidelines for Population Level Management Plans for Large Carnivores (Carnivore Guidelines), endorsed by the European Commission in 2008. I analyse the role of the applicable international legal framework as regards the implementation of TPLM, employing standard international law research methodology. Chief instruments are the Bern Convention on European Wildlife Conservation and the EU Habitats Directive. For two sets of large carnivore populations, the Alpine and Carpathian ones, additional legal instruments are in place, i.e. the Alpine and Carpathian Conventions with their Protocols on



biodiversity. Crucially, the geographic scope of these regimes is not defined by state boundaries but coincides approximately with the occurrence of the carnivore populations. Using the Carnivore Guidelines as benchmark, I assess to what degree each of the mountain regimes fulfils its apparent potential to serve as a forum for operationalising TPLM. The assessment covers the instruments' mandates, parties' duties, institutional frameworks, and actual steps towards TPLM of large carnivores. A comparison is made on these counts with populations that are only covered by the Habitats Directive and/or Bern Convention. Results indicate that, even if fully-fledged TPLM has not yet been achieved for any population, the two mountain regimes clearly give the Alpine and Carpathian bear, wolf and lynx populations an edge as compared to other European populations.

SCIENCE AND CIVIL SOCIETIES FOR CONSERVATION OF ENDANGERED, ENDEMIC BIRD SPECIES IN FRENCH OVERSEAS DÉPARTEMENTS.

Alison Duncan

Ligue pour la Protection des Oiseaux
François-Xavier COUZI, Société d'Etudes Ornithologiques de La Réunion ; Nyls DE PRACONTAL, Groupe d'Etude et de Protection des Oiseaux de Guyane ; Jean-Raphaël GROSDORMEAUX, Centre National de Recherche Scientifique ; Alizée RICARDOU, Groupe d'Etude et de Protection des Oiseaux Guyane ; Marc SALAMOLARD, Parc National de La Réunion ; Anna STIER, Groupe d'Etude et de Protection des Oiseaux Guyane ; Anne-France TOUVERON, Ligue pour la Protection des Oiseaux

Overseas entities harbour a key part of world biodiversity, and France is ranked 10th for the number of globally threatened bird species, on islands and in the 80,500km² of tropical rainforest in French Guiana. In 2007, the EU budget-line LIFE Biodiversity was opened to outermost regions (ORs), and LPO/BirdLife France prepared a project with local partners (ornithological NGOs and a National Park) in 3 ORs to conserve globally threatened species and one very rare habitat, and to allow networking for the NGOs. Each project is steered by a committee with stakeholders from research, government agencies, conservation management and civil society. This new funding instrument gives the small NGOs access to modern technology to acquire knowledge necessary for effective conservation and for the relevant actions; conservation has changed level in these vulnerable territories. In French Guiana, inselbergs contain leks of Cock of the Rock (*Rupicola rupicola*): telemetry allowed the movements of these birds to be discovered. Conflict between protection of the birds and different uses (by foresters, mining companies, tour operators) is reduced by better use of the sites by people. The world largest colony of Agami heron (*Agamia agami*) is in the Kaw Marshes, accessible only by helicopter. Satellite

transmitters enabled the key habitats and migration of this little-known species to be discovered for an Action plan. In La Réunion, a new method of controlling rats has led to an increase in the critically endangered Réunion cuckoo-shrike (*Coracina newtoni*, only 30 pairs in 2010). To discover the preferred habitat of White-breasted Thrasher (*Ramphocinclus brachyurus*), song-meters and Ecko-sensors were used in Martinique. Management of visits to the site has been improved and new sites identified for translocation. The network of the small NGOs in French ORs, supported by LPO, an experienced NGO in metropolitan France has enabled considerable growth in their capacity.

OVERWINTER SITE SELECTION OF A NORTHERN POPULATION OF WESTERN PAINTED TURTLES (*CHRYSEMYS PICTA BELLII*) IN A HYDROELECTRIC RESERVOIR ENVIRONMENT

Amy Duncan

Thompson Rivers University
Karl LARSEN, Thompson Rivers University

Winter represents a critical life cycle phase for many temperate species, often involving the use of specific sites that provide suitable overwintering conditions. Animals inhabiting anthropogenic environments may face additional challenges locating suitable overwintering sites, requiring different tactics to deal with different situations. In Western Canada, the Painted Turtle (*Chrysemys picta*) may spend up to five months overwintering submerged under ice. Within a hydroelectric reservoir in British Columbia, two main overwintering tactics (dispersive and communal positioning) have been observed between subpopulations. To investigate the factors responsible for this variation in behaviour, we (i) identified habitats used by overwintering turtles, (ii) evaluated habitat availability in the reservoir, and (iii) investigated reasons for the variation in spatial display. Turtles at both locations used overwintering sites typical of other populations of northern Painted Turtles: shallow depths (35 ± 19 cm), cool water temperatures (0.6 ± 0.8°C), normoxic oxygen content (> 0.5 mg/L) and loose substrate for burrowing (31 ± 25 cm). Tactics also shifted between years; turtles in the first study year displayed two distinct tactics between subpopulations, in the second year turtles in the previously congregated subpopulation displayed both tactics. Turtles exhibited under-ice movements between consecutive winter months which were correlated to water fluctuations; although this did not appear to affect turtle survival during winter. In conclusion, the variation in tactics shown does not appear to be correlated with the different environmental conditions that I studied (temperature, dissolved oxygen and water depth). The results of this work contribute to the knowledge of behavioural plasticity in animals, and also aid in the creation of conservation efforts for species inhabiting human-influenced environments.



BIODIVERSITY INFLUENCES ON MANGROVE FOREST MULTIFUNCTIONALITY AND ECOSYSTEM SERVICES PROVISION

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A recent shift away from traditional 'fortress conservation' toward ecosystem approaches to land management has seen an increase in focus in the dual goals of conserving biodiversity and the goods and services (ES) derived from the world's ecosystems. The potential success of such approaches demands a mechanistic understanding of how biodiversity and ecosystem functioning and ES provision are related. Currently, however, this understanding is hindered by a lack of research into multiple mechanisms (e.g. niche complementarity, mass ratio, selection effect) by which biodiversity may influence ES provision in real systems at scales at which the multiple ecosystem processes driving ES occur. Our study explores ecosystem multifunctionality and ES provision in mangrove forests in Panay island, Philippines. We examine how species richness, alpha, beta and gamma diversity, and functional richness and trait dominance (multiple mangrove species traits: growth form, maximum height, salt tolerance, rooting system complexity, average leaf area and litter fall rate) of mangrove species influences multiple ES provision (as indexed by soil organic carbon content, above- and belowground mangrove carbon storage, harvestable timber production, charcoal production and storm attenuation potential (as indexed by a combination of forest structure parameters (tree DBH and height differentiation and dominance factors))). We assess the biodiversity drivers of mangrove ES provision across two scales (within-site (plot level) and between-site), and discuss the relative mechanisms by which biodiversity drives multiple mangrove ES as well as discrepancies between the spatial scale considered. Our findings reveal important implications regarding the metrics and scales considered in B-ES research, as well as for mangrove forest rehabilitation and restoration efforts for the maintenance of their crucial ES worldwide.

ASSESSING THE ECOLOGICAL CONSTRAINTS ON MANGROVE FOREST RESILIENCE TO SEA LEVEL RISE GLOBALLY

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Mangrove forests are highly important ecosystems, providing habitat and resources for biodiversity and a plethora of ecosystem services benefits to humanity. At a global scale they play a vital role in climate regulation as some of the most carbon-rich forests in the tropics, and locally afford coastal protection from extreme weather events such as hurricanes and tidal surges, and food and timber resources. However, due to the effects of multiple interacting global threats of land-use (particularly for aquaculture) and climate change, mangroves are now one of the world's most threatened biomes. Mangrove forests are highly sensitive to environmental and ecological changes. The future outlook for mangroves is thus severely compromised by climate change, and particularly by sea level rise (SLR). Mangroves can exhibit resilience to SLR through expansion at their inland fringes. However, the strong influence of hydrology and inundation on mangrove ecology and zonation means that inland expansion is only possible if appropriate sloping conditions exist. Applications of remote sensing analyses to these largely remote areas have enabled the mapping of both mangrove coastline retreat and inland expansion under SLR. However, tropics-wide coverage of studies is limited, restricting our understanding of potential generalities in the contextual and ecological requirements promoting resilience to SLR, and hindering the direction of management priorities for land-use planning. This work aims to fill this knowledge gap, utilising moderate resolution radar and multispectral satellite data (ALOS PALSAR, Landsat 5 TM and ASTER) across 12 mangrove sites currently affected by SLR to explore conditions (elevational and climatic) under which mangrove inland expansion is promoted. This poster discusses the methodologies that will be employed in this study, and presents some preliminary findings from one study site in the Ruvuma Estuary Marine Park on the border of Tanzania and Mozambique.

SYMPOSIUM#163_ECOSYSTEM-BASED ADAPTATION AND TRANSFORMATION: ADAPTATION SERVICES AND PATHWAYS

Michael Dunlop

CSIRO

Russell WISE, CSIRO; Sandra LAVOREL, CNRS; Matthew COLLOFF, CSIRO; Russell GORDDARD, CSIRO; Paul RYAN, Australian Resilience Centre; David HOLE, Conservation International

Many ecosystems have the potential to be resilient to small amounts of climate change, thereby preserving biodiversity and helping people adapt to climate change. However, widespread and significant impacts on ecosystems are possible by the second half of the century. How does this affect their



ability to conserve biodiversity and sustain livelihoods? Are the two complementary or alternatives? What sort of ecosystem management might be effective? The answers to these questions will depend critically on the range of trajectories of ecological change that are possible in different contexts. Some ecosystems may be able to transform, remain healthy and continue to sustain livelihoods. However, others may become more vulnerable to being degraded by the actions of ecosystem-dependent communities, losing biodiversity and failing to support livelihoods: a lose-lose outcome. Trajectories of change may be known for some ecosystems and in the near-term. However, future ecological trajectories in the face of more significant climate change, and the extent to which changing ecosystems can sustain human impacts, are likely to be unknown for many ecosystems. We discuss how an adaptation pathways approach could be used to help communities and their partners plan for future but uncertain ecological change, avoiding maladaptive decisions and creating and maintaining future adaptation options. The approach considers the range of ecological trajectories in response to climate change and other factors, different ecosystem services and livelihood options potentially available under different trajectories, the decisions needed to manage ecological change and the delivery of ecosystem services, how knowledge, social and institutional factors may inhibit or enable decisions, and temporal dependence of climate change, ecological responses, decision making and social change. Discussion will draw on examples from around the world.

HEARD BUT NOT SEEN: EXPLORING ACOUSTIC MONITORING METHODS FOR WILD TIGER POPULATIONS

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Development of new methods of remote monitoring is essential for more efficient as well as minimally disruptive census of species where dense jungle prohibits visual confirmation. This is particularly important for *Panthera tigris* whose populations have plummeted by over 50% within the past century and whose ranges have been reduced to 7% of their historic lands. With the population decline of many other forest-dwelling species following that of this flagship species, it is important now more than ever to establish an efficient, all-encompassing census method for such landscapes. We sought to determine what makes an individual tiger's call unique in hopes of developing a non-invasive acoustic monitoring system within rangeland countries. To answer this question, spectrogram outputs of 265 bouts from approximately 1,618 hours of recording were analyzed to determine vocal characteristics from eight female and nine male adult Bengal tigers residing in controlled, ex-situ conditions. Volunteers

extracted data on minimum and maximum fundamental frequencies, duration of bouts, inter-call intervals, average call duration, first call duration, and the time of day a vocalization occurred. Comparison of acoustic parameters among the 17 individuals revealed a significant difference existed between sexes as well as among individuals. We are beginning to collect vocalizations from Amur, Sumatran, and Malayan subspecies to determine if these differences continue species wide. The apparent complexity of tiger vocalizations will potentially enable a vocal "fingerprint" to be assigned to individuals, which, in turn would allow for censusing when using microphone arrays placed strategically over tigers' home ranges. Increasing ease of access to bioacoustics tools has also expanded interest to not just other scientists but government agencies which can benefit from the automated detection of threatened native species which rely largely on vocal communication.

PROTECTED AREA PLANNING, INSTITUTIONAL DESIGN, & IMPLICATIONS FOR ECOSYSTEM SERVICE DELIVERY: A COMPARATIVE ANALYSIS OF INDONESIAN REEF COMMUNITIES

Kelly Heber Dunning

MIT

Common pool resource management theory tells us that given an appropriate institutional design, shared resources can be managed to ensure that dependent communities benefit from healthy environments. These benefits can be conceptualized as ecosystem services, and in coastal communities these include fisheries provisioning, incomes from eco-tourism, and erosion and extreme weather buffering. An ever-expanding institutional framework to enhance ecosystem service delivery is the marine protected area (MPA). This study examines participatory planning in MPAs, theorizing them as institutions for shared resource management, and hones in on 1) collaborative planning for risk, and 2) adaptive learning. The research explores what specific form participation, risk planning, and learning can and should take in order to ensure ecosystem service delivery in communities implementing MPAs. I use two cases in Bali, Indonesia where co-management of MPAs is occurring, where instead of a top down bureaucratic formulation of natural resource management, the central government has instead devolved responsibility to communities who are dominated by reef-dependent livelihoods such as subsistence fishing and dive or snorkel tourism. This study is a comparative one, where case communities have bounced back from years of dynamite fishing but with different biophysical and social outcomes. I use qualitative and quantitative methods to formulate my independent variable (institutional makeup around participatory reef governance via an MPA), and



biophysical reef surveys to formulate my dependent variable. My findings include: 1. Participatory risk planning did not occur in the community with healthier reefs as hypothesized. 2. Cooperative education programs where tourists and visitors were the intended audience did occur in areas with healthy reefs. 3. High levels of participation and interpersonal trust did not predict healthier reefs.

VULTURE ATTACKS? THE IMPORTANCE OF CONSIDERING PUBLIC AWARENESS AND COLLABORATION FOR A BETTER UNDERSTANDING OF VULTURE/LIVESTOCK INTERACTIONS

Olivier Duriez

CEFE-CNRS

Raphaël NEOUZE, Ligue pour la Protection des oiseaux ; Régis GALLAIS, Office National de la Chasse et de la Faune Sauvage

In southern Europe, vultures evolved together with extensive livestock farming. The quartering service provided by these scavengers has been used and appreciated by farmers since Antiquity. With the decline of vultures in the 20th century, this ancestral relationship was broken, and only re-established with the recent recovery of vulture populations, particularly in Spain and France thanks to conservation and reintroduction programs. In French Grands Causses along with a reintroduction program started in 1981, farmers are voluntarily creating feeding stations to benefit from vulture scavenging services. However, complaints about vultures attacking livestock appeared in both countries in 1995, with media reporting changes in vultures' behavior. After a wave of complaints in the Pyrenees, the cases also increased since 2007 in Grands Causses. To understand these events, the local partners created a "vulture & livestock committee", gathering farmers, conservationists, animal health services and state agencies. It works on 4 themes: census of events, carrion management, communication and procedures. Since 2010 for each complaint, a standardized procedure is followed by a state warden and a veterinarian, to determine the cause of the animal's death and the role of vultures. We analyzed 156 official reports. Complaints generally occurred at the periphery of vulture home range (determined by GPS tracking) and close to known feeding sites. Cause of the death could be assessed for 59 reports and vultures were never the primary factor. On 17 cases, vultures consumed ante-mortem an animal, already condemned and suffering partial or total immobility. Since most complaints happened in areas sparsely visited by vultures, our analysis suggests that the perception of attacks is mostly due to a lack of awareness about vulture natural feeding behavior and environmental education in these areas. Also, the role of mass media in spreading rumors is not negligible.

COMPLEX INTERACTIONS BETWEEN LONG STANDING INTRODUCED RATS AND NATIVE PLANTS IN A NEW-CALEDONIAN RAINFOREST

Quiterie Duron

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The new-Caledonian archipelago is listed as one of the 35 biodiversity hotspots with an unusual rate of endemism on flora (80%). Unfortunately, this heritage is threatened by various invasive species including rats. Number of studies worldwide quote strong negative rat impacts on plants by seed and fruit predation but few others suggest potential rat positive roles in native seed dispersion. Thus, studying the interactions between invasive rats and native plants is crucial to make adequate management decisions. We studied the effects of two sympatric invasive rat species (*Rattus rattus* and *R. exulans*) on native new-Caledonian plants in a dense evergreen rainforest through three experiments: i), we intensively studied rat diet by evaluating the abundance of native plants items in 330 rat stomachs, collected in 3 different seasons; ii), we set up an in situ fruit consumption experiment using camera traps testing 3 major palm tree species; iii) we studied the effects of fruit predation by rats on seed germination performances via captive feeding trials and seed germination experiments compared with effects of native dispersers (flying foxes and frugivorous birds). Results showed that native flora make up a large proportion of rat diet: 76% of



R. rattus and 38% of *R. exulans* diets. Palm fruit predation rates observed during 7 days differed between the 3 species tested (11-92%). Conversely, small seeds remained intact after rat predation and may be dispersed by rats. The results showed strong interaction between rats and native plants, especially for *R. rattus*. However, even if invasive rats were proved to induce severe deleterious effects on native flora, our study also confirmed that they may help maintaining ecosystem functions and contribute to new ecosystem equilibriums. Such cost-benefices analysis has to be taken into account to evaluate the opportunity to control invasive rats for restoring native biodiversity.

DIVERSITY IN INVASION: VARIATION IN THE INVASIVE ECOLOGY OF AUSTRALIAN POTAMOPYRGUS ANTIPODARUM CLONES

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The distribution and spread of an invasive species is governed by many stochastic, environmental and evolutionary factors. In particular it has been established that genetic diversity and evolutionary factors may affect the ecological processes that govern species distributions. Despite this it has often been taken for granted that the way in which an invader interacts with its environment is homogenous among invasive populations. We measured the variation of ecological responses of distinct clonal lineages of an invader of Australian freshwaters, *Potamopyrgus antipodarum*. *Potamopyrgus* is an invasive freshwater snail of global significance, having invaded waters in Europe, Australia, Asia and North America. Using genetic markers, three clonal lineages were identified amongst south-eastern Australian populations. The lineages were then exposed to environmental stressors and their survival, growth and reproductive output were measured. We found differences amongst clonal lineages in their ecological responses to environmental stressors. Some of these differences were associated with the distributions of different lineages across their invaded range in south-eastern Australia. These findings illuminate the role of important environmental variables in shaping the spread of *P. antipodarum* and imply that some clonal lineages may be more "invasive" than others. The findings of this study also have implications for models used to forecast invasive range of species, violating a common assumption of homogeneity in species ecology across invasive populations.

ID #191: THE EFFECTIVENESS OF CELEBRITIES IN CONSERVATION MARKETING

Elizabeth Duthie

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With the increasing recognition that conservation is ultimately dependent on human behaviour and attitudes, there is a growing need to ensure that communications between the conservation community and the public are effective. Whilst there is a strong emphasis on monitoring and evaluation in other areas of conservation, there is limited or no testing and analysis of the methods used to communicate with different stakeholders by the majority of conservation NGOs. Given the importance of remaining visible and relevant on the global stage, conservation NGOs should be ensuring their marketing outputs and communications are in line with current best practice. Celebrity endorsement is a popular, and often used, technique for generate income and awareness, both for commercial brands, and for non-profit organisations. Conservation marketers use celebrities such as Leonardo DiCaprio, HRH The Duke of Cambridge and Yao Ming to raise awareness, generate funding and effect behaviour change. However, whilst celebrity endorsement effectiveness is extensively evaluated in other marketing fields, we found no evaluation or testing of the effectiveness of celebrity endorsement has been conducted by researchers or conservation organisations to date. Without this analysis, conservation NGOs are unable to ensure their celebrity campaigns are reaching the correct audience or communicating the message successfully. We assessed the effectiveness of celebrity endorsement against several advertising key performance indicators. Whilst we found that celebrities are more effective than non-celebrities in generating positive Willingness-to-Engage behavior, celebrities are less effective at generating campaign message recall than non-celebrities. Furthermore celebrity endorser credibility is a key factor in determining public engagement. I will discuss these findings and their implications, and look at other areas that require research to ensure conservation is being communicated effectively.

COMMUNITY-BASED CONSERVATION - A KEY TO SUCCESSFUL CONSERVATION IN MAIO ISLAND, CAPE VERDE

Amanda Dutra

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Maio Island is largest remaining island in the Cape Verdean Archipelago that has escaped mass tourism. The island is a major nesting site for endangered loggerhead sea turtles, it has significant whale and dolphin populations, and important breeding shorebird populations. Maio Biodiversity Foundation (FMB) was established in 2010 to protect wildlife, with the support of local communities. Before FMB's turtle conservation project, the island had the highest rates of killed females and poached nests in Cape Verde. In 2013 FMB developed a new conservation strategy: from July to September protection teams were placed in 8 coastal villages around the island to patrol 25km of nesting beaches. Night patrols ensured the protection of turtles and also the first daily data collection ever done on Maio's nesting beaches. As a result, the number of killed females was reduced by 75% on the protected beaches as compared to the same area the previous year (152 versus 38 in 2012 and 2013, respectively), and only 2% of the nests were poached. The integration of the teams in the communities made the conservation efforts more visible to the villagers, which had opportunities to join patrols and awareness events. In addition, host families received financial benefits for their hospitality. The combination of direct protection, practical education and turtle friendly income opportunities was the key to the success of this strategy. Based upon these experiences, in 2014 FMB started training community-lead monitoring of the largest protected area in Maio Parque Natural da Ilha do Maio as well initiated participatory monitoring of marine megafauna species such as whales, dolphins, turtles and sharks.

CONNECTING THE DOTS: CONNECTIVITY MAPPING FOR TIGERS IN CENTRAL INDIA

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Connectivity between Protected areas (PAs) is an important feature of a conservation landscape because it maintains natural dispersal pathways for wildlife. Due to their inherent wide ranging movement patterns, large carnivores are excellent focal species for connectivity and landscape level conservation planning. In order to conserve viable populations of species that depend on long distance movement and dispersal, conservation needs to take place at a level larger than individual PAs, such as a larger landscape or at a regional scale. Tigers (*Panthera tigris*) act as a flagship species for the conservation of forested ecosystems throughout their range in Asia, and typify the challenges and opportunities of large carnivore conservation elsewhere. Dispersing tigers are very

important in the viability of the population because they have the potential to colonize new areas, and spread their genes with other populations. These individuals need pathways that connect good habitat patches that are conducive to successful animal movement and dispersal. In developing countries such as India that have burgeoning human populations and shrinking forest areas, it is a challenge to maintain and carve additional protected areas. The existing PAs are too small, scattered, and insufficient to support viable populations of wide-ranging species in the long term. We mapped connectivity in the Central Indian Landscape, and examined landscape features that are important to tigers during dispersal. This landscape is part of the Global Tiger Recovery Program, and holds a significant population of the country's wild tiger population. Here, I discuss the existing connectivity in the region, and identify pinch points, i.e., sections of the corridors that are of disproportionately high conservation value. We anticipate that the outcomes of this study will be used in the planning and management of the landscape.

THE GLOBAL DATABASE ON PROTECTED AREA MANAGEMENT EFFECTIVENESS: HISTORY, GLOBAL STATISTICS, AND FURTHER DEVELOPMENT.

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Reliable information on the effectiveness of protected area management is essential to assess the performance of protected areas. Building upon the World Commission on Protected Areas (WCPA) framework for assessment of protected areas, in 2006, WWF and TNC established the Global Database for Protected Area Management Effectiveness (GD-PAME). The GD-PAME has been redeveloped and linked to the World Database on Protected Areas (WDPA) and is managed by UNEP-WCMC. It is the most comprehensive global database of methodologies and associated indicators designed to assess protected area management effectiveness. The database contains 95 methodologies and over 17,000 assessments for many different protected areas globally. The results of the assessments are converted to a common reporting format which is used by national ministries and international organizations to: improve protected area management, better allocate resources and measure progress towards global conservation biodiversity targets. However, the GD-PAME is not without its limitations. For example, only a few PAME methodologies include quantitative social and biological data, making it difficult to evaluate whether effectiveness of protected area management translates into positive biodiversity outcomes. . Furthermore, there is an



under-representation of assessments in several regions across the world's protected area estate. To address these limitations, efforts are being made to integrate biodiversity and social information into the GD-PAME and bring existing data from these regions together in order to offer a more globally complete dataset. We review the evolution and application of the GD-PAME, highlighting key statistics derived from recent analyses, and caveats associated with analytical decisions made in preparing the database. We then explain the recent improvements made to the database and how these will help move the conservation agenda forward.

USING POPULATION CONNECTIVITY MEASURES OF FISHERY-TARGETED CORAL REEF SPECIES TO INFORM MARINE RESERVE DESIGN

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Coral reefs are some of the most beautiful and diverse ecosystems on the planet, yet are vulnerable to mounting anthropogenic pressures such as overfishing. Marine protected area (MPA) networks have become important tools for mitigating these pressures, but their implementation requires multiple pieces of scientific information to ensure that they are effective. One of the most critical factors in determining spatial design for MPA networks is the degree of connectivity among different populations of species targeted for protection. In order to delineate this connectivity, it is important to calculate the magnitude and direction of gene flow occurring among populations. In this study, we investigate the connectivity patterns of three species commonly targeted by fisheries in Fiji, in order to inform the spatial design of a large MPA network within the country. Using mtDNA sequences, we characterize the degree to which different populations within five regions of Fiji were related, estimate per generation migration rates, and describe the ability of upstream populations to provide larvae to downstream areas. Taken together, these data provide important information to management officials for the protection of economically as well as ecologically important species through the creation of MPA networks.

ESTIMATING IMPACT LEVELS FOR SUSTAINABILITY RISK ASSESSMENT OF NEW ZEALAND DEEPWATER FISH STOCKS

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Until recently, the majority of by-catch species in New Zealand have been managed using qualitative indicators of status, without reference to estimates of productivity or exploitation rate. A semi-quantitative sustainability risk assessment for non-

target fish species captured using trawl and bottom longline methods in New Zealand deepwater fisheries is presently under development. The assessment framework relies on the impact/threshold approach to risk evaluation, which consists in the estimation of a spatially-explicit fisheries by-catch level relative to a population size proxy, and a maximum impact sustainable threshold derived from productivity parameters. A number of alternative methods are being developed for estimating fisheries by-catch and impact levels with reference to the information needs of fisheries managers charged with managing impacts on non-target species by New Zealand fisheries, and the known availability of data and ecological knowledge to inform inputs into the risk assessment process. This presentation will give an overview of progress made, with preliminary applications to selected by-catch species.

ID 161: MARINE SPATIAL PLANNING: TOWARD ECOSYSTEM-BASED MANAGEMENT

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Among many coastal countries Marine Spatial Planning (MSP) has become the preferred management approach to address increasing conflicts among multiple uses of coastal and marine areas, including their contiguous exclusive economic zones (EEZs)—about 40 countries are now experimenting with MSP. Over the next decade another 30 countries, including the 23 coastal countries of the European Union (EU) and North America, will develop and approve marine spatial plans that will cover about a third of the surface area of the EEZs of the world. A common theme underpinning these concepts is the importance of ecosystem-based approaches to manage human uses and sustain ecosystem services while adapting to the impacts of climate change. The new challenges of climate variability and change, alongside the other existing drivers that cause depletion and degradation within coastal and marine ecosystems, increases the urgency and the need to scale up these efforts at national and regional scales. There is now a need to support adaptive ecosystem-management and governance that is informed by and evolves through on-going learning and adaptive processes, to help increase the resilience of marine ecosystems and well-being of societies dependent on marine goods and services. MSP is a practical, operational approach that has the promise of implementing marine ecosystem-based management. The status of MSP around the world will be described, including an assessment of how many of these initiatives actually take an approach that can be described as "ecosystem-based." Lessons learned regarding the success of ecosystem-based MSP initiatives will be identified.



LANDSCAPE-SCALE EFFECTS OF PRESCRIBED FIRE AND WOLVES ON ELK UTILIZATION OF ASPEN IN THE CANADIAN ROCKY MOUNTAINS

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We conducted a landscape-scale study of aspen (*Populus tremuloides*) and elk (*Cervus elaphus*) response to a 2008 prescribed fire (1200 ha) in Waterton Lakes National Park, AB. Parks Canada set the fire in an aspen parkland in elk winter range, to reduce aspen land cover and restore fescue (*Festuca* spp.) within the burn unit. At this site, which contains 1-2 wolf (*Canis lupus*) packs, aspen provide a key elk food, and elk are the dominant herbivore by biomass. Previous research in non-wolf systems found a strong positive relationship between aspen sprouting, fire severity, and elk browse, with little to no aspen recruitment. We hypothesized that in a wolf-elk-aspen system, elk would avoid areas of highest fire severity, due to the high predation risk created by thick vegetation and coarse woody debris at such sites. We measured aspen and elk response to the fire annually for 6 years (2008-2013). We used an information theoretic approach to test our hypothesis, generating predictive models to examine the influence of fire severity (snag basal area), site index (a measure of productivity), shrub cover (proportion), aspen sprout density (per ha), and distance to edge of the aspen parkland (m) on the proportion of aspen sprouts browsed. We used GPS-collar data to confirm elk use of the parkland and camera traps to confirm wolf activity. Elk browse declined with increasing distance from the edge of the parkland ($p=0.0008$). We examined models $< 4 \Delta$ AIC values of the best-fitting model. Fire severity ($p<.0001$), aspen sprout density ($p<.0001$), and site index appeared in the best-fitting models, with increases in these variables linked to a decrease in elk browse. Elk avoided areas with the highest sprout density, productivity, or fire severity. This avoidance may be associated with a preference for the heightened post-fire nutritional value of fescue, energy conservation due to the higher energetic cost of moving through burned forest, and avoidance of wolf predation.

DO LIMITS TO THE GLOBAL OIL SUPPLY INCREASE THE RATE OF DEFORESTATION AND BIODIVERSITY LOSS?

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Biodiversity loss is driven globally by the expansion of human land-use, in particular, agriculture. The expansion

of agriculture has slowed over the last 50 years due to the green revolution, with an increase in agricultural intensity achieved largely through the use of petrochemical-based fertilisers. The mid 2000s saw a transition in oil production where the supply became unresponsive to increased demand pushing up the price of petrochemicals and the products made from them, including fertilisers. Such constraints to the oil supply threaten to reverse the agricultural intensity gains of the green revolution and put increased pressure on biodiversity. Land and food speculation and the search for alternative energy sources which ensued from the oil transition also increase the demand for land. This study measures the change in the rate of deforestation and maps the resultant change in threat to biodiversity as the oil supply became inelastic. The rate of deforestation increased by 29% in the second half of the 2000-2012 period, resulting in the loss of an additional 290,000 km² of forest. Spatially, the areas of increased forest loss broadly corresponded with the areas of highest biodiversity but there was little correspondence with the land-grabbing phenomenon (large-scale, corporate land acquisition). Statistically significant areas of increased threat to biodiversity generally lie in a band through the tropics, in Asia from southern China to Indonesia, across Africa from Angola to Madagascar and in the Americas from Paraguay to southern Mexico. Conservation efforts need to be aware of the accelerating rate of loss, and of the coincidence of the loss with the areas of highest biodiversity.

THE EFFECTIVENESS OF THE PROTECTED AREA NETWORK IN MADAGASCAR

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Networks of protected areas form the backbone of biodiversity conservation. However, pervasive threats such as illegal deforestation are high within protected areas, jeopardizing the success of this conservation measure. Analyses of the effectiveness of protected areas have revealed that confounding factors correlated with both protection and extractive behaviors affect effectiveness perceptions. We investigated the effectiveness of the Madagascar protected area network in reducing deforestation rates while accounting for confounding factors such as remoteness and accessibility. We developed a novel, computationally efficient methodology to get an overall assessment of the effectiveness of the protected area network as a whole, accounting for distance to roads, rivers, major cities and altitude/slope. The assessment was independently conducted for two different time periods, 1990-2000 and 2000-2005, linking the differences to trends in the political discourse in the country. We find lower



deforestation rates inside protected areas than outside, but the network only mitigate the pressure of deforestation slightly, most of the decrease can just be attributed to the confounding factors rendering the land assigned for protection less likely to be deforested. This result emphasizes the need to improve the protected area management and the importance of expanding protected area networks in a systematic manner, based on ecological considerations. However, we also note important regional differences that need further assessments. Our methodology is computationally efficient and can be scaled up for larger studies. The work has clear practical implications for the conservation of Madagascar's biodiversity and the results are of potential interest for both NGOs and the Madagascar National Park administration.

BIOREMEDIATION OF PETROLEUM HYDROCARBONS FROM DIESEL CONTAMINATED SOIL WITH THE EARTHWORM - EUDRILUS EUGENIAE

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A laboratory study on the bioremediation potentials of the earthworm *Eudrilus eugeniae* Kingberg in soil contaminated with diesel was investigated at the main campus of University of Benin, Benin City, Nigeria. Dried and sieved soils were contaminated with 5ml each of diesel with replicates and inoculated with earthworms and monitored daily for 12 weeks. Physical and chemical parameters such as pH, total organic carbon, sulphate, nitrate, phosphate, sodium, potassium, calcium and magnesium were determined using standard procedures. Total petroleum hydrocarbons (TPH) was determined using Atomic Absorption Spectrophotometer (AAS), while benzene, toluene, ethylbenzene and xylene (BTEX) constituents and earthworms tissues were analyzed using Gas Chromatography with Flame Ionization Detector (GC-FID). The physical and chemical conditions showed a decrease; pH (3.0%), total organic carbon (49.22%), sulphate (60.59%), nitrate (60.65%), phosphate (60.80%), sodium (60.65%), potassium (60.67%), calcium (60.67%), magnesium (60.68%). TPH decreases by 84.99%. BTEX decreases by benzene (91.65%), toluene (100.00%), ethylbenzene (100.00%) and xylene (100.00%). Analyses of the tissues of the earthworm at the end of the experiment showed that the earthworms bioaccumulated/biodegraded 57.35/27.64% TPH, 38.91/52.73% benzene, 27.76/72.24% toluene, 42.16/57.85% ethylbenzene and 09.62/90.38% xylene. The results showed that the earthworms *Eudrilus eugeniae* could be used to bioremediate moderately polluted soil with diesel contamination in the Niger Delta region of Nigeria.

DOES AGRICULTURAL LAND-USE INTENSITY DRIVE THE LOSS OF RARE BEE SPECIES IN CENTRAL EUROPE?

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An increasing number of studies find no relations between bee species richness and land-use intensity, or only for a subset of all species, but do find consistent relations with landscape structure. However, the effect of land-use intensity may have been underestimated as most individual studies consider fairly restricted intensity gradients. In particular, whether species loss leads to nestedness of bee communities caused by a systematic loss of rare species, or species with restricted foraging ranges, is not known. Here we investigate this relationship using 202 grasslands covering the whole range of low intensity, no-input systems, to high-input sites (>300 kg N/ha/year) across Central Europe. The data were collected in The Netherlands, Germany and Switzerland. The grasslands were embedded in agricultural landscapes varying from 0 to 100% agricultural land. We found that species richness of bees measured at the plot scale was not explained by nitrogen inputs or by percentage arable fields in the surrounding landscapes. In contrast, the proportion of rare species observed in the bee assemblages were non-linearly related to landscape structure, peaking in landscapes with intermediate amounts of arable land. Those bee communities containing high proportions of rare species also included the largest share of species with a restricted foraging range. Finally, we found that neither land-use intensity nor landscape structure caused significant nestedness in bee communities. This was explained by the fact that communities dominated by common species were species-poor, but species-poor communities could also largely consist of rare species. This created a high degree of turnover of species in bee communities across the studied grassland sites. Our results revealed surprisingly weak effects of land-use intensity on the species richness and community composition of bees. Possible implications at larger spatial scales relevant for conservation measures will be discussed.

EPIPELAGIC MESOZOOPLANKTON DIVERSITY AND DISTRIBUTION IN ATLANTIC COAST OF SOUTHERN MOROCCO (CAPE BLANC 21°N - CAPE BOUJDOR 26°30'N)

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The purpose of this study is to attempt to explain how is epipelagic mesozooplankton distributed along the South Atlantic Moroccan shore and how fluctuate and intervene environmental parameters, as zooplankton has a main position in the trophic food web especially copepods; that are consumed by small pelagic fishes which are abundant in this area. Furthermore, this area is submitted to a permanent upwelling activity and is consequently the most productive zone of Moroccan shore. Actually, this work is part of CCLME program (Canary Current Large Marine Ecosystem). Two surveys were carried out in this area, one in November 2011 and another in July 2012 aboard the Norwegian ship 'Fridjof Nansen'. During cruises, mesozooplankton were collected over 7 transects, within 5 depth ranges of the water column (0-25, 25-50, 50-75, 75-100 and 100-200 m) at several stations from Cape Blanc 21°N to Cape Boujdor 26°30'N. Some environmental parameters were measured in situ using a multiprobe CTD: chlorophyll 'a', temperature, salinity and dissolved oxygen. Vertical profiles of mesozooplankton's densities have shown that highest values are observed in the superficial and intermediate layers and were also higher in the shallower during both seasons. The group of copepods seems to be the predominant component all over the water column, they constitute more than 90%. In total, 74 copepod species were identified and cosmopolitan species were dominant. According to Shannon-wiener index, diversity was higher in summer than autumn. A Principal Component Analysis has been performed on copepods densities in relation to environmental parameters and method of clustering too. Vertical profiles of hydrological parameters have shown a cooler temperature and high chlorophyll 'a' concentrations in shallower stations. Key words: Southern Atlantic coast; Mesozooplankton; Copepods; Upwelling and environmental parameters.

BUILDING AN IMMUNOME FOR THE GOPHER TORTOISE: IS THERE A GENETIC BASIS TO UPPER RESPIRATORY TRACT DISEASE?

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Genetic diversity at functional genes such as those involved in immune responses can influence individual fitness and population viability. Populations of threatened species typically have low overall genetic diversity and are depauperate in immunogenetic variation, which can negatively influence disease susceptibility. Most studies of immunogenetic variation in the threatened wildlife have focused on a handful

of genes, but genomic resources and next-generation sequencing now enable researchers to assess hundreds of immune genes simultaneously. In this study, we filtered the genome of the western painted turtle for genes involved in immune response (i.e., the immunome) and then designed reagents to acquire these genes from a species of conservation concern, the gopher tortoise (*Gopherus polyphemus*), to better understand the genetic basis of disease susceptibility. Gopher tortoises are associated with long-leaf pine forests of the southeastern United States and are susceptible to an infectious and occasionally deadly upper respiratory tract disease. We sequenced the immunomes of 16 gopher tortoises from 4 populations along an east to west gradient covering the range of the species and assessed population genetic diversity and differentiation. Nearly all desired genomic regions were represented, and we obtained approximately 20000 variable single nucleotide polymorphism (SNP) loci. Population genetic diversity and differentiation estimated with SNP loci paralleled patterns previously inferred by genotyping more than 19 tortoises per population using 10 microsatellite loci. Further work will involve sequencing immunomes from healthy and sick gopher tortoises to better understand what genetic variants are associated with susceptibility to upper respiratory tract disease. Our study illustrates the effectiveness of immunome sequencing as a practical tool for not only population but also conservation genomics.

PROMOTING SUSTAINABLE COMMUNITY-BASED SEA TURTLE CONSERVATION IN AKASSA WETLANDS, BAYELSA STATE, NIGERIA

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Akassa wetland is located in the Niger Delta at the southernmost tip of Nigeria along the Atlantic coast. It lies between 4° 21' N and 5° 59' E and consists of three barrier Islands separated by the Nun River, the Sangana River and the Fishtown River. The wetland is highly threatened by the unsustainable forest harvesting and massive oil exploration in the region. Akassa sand beaches (Oginibiri beach, Okumbiri beach- turtle beach, Fishtown beach and Sangana beach) play host to migratory sea turtles and serve as nesting sites for these endangered species. Three species of sea turtles more frequently seen in Akassa are: Leather Back Sea Turtle (*Demochelys coriacea*), Green Turtles (*Chelonia mydas*) and Olive Ridley (*Lepidochelis olivacea*). The rates of migration are higher during the breeding seasons-between September and February yearly. Despite the threat of oil spill and restiveness in the region, community support for conservation of endangered sea turtles has been strengthened through awareness campaigns and rallies conducted across the Akassa wetland by the Sea Turtle Club (a voluntary club of over



100 members). The turtle club activities has helped increase community support for sea turtle conservation and reduced killing of sea turtles by 85% in five years. The construction of a turtle observatory at the turtle beach has also initiated concerted efforts to improve activities of the youth group and facilitate responsible ecotourism in the Akassa wetland. Sea turtle conservation initiatives in Akassa need to be prioritized; focused capacity building on techniques for preserving and protecting turtle eggs at the nesting sites, incubation technologies, materials and best practices for turtle tagging will facilitate sustainable sea turtle conservation activities in Akassa wetlands.

LOW-INPUT FARMING PRACTICES SUPPORT BETTER PEST CONTROL THROUGH HIGHER ABUNDANCE OF NATURAL ENEMIES IN HUNGARY

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Modern agriculture in Europe has simplified the traditional agro-ecosystems and replaced the ecosystem services with increased external inputs of energy and chemicals. In order to search targets of sustainable development, agriculture needs to be more productive, while minimizing its negative environmental impact. The aim of the Liberation FP7 project was to achieve such ecological intensification by enhanced invertebrate communities and related ecosystem services through reduced level of management intensity. To quantify the impacts of ecological intensification on winter-wheat production, we tested how pest organisms and their natural enemies were affected by landscape properties and by local field management such as experimentally manipulated fertilizer and insecticide use in Hevesi-sík Region, Hungary, Central Europe. We stratified our 24-plot sampling design according to the proportion of semi-natural habitats in the landscape and soil organic matter content. The fertilizer application had no consistent effects on the phenology of the wheat, however the prevalence of pathogen fungi tended to be higher in low input plots than in high-input ones. The abundance of carabids and spiders was higher in the low-input plots than in the high ones. Aphids showed an opposite distribution, suggesting successful pest control in the low-input plots. These results supports the possibility of ecological

intensification that is to substitute agrochemicals with ecosystem processes without loss in yield.

SAMPLING DESIGN MAY DISTORT THE ESTIMATIONS OF MARK-RECAPTURE MODELS FOR CARABUS HUNGARCIUS

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One of the most important question of mark-recapture studies for insects is whether the sampling design may bias the applied statistical models for estimation of population parameters such as survival or recapture rate. We intended to study the effect of different spatial arrangement of pitfall traps on the capture/recapture rate of *Carabus hungaricus* and in addition on the applied statistical model's estimations for capture history data such as Jolly-Seber/Cormarck Jolly-Seber models. The pilot site was a Pannonian sand steppe (*Festucetum vaginatae*) located in the vicinity of Táborfalva village, Hungary. We used two spatially different sampling grids of non-baited pitfall traps between September 1 and November 30, 2013. The inter-trap distance in the grid "A" was four meters, while in the grid "B" it was two meters, each grid consisted of 64 traps. We found that there was no difference in the number of captures (Grid „A”: 200 individuals, Grid „B”: 209 individuals). However, the survival rate (Grid „A”: 0.04 ± 0.004 , Grid „B”: 0.1 ± 0.02) and the estimation of population size (Grid „A”: 129 ± 9 individuals, Grid „B”: 329 ± 65 individuals) were different between grids suggesting that the applied common statistical models for mark-recapture data were sensitive for the spatial arrangement of sampling points.

CONTRIBUTION TO THE STUDY OF POLLUTION BY WASTE FROM THE TANNERY WASTEWATER AIN FAKROUN THE OUED SIGUS - OUM EL BOUAGHI-ALGERIA

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The aim of this study is to assess the level of pollution caused by the Tannery of Ain Fakroun - Oum El Bouaghi, and the influence of heavy metals (Cr, Pb, Cd, Hg) on Sigus' river. To evaluate these last ones' environmental risks, water samples were taken and subjected to a total digestion and analyzed for Cr, Pb, Cd, Hg. Concentrations of metals in the solutions were determined by atomic absorption spectrometry. The



results show that the concentrations of the studied heavy metals are high, especially for the Chromium (3.2mg/L), and exceeds in most cases the acceptable standards. In addition to the physico-chemical and biological parameters which indicate a strong pollution, and as a result of a survey conducted at the perimeter of the area, it is shown that the damage recorded from the year 2000 and on are catastrophic: one dead man, 50 poisoned patients, 70 dead cows, 60 dead sheep, contamination of wells ... etc. This study demonstrates that the waters of the river are heavily polluted, and this area of study requires building a water treatment plant at the main collector of Ain Fakroun city to decrease the risk of a total destruction of the ecosystem. Keywords: River, Ain Fakroun, tannery, heavy metal, pollution, ecosystem.

RESISTANCE OF COASTAL MARSH ECOSYSTEMS TO LARGE-SCALE PERTURBATIONS: REGIONAL EFFECTS OF HURRICANE SANDY ON SALTMARSH VEGETATION AND BIRD POPULATIONS IN THE NORTHEASTERN USA

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Coastal marshes are limited in extent, vulnerable to sea-level rise, and have undergone substantial modification by humans. Consequently, many species that use these habitats are considered to be high conservation priorities. The landfall of Hurricane Sandy on the northeastern coast of the USA in October 2012 imposed a major disturbance on coastal habitats in a region already greatly altered by humans. We investigated the effects of this disturbance on saltmarsh plant communities and the populations of five specialist saltmarsh bird species. We used an extensive data set that sampled >1500 randomly-selected points distributed from Virginia to Maine (i.e., spanning the entire portion of the US coast affected by Hurricane Sandy) in the two summers prior to the storm, and again the following year. By sampling across the entire landfall region, our study mirrors a before-after control-impact study, allowing us to assess ecological changes at sites that experienced very different storm conditions and that have been subject to diverse combinations of anthropogenic conditions (e.g., upland urbanization, introduced species, historic management, contemporary protection, etc.). Using these data, we found little evidence for widespread effects of the hurricane on either vegetation communities or focal bird populations. Nonetheless, we did find evidence that plant communities are changing in a manner consistent with an

increase in relative sea level. This shift towards wetter marsh conditions is strongly supported by a longer term data set from 55 study plots distributed across 12 marsh systems in the center of our study region. These changes in marsh conditions have serious repercussions for the population viability of saltmarsh-nesting birds that are vulnerable to tidal flooding.

GLOBAL MOUNTAIN TOPOGRAPHY AND THE FATE OF MONTANE SPECIES UNDER CLIMATE CHANGE

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Increasing evidence indicates species throughout the world are responding to climate change by shifting their geographic distributions. Although shifts can be directionally heterogeneous, they generally follow warming temperatures poleward and upslope. Montane species are of particular concern in this regard, as they are expected to face reduced available area of occupancy and increased risk of extinction with upslope movements. However, this expectation hinges on the assumption that surface area decreases monotonically as species move up mountainsides. We analyzed the elevational availability of surface area for a global dataset containing 182 of the world's mountain ranges. Sixty-eight percent of these mountain ranges had topographies in which area did not decrease monotonically with elevation. Rather, mountain range topographies exhibited four distinct area-elevation patterns: decreasing (32% of ranges), increasing (6%), a mid-elevation peak in area (39%), and a mid-elevation trough in area (23%). These findings suggest that many species, particularly those of foothills and lower montane zones, may encounter increases in available area as a result of shifting upslope due to climate change. A deeper understanding of underlying mountain topography can inform conservation priorities by revealing where shifting species stand to undergo area increases, decreases, and bottlenecks as they respond to climate change.

A PROCESS FOR SELECTING PRIORITY SPECIES FOR DIRECT CONSERVATION ACTION BY THE ZOOLOGICAL COMMUNITY.

Sandra Elvin

Association of Zoos and Aquariums

Paul BOYLE, Association of Zoos and Aquariums

The Association of Zoos and Aquariums (AZA) recently launched SAFE – Saving Animals From Extinction (SAFE), a program to advance the role of zoos and aquariums in wildlife conservation. Each year AZA-accredited zoos and aquariums invest \$160 million in wildlife conservation and serve 180 million people providing opportunities for engaging people in conservation. SAFE initiatives focus efforts on selected threatened species and providing ways for people to assist



meaningfully in conservation actions related to those species. To prioritize species for conservation investment, AZA developed a set of qualitative criteria for nominating “eligible” species. AZA members working at the taxon advisory, species management, field conservation, and other levels were involved in nominating species for AZA SAFE. Nominated species were then assessed according to a separate set of criteria called “portfolio rules” to identify species as Candidates for AZA SAFE. The portfolio rules identified an inaugural group of ten SAFE species with the greatest potential for the AZA community to contribute expertise and resources to conservation success. Success is defined in terms of increasing the sustainability of a species by applying the unique expertise of the professional zoological community to conservation in the wild in ways that yield multiple stable, or increasing, populations of the species across its natural range. Prioritizing species is a complex undertaking that requires a clear and transparent process to foster trust and establish accountability. The use of qualitative criteria allows the nomination of threatened species to proceed while incorporating a wide array of relevant information including anecdotal knowledge from husbandry practitioners and quantitative results of field scientists. The use of qualitative criteria also affords the capacity to judge nominations based on a combination of the best available science and practical, animal handling experience.

165 AN OPERATIONAL MODEL FOR IMPLEMENTING EVALUATIVE THINKING IN CONSERVATION SCIENCE AND PRACTICE

Glenda Eoyang

Human Systems Dynamics Institute

Evaluative Thinking in Conservation (ETC) proposes to address multiple challenges to the quality of conservation practice. Those challenges, deriving from the complexity of conservation systems, include: 1) Interdependencies among economic, ecological, political, and cultural systems; 2) Nonlinear causalities of vertical relationships (across scales) and horizontal relationships (across domains within the same scales); 3) Ambiguous boundaries within and among physical and social systems; and 4) Contradictory perspectives among individuals, organizations, and communities. Within this complex landscape, it may be possible to design and implement a rigorous randomized controlled trial. The question is, “What can the restricted environment of a randomized controlled trial reveal about the extraordinarily unconstrained environments of conservation practice?” Complexity science, and its applications in dynamics of human systems, offers an evaluative thinking approach that leverages interdependencies to generate insights; engages in iterative cycles of data collection, meaning making, and action;

discovers and defines patterns within and between physical and social systems; and surfaces and resolves contradictory perspectives. This approach includes two, interdependent features. Pattern Thinking integrates qualitative and quantitative models to observe and explain conservation systems and practice. Adaptive Action defines a simple, iterative, algorithmic approach to data collection, analysis, and action. Together, Pattern Thinking and Adaptive Action provide a practical and rigorous method to implement ETC. This presentation introduces these ETC practices through a case study, in which the approach was used to evaluate and inform work across scales in a global research program focused on agro-ecological intensification. Models, methods, and additional resources are provided.

BORDER ZONE EXPANSION: NEW STATE APPROACH TO REGULATE ENVIRONMENTAL CRIMES IN NON-DEMOCRATIC REGIMES

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International treaties meant to protect critically endangered and endangered species mainly in the developing countries of Latin America, Africa and South – Eastern Asia are not working. For this reason both developed and developing countries are trying to test newly elaborated mechanisms for sustainable bio-regulation, such as the creation of Marine Protected Areas, co-management systems and etc., suggesting on one hand to integrate the system of traditional self-governance, but on other hand to give state officials the rights for participation in management. However, in many cases this adaptation of new mechanisms failed. It turned out that rigid autocratic (vertical) management system existed in many developing countries is not conducive to the developing the communal management system. The autocratic system prevents some communal stakeholders from the involvement in the regulatory policy. What can we do in this case? Based on three years study of sturgeon poaching issues in the Caspian Sea regions of Russia, Azerbaijan and Kazakhstan, the authors propose a discussion on how to develop the self – regulatory mechanisms in the local fishing community within a set of the autocratic decision-making structure. The authors will present a seamless attempt to introduce the border guards as integrated agents for changes in the community aimed and, at the same time, the implementations of strict anti-poaching measures. On one hand, we propose a scenario where the border guards’ field of action will extend into the public domain (control over expenditure of public subsidies for the development of small-scale fisheries), so to bypass a highly corrupt political environment and to overcome the existing monopolies.



Secondly, we discuss potential socio-cultural and ethical implications for the implementation of such policy.

ANALYZING SOCIAL VALUES AND PERCEPTIONS TO BETTER ADAPT BIOLOGICAL CONSERVATION STRATEGIES IN TWO MEDITERRANEAN DELTAS

Lisa Ernoul

Tour du Valat

Angela WARDELL-JOHNSON, School of Social Sciences, University of the Sunshine Coast

Social conflict is often an important obstacle in biological conservation. Identifying environmental values and perceptions is essential for conservation managers to adapt management strategies in each site that will effectively engage local decision-makers in biodiversity conservation. This study identified and compared local populations' values and perceptions of nature in two Mediterranean deltas (Rhône delta - France and - Gediz delta - Turkey). A total of 93 interviews were conducted in the deltas using a deliberative sampling methodology. Thirteen landscape values were evaluated and the results demonstrate that while nature is valued in both deltas, there were differences in the reasons for its importance. Participants in the Rhône delta valued nature for its symbolic and social values (biodiversity:58%; aesthetic:53%; and recreation:53%). While participants in the Gediz delta also valued nature for symbolic and social values, the specific values were different (the future:51%; intrinsic:48%; and recreation:49%). The results of our study also show that the stakeholders in each site attribute responsibility for nature differently. The Gediz participants favored macro and meso scale responsibility with less importance given to the micro-scale, while participants in the Rhône delta favored cross-scale responsibility. The differences in perception and values of nature, and the perception of responsibility between the two deltas demonstrates a need to adapt conservation strategies to social context in order to increase stakeholder buy-in into conservation actions.

PARTNERSHIP AS A TOOL FOR ANDES-AMAZON CONSERVATION: A CASE STUDY FROM THE COFÁN NATION IN ECUADOR

Michael Esbach

University of Florida

Randall BORMAN, Cofán Survival Fund

Ecuador lays a crossroads. Few countries support a greater proportion of the Earth's living diversity or a richer array of human ways of life and languages. This wealth is imminently threatened by large-scale resource extraction: petroleum exploitation, lumbering, and colonization continue to expand with little control, threatening living diversity and subsistence livelihoods across Ecuador. Leading the indigenous

conservation movement in Ecuador is the Cofán Nation. One of the oldest still-intact indigenous groups in Ecuador, the Cofán Nation has occupied the forests of Northeastern Ecuador for centuries. While much of their once-vast ancestral territories have been colonized during the past forty years, partnerships between Cofán leaders and international supporters have fought to protect the still-intact areas of forests that survive. As a result of their efforts, the Cofán have successfully recovered the rights to just over 500,000 hectares of their ancestral territories, effectively linking intact natural systems from the Andes to the Amazon. Further examination of these efforts helps to elucidate a framework for community-level partnership, a critical tool in conservation planning within an indigenous context. This framework focuses on 1) building social capital, 2) accepting diverse perspectives, 3) empowering local decision-making, and 4) a long-term commitment to the partnership. By adopting such a framework in tandem with a range of biological and social science methods, practitioners can improve local capacity, decision-making, and governance in ways that are directly linked conservation.

MEGAFUNA AND PURSE SEINE FISHERIES: INTERACTIONS AND SURVIVAL OF THE WHALE SHARK, THE WORLD'S LARGEST FISH

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The expansion of human activities is endangering megafauna in both terrestrial and marine ecosystems. Large marine vertebrates are often vulnerable and emblematic species, with many of their populations considered to be declining, primarily due to fisheries activities. In the open ocean, certain fisheries improve their efficiency of detecting tuna schools at the surface by locating and fishing close to some macro-organisms, such as whale sharks or marine mammals. While the whale shark, the world largest fish, is particularly vulnerable to



impacts and referenced by the IUCN and the CITES, collecting accurate data on the accidental capture and mortality of these organisms is a complex process. We analyzed a large database of logbooks from 65 industrial vessels with and without scientific observers on board (487 272 and 16 096 fishing sets since 1980 and 1995 respectively) in both the eastern Atlantic and western Indian Oceans. Distribution maps of Sightings Per Unit of Effort highlights major hotspots of interactions between the fishery and whale sharks in the oceanic near-shore area from Gabon to Angola in the Atlantic from April to September, and in the Mozambique Channel in the Indian Ocean between April and May. The incidence of apparent whale shark mortality due to fishery interaction is extremely low (two of the 145 whale sharks encircled by the net died, i.e.1.38%). To confirm this result on a longer term, post-release survival was investigated through satellite tagging of whale sharks encircled in purse seine nets. First assessments of post-release survival were performed on five whale sharks equipped with pop-up archival tags, with all tagged whale sharks surviving at least 21 days after encirclement. However, obtaining accurate estimations of the post-release survival of whale shark encircled by purse seine nets requires the deployment of further tags on accidentally encircled individuals, which may help define precise conservation management measures.

EFFECT OF CLEARCUTTING OPERATIONS ON THE SURVIVAL RATE OF A SMALL MAMMAL

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Clearcutting is a common timber harvesting technique that represents a significant and abrupt change in habitat conditions for wildlife living in industrial forests. Most research on this type of impact has focussed on comparing populations or communities in mature forests/plantations and the resulting clearcut stands. However, this approach does not separate the effect of changes in habitat attributes from direct mortality produced by the intensive use of heavy machinery required for cutting down trees and dragging them to a road. Because knowing the fate of individuals after a disturbance is important for modelling landscape-scale population dynamics in industrial forests, we conducted a study in South-Central Chile to understand the short-term response to clearcutting operations of the long-haired Akodont (*Abrothrix longipillis*), a forest specialist mouse. Between

2009 and 2013 we radiotracked a total of 51 adult male Akodonts, before, during and after the clearcutting of the pine plantations in which they lived. A minimum of 52.4% of the individuals died as a direct cause of the timbering operations, being crushed by vehicles or logs during logging operations. Our observations suggest that, instead of fleeing the area, the response of long-haired Akodonts to the approaching machinery is to hide under the forest litter or in burrows, which exposes them to a serious risk of death. The real mortality rate associated to clearcutting may be higher than that estimated by us because of some methodological biases (i.e. individuals with crushed radiotransmitters not recorded) and the fact that additional mortality sources may affect the population in the weeks following logging operations (e.g. higher exposure to predation, effects of site preparation for the new plantation, etc).

USE THE SPOTLIGHTING FOR MONITORING ENDANGERED CHILEAN CHINCHILLA

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The Chilean chinchilla (*Chinchilla laniger*) is a "Critically Endangered" (IUCN) rodent species, endemic to Chile. The strong decline of populations of the Chilean chinchilla was due to overhunting for its fur. In 1929, local authorities prohibited their capture, but the species was believed extinct in the wild. In 1975, the Chilean chinchilla was rediscovered. Currently, chinchillas are still facing major threats due to anthropogenic land use (e.g. livestock, mining), which threaten wild populations and their habitats. Despite the species lives in colonies formed by few to hundreds individuals, there is a high level of uncertainty about its population status. This lack of knowledge of chinchilla populations is mainly due to its nocturnal behavior and the negative effects of trapping on its survival. To address the urgent need for new sampling techniques which allow estimates of population abundance, we used "spotlighting" to estimate the relative abundance of five colonies of the Chilean chinchilla in Auco, north-central Chile. To evaluate each colony, we spotlighted along a 400 m transect located at the center of each site. In the same night, two passes were done on each transect, where all observed individuals were recorded. All evaluations were done one hour after sunset until 02:00 am. We recorded chinchillas at



all sites (from 1 to 6 individuals). The number of chinchillas recorded was significantly higher in the first pass than in the second ($W = 38$; $p = 0.04$). Most individuals were sighted upslope and perpendicular to transects, but these trends were not significant ($p > 0.5$). Our investigation suggests that 'spotlighting' can be an effective technique to study colonies of the Chilean chinchilla. This non-invasive technique can help improve our knowledge on the Chilean chinchilla and allow stakeholders better plan for the conservation of this critically endangered species.

THE CHECKLIST AND ABUNDANCES OF SMALL MAMMALS IN IDU, AKWA IBOM STATE, NIGERIA.

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University of Uyo

Akaniyene AKPAN, University of Uyo ; Edwin EGWALI, University of Uyo ; Solomon JAMES, University of Uyo

A study of the abundances of small mammals was conducted in Idu, Uruan L.G.A of Akwa Ibom State Nigeria from April to December 2013. Indirect and direct methods for the observation of small mammals were employed in the area under study. A total of 36 individuals, consisting of 3 Orders (Rodentia, Carnivora and Pholidota) and 7 families of small mammals were encountered. The most abundant was *Thryonomys swinderianus* with a percentage of 63.88 followed by *Rattus rattus* 16.66, *Cricetomys gambianus* 8.33 while *Crossarchus obscurus*, *Atherurus africanus*, *Xerus erythropus* and *Manis tricuspis* accounted for 2.77 respectively. The *Thryonomys swinderianus* had the highest body mass of 3.9kg while, *Manis tricuspis* has the highest body length of 79.9cm.. The abundance and diversity index of small mammal encountered were low and this may be attributed to deforestation, habitat loss, hunting and other anthropogenic activities in the study area. There is therefore a great need for conservation and management practices to protect these vulnerable mammals and their habitats.

133: THE EXPERIENCE OF ETHIOPIAN ORTHODOX CHURCH IN CONSERVING FOREST AND OTHER BIO RESOURCES

Alemayehu Wassie Eshete

Bahirdar University

The Ethiopian Orthodox Tewahido Church (EOTC) has a long history of conserving forests which usually surround the churches. Although the main purpose of the churches is to serve as places for worship, burials, and religious festivals, they also provide secured habitats for plants and animals and green spaces for people. In the northern highlands of Ethiopia, patchy remnants of old-aged Afromontane forests can be found mainly around the EOT churches. When a traveler encounters a

patch of indigenous old-aged trees in the northern highlands of Ethiopia, he/she can be sure that there is an Orthodox Church in the middle. The local people refer to these churches with the surrounding trees as "debr" or "geddam" and consider them the most holy of all places. Their survival is the result of a patriotic conservation tradition of the EOTC which has strong biblical justification and theological thinking, but their survival is currently challenged by ecological and social concerns. Pilot studies suggest that these church forests might be relics of ancient forest ecosystems and hotspots of biodiversity for indigenous species that could be prioritized for combined in-situ conservation and maintenance of prestigious religious sites.

IMPACTS OF GRAZING MANAGEMENT UPON AFROALPINE VEGETATION AND PREY AVAILABILITY FOR ETHIOPIAN WOLVES

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Abstract Human and livestock population growth is the main reason for ecosystem degradation in tropical mountains. The Ethiopian Afroalpine ecosystem and its numerous endemic rodents are threatened by livestock grazing in natural pastures, with potential impacts across the food web. This case study consider an Afroalpine area where five years ago the local communities implemented the area closure management to a portion of the range, to rehabilitate and maintaining biodiversity and ecosystem functions. Ecological data was recorded inside and outside the exclusion zone in 46 circular sample plots to study the effect of grazing on vegetation and on abundance of rodent prey for the Ethiopian wolf (*Canis simensis*), the most endangered canid of the world. There was a significant difference ($P=0.0038$) in vegetation cover but not ($P>0.05$) in vegetation height between protected and unprotected land uses, and rodent hole counts were highest in the protected area ($P=0.0006$), while rodents showed preference for medium height vegetation ($P=0.0230$) and areas with high vegetation cover ($P=0.0037$) and flat areas and moderate slopes (0.0126). Understanding the factors impacting an Afroalpine ecosystem has importance in conserving the rare and endemic biological associations of the area plus to encourage the local management strategies sustainably. Excluding livestock from Afroalpine habitats over five years have measurable impact on vegetation, favoring higher cover and more rodents. This case study is an important contribution in favor of habitat restoration as a management tool for the protection of Afroalpine areas under intense human pressure.



SYMPOSIUM 27: OVERVIEW OF BIODIVERSITY CONSERVATION RESEARCH IN MEDITERRANEAN-TYPE ECOSYSTEMS OF THE WORLD

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All five Mediterranean-Type Ecosystems (MTE) are global biodiversity hotspots, with exceptionally high densities of endemic species. These regions face disproportionately high conservation threats with only 4.3% of the total land area encompassed within protected areas. Their favourable climates and abundant resources render them highly desirable for human habitation, and all are now highly populated. This has led to the transformation of natural ecosystems to other land cover types, high levels of resource extraction, altered fire regimes, the introduction of useful and damaging species that invade and degrade ecosystems, and water extraction impacts on the ecological integrity of freshwater systems. This confluence of circumstances has stimulated MTE researchers to be world-leaders in conservation and environmental research. We present a global overview of academic literature and pivotal events stimulating conservation research in MTEs both globally and regionally. Our understanding of how best to conserve and manage MTEs has evolved rapidly over the past few decades and reflects the variability in the human-environment history and environmental changes affecting the different regions. This overview serves to highlight the advent of new conservation research tools and theory, and the initiatives that led to their discovery and development.

SHORT-TERM RESPONSE OF WILDLIFE TO CLEAR-CUTTING OF PINE PLANTATIONS IN CENTRAL CHILE

Cristian Estades

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Sandra URIBE, Universidad de Chile

Despite their clear differences with natural forests, exotic pine plantations in Chile can be habitat for several wildlife

species, and there is growing evidence that these artificial forests may play an important role in the conservation of many species at the landscape level. However, during clearcutting, habitat conditions change drastically for most species, likely causing the death or dispersal of many individuals. Besides, through the forced dispersal of wildlife it is expected that the remaining uncut vegetation (e.g. native forests) will receive potentially large numbers of immigrants, eventually causing the overcrowding of the local populations. During the past three years we have been studying the response of different wildlife species to clearcutting in pine plantations in seven sites in Central Chile. At each site we studied birds (point counts and mistnetting), small mammals (live trapping, radio-tracking) and carnivores (camera trapping), both in the native forest and adjacent pine plantations, before and after clearcutting. Two sites were not harvested and used as controls. Our results showed important changes in the abundance of most species in the plantations after harvest. However, we found little evidence for movements of evicted individuals from the plantations to native forests, which agrees with our failure to detect any significant overcrowding of wildlife in the uncut forests. Some potential explanations for this pattern include high mortality of some species during harvesting (telemetry data showed > 52% mortality of *Abrothrix longipillis* due to crushing by logging machinery) and site tenacity in some bird species (e.g. *Elaenia albiceps*). Finally, because clearcuts represented only 30-40% of the area of the studied landscapes (normal for the region), most individuals forced to disperse might have found suitable places where to settle without causing significant increases in density. (Fondecyt 1120314).

USING REMOTE SENSING TO INVESTIGATE PATTERNS AND DRIVERS OF VEGETATION CHANGE IN THE SERENGETI ECOSYSTEM FROM 1984 TO 2011

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Managing ecosystems for biodiversity conservation requires understanding the processes that shape them at multiple scales. Remotely-sensed data allow analysis of ecosystem changes over long periods of time and across broad spatial scales. This can help contextualize smaller-scale changes that are observable in the field, and upon which conservation decisions are often based. The Serengeti ecosystem in Tanzania is an area of global biodiversity importance, and changes in woody vegetation cover have long been a concern to managers and conservationists. We used time series of Landsat imagery to analyze long-term vegetation change in the Serengeti at a spatially-continuous landscape scale. We identified shifts between woodland and grassland in three



periods between 1984 and 2011 and compared these to known drivers of change in savanna ecosystems, namely elephant numbers and fire frequencies derived from the MODIS burned area product. We found frequent, small-scale increases and decreases in woody vegetation cover occurring simultaneously in all time periods, with over half of the woodlands and grasslands transitioning between states at least once between 1984 and 2011. But despite these small-scale, highly-dynamic vegetation changes, the magnitude of change aggregated over the entire ecosystem was relatively minor. At the ecosystem scale, we observed an increase in woody cover between 1984 and 1995 and consistent but moderate declines in woodland extent thereafter, from 62.5% in 1995 to 57.5% in 2011. While these changes coincide with changes in elephant numbers, our results suggest that fire frequency played a larger role in woodland declines in Serengeti than currently assumed. Some areas experienced as many as 20 fires in 10 years, and areas showing declines in woodland in the past decade had a higher mean number of fires. This indicates that management interventions to control woody vegetation loss could be targeted at reducing the number of human-caused fires.

IN THE SEARCH OF GOOD BIODIVERSITY SURROGATES: RAPTORS POOR INDICATORS IN THE BAJA CALIFORNIA PENINSULA DESERT?

Christian Estrada

CIBNOR

Ricardo RODRÍGUEZ-ESTRELLA, CIBNOR

Predators have been considered as good surrogates of biodiversity, raptors in particular, have been proposed and used as biodiversity surrogates. Assumption based on the general idea of concordance between two taxonomic groups that show a similar spatial/temporal structure, the aim is using one of the groups as a surrogate of the other. If a surrogate can be identified, then theoretical inferences can be made and conservation strategies can be established about the other. We evaluated the effect of spatial and environmental variability on the degree of assemblage concordance between top-order predators (i.e., raptors), as the surrogate group, and vascular plants, reptiles, birds and mammals, as target groups in order to measure the degree of relationship between the composition patterns. We also examined the potential causes of assemblage concordance and the degree to which the surrogate assemblage can predict the target groups in the southern Baja California peninsula. Data for the four biological assemblages collected from an array of sampling points throughout Baja California Sur were used for these analyses. Levels of assemblage concordance varied in all cross-taxon comparisons. We discuss the main mechanisms that better explain the patterns of assemblage concordance observed. We used Mantel tests to evaluate the level of community concordance and co-correspondence analysis to evaluate

how well one taxonomic group predicts the structure of other communities. We found that the concordance between raptors and birds is due to their similar responses to environmental gradients, whereas other patterns of assemblage concordance are more likely derived from interactions between groups. However, predictability was low and no particular taxonomic group significantly predicted all the other groups. The low and variable levels of assemblage concordance suggest that raptors are not good biodiversity surrogates in this desert ecosystem.

SYMPOSIUM 177 - TEACHING BIODIVERSITY CONSERVATION THROUGH COMPANION MODELLING: AN ORIGINAL WAY TO TACKLE SOCIAL AND ECOLOGICAL DYNAMICS

Michel Etienne

INRA

Companion modelling (ComMod) is an approach based on the use of models as tools to facilitate the understanding of multi-functionality, and adaptive management of socio-ecological systems. It uses multi-agent models and role-playing games as mediation tools stimulating the implementation of new ways to build and share information. Emphasis has been recently placed on using the approach as an educational tool to increase awareness of the interactions between stakeholders and resources, to experience mediation processes among users of the same land, and to simulate decision-making in the implementation of a concerted land management plan. The target of the educational programme was to adapt role-playing games used in real ComMod processes to make agronomy, anthropology, ecology, forestry, geography or landscape planning students understand the complexity of the interactions between agricultural activities, landscape dynamics and biodiversity management. The training course is based on the alternance of lectures, computer based exercises and interactive workshops. According to the duration of the course, the students go more or less deeply through the main steps of the companion modelling approach. First, they try to understand the complexity of the socio-ecological system by representing it in the form of a conceptual model describing the interactions between stakeholders and resources on a given territory. Then, they play the role of the main stakeholders in the system by living from inside the interactions with the other stakeholders and bearing the consequences of their decisions on the environment. Lastly, according to what they experienced during the role-playing game, they propose alternatives of management to improve the current situation, according to a set of available techniques. Examples are given on biodiversity conservation in Mediterranean forests (SylvoPast), limestone plateaus (MejanJeuBiodiv) and oceanic islands (MottePiquet).



ELEPHANTS ON THE EDGE: AN EXAMINATION OF ELEPHANT FENCE-BREAKING BEHAVIOUR

Lauren Evans

University of Cambridge

Human-elephant conflict, in particularly the problem of crop-raiding, is a complex and intractable problem in rural Africa that occurs wherever people and elephants share space. As elephant range decreases and human population and cultivation increases, the hard boundary along the human-elephant interface is lengthening. This, coupled with persistent political and media attention, is creating a growing culture of intolerance towards elephants. Electrified fences, constructed along the hard boundaries that separate elephant range from cultivation, are increasingly viewed as a panacea. By compartmentalizing landscapes into a place where elephants are tolerated from a place where they are not, fences offer a simple, and technical solution to a complex problem. However fences frequently fail in their objectives, as elephants adapt to break them and to due to the considerable institutional and financial capital required to maintain them. Yet little is known about how, where and why elephants break fences. Drawing on research from Laikipia County Kenya, this presentation challenges three assumptions concerning the nature and drivers of elephant fence-breaking behaviour: 1. Elephants will break any fence once they have learn that the electric shock won't kill them 2. Fence-breaking behaviour is unpredictable 3. Individual 'problem elephants' are responsible for fence-breaking The presentation also discusses why fences vary as barriers to elephant movement. This examination of elephant fence-breaking behaviour sheds new light on our understanding of the bull elephant socio-ecology and individuality and on the constantly shifting and evolving challenge of mitigating HEC.

122: IS NO NET LOSS POSSIBLE? EVALUATING POLICY INSTRUMENTS FOR REDUCING DEFORESTATION WITH A GROWING ECONOMY

Megan Evans

Australian National University

Grace CHIU, CSIRO Digital Productivity Flagship ; Andrew MACINTOSH, Australian National University ; Philip GIBBONS, Australian National University

Deforestation is a major driver of biodiversity loss and environmental degradation worldwide. International and national efforts to combat deforestation have taken a number of forms, ranging from policies which restrict forest clearing, to broader commitments to achieve 'no net loss' of vegetation. However, the efficacy of such policies is rarely evaluated. Data limitations and methodological challenges can impede the evaluation of policy impact in the presence of confounding

variables, time-lags and misalignment of spatial and temporal data. Such challenges in evaluation must be overcome to ensure policy effectiveness and the delivery of environmental benefits. We combine satellite imagery of forest loss, along with information on key macroeconomic and climatic variables within a novel statistical framework, to evaluate the impact of successive policies aimed at reducing deforestation in Australia. A wealthy nation with strong governance and high institutional capacity, Australia has introduced at least fifteen sub-national policies to combat deforestation since the 1980's, in addition to an overarching national goal to reverse deforestation by 2020. Despite these efforts, little is known of what effect these policies have had on the rate of forest loss over time. We analyze the change in forest cover across Australia between 1972 and 2012, and model trends in deforestation using a spatially explicit bent-cable regression framework. The bent-cable model provides a more realistic and flexible representation of system changes than traditional regression methods, and has a greater capacity to detect the impact of a policy intervention on the response of interest. We find that the introduction of policies generally had a limited effect on the rate of forest loss, while terms of trade, rainfall and amount of forest remaining had an overall greater influence. Our study provides much needed insight into how societal and environmental goals can effectively be balanced.

SYMPOSIUM 159: MAKING THE RIGHT CHOICES IN REWILDING HUMAN-DOMINATED LANDSCAPES

John Ewen

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Reintroductions and other conservation translocations are an important but often controversial form of wildlife management. Whilst the benefits may appear clear (for example the successful reestablishment of a lost species, ecosystem function or human wellbeing) there are also a range of costs that should be considered (for example human-wildlife conflict, co-introduction of novel pathogens that can affect other wild species, agriculture or humans). The concept of rewilding within human dominated landscapes exemplifies tradeoffs between these costs and benefits, highlighting that reintroductions influence a wide range of stakeholders with potentially very different values. From a management perspective, rewilding through translocations are fundamentally sequences of decisions. How then do we approach these and make the best choices? We argue that the adoption of a more structured approach to translocation decisions can help do this. By using a range of decision analysis tools encompassed by structured decision making we can ensure translocations aimed at restoring or increasing the 'wildness' of human dominated landscapes are achieved in



such a way that the values of diverse human groups in this landscape are respected. Here we will introduce the key components of these decision tools and show how rational decisions can be made in the face of competing values.

MAPPING BUSHMEAT HUNTING SUSTAINABILITY AND HUMAN NUTRITION IN CENTRAL AFRICA

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Wild animals are a primary source of protein (bushmeat) for tropical forest inhabitants worldwide. The impact of bushmeat harvests on wildlife populations is ideally monitored from estimates of offtake and size of prey populations. However, these data are difficult and expensive to obtain at large geographical scales. Here, we employed biogeographical modelling techniques, using favourability function models, to map species richness and vulnerable areas of all hunted mammals in central Africa. Based on a number of ecological traits, we first develop an index - the Potential Hunting Sustainability (PHS) - to assess the vulnerability to overhunting of each species. We use favourability values derived for all species pooled, and their PHS values, to identify weak spots, high diversity regions of high hunting vulnerability for wildlife, as well as strong spots, or high diversity areas of species with low hunting sustainability. Using these maps, and maps of the distribution of available standing biomass of hunted mammals and the inferred levels of bushmeat extraction, we then suggest that these new analyses can allow us to advance our understanding of the threat of overexploitation of wildlife in tropical forest regions.

EFFECTS OF UNPREDICTABILITY OF HABITAT MANAGEMENT TO THE CONSERVATION OF EARLY-SUCCESSION SPECIES

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A key challenge in the conservation of early-succession habitats is the need of their constant regeneration due to fast successional dynamics and overgrowth. Apart from schemes for maintaining traditional agricultural habitats, few institutional structures have been developed in the European Union that enable long-term commitment to the maintenance of specific early-succession habitat types. We studied the institutional setup of the conservation of

an endangered butterfly, the false heath fritillary (*Melitaea diamina*) in Finland. The false heath fritillary is a specialist species of wet *Valeriana sambucifolia* meadows and has been listed as a species of special conservation concern in Finland, which obligates regional environmental agencies to maintain a favorable conservation status for the species, but does not guarantee long-term resourcing for maintenance activities. The institutional study revealed a complex and uncoordinated structure of management resource allocation for this species, including small maintenance funds granted by several independent sources depending on the ownership category of habitat sites. Additionally, the study revealed high annual variation of resource availability at the regional environmental agencies, which complicated the execution of long-term habitat maintenance plans. We tested the consequences of a corresponding, high annual variation of resources and short-term decision-making by developing a dynamic metapopulation model based on false heath fritillary field data and studying false heath fritillary metapopulation viability under alternative scenarios of resource allocation and decision-making. Our results indicate that unpredictable, short-term provision of habitat maintenance resources can result in lower population sizes and higher extinction probabilities and thus impair the effectiveness of conservation for endangered early-succession species.

IMPACT OF HERDERS' HARVESTS OF FODDER PLANTS IN YANKARI GAME RESERVE, NIGERIA: PATTERNS AND EXTENT

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Understanding the social drivers of resource use is of key importance in conservation and environmental management. We surveyed six tree and shrub species (*Azelia africana*, *Pterocarpus erinaceus*, *Strychnos spinosa*, *Balanites aegyptiaca*, *Khaya senegalensis* and *Tamarandus* = FTS) to determine trends in abundance and to identify any significant social drivers of change. These species are multi-use trees used widely in tropical Africa, heavily harvested in tropical Africa for a variety of uses and their populations are threatened in their natural environment. *Azelia africana* and *Khaya senegalensis* are currently classified as endangered by the IUCN Red List. Our surveys showed high rates of decline in these species of FTS. Previous research based on remote sensing data indicates human activities in the Reserve to be most prevalent within 5km of the Reserve boundary. We therefore investigated the degree to which observed changes in FTS may be being driven by herders' activities. We used a non-random cluster method to sample 82, 100x100m² plots, and recorded FTS abundance, diameter at breast height, plant height, harvest



rates and canopy cover. We also used visual estimates to record fire impacts on the plants. We found *Azelia africana* to be the dominant, and most disturbed, species of the Reserve. Using a regression model, we found no relationship between distance (km) from the Reserve boundary and harvest rate (%). In addition, we fitted Poisson regressions of the generalised linear model and found no relationship between distance from the Reserve boundary and the seedlings, saplings and adults of the FTS. We suggest that *Azelia africana* is the most heavily harvested FTS with weighted average harvest rates of 61-75% indicating severe harvest. Our findings suggest further research is needed to understand anthropogenic threats to FTS and predict how FTS may fare in the future.

HUMAN-BIRD CONFLICTS ARISING FROM CONSERVATION EFFORTS IN THE AMURUM FOREST RESERVE, JOS NIGERIA

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Human-wildlife conflict (HWC) may occur due to increasing wildlife population resulting from successful conservation efforts. However, continued community support is essential for long-term conservation success. In the Amurum Forest Reserve (AFR), north-central Nigeria, created specifically for the conservation of birds, potential conflicts arising from crop damage by birds could lead to loss of the long existing community support. It is against this backdrop that this 12-month study was conducted in three villages around AFR to explore the socio-economic impact of and potential solutions to farmer-bird conflicts. Approach included: 1) social interviews; 2) experimental investigation of economic loss - construction of enclosures on a portion of the farm to prevent entry by birds and comparing yield between enclosed and exposed plots and 3) observation of farm bird activities to identify problem species. Over 90% of farmers interviewed were positive about the creation of the reserve and two-thirds were in support of conservation. However, 60% of respondents attributed crop damage to birds and linked it to conservation efforts in the AFR. All traditional methods employed to reduce bird damage on farms seemed unsuccessful except for the use of an owl model applied by only one farmer. The most frequent activity carried out by birds was foraging and the most consumed crop was *Acha Digitaria exilis*. Problem species identified through focal observations corroborated interview data. Crop yield in the enclosed farm plot was twice the yield in the exposed plot. Effective conservation of wildlife in the Amurum Forest stands the risk of being hindered by conflicts between farmers and birds if not properly addressed. Use of an avian predator model may be the most effective short-term means of controlling crop depredation by birds. However, an understanding of the ecology of bird pests may provide useful

information for developing appropriate long-term mitigation strategies.

COMMERCIAL ECOSYSTEM SERVICES: PLANTATION FOREST CONTRIBUTIONS TO US CARBON SEQUESTRATION

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Quantifying and increasing the provision of ecosystem services from agricultural lands is a major goal of conservation biology. The southeastern U.S. is one of the most productive regions in the world for wood pulp and logs, based on large-scale management of pine plantations. Time series of satellite imagery offer a detailed account of forest loss and gain, but the potential contribution of plantation management in the southeast US to the US forest carbon sink has not been quantified. In this study, we used nearly 3,000 km of airborne remote sensing transects from Goddard's Lidar, Hyperspectral, and Thermal Airborne Imager (G-LiHT) to link Landsat-based estimates of forest cover change to height growth and carbon accumulation in plantation forests. Carbon accumulation in plantation forests was estimated using two methods—yield tables and lidar-biomass relationships derived from field measurements in the USFS Forest Inventory & Analysis Program. Scenarios of carbon accumulation were developed using plantation area and age information, derived from Landsat data using the Vegetation Change Tracker (VCT) algorithm. The ability to combine high-resolution (1 m) information from airborne lidar and long time series of Landsat imagery provided unique constraints on the height structure and spatial extent of plantation forests. Our results also highlighted the potential to further increase the carbon storage benefits of plantation forests through longer rotation ages to favor wood over pulp production. By estimating the current contribution of large-scale forest management in the southeastern U.S. to carbon sequestration, this study bounds the potential of additional regional reforestation to ameliorate climate change.

TARGETED REFORESTATION TO COMBAT DECLINES IN CONNECTIVITY FOR UNDERSTORY BIRDS IN A TROPICAL HABITAT CORRIDOR

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Re-establishing connectivity between protected areas isolated by habitat clearing is a key conservation goal in the humid tropics. In northeastern Costa Rica, payments for environmental services (PES) and a government deforestation ban have subsidized forest protection and reforestation in the San Juan-La Selva Biological Corridor (SLJSBC), resulting in a decline in mature forest loss and the expansion of tree plantations. We used field studies and graph models to assess how conservation efforts have altered functional connectivity over the past 25 years for four species of insectivorous understory birds. Field playback studies assessed how reforestation habitat quality affected the willingness of *Myrmeciza exsul*, *Henicorhina leucosticte*, *Thamnophilus atrinucha*, and *Glyphorhynchus spirurus* to travel outside forest habitat for territorial defense. *G. spirurus* travel was related to tree density and was high in native and non-native tree plantations. In the other species, matrix travel distances increased with understory density; open tree plantations were comparable to pastures. We modeled landscape connectivity using graph models that varied possible travel distances in tree plantations, gallery forests, and pastures. From 1986 to 2011, connectivity for all species declined in the SLJSBC landscape (5825 km²) by 14 to 21% despite only a 4.9% net loss in forest area and the expansion of tree plantations over 2% of the landscape. Plantation placement in the landscape limited their potential facilitation of connectivity. By mapping current connectivity bottlenecks and priority areas for future reforestation, we estimated that spatial prioritization could nearly double the benefits of reforestation efforts (i.e., a 1.8% improvement in connectivity for each 1% gain in forest cover). Our results indicated key locations where spatial targeting of PES within the SLJSBC would protect existing forest connectivity and enhance the connectivity benefits of reforestation.

DEMONSTRATING ECOSYSTEM SERVICE VALUES IN AFRICA: THE EXAMPLE OF DRIEFONTEIN GRASSLANDS IMPORTANT BIRD AREA, ZIMBABWE.

Togarasei Fakarayi

BirdLife Zimbabwe

Ken MWATHE, *BirdLife International*; Olivia ODHIAMBO, *BirdLife International*

Ecosystems play a major role in meeting the basic needs of the poor. The value of ecosystem services, the goods and services or benefits that humans derive from ecosystems is rarely quantified. However since the Millennium Ecosystem Assessment 2005, some efforts have gone towards quantifying and attaching a value to ecosystem services. BirdLife Zimbabwe has applied a Toolkit for Ecosystem Services Site-based

Assessment (TESSA) in Driefontein Grasslands Important Bird Area, Zimbabwe. The Driefontein Grasslands provides essential ecosystem services supporting a diverse of human livelihoods and biodiversity. However, there was a gap in knowledge on the value of ecosystem services in sustaining life. Using TESSA, three ecosystem services namely cultivated goods, harvested wild goods, and water services were assessed. The assessment was conducted at two sites, site in its current state (well managed) and alternative state (poorly managed) site. This study showed that benefits from ecosystem services in a well managed site are higher than those in a poorly managed site. For instance, contribution of ecosystem services were valued at about US\$1,364 and US\$4,631 per hectare per year for maize and beans crops respectively in a current state, while for the alternative site contribution of ecosystem services were valued at about US\$285 and US\$2,923 for maize and beans respectively. Economic values of harvested wild goods followed similar trend, showing a total net economic provisioning services was high in a current state site as compared to alternative state. Our study value US\$181 per household per year in a current state site and US\$129 in an alternative state site. Water generated useful knowledge on ecosystem services which has been instrumental in promoting active stakeholder participation and policy influence towards biodiversity conservation at site and national levels.

EVALUATION OF POTENTIAL PUAIOHI MANAGEMENT ACTIVITIES VIA POPULATION VIABILITY ANALYSIS

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The Hawaiian Islands house a unique avian assemblage comprised of some of the rarest bird species in the world. Unfortunately, many of these species are highly endangered or have gone extinct. Despite numerous and potentially increasing threats and great effort aimed at saving endemic birds, we lack some of the basic science necessary for understanding species of concern. For instance, population models and population viability analyses (PVA) have not been conducted for 66% of Hawaii's endangered avifauna, which represents a critical gap in knowledge. One species lacking any PVA is the critically endangered (IUCN) Puaiohi (*Myadestes palmeri*), a historically rare songbird endemic to the island of Kauai and the only remaining native thrush on the island. At present, 75% of the Puaiohi's breeding population of about 500 birds occurs in just 10 km² of the Alakai Wilderness Preserve. To develop Puaiohi models, we collected demographic data from 2007-2012, and supplemented with



data from published sources. Using Vortex and RAMAS, we developed stochastic models to represent Puaiohi population dynamics under current and potential management scenarios to determine management's potential efficacy in aiding species recovery. Management scenarios modeled included rat control, supplemental feeding, general survival facilitation, and provision of nest boxes. Both Vortex and RAMAS produced similar results, indicating a current decline in abundance. Female and juvenile mortality/survival appeared to be the most influential parameters in the model, so we suggest that any proposed management focus on increasing female and juvenile Puaiohi survival. Rat control, even at more conservative levels, appeared to be the most effective method of increasing Puaiohi abundance. Our results indicate that real world, attainable management activities have potential to increase Puaiohi numbers and bring the species back from the brink of extinction.

HOODED GREBE AND THE INVASIVE AMERICAN MINK IN AUSTRAL PATAGONIA: A CONTROL STRATEGY BASED ON A TWO SCALES DESIGN OF COMBINED MANAGEMENT ACTIONS

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American mink is the most acute not natural threat faced by the critically endangered Hooded Grebe at its breeding grounds. A single American mink could kill over 30 reproductive adults on a short span of time. Mink predation is the main threat affecting adult grebes, and thus, the its future that is highly dependent on the adult survivorship. The control program area in the NW of Santa Cruz Province (Argentina), encompasses the Buenos Aires Lake plateau and its surroundings, covering 10000 km² of limited access, 9 semi-individual watersheds that belong to two different drainages and two localities (>5000 inhabitants). The objective of the Control Program is to remove all mink from a CORE area that includes the grebe's lakes and the head of the rivers that access the high parts, maintain a low abundances of mink on the surrounding BUFFER area and set a series of BARRIER-POINTS dividing the CORE and the BUFFER areas to prevent individuals flux. At the coarse scale, we seek for a combined strategy of employed work in the rural areas and a social based control in the suburban areas. At the finer scale, the strategy is characterized by a time-habitat dynamic combination of removal methodologies: lethal-live trapping, constant monitoring-patrolling and hunting together with monitoring of the management results. In its first year of

implementation in the rural areas, 37 mink were trapped, 4 were hunted and predation on grebes was avoided. Next steps are to develop a social based control program and start genetic and morphometric studies of the removed animals to improve allocation of control efforts by assessing the connectivity amongst sub-basins for animal flux and complete sex-age determinations of the captures. Finally, trapping and hunting assisted by sniffer-dogs will complete the set of removal methodologies.

OCCURRENCE AND DIVERSITY OF LARGE MAMMALS IN OMO-SHASHA-OLUWA FOREST LANDSCAPE SOUTH-WEST NIGERIA: A PRELIMINARY SURVEY

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The occurrence and diversity of large mammals study was done in the Omo-shasha-Oluwa forest reserves. The study area was stratified into four habitat type (Natural forest, Gmelina plantation, Teak plantation and Agricultural lands) based on the land-use of the study area. Transects were used to identify large mammals in each habitat type in the study area. A total of nine large mammal species were recorded during the study included; Red-capped Mangabey (*Cercocebus torquatus*), African Civet (*Civettictis civetta*), Bush Buck (*Tragelaphus sylvaticus*), Forest Buffalo (*Syncerus caffer nanus*), Forest elephant (*Loxodonta africana cyclotis*), Red River Hog (*Potamochoerus porcus*), Mona Monkey (*Cercopithecus mona*), Maxwell's duiker (*Cephalophus maxwelli*) and Black duiker (*Cephalophus niger*). Variation in species diversity was evaluated using diversity indices. The Maxwell's duiker had the highest relative abundance (45.6 %). It was observed that species were more abundant (Mean=9 ±3.009, S.D=9.027) in natural forest compared to Gmelina plantation (3.777 ±2.259, S.D=6.778), Teak plantation (1.5556 ±1.068, S.D=3.205) and Agricultural lands (0.777 ±0.323, S.D=0.971). Species diversity in natural forest was higher (H'=1.798) when compared to Agricultural lands (H'=1.475), Gmelina plantation (H'=1.136) and Teak plantation (H'=0.994). Urgent conservation measures and appropriate management plans are needed to conserve the wildlife diversity across the Omo-Shasha-Oluwa forest landscape.

SYSTEMATIC CONSERVATION PLANNING IN THE HIGH ANDES: A CASE-STUDY IN THE TUNARI NATIONAL PARK, BOLIVIA

Constance Fastré

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Defining conservation priorities represents a major challenge in developing tropical countries where biodiversity conservation often conflicts with the need for economic development. In order to facilitate reserve network design, systematic conservation planning tools have been created and allow combining information on biodiversity and other parameters such as socio-economic data and land-use. In this case-study, we use data from a national park located in the Andes of Bolivia where the anthropogenic pressure threatens biodiversity, which is mainly contained inside small *Polylepis* forest remnants, a highly threatened ecosystem. We assessed the current conservation state of *Polylepis* patches in the field and analyzed the composition of bird communities living in this fragmented habitat. Based on these data, Species Distribution Modeling techniques were used to model patterns of biodiversity for the Tunari National Park. By combining these data with information on ecosystem services and land-use, we will generate a flexible decision-system for conservation actions in the study area using Marxan and Zonation, the two most widely used conservation planning tools.

MAMMALS SPECIES BIODIVERSITY OF GEMA HUTAN LESTARI (GHL) LOGGING CONCESSION, BURU ISLAND, MOLLUCAS-INDONESIA

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Abstract In order to implement the concept of tropical forest certification for sustainable forest management, the research observed the diversity of mammalia in the concession area of PT. Gema Hutan Lestari Buru Island, on January to February 2012. The study conducted was a component of identifying high conservation value of forests and an effort to provide recommendations for their monitoring and management. The main study sites were primary and secondary forests around the villages which were also the concession areas of annual management plan of HPH PT. Gema Hutan Lestari Buru Island in Buru- Maluku. The data of mammals species was obtained through observation in the morning, day and night. Beside the use of various trappings such as traditional traps (dodeso), misnet and mouse traps was carried out in the field. Structural interview was taken place to wrap up the data. The study recorded that 28 species were collected, of which 16 mammals species were allegedly found inside the area of concession. However, it was assumed that there were other species that were not captured due to limited data, information and topography factors. To complete the missing data, literature study and local interview were considered. The result showed

that 4 mammals species were protected by Government Regulation No. 7 of 1999, 4 species were vulnerable and 1 species was endangered. In general, the diversity of mammals species was too low (less diverse). The logging activity was considered as a cause of species migration both endemic and non-endemic species. The survived mammals was assumed having high adaptation to the area by using the logging area as their habitat as well as playground. Therefore, the company is further necessary to actively monitor the condition of mammals species in the concession area.. Keyword: Buru Island, Mammals of Buru, Gema Hutan Lestari

PHYLOGENOMICS METHOD FOR RANKING POPULATIONS OF THE ENDANGERED ANADROMOUS ATLANTIC SALMON (*SALMO SALAR*) FOR CONSERVATION MANAGEMENT.

Laurélène Faye

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In an Age of Extinction, wildlife managers need tools to help conserve and manage genetic resources for the future. Wild Atlantic salmon (*Salmo salar*) is at risk across its range, and so genetic prioritization would seem prudent. Recently, Volkmann and his colleagues developed a new network-based tool allowing the ranking of populations by conservation importance based on their expected genetic contribution (Volkmann et al. 2014, doi: 10.1371/journal.pone.0088945). We tested the applicability of such measures for safeguarding species-level genetic variation using landscape genetic simulations on the Nemo platform (Guillamne & Rougemont 2006, doi: 10.1093/bioinformatics/btl415). Then, using *S. salar* genomic-scale >3000 SNPs and 15 microsatellite data we constructed the phylogenetic network of 50 populations representing all the legally designated at-risk populations in Canada and applied the network prioritization approach. We identify populations that are currently under-appreciated regarding their contribution to present and future *S. salar* genetic diversities. Such populations might be prioritized both for more active research into the genetic basis of local adaptation, and for conservation by managers, immediately.

CONSERVATION WITHIN AN EXTREME ENVIRONMENT: DISENTANGLING THE DEMOGRAPHIC STRUCTURE OF ARABIAN GULF FISHERIES

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Despite living in one of the most extreme marine environments in the world, biomass density of reef fish in the Arabian Gulf



can be high, with values up to 290 mt/km² being recorded. This high fisheries biomass is incongruent with the population structure and life history of Gulf fishes. Although there is no inherent barrier to species movement into the Arabian Gulf, the diversity of reef fish populations substantially reduces when moving from sites between the western Indian Ocean (WIO) to inside the Arabian Gulf (only 43 of the 134 reef fish species found within the WIO present), while lower average abundance of conspecific populations and lower size at age are apparent for the majority of Arabian Gulf reef fish populations. I argue that such discordance between population structure and high fisheries productivity may be associated with the structure and spatial configuration of coral reef habitats, and the resulting aggregation of fisher effort on small, spatially disparate fishing grounds. Such regionally specific fishing impacts have resulted in substantial reductions in Gulf fisheries resources, while also highlighting the importance of quantifying marine habitat throughout the region and the increasing role of marine reserves in protecting nationally important resources against widespread and increasingly destructive exploitation.

RESTRICTING AN INTRODUCED VERTEBRATE'S ACCESS TO INVASION HUBS REDUCES BOTH THEIR ABUNDANCE AND IMPACT ON A NATIVE PREDATOR

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Many biological invasions do not occur as gradual expansions along a continuous front, but from expansion of satellite populations that become established at "invasion hubs". Targeted control at invasion hubs can be an effective way to suppress invaders' populations but there is little evidence that such control activities alleviate the impacts of invaders. Proliferation of artificial water points (AWP) to increase livestock production has fundamentally changed the ecology of dryland ecosystems by facilitating range expansions of water-dependent native and introduced species. In Australia's rangelands AWP that use earthen dams as reservoirs function as invasion hubs for introduced cane toads (*Rhinella marina*) by allowing toads to rehydrate during periods of hot dry conditions. We investigated whether restricting toads' access to water at AWP can reduce toad populations and alleviate their impact on a monitor lizard, the sand goanna (*Varanus gouldii*) at risk of being poisoned by toads. Over a 3 year period, we compared cane toad abundance and occurrence of goanna tracks along 10 km transects radiating away from AWP fitted with two types of reservoir, dams (n=10) and tanks (n=21). Toads could readily access water stored in dams, but not tanks. Cane toads were more abundant at dams than

tanks. Toad abundance decreased with distance from AWP. When distance to AWP was held constant, toads occurred in higher abundances in the vicinity of dams than tanks. Conversely, the probability of encountering goanna tracks was greater in the vicinity of tanks than dams when distance to AWP was held constant. Our results indicate that restricting access to invasion hubs, by eliminating or modifying invasion hub habitats, can reduce the abundance of invasive species and their impacts. In dryland ecosystems, water-exclusion strategies tailored for specific species can be implemented at AWP to control populations of water-dependent invaders and alleviate their impacts.

217. ORCHISAUVAGE.FR: AN AMBITIOUS PARTICIPATORY SCIENCE PROJECT SUPPORTING THE KNOWLEDGE AND CONSERVATION OF WILD ORCHIDS

Philippe Feldmann

Cirad

Sophie DAULMERIE, SFO ; Alain GÉVAUDAN, SFO ; Jean-Marie NADEAU, SFO ; Michel NICOLE, SFO ; Daniel PRAT, SFO

Session 217. Orchisauvage.fr is a collaborative project which aims at collecting and sharing orchid data throughout France using ITC and Internet tools. It is coordinated by the French Orchid Society (SFO). Its main objectives are conservation and knowledge sharing on orchid's data. This project is open to everyone. It covers the whole country (France mainland and Corsica). The data collected by the members are uploaded on line. The web site is user friendly. Data can be shared between all participants. The use of recorded data is regulated. Uploaded data are checked out through a validation process (experts). Since its release in February 2014. It has encountered a significant success with more than 1 000 registered people and about 80 000 orchid observations. The data providers are new and much younger than the initial SFO members. More than 80 %, are new, with 5 times more people under 40 years old than in the initial membership. Motivations of these new contributors will be discussed, in order to adapt Orchisauvage to their needs and expectations and to enable them to take part into the whole process. Orchisauvage is managed by volunteers. The web site coordinators and data providers are working on ways to keep a high rate of participation, expand the involvement in all steps of the web based project and understand the benefit of such a participatory science project. The second part of the 217 session discussion will help us to explore future developments aiming at sharing and merging data between different NGO's and stakeholders. It will look at how to disseminate the recorded information and how to develop new on-line tools (GIS, stats, communication,...) made available to participants, such as links to conservation actions and members pages



MAKING SPACE FOR NATURE: BALANCING FOOD PRODUCTION AND BIODIVERSITY CONSERVATION IN EUROPE

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Reconciling the conflict between food production and biodiversity conservation is one of greatest challenges we face this century, and the focus of major debate within the conservation community. Central to this debate are comparisons of 'land sharing' (integrating production and conservation on the same land through low-yield farming, requiring a relatively greater area under cultivation) and 'land sparing' (segregating the two aims, using high-yield agriculture to minimise the area needed for production, maximising the area that can be set aside for conservation). To compare these alternatives, we used empirical data from Poland to assess changes in the population densities of individual species of birds, trees and sedges across a gradient of agricultural yield, from natural habitats to high-yielding arable land. Our results indicate that more species will benefit from a land sparing approach, where 'spared' land may be used for both the protection/restoration of natural habitats AND for the conservation of mixed-habitat mosaics that include some extremely low-yielding farmland but contribute very little in terms of overall food production. This research raises many questions about mechanisms for delivering such an approach within the EU, in landscapes with complex systems of land-ownership and multiple objectives underlying land-management decisions. It stresses an urgent need to link EU policy tools that deliver sustainable food production (through the CAP) with those that deliver nature protection (e.g. Natura2000). It also highlights the importance of conserving the extremely low-yielding 'High Nature Value' (HNV) farmland habitats that are rapidly disappearing from many parts of the EU. Alongside our results, I will present a case-study that explores how landscape-scale land-use strategies might be delivered in practice, and the outcomes of a science-policy workshop focussed on the challenge of conserving HNV systems within the wider landscape in Europe.

(147) A GLOBAL INDICATOR FOR AICHI TARGET 15: A CASE STUDY FOR EBV APPLICATION

Miguel Fernandez

IDIV

Laetitia NAVARRO, IDIV ; Alexandra MARQUES, IDIV ; Florian WOLF, IDIV ; Henrique PEREIRA, IDIV

Despite the progress in biodiversity data mobilization and monitoring initiatives there are still no clear indicators that can help us to assess the pulse of biodiversity of the planet. Degraded landscapes around the globe constitute an opportunity for biodiversity restoration and carbon sequestration, which are two key components of Target 15 of the Convention on Biological Diversity. Using remote sensing information we evaluated a couple Essential Biodiversity Variables that address Target 15, over a decade, to provide a global assessment of trends in ecosystem restoration at global scale.

PRIORITIZING BIODIVERSITY MONITORING IN BOLIVIA

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Pragmatic methods to assess the status of biodiversity at multiple scales are required to support conservation decision-making. With ~10 million people in an area the size of Texas and California combined, in which almost every South American ecosystem is represented, Bolivia has extraordinary potential to develop a monitoring strategy aligned with the Group on Earth Observations Biodiversity Observation Network' objectives. Fortunately, Bolivia, a GEO Observer since 2005, is already taking small steps towards a national earth observation system with the creation of GEO Bolivia, a portal for standardized geospatial information that can inform policy and management. However biodiversity is still a missing component in this initiative. Bolivia, as a Member State of the Convention on Biological Diversity is currently at a crossroad where it should build upon knowledge and good practices to develop a country level biodiversity monitoring strategy. Here we discuss two aspects of the process: identification of taxonomic, temporal, and spatial data availability to detect both data gaps and opportunities for long term monitoring; and evaluation of issues related to the acquisition, integration and analyses of multi-scale biodiversity datasets. We capitalize this information into recommendations for the implementation of the Bolivian Biodiversity Observation Network consistent with the Essential Biodiversity Variables framework. This network will guide stakeholders to make better-informed decisions regarding urgent issues such as climate change adaptation and mitigation, food and water security, disaster



prevention and public health but will also help ensure that biodiversity is sustained as the country continues on its path of development.

ID 34 USING EARTH OBSERVATIONS TO MANAGE PROTECTED ECOSYSTEMS

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Conservation management of protected ecosystems has traditionally focused on preserving and restoring structural components of biodiversity such as species composition, while paying less attention to ecosystem functioning. This bias has been partly motivated by the “intangible” nature of ecosystem functioning attributes important in conservation such as the matter and energy balance in the land surface, making it difficult to identify specific conservation and monitoring targets. We illustrate the implementation of an Ecosystem Observatory for Protected Areas as a means to provide conservation practitioners with accessible information on changes in ecosystem functioning parameters and their responses to management interventions. The Observatory is based on the continuous monitoring of synoptic indicators of ecosystem functioning calculated from satellite imagery, including vegetation greenness, evapotranspiration and vegetation drought. It builds along three main components: 1) the identification of baseline conditions to evaluate change, 2) the definition of quantitative criteria to diagnose the conservation status of ecosystems, and 3) a monitoring interface informing on trends and anomalies. The Observatory is being implemented in the Doñana Biosphere Reserve and is providing useful information on both short-term and long-term ecosystem responses to perturbations and management interventions, including the effects of flood management on the seasonal dynamics of primary production in marsh; the impact of shrubland restorations on the estimated carbon assimilation; and the differential ecosystem responses to climate anomalies like extreme droughts. Such successful applications point out the importance of remote sensing of ecosystem functioning in conservation. However, much more progress is still needed to broaden applications and to connect functioning-based monitoring to specific management targets required by conservation practitioners.

CAUSE-SPECIFIC MORTALITY OF ATLANTIC COD AND PREDICTED SURVIVAL UNDER ALTERNATIVE MANAGEMENT SCENARIOS

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Individual deaths in animal populations can be related to multiple causes, either natural or anthropogenic, but the contribution of each of these factors to total mortality has seldom been evaluated, despite cause-specific mortality proportions may help us to understand the demographic impacts of different mortality factors and allow us to derive adequate management actions for the corresponding populations. Here we investigated the mortality dynamics of a heavily exploited species, the Atlantic cod (*Gadus morhua*), with the aim to provide scientifically sound knowledge for the management of existing cod stocks. Our research was based on capture-recapture and recovery records of individually tagged coastal cod collected from 2005 to 2013 in Southern Norway, also including information on the type of gear used by fishers reporting tagged fish. This long-term information-rich database was analysed under a multi-event modelling approach, an extension of classical capture-recapture models that allowed us to link our field observations to multiple underlying “dead states” and thus robustly estimate the proportion of deaths associated to different gear types while controlling for natural mortality and detection errors. Our results revealed that the average annual survival of cod was low (28 %) and that fishing mortality accounted for nearly a 68 % of the total annual mortality in our study area. Model results indicated that the majority of deaths (45 %) were caused by fixed gear types (gill nets and fyke nets) and secondly by hand lines (22 %), with only a 0.9 % caused by other gear types (long lines and trawls), although such estimates varied over time. Using the model outputs, we could estimate annual survival rates for different fishing scenarios and predicted current survival rates to double (60 %) if fixed gear types were banned, thus linking fishing practices to local demographic responses.

ARE LARGE MPA'S EFFECTIVE FOR MARINE MEGAFUNA? A CASE STUDY OF MANTA ALFREDI (FAMILY: MOBULIDAE) IN THE CHAGOS MPA.

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Manta alfredi are cartilaginous, planktivorous filter feeding rays found in tropical and subtropical waters of the Indian and Pacific Oceans. Like other elasmobranchs, *M. alfredi* are characterised by their low fecundity, matrotrophic



reproduction, late maturity, slow growth rates and longevity, making them highly susceptible to fishing pressure and slow to recover from depletion. The driving force behind the global manta fishery is the increasing demand for dried manta gill plates used in Chinese Medicine, which led to their “Vulnerable” status on the IUCN RedList. As part of a precautionary approach, they were listed under Appendix I & II of CMS and Appendix II of CITES. *M. alfredi* are found in Chagos, an island chain in the Indian Ocean which is at the centre of the world’s largest enforced no-take MPA. Little is known about the spatial ecology of manta rays in Chagos, and a key question is whether the MPA can effectively protect the species from fisheries based in nearby countries such as Sri Lanka. We used Wildlife Computers SPOT (GPS) tags to track *M. alfredi* in the Chagos MPA and determine habitat use and spatial ecology. CTD casts were conducted to profile the physical environment, and scientific echo-sounders (EK60; 120 kHz and 38 kHz) to survey the zooplankton prey. These data will provide insights into the spatial arrangement of the manta’s deep prey field and help evaluate the effectiveness of the MPA. Previous telemetry studies have reported daily diurnal migrations of *M. alfredi* seeking deeper water/offshore habitats in the evening hours, which in Chagos could make them vulnerable to IUU fisheries that attempt to enter the MPA under the cover of darkness. Furthermore, their potential to undertake seasonal migrations of several hundred kilometres could take them across unprotected international waters which, combined with their tendency to aggregate at feeding sites, could lead to local population collapses.

BRIDGING THE GAP BETWEEN SMALL-SCALE HIGH-RESOLUTION AND LARGE-SCALE LOW-RESOLUTION MARINE STUDIES

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Modern marine conservation planning is based on models that predict species distributions, map threats and calculate the most cost effective solution to achieve the highest possible conservation target with the minimum economical investment. These conservation tools rely upon species distribution models, which are often based on data extrapolation obtained through monitoring programs. These models are useless without data that can represent the larger area under management. Nonetheless the assumption that a few transects/quadrats are representative of a larger area is inaccurate. Alternatively, remote sensing can cover large spatial scales, but the resolution of these data is not high enough to understand processes and patterns influencing an ecosystem’s trajectory. Automated Underwater Vehicles (AUV) and computer vision

can cover large areas and collect data that can be used to characterize benthic communities and measure habitat structural complexity with unparalleled accuracy. Here, we present a few study cases that have used imagery to measure habitat complexity and community composition. Some cases have compared the relationship of habitat structural complexity and marine communities inside and outside marine protected areas; while others are investigating the effect of climate change on the community composition and habitat structural complexity of threatened ecosystems. Imagery is also used to reconstruct 3D models of different habitats, which are great tools for outreach and policy. This tool is applied to improving marine conservation around Australia, and is an example of how conservation challenges are best solved by multidisciplinary teams. The accuracy of spatial predictive models is significantly improved by AUV imagery, and the measurement of a key habitat attribute, 3D structural complexity, is now possible.

HISTORIC REVIEW OF PREDATOR CONTROL IN THE IBERIAN PENINSULA

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The reconstruction of the historic relationship between Man and wildlife is a recurring topic of the world scientific literature, being the study of the effects of direct and indirect legal persecution over predator species particularly exhaustive. The investigation of the historical human impact in animal populations is essential to understand current patterns of species abundance and distribution, their expansive or regressive trends, as well as the potential causes for extant hotspots of human-wildlife conflict. Moreover, historical information is vital to properly guide management decisions for several species, especially for those facing serious conservation issues or those that are socially conflictive. This study represents the first comprehensive attempt to compile information relative to the persecution of predator species in the Iberian Peninsula throughout the XXth century. Preliminary results show that legal mechanisms operated almost simultaneously in both Portugal and Spain although at different rates and spatially asynchronous. The official extermination campaigns of predator species was overall very effective and their impact in mammal, bird and reptile



populations must have been devastating. Nowadays, the near disappearance of many species of predators and the drastic reduction of their distribution area is a consequence of the direct persecution imposed over this period. The legal protection that these species enjoy currently is not yet warranty of their survival in the long-term in this region.

82-CHALLENGES AND OPPORTUNITIES FACING SUSTAINABLE LAND-USE IN FRONTIER REGIONS OF THE AMAZON

Joice Ferreira
Embrapa

In the last ten years the Brazilian Amazon has received increasing international attention, both for the dramatic fall in deforestation rates and the rising importance of its agricultural sector. The conservation and development trajectory of the region now stands at a crossroads, the future of which will be shaped in great part by landscape management decisions that are made in the coming decade. Here we provide a focus on some of the key issues facing the future of biodiversity conservation in regenerating and degraded forests that dominate much of the remaining private forest estate in frontier and post-frontier regions of eastern Amazonia. We employ both empirical data on the characteristics of more than 500 rural properties in two municipalities, together with an analysis of governance and institutional change in the state of Pará, and personal experience from engagement in state-level science-policy processes. We illustrate that while second-growth and degraded forests are a critical resource for smallholders who depend on fallow-farming systems, they are also of central importance in efforts to achieve compliance of these actors with Brazil's environmental legislation. However, significant uncertainties remain regarding the spatial planning and management of regenerating and degraded forests, including priorities and incentives for on and off-farm restoration, rehabilitation and compensation programs, and opportunities to integrate the management of both forest and production areas at both property and landscape scales. In situating our observations alongside the development a "Green Counties" program for the state, and Brazil's new federal restoration strategy and revised Forest Code, we identify specific opportunities for public policies seeking to foster more sustainable land-management and conservation programs in one of the most dynamic agricultural-forest frontier regions on the planet.

CRYOPRESERVATION FOR LONG-TERM CONSERVATION OF CORAL DIVERSITY: A CASE STUDY WITH POCILLOPORA DAMICORNIS.

Lionel Feuillassier

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For several decades, the decline of coral diversity has been largely relayed by the scientific community. Increasing environmental perturbations and human activities drastically impact coral reef biodiversity. Ocean acidification and global warming constitute the two major threats. Despite the multiplicity of safeguard programs, the danger of extinction is now becoming a reality for a range of coral species. Cryopreservation, i.e. the storage of biological material at ultra-low temperature (liquid nitrogen, -196°C) may provide an alternative for the long-term ex situ conservation of these threatened organisms, which often have medical or pharmaceutical potential. Moreover, the development of cryopreservation protocols for coral may facilitate their establishment for other phyla of marine invertebrates. To date, only coral spermatozoa and dissociated cells have been successfully cryopreserved using a slow cooling protocol, while no such success has been obtained with pluricellular forms such as apexes or planulae. Various biomaterials from other phyla which failed to respond positively to slow cooling techniques have been successfully cryopreserved using the vitrification technique, which is based on the use of highly concentrated cryoprotectant (CPA) solutions and very high cooling and warming rates. With the objective of cryopreserving pluricellular forms from the tropical coral *Pocillopora damicornis* using a vitrification procedure, we tested the tolerance of cellular aggregates termed tissue balls (TBs) to CPA solutions. In addition to survival evaluation, histological observations were performed to study the effect of CPA treatments on TB structure. Our results showed that TBs could withstand exposure to CPA concentrations higher than 4.0 M and that they constituted a suitable material to optimize the various parameters of a cryopreservation protocol.

PRODUCTION VERSUS ENVIRONMENTAL IMPACT: CAN WE HAVE IT ALL ON A CONVENTIONAL ARABLE FARM?

Rob Field
RSPB



Rachel HILL, RSPB ; Matthew CARROLL, RSPB ; Tony MORRIS, RSPB

European farmland biodiversity has undergone declines through the late 20th and early 21st centuries, as a result of increased productivity. Both these trends are likely to continue as the drivers (human population increase, availability and cost of raw materials, policy constraints, price volatility and climatic changes) increase. These are likely to be complicated and exacerbated by the attendant environmental impacts of conventional farming. We assess the effects of different management priorities (production driven cropping versus wildlife friendly farming) at an arable farm in eastern England on crop yield, greenhouse gas emissions and biodiversity between 2000 and 2012. Loss of small areas (up to 10.5%) of productive land coupled with a more diverse rotation (including legumes) resulted in a large increase in breeding birds (177%) and reduction of 9.4% in greenhouse gas emissions at the cost of 9.6% of food energy. Food protein lost was only 2.9%. A smaller increase in bird numbers of 50% could be achieved at a much smaller cost to yield (~1.7% energy or protein) but with correspondingly smaller emissions reductions (1.2%). We demonstrate that it is possible to incorporate wildlife friendly farming techniques into a conventional arable farm, whilst reducing climate forcing emissions and maintaining the majority of food production, but that further improvement of environmental performance may impact production under this system. To become more sustainable, the current system may have to change more fundamentally.

A BUZZWORD LOST IN SPACE? UNDERSTANDING THE NEW RELATIONSHIP BETWEEN RESILIENCE KNOWLEDGE AND PARTICIPATORY CORAL REEF MANAGEMENT

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UNC Chapel Hill

Lisa CAMPBELL, Duke University Marine Lab ; Chris BERGH, The Nature Conservancy

Coral reef scientists and managers increasingly discuss adaptive management as a global imperative. In addition to single-actor management and stress abatement, ecosystem resilience and participatory feedback are newly fundamental. Broadly defined, ecosystem resilience is the capacity or an ecosystem to absorb disturbances and reorganize. Although the system may shift, it essentially retains the same function, structure, identity, and feedbacks. Few managers have practically incorporated the concept of ecological resilience in decision-making on coral reefs. However, in 2011, the Florida Keys National Marine Sanctuary adopted a novel guideline; resilient reef areas were identified and prioritized in a multi-year review of the sanctuary's zoning. From 2012 through 2014,

scientists, agency staff, and stakeholders were engaged – via a specially appointed Working Group and long standing Advisory Council – to recommend improvements to the zoning network using this and other conservation guidelines. Drawing from interviews, meeting transcripts, and surveys, this research illuminates the informational (i.e., visual representation) and social contexts in which these two groups translated reef resilience. The interaction of a complex concept – resilience – with stakeholder discourse led to a re-shaping of resilience by sociopolitical narratives. Political ecology provides a lens to reflect on broader, professional implications: can the scientific community effectively inform resilience-based management without considering if and how new management understandings of resilience, in turn, affect the science?

ISLANDS IN THE SKY: SCIENCE, SYMBOLISM, AND THE CONSERVATION IMPACT OF MONTANE EXPEDITIONS ACROSS TROPICAL PACIFIC ISLANDS

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American Museum of Natural History

Patrick PIKACHA, Solomon Islands Community Conservation Partnership

Pacific island arcs comprise natural laboratories that have inspired some of the most influential scientific theory of our time. Much of the data underlying this theory were gathered nearly a century ago on world-renowned expeditions. Despite the scientific and social impact of early expeditions, numerous upland areas have never been rigorously sampled. At the same time, as lowland areas have been degraded by poorly regulated resource extraction, montane areas are under increasing threat from direct and indirect impacts of timber extraction and recent upsurge in mining activity. Montane and cloud forest areas are characterized by high endemism and are also primary, often sacred, elements of the customary lands of island peoples, the original custodians of Pacific island biodiversity. On high islands, where customary landholders largely retain subsistence, economic, and spiritual reliance upon biodiversity, both ecological process and human well-being rely on the integrity of upland forests and altitudinal gradients. Contemporary biodiversity expeditions focused on montane endemism can provide scientific, practical, and symbolic opportunity to improve regional conservation efforts for currently under-studied and threatened high-elevation ecosystems. This presentation describes several case studies from the Solomon Islands that highlight how investing in the broader social context of exploring islands in the sky provides a means to advance biodiversity science and conservation. By combining landholder engagement, scientific training, and public outreach with biodiversity discovery and analysis, collaborative expeditions are reviving the local co-creation of protected areas. Beyond Pacific Islands, the examples presented in this talk provide guidelines for well-designed



expeditions that not only revive the potency of basic natural history, but also improve conservation prospects of protected areas strategies.

117-NOVEL ECOSYSTEM THEORY: IS IT USEFUL FOR THE MARKET-ORIENTED MANAGEMENT OF LANDSCAPES FOR BIODIVERSITY AND PEOPLE

Jennifer Finn

Queensland University of Technology

Ecosystems can end up degraded because previous species and environmental conditions were not compatible with the demands of past or present-day land-use. Non-native plants have been introduced globally, with a genuine intention to improve ecosystems and many times with a specific market in mind. Some of these introductions have proven successful, but others have not. The degradation of our natural ecosystems has occurred, despite the best intentions of aiming to improve an ecosystem to fit “present-day” and projected future needs. Both a problem and a benefit with novel ecosystem theory is that it has this same goal—managing ecosystems with current and predicted futures needs in mind, a challenging task to monitor and evaluate. In this talk, I will discuss examples of the benefits of adapting and integrating existing frameworks (i.e. reclamation, rehabilitation and restoration goals with theories such as alternative states) to underpin the design of restoration goals for rangelands and forests where trade-offs between multiple objectives can be clearly defined and progress monitored and evaluated in a systematic manner. Most importantly strategies and maybe even goals changed as knowledge of the system increases.

DOES SEED FATE DETERMINE INVASION SUCCESS OF A HIGHLY COMPETITIVE HERBACEOUS LEGUME IN ARID RANGELANDS?

Christina Fischer

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Seed predation is an important ecosystem process, which significantly reduces recruitment in many plant species, thereby it can impact the invasion success of non-native but also native plants. In contrast plant invasion can be facilitated by higher seed production and more effective dispersal. Here, we studied pre- and post-dispersal seed predation, as well as primary and secondary seed dispersal of *Crotalaria podocarpa*, an invasive native herbaceous legume, which considerably increased in arid rangelands of Namibia during the past years of elevated rainfall, thereby reducing the density and vitality of economically important fodder grasses. Additionally, we

quantified the impact of different predator groups on post-dispersal seed removal by experimentally excluding (i) birds, (ii) vertebrates (birds and rodents), (iii) vertebrates and large invertebrates, and (iv) neither vertebrates nor invertebrates (control). Seed predation was mainly caused by invertebrates, with 30% pre-dispersal seed predation in pods and up to 90% post-dispersal seed removal for free seeds on the ground which is the most persistent seed stage. The main primary dispersal mode for *C. podocarpa* is explosive dehiscence, with seeds reaching dispersal distances of up to 5 m, while wind or rolling dispersal played a minor role. Subsequent secondary dispersal by animals accounted for dispersal distances up to 19 m. Our study highlights the combined effects of pre- and post-dispersal seed predation to determine the total seed fate. However, for *C. podocarpa* invasion the remaining ca. 370 seeds m⁻² that are constituting its persistent soil seed bank seem more decisive than the species dispersal ability. However, to reliably develop management options against economic loss through *C. podocarpa* spread seed predation, seed dispersal and seed bank dynamics have to be studied in the long-run.

CHALLENGES OF MULTIPLE SPECIES MANAGEMENT: EFFECTS OF CATTLE GRAZING AND RESTING RANGELAND ON SONGBIRD ABUNDANCE AND VEGETATION STRUCTURE IN A MIXED-GRASS PRAIRIE IN SOUTHWESTERN SASKATCHEWAN

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University of Manitoba

Nicola KOPER, University of Manitoba

Using livestock grazing to mimic historical disturbances, via the application of variable stocking rates and resting rangeland, has been proposed as a method for addressing the mass declines of grassland songbirds occurring today. Both strategies could provide a means of increasing landscape heterogeneity, thereby increasing the variety of habitats available to songbirds. We collected data on bird abundance at 90 point count locations in 9 experimental pastures, each 300 ha, located in Grasslands National Park, Saskatchewan. After at least 15 years of rest, followed by 2 years of baseline surveys, pastures were grazed from 2008-2011 with stocking rates ranging from low to very high. In 2012 grazing was removed from the experimental pastures. Our goal for this component of the project was to determine if differences in songbird abundances and vegetation structure among pastures, created by applying variable stocking rates for 4 years, persisted following grazing removal. Stocking rate had a negative effect on Savannah Sparrow, Grasshopper Sparrow, and Baird's Sparrow abundances but a positive effect on Chestnut-collared Longspur abundance. Following grazing removal, Grasshopper Sparrow and Savannah Sparrow abundances returned to pre-grazing levels, but the effects of stocking



rate on Baird's Sparrow and Chestnut-collared Longspur abundances persisted for at least two years. Stocking rate had a negative effect on litter depth, litter cover, and vegetation height-density but a positive effect on *Selaginella densa* cover. Vegetation height-density and *S. densa* cover returned to pre-grazing levels following two years of rest, however, stocking rate previously applied continued to affect litter depth and litter cover for the duration of our study. Our analysis suggests that resting rangeland could quickly erase changes in songbird abundance and vegetation structure created by grazing but for certain variables more than three years of rest may be necessary to achieve this.

21 EQUITY AND JUSTICE AS GOALS FOR CONSERVATION: ANALYTICAL TOOLS AND THEIR APPLICATION

Janet Fisher

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Time-honoured debates about conservation and people are resurfacing in contemporary exchanges about the 'new' conservation. While the debates are not new, new elements do exist regarding who should benefit from ecosystem services (ES). In parallel, much research effort, catalysed by the MEA and funded in part by development agencies, seeks to disentangle the links between ES and poverty alleviation. This paper discusses research asking a fundamental and slightly provocative question: why should ES be used for poverty alleviation? It is a fundamental question because, in the presence of ecological and social trade-offs, ES do not automatically benefit poor people, but have been demonstrated to accrue to wealthy and powerful actors. It is also a timely question, not only because many environmental interventions continue to take place amidst entrenched poverty, but also because demand for ES from non-poor and distant actors is predicted to rise. These matters concern ethics and justice, encompassing questions about the common good, non-human nature and inter-/intra-generational distribution. While research increasingly seeks to disentangle the nexus between ES/poverty, none has considered the ethical foundations of the proposition that ES should be governed for poverty alleviation. Our paper comprises two bodies of work that address this question. The first seeks through qualitative and Q-methodological research, to understand how conservation practitioners rationalise whether and why ES should be governed for poverty alleviation. The second identifies theories in political philosophy and environmental ethics underpinning the same proposition. Through these combined analytical tools, we seek to identify an explicit and defensible case, from theoretical and practitioner perspectives,

of why the poorest should take priority as ES beneficiaries. We also reflect on this unusual combination of disciplinary approaches and methods for examining environmental justice.

EXTENSIVE LANDSCAPE DISTURBANCE EXPLAINS MAMMALIAN DISTRIBUTION IN THE CANADIAN OIL SANDS

Jason Fisher

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Cole BURTON, Alberta Innovates - Technology Futures

Landscape disturbance is often synonymous with habitat loss and fragmentation, and subsequent biodiversity loss. However, the effects of landscape disturbance vary among species and disturbance types, creating ecological "winners and losers" in human-dominated landscapes. In Canada's oil sands, petroleum extraction interacts with logging and road building to create an extensively disturbed landscape with few global analogs. This unique disturbance is implicated in endangered woodland caribou declines. We hypothesized that the effects of oil sands development are not limited to caribou, but manifest across the boreal mammal community. We sampled mammalian occurrence in a 3000 km² area of Alberta's boreal forest at 60 camera-trap stations deployed in a stratified systematic design, sampled between 2011 and 2013. We quantified natural land cover and anthropogenic disturbance from Geographic Information System (GIS) data. We used generalized linear models to relate each species' occurrence to landscape features in an information-theoretic approach. For every species examined, anthropogenic features were a key component of the best-supported model. Some species were positively, and others negatively, associated with landscape disturbance. Overall, anthropogenic features had a greater effect on species than did natural land cover. We contend that these widespread effects signal a change in landscape function, with increasing landscape fragmentation and permeability favoring generalist predators and browsers at the expense of other species. As world leaders contemplate continental-scale pipelines and international climate change agreements, the regional-scale impacts of oil sands development take on global significance. The oil sands' spatial footprint is manifested across the boreal forest mammal community, and the future trajectory of these species may hinge on global decisions.

WHAT LIES BENEATH: DETECTING SUB-CANOPY CHANGES IN SAVANNA WOODLANDS USING A 3D CLASSIFICATION METHOD

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The co-existence of woody plants and grasses characterise savannas, with the horizontal and vertical spatial arrangement of trees creating a heterogeneous biotic environment. To understand the influence of biogeophysical drivers on the spatial patterns of 3D structure of woody vegetation, these patterns need to be explained over large areas to capture the context. The aim of the study was to produce an ecologically meaningful savanna classification using LiDAR (Light Detection and Ranging). We then applied the classification to detect change in a protected area (PA) and a communal rangeland (CR). Canopy height model (CHM) and volumetric pixel (voxel) data from the Carnegie Airborne Observatory-Alpha system were used to create the structural classification. Vegetation was classified as shrub (1-3 m), low tree (3-6 m), high tree (6-10 m) or tall tree (>10 m). A hierarchical a priori approach was used to develop classification criteria. Metrics were based on the cover and spatial arrangement of the height classes: Canopy Cover, Sub-canopy Cover, Canopy Layers, Simpson's Diversity Index and Cohesion. For change detection four of the metrics were used (Canopy Cover, Canopy Layers, Cohesion and Number of height classes present). Gains, losses and persistence (GLP) of cover at each height class and of the four structural metrics were calculated. Trees >3 m in height showed gains up to 2.2 times higher in the CR where they are likely to be protected for cultural reasons, but losses of up to 3.2 times more in the PA, possibly due to treefall caused by elephant and/or fire. A 3D classification approach was successful in detecting fine scale, short term changes between land uses, and can thus be used as a monitoring tool for savanna woody vegetation structure.

ROCKY OUTCROPS: A HARD ROAD IN THE CONSERVATION OF CRITICAL HABITATS

James Fitzsimons

The Nature Conservancy

Damian MICHAEL, Australian National University

Rocky outcrops form important landscape and geological features, and important wildlife habitats. Rocky habitats come in many varieties including escarpments, overhangs, cliffs, tors and boulder-heaps, and large rock domes (inselbergs). Being hard and inorganic, they provide long-lasting landscape features that provide stable micro-climates, habitat and shelter for thousands of years. They provide breeding sites for many top order mammalian and avian predators, as well as colonial nesting species such as bats and swifts. They are also home to rare or endemic plant and reptile species. Due to their relatively stable position in the landscape, and general inaccessibility,

they are considered ecological refugia and can contain high species diversity. In addition, rock overhangs and caves can provide important insights into our ecological past where they contain the remains of species which have long since disappeared. As rocky environments are generally less fertile and less accessible than the surrounding landscape, they are typically less prone to vegetation removal. Nonetheless, they face a variety of threats including compaction of soil (from stock), leading to increased runoff and nutrient enrichment which can encourage weeds; recreational activity causing physical damage and disturbance to nesting birds by walkers and climbers; and potentially climate change. Rocky outcrops also provide refuge for economically- and ecologically-damaging feral animals, and invasive weeds. In fragmented landscapes various approaches have been taken to conserve rocky outcrops, including land acquisition for conservation, fencing from stock and private land conservation agreements with landholders. Where rocky outcrops occur in more intact landscapes, targeted responses for faunal species have included limiting human access around key breeding sites, baiting to reduce pressure from introduced predators, restoring rock habitat and translocation of key species (particularly mammals).

COMMUNITY COMPOSITION OF ENDOPHYTIC FUNGI IN NATIVE VANILLA SPECIES IN THE CHOCÓ BIODIVERSITY HOTSPOT IN COLOMBIA ASSESSED USING NGS: BASELINE DATA FOR MONITORING OF ECOSYSTEM FUNCTIONING.

Nicola S. Flanagan

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Fungi are rarely considered in conservation biology despite their key role as providers of ecosystem services. In an integrative ecosystem-based approach to forest conservation, documentation of the diversity and functional roles of fungal communities is imperative. Endophytic fungi represent a hyperdiverse group globally, and are a source of both unknown species and undiscovered bioactive compounds. The tropical lowland forest of the Chocó biogeographic region in western Colombia is a neglected biodiversity hotspot. The approximately 50% of the original ecosystem remaining is under increasing pressure, and novel solutions for enhancing livelihoods are essential. Within this ecosystem the native species of *Vanilla* are understudied and underexploited as potential non-timber forest products. In order to determine the phylogenetic diversity of the endophyte community of terrestrial and aerial roots, and leaf tissue of five native



Vanilla species, we used Ion Torrent sequencing of 200bp of the D1 variable region of the Large Sub Unit rDNA. In total, more than 6,000 fungal Operational Taxonomic Units (OTUs) were found. 70% of fungal sequences were identified to family, and 59% to genus. Dominant genera were *Veronaea*, *Trechispora* and *Tulasnella*. The community composition was tested using Permanova. No significant differences were seen between tissue types within the same species, but differences were seen between species. *Vanilla bicolor* showed the greatest dissimilarity to other species, reflecting the distinct ecology of this species. This study attests to the utility of NGS to characterize hidden fungal diversity. Our results greatly extend a previous culture-dependent study of terrestrial root endophytes of native *Vanilla* species, enhancing our understanding of the phylogenetic diversity and distributions of these cryptic microorganisms. It is essential that conservation actions begin to consider both the function and potential of fungal endophytic biodiversity.

EFFECTS OF QUARRYING ON LANDSCAPE CONNECTIVITY: A RESISTANCE CALIBRATION APPROACH ACROSS SPECIES, LANDSCAPES AND TIME

Théo Flavenot

CESCO, MNHN

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Landscape connectivity is a key element to biodiversity. Its conservation is threatened by anthropogenic land conversion, which triggers (among other things) an isolation of populations. As other industrial activities, quarrying has a deep effect on landscapes, and may disturb local dispersal processes. However, newly created habitats can be favourable for some specialist species. To assess the global effect of quarrying on connectivity, we estimated its resistance to gene flow relative to that of surrounding land cover classes. We focused on two amphibians with opposed habitat preferences: the common toad (*Bufo bufo*), a species favouring vegetated environments; and the natterjack toad (*Bufo calamita*), a pioneer species. Resistances were inferred with an innovative calibration procedure that integrates mixed modelling and circuit theory. The study was conducted in six contrasted areas to account for the influence of landscape context; and at three points in time to control for time lags between landscape modifications and changes in genetic structure. Results show that time lags between genetic and landscape processes vary among sites and species, and are driven by the type of changes that happened in the landscapes. The calibration procedure failed for areas showing high rates of land conversion. For the others,

the estimated resistances of the surrounding land cover classes were consistent with the biology of our species, but were influenced by the landscape context. Active quarry sites were shown to support connectivity for *B. calamita*, whereas the effect on *B. bufo* was closely linked to landscape context.

(117) NATURE, CAPITAL, AND SOCIAL JUSTICE: DEBATING THE ROLE OF ECONOMICS IN CONSERVATION

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Whether economic interests – either those of resident populations or of outside investors – should be included within conservation policy has been a contentious issue since the advent of the ICDP movement - coalescing into the so-called ‘people vs. parks’ debate that has polarized conservationists for decades. Recently, this debate has become more complicated with advancement of a call for a(nother) ‘new’ conservation paradigm appropriate for the advent of the ‘Anthropocene’, which builds on the growing popularity of market environmentalism to advocate an explicitly anthropogenic approach to conservation in which the capacity to harness the economic value of in situ natural resources is foregrounded. This approach, however, has been called into question by two opposing positions: one demanding a return to strict nature preservation; the other foregrounding concerns for social justice in conservation programming. At the same time, each of these critical positions has questioned the other - for minimizing consideration of the rights of humans and nonhumans, respectively. The result is (at least) a three-pronged debate concerning the relative importance of people, capital, and nonhuman nature in conservation planning. This presentation seeks to dissect this debate, highlighting the terms of debate among these different positions in order to ask whether there exists any possibility to finding common ground among them that might serve as the basis for a new consensus on appropriate conservation futures.

THE EU HABITATS DIRECTIVE AND THE RESTORATION OF VANISHED WILDLIFE POPULATIONS: THE CASE OF LARGE CARNIVORES

Floor Fleurke

Tilburg University

Arie TROUWBORST, Tilburg University

The EU Habitats Directive (HD) instructs EU member states ‘to maintain or restore, at favourable conservation status, natural habitats and species’ covered by the Directive (Article 2(2)), and sets out further duties to achieve this. Much has been published on what is required to fulfill these duties in respect of currently existing wildlife. Far less attention has



been paid to the question what the obligations are once a wildlife population has disappeared, and in particular to what extent the HD requires the restoration of such vanished populations. We address this question using standard EU law research methodology, i.e., identifying and interpreting relevant HD provisions, case law of the EU Court of Justice, overarching treaties, and EU guidance documents, while also using relevant legal and biological literature. We conduct our analysis with particular reference to the large carnivore species brown bear (*Ursus arctos*), wolf (*Canis lupus*) and Eurasian lynx (*Lynx lynx*). These are associated with an array of restoration scenarios and HD regimes, i.e., Annex II (habitat protection), Annex IV (strict protection) and Annex V (flexible protection). Our analysis indicates that the extent of member states' duties regarding the restoration of vanished populations is context-dependent and influenced by a range of variables including (a) the applicable HD regime(s); (b) whether extinction occurred prior or subsequent to the HD's entry into force; (c) whether the population was original or reintroduced; (d) the causes of extinction (natural/anthropogenic); and (e) the prospect of natural recolonization. For each combination of variables we identify and discuss the corresponding obligations. To illustrate, different duties apply regarding each of the following extinct populations: lynx in the UK; wolves in the Netherlands; bears in central Austria; and (assuming they are extinct) wolves in southern Spain.

SUPPLEMENTARY FEEDING STATIONS TO SUSTAIN GRIFFON VULTURE POPULATIONS: A RISK OF ECOLOGICAL TRAP ?

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As a conservation tool, supplementary feeding programs are widely applied on scavengers, likely to bring positive benefits but also negative ones. While scavengers have supposedly evolved to search for unpredictable resources, gathering food at feeding stations are likely to promote non-natural behaviours. Birds may face a risk of "ecological trap" since their behavioural responses inherited from their evolutionary history may be inappropriate in a context of predictable food resources in space even time. As part of a reintroduction program of Griffon vultures (*Gyps fulvus*) in the Grands Causses (France), managers established two types of feeding stations, providing a quasi-experimental framework to address the impact of food predictability on foraging behaviour. While "heavy feeding stations" – concentrating carcasses at a few sites – can be considered as highly spatially and temporally predictable, the network of hundred "light feeding stations"

– diluting the concentration of carrions in space and time – is only spatially predictable, and "open grasslands" – where carcasses are randomly distributed – are, in essence, unpredictable. Using high resolution GPS tracks for 15 vultures, we investigated both spatial and temporal components of foraging movement patterns. We first studied the sequences of visited sites to assess the extent to which vultures rely on routine rather than random behaviour to find ephemeral food resources. In a second step, we focused on the periodicities of movement recursions, likely to reflect and inform about the adaptation of behaviour to periodic constraints.

WHICH METHOD IS BEST? THE IUCN SSC'S NEW GUIDELINES FOR ASSESSING CLIMATE CHANGE VULNERABILITY OF SPECIES

Wendy Foden

IUCN Species Survival Commission

Conservation practitioners wishing to carry out assessments of species' vulnerability to climate change face a burgeoning literature describing a wide variety of methods, each with its own strengths and limitations. Similarly those wishing to use existing assessments increasingly encounter conflicting results from multiple sources. Based on a broad literature review and input from a wide range of experts, the IUCN SSC Climate Change Specialist Group has developed guidance for selecting methods for assessing species' climate change vulnerability and interpreting their results. We outline commonly used approaches for assessing species' climate change vulnerability namely correlative (niche-based), mechanistic and trait-based approaches. We then guide users through clearly defining the scope and objectives of their assessment, as well as to identify and evaluate their available data, technical, expertise, time and financial resources. Using a decision framework, we help users to identify the approaches and methods that meet their objectives and/or are possible given their available resources. The guidelines also include sections on selection and appropriate use of climate and biological data, selecting temporal and spatial scales, and working with uncertainty, knowledge gaps and indirect climate change impacts. We also present ideas for communicating assessment results for practical conservation use. Lastly, we provide examples of how the guidelines can be applied, including for IUCN Red Listing. This presentation will provide an overview of the new IUCN SSC guidelines on assessing species' climate change vulnerability, and familiarize attendees with steps for making sound and defensible decisions on method choice. Through these guidelines we hope to make climate change vulnerability assessment more accessible to conservation practitioners, thereby providing the best possible foundation for climate change adaptation planning.



MITIGATING EXTINCTION RISK FROM FORECAST CLIMATE CHANGE USING MODELS, FOSSILS AND MOLECULAR LOG BOOKS

Damien Fordham

University of Adelaide

Disregarding or misinterpreting biotic responses to past environmental changes could impede our understanding of future ecological dynamics under global change and make accurate predictions and effective solutions difficult to formulate. Current forecasts indicate that anthropogenic climate change will cause widespread biodiversity loss. However, the accuracy of these ecological predictions remains largely untested. I will discuss how biotic responses to past climate change, imprinted in species' genes and observed in fossils, can be used to establish if forecasts of extensive biodiversity loss from future climate change are a likely reality; and to identify traits that make some species more prone to extinction from climate change. A tighter integration of genetic and fossil data into ecological models will generate more robust and validated predictions of the response of demographic and evolutionary processes to large-scale environmental change. These multidisciplinary methods will help conservation scientists to better connect theory to the on-ground design and implementation of effective measures to protect biodiversity.

INCORPORATING ENVIRONMENTAL AND SOCIAL CO-BENEFITS INTO REDD+ SPATIAL PLANNING

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Forests do more than store carbon. They offer co-benefits such as habitat for species, regulation of water flow and quality, and support for livelihoods. REDD+ countries must balance international incentives for global climate change mitigation with national interests in maintaining local co-benefits. Exploring spatial tradeoffs among carbon, biodiversity, ecosystem services, and poverty alleviation reveals where there may be opportunities for gains in co-benefits without large sacrifices in carbon. Countries may find that the value of the gains in some co-benefits outweighs that of the carbon lost. Such findings could encourage countries to pursue strategies that emphasize these co-benefits rather than maximize carbon. Not all forests, however, are eligible for REDD+ because they may not be at risk of deforestation or the value of their carbon and non-carbon benefits does not exceed foregone development costs. Modeling deforestation and calculating the financial viability of forest protection define the extent of forests that qualify for REDD+. This study puts forward a spatially explicit method for incorporating co-benefits into

REDD+ planning. It applies the method in Kenya, a country in the REDD+ readiness stage which has pledged to focus on co-benefits, in hopes that it will provide a template for countries elsewhere.

MANAGING CO-OCCURRING DISTURBANCES FOR THE CONSERVATION OF FOREST VEGETATION AND SMALL VERTEBRATE FAUNA

Claire Foster

ANU

Philip BARTON, ANU ; Chloe SATO, ANU ; Jeff WOOD, ANU ; Christopher MACGREGOR, ANU ; David LINDENMAYER, ANU

Reinstating natural disturbance regimes in ecosystems where they have been disrupted is a priority of many biodiversity conservation programs. As different kinds of disturbances often co-occur, understanding their interactive effects is essential to avoid unintended management outcomes. Fire and herbivory are two disturbances which often co-occur, but studies of their interactive effects are rare in forest ecosystems. We experimentally tested the interactive effects of prescribed fire and browsing by macropod herbivores on understory vegetation and its vertebrate fauna. Fire and herbivory interacted synergistically to affect the forest understory, with palatable plants showing poor post-fire recovery in browsed compared with un-browsed sites. Despite these strong interactive effects on vegetation, the effects of fire and herbivory on the small vertebrate fauna were additive rather than interactive. The native insectivorous mammal *Antechinus stuartii* was more frequently encountered on large herbivore exclusion sites, as was the introduced European rabbit. In contrast, the small skink *Lampropholis delicata* was more common on sites with high densities of large herbivores. Skinks, snakes and European rabbits were also more active on burnt than unburnt sites. Our results suggest that it may be necessary to manage the macropod herbivore population after fire to prevent the decline of palatable plants, and maintain the dense habitat required by some small mammals. However, as the invasive rabbit was most active in macropod-free sites after fire, any management must include both types of herbivores. Our study demonstrates that interactive effects of disturbance on vegetation communities may not lead to predictable effects on animals, and highlights the importance of considering both multiple stressors, and multiple species, in the management of disturbance regimes.

WHAT IS THE REAL COST OF CONSERVATION INVESTMENTS?: CALCULATING THE CONSERVATION OPPORTUNITY COST OF FINANCING LAND PROTECTION

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Evaluating costs of large conservation land deals is a vital but complicated component of conservation planning. For the most expensive land deals, simple acquisition costs are often confounded by loans, cost sharing and sale of easements, after which the realized cost of the deal may be significantly different than the estimated purchase price. The practice of financing is rarely considered when evaluating the cost of conservation in the conservation planning literature, even though about half of land trusts use loan financing strategies for land acquisition. We used a case study of historical land deals conducted by The Nature Conservancy, the world's largest land trust, and financed through internal loans to calculate the 'conservation opportunity cost' of financed conservation deals. This conservation opportunity cost reflects dollars that are unavailable through time for other projects, because of outstanding loans. These conservation opportunity costs of potential deals are uncertain because they are affected by the time required to repay the loans. We conclude that conservation opportunity costs do not simply reflect purchase prices, and thus may be important to consider separately to other cost estimates. We developed a regression model to show how financial characteristics of a deal, such as percent of purchase price in hand, and deal structure characteristics, such as number of conservation partners, affect the opportunity cost. Our results will help conservation planners to consider the likely conservation opportunity costs when comparing the return on investment across new conservation projects.

SPATIAL VARIATION AND THE ROLE OF WILDLIFE IN SEASONAL WATER QUALITY DECLINES IN THE CHOBE RIVER, BOTSWANA

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In water-stressed regions of southern Africa, freshwater resources are under increasing extractive pressures. Sustainable management of dryland river systems is often complicated by extreme variability of rainfall in time and space, especially across large catchment areas. The Chobe River is the only permanent surface water source in the remote Chobe District of northern Botswana, and its floodplain and associated wetlands ecosystem are among the most biodiverse in the world. Seasonal rainfall and floods in the Chobe River system exert a significant impact on the timing of human activities, as well as the movement and ecology of native wildlife. Further, significant temporal relationships have been identified between hydrological dynamics in this system and diarrheal disease outbreaks in the local community. Because

of the extensive provision of ecosystem services and high subsistence value of the Chobe River, and other southern African dryland rivers and their wetlands, there is a critical need to better understand the interdependent drivers of water quality changes in the region. Using field-transect data, GIS, remote sensing, geospatial analysis, and a spatiotemporal modeling framework, we examined seasonal variation of the fecal indicator bacteria, *Escherichia coli*, and total suspended solids (TSS) in the Chobe River in relation to land use and hydrology. Distinct seasonal variations in *E. coli* and TSS concentrations coincided with a transition period between wet and dry seasons. Areas of protected land use (national park) and presence of river floodplain were significantly associated with higher *E. coli* concentrations. *E. coli* levels within the national park were also greater in locations where high-density wildlife populations occur. The results suggest seasonal wildlife presence, floodplain distribution, rainfall, and annual flood pulses influence the timing of water quality declines in this dryland river system.

CONTRASTING TRENDS IN THE BIRD POPULATIONS OF NORTH EUROPEAN PEATLANDS

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Climate change is posing a threat to biodiversity, forcing it to adapt through shifts in species' distributions and thus altering their abundances. Given the prediction of greater temperature increases at high compared to low latitudes, species with restricted range, habitat or climatic niche may face problems. As a further complication, degradation, destruction and fragmentation of natural habitats are clearly increasing the vulnerability of species worldwide. In this context, the relevance of North European (hereinafter NE) peatlands lies not only in the role they play in the carbon cycle, but also because they act as biodiversity reservoirs. In this work we investigate the status of NE peatland birds based on data collected in breeding bird monitoring schemes. Using geometric means of common species' population indices, we analyse the state of the NE peatland bird populations in three different areas: Finland, Scandinavia (Sweden and Norway) and the Baltic region (Estonia and Latvia). While the Finnish populations have declined ca 30% over three decades, the Scandinavian ones have remained stable during the last 20 years. On the other hand, the Baltic populations show moderate increases, providing a contrast with the Finnish populations. We relate these results with the country-specific historical management of these particular ecosystems, therefore gaining insight into the target habitats that are more conducive to biodiversity. Additionally, as a follow-up of the analysis, we explore the effects of climate change by means of community climatic



indices. Our findings call for more effective conservation actions in NE peatland habitats and a deep reconsideration of the current management schemes, particularly in Finland, where the studied populations show the poorest conservation status.

ARE WE UNDERESTIMATING BIODIVERSITY LOSS USING SPACE-FOR-TIME APPROACHES?

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A key challenge for conservation is assess how forest conversion and degradation reduces the biodiversity. However, are we really assessing the true impacts of human disturbances on biodiversity loss? Most of studies in literature use space-for-time substitution, implying that average changes over space are representative of changes through time. A less common approach is the temporal change approach, here considered as before-and-after, whereas the biodiversity is assessed prior and after a disturbance. We compared both approaches to evaluate if space-for-time approach may lead to underestimate the biodiversity loss of dung beetles in Amazon forest selectively logged. We detected a positive relationship between the dung beetles species richness before selective logging and the number of trees that would be removed by selective logging later, revealing that areas with greater potential for selective logging may be those which display greater biodiversity. Both approaches showed significant negative effects of selective logging intensity, but space-for-time approach showed weaker explanation, effect size and significance. Therefore, before-and-after approach had some logistical implications, such higher costs and longer time spent for data sampling. We highlight that future studies using meta-analysis to assess human disturbances impacts should be aware of underestimation of the disturbance effects on biodiversity loss when including space-for-time studies in their analysis.

SURROUNDING AGRICULTURE PRACTICES MAY IMPACT POND BIODIVERSITY: THE EXAMPLE BLACK-HEADED GULLS COLONIES

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The Forez agricultural plain (central France) comprises 343 ponds, managed for fishing and hunting purposes. These ponds present various sizes and vegetation covers and the surrounding landscape can either be openfield or wood. These man-made wetlands welcome high biodiversity, especially of waterbirds. However, there are currently suffering of significant changes due to the piscicultural crisis that might affect species at different speed and intensities. Moreover agricultural practices can as well have important consequences on the biodiversity that the ponds hosted, because they affect pond functioning or because some species use both ecosystems. Every spring, black-headed gulls, *Chroicocephalus ridibundus*, settle in ponds to breed, at the same time they feed in the surrounding ploughed fields. In this plain, the population size decreases over the last 30 years and presents a high spatio-temporal dynamics. We took advantage of the 37 years monitoring of the black-headed gull population to explore the potential relative impact of ponds and land use modifications on this decrease. We demonstrated that both agriculture practices and pond vegetation sharply change over the past 30 years, with an intensification of the former and mainly decreases of the latter. We proved that even today several ponds seem favorable to colony settlement. The cultivated lands surrounding the ponds, and the cover of bulrushes favour long occupation of the ponds by gulls, probably by allowing a better reproductive success. The decrease of helophytes and the alteration of agricultural practices, notably the reduction in the duration of tilling, have probably caused the decrease in the number of gulls observed over the past 30 years because it might have reduced their ability to construct their nests on proper vegetation and decrease the food availability needed on this crucial period of reproduction. This study shows the impact environmental conditions can have on wetlands biodiversity.

THE ROLE OF EGG PREDATION IN HERRING POPULATION DYNAMICS IN PACIFIC HERRING, PUGET SOUND, USA

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Forage fish such as Pacific herring (*Clupea pallasii*) are ecological foundation species in many marine and estuarine ecosystems. In the Puget Sound estuary, USA, Pacific herring are an indicator species, owing to their critical position in the marine foodweb, and the regional management agency has set recovery targets to guide herring management. Puget Sound herring are spatially and temporally segregated into individual



subpopulations by their spawning behavior, and these individual subpopulations show asynchronous abundance trends over the past several decades. While the Puget Sound herring stock as a whole shows variable but largely stable biomass through time, some local spawning subpopulations have significantly declining trends. Efforts are underway to identify leading potential limitations on herring populations to inform recovery targets and potential management strategies for reaching them. Here we focus on the embryonic stage as a potential limiting stage for herring, assessing the relative importance of predation in determining herring egg hatch success, and the implications of predation rates for observed local trends in herring biomass. Using a combination of in situ incubations and predation exclusion devices, we estimated herring egg loss rates both in the presence and absence of large predators, across multiple spawning subpopulations in Puget Sound. We found that predation accounted for approximately 50% of egg loss across all spawning populations. We link predation rates to 40+ years of herring biomass estimates for each spawning population and trends in major egg predators (diving ducks) to develop hypotheses about leading pressures on herring populations in Puget Sound.

118 INTEGRATED CONSERVATION AND DEVELOPMENT PROJECTS, POVERTY AND EQUITY

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Integrated conservation and development projects (ICDPs) began in the 1980's with a narrow focus on providing alternatives to income and resources obtained from a protected area (PA). In some cases such projects evolved into a broader effort that combined interventions to decouple livelihoods from PA resources, interventions to enhance the contribution of PAs to livelihoods, and, in some cases, interventions to promote stronger community participation in PA governance. With both the narrower and broader strategies there was very often an underlying assumption that threats to conservation were essentially driven by poverty within PA-adjacent communities, and thus the "D" in ICDP was framed in terms of poverty reduction. Recent research from PAs in Uganda and Kenya suggests that the ability (or otherwise) of PA management and associated development activities to enable more equitable distribution of the benefits and costs of conservation may be as important in addressing drivers of biodiversity loss as attempts to reduce poverty (or more important). The presentation will discuss an analytical framework for understanding equity in PA management based on research in related fields, and the extent to which different notions of equity may (or may not) contribute to poverty reduction. Clearly there is a need for further research in this area. At this stage we suggest that many of the ICDPs of the

past, and much of current practice in the social dimension of conservation, might be more successful in terms of both conservation and social objectives if framed in terms of addressing (in)equity in stakeholder participation and in distribution of the costs and benefits arising from conservation and development interventions. Such a framing would utilise a broader conceptualisation of human well-being beyond a focus on addressing poverty in a purely economic sense. Some implications for policy and practice will also be explored.

CONSERVATION NEEDS FOR THE VERMETID REEFS IN THE MEDITERRANEAN SEA

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Vermetid reefs are intertidal bioconstructions typical of many subtropical and temperate coastal areas worldwide. Distributed in the warmest waters of the Mediterranean Sea, the reefs are built by the vermetid gastropod *Dendropoma petraeum* and the coralline alga *Neogoniolithon brassica-florida*, two species included in the annexes of the Berna Convention. Vermetid reefs provide a wide set of ecosystem services, such as coastal protection from erosion, regulation of sediment transport and accumulation, serving as carbon deposit and increasing biodiversity at the intertidal level. Despite its vulnerability to several threats, such as pollution, spread of invasive species, ocean acidification and anthropic use of rocky shores, the vermetid reef is only generically protected under the European Habitat Directive (92/43/EEC, code 1170), but not explicitly taken into account in many conservation management plans. On 112 censused reefs, the percentage of protected sites varies among countries. About 50 % of the reefs are officially protected in Italy, Malta, Spain, Morocco and Syria, but less than 20 % is protected in Lebanon, Tunisia and Turkey, and no protection is ensured in Algeria, Cyprus and Libya. In Israel, where protection regards more than 50 % of the reefs, *Dendropoma petraeum* got recently extinct. Up to date, less than 30 % of vermetid reefs in the Mediterranean are apparently protected by means of MPAs or coastal reserves, but a lack of information on the reef conservation status for the coastal areas of northern Africa and the eastern basin is clear. These data marks the need to extend action plans to protect the vermetid reefs and to improve its management in the Mediterranean. Developing a conservation strategy at basin scale and implementing monitoring of protected and not protected reefs are essential to guarantee an effective and sufficient protection of this neglected but relevant coastal key habitat.



133 “WHOSE FAITH, WHOSE BIODIVERSITY?” MULTISCALE ISSUES IN THE CONTRIBUTION OF FAITH TO BIOCULTURAL CONSERVATION: CENTRAL ITALY AS A CASE STUDY

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There are increasing expectations about the role that the world's faiths can play in the conservation of biological diversity. This understanding, however, is often based on a theoretic examination of the 'values' associated with different spiritual traditions rather than on empirical evidence. In particular, it is seldom recognized that faiths are dynamic manifestations in which contrasting values and multiple levels of spatial and social organization frequently coexist. In this paper, I illustrate this multilayered character with case studies drawn from years of socio-ecological research in Central Italy. Based on spatial, ecological and ethnographic data, I show that even within the same faith tradition, Roman Catholicism, there are multiple ways to conceive and realize the relationship with the environment. I show that divergent views and tensions around the spiritual meaning and management of biodiversity-rich sacred sites are frequent. I review some of the practical and ethical implications that this has for faith-based conservation and suggest that faith-based initiatives should ideally be conceived in a framework equally attentive to both biological and cultural diversity. I conclude by calling for more systematic research in the future: without a thorough understanding of and engagement with each local context, faith-based conservation will hardly be able to deliver its expected bounty.

THE ROLE OF BUFFER ZONES IN THE CONSERVATION OF BIRDS IN PROTECTED AREAS: A CASE STUDY OF SAPO NATIONAL PARK, LIBERIA

Benedictus Freeman

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The inclusion of buffer zones in the establishment of protected areas has become a common practice in conservation. However, little is known about the efficiency of these buffer zones around national parks in Liberia and most parts of Africa. Sapo National Park (SNP) is the only national park in Liberia and contains the second-largest area of primary rainforest in West Africa. This study assessed the role of the buffer zone in the conservation of birds of SNP. Birds were surveyed using Distance Sampling with line transects. A total

of 183 bird species belonging to 55 families were recorded. Sixteen species of global conservation concern were recorded in both SNP and the buffer zone including the 'Endangered' Gola Malimbe Malimbus ballmanni and 'Vulnerable' Yellow-bearded Greenbul Criniger Olivaceous. Overall mean density of species and Pielou's evenness index were significantly higher in the Park than the buffer zone, while species richness and diversity were higher in the buffer zone compared to the Park. The high density and evenness of birds in the Park maybe attributed to the intactness and homogeneity of the forest inside the Park. On the other hand, the high species richness and slightly higher diversity in the buffer could be attributed to the heterogeneity in the buffer habitats and the observed availability of food resources (several fruiting trees and farmlands) in the buffer zone as compared to the Park during the time of this study. The presence of 16 bird species of global conservation concern and other birds in both SNP and its buffer zone suggest the conservation importance of not only the Park but also the buffer zone in the conservation of these species. Thus, to effectively conserve biodiversity in SNP, conservation planning and active management efforts should explicitly include a well-defined buffer zone around the Park.

INCORPORATING FUNCTIONAL DIVERSITY IN ECOLOGICAL INDICATORS OF CONSERVATION IN BRAZILIAN SAVANNA

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Developing effective ecological indicators is a great challenge of conservation. Surrogates of biodiversity are frequently used as indicator of ecosystems performance and most of times they are based on taxonomic criteria. Nevertheless, the maintenance of ecosystems functioning are more related to the role of each species in the ecosystem than to species per se. Surrogates that incorporate functional component of biodiversity are related to the niche model and may be more effective indicators. Functional diversity seeks to measure the extent of the functional differences among the species of an assembly, using functional traits diversity. Traits are defined as individual's measurable characteristics that potentially affect the species performance. The cerrado (Brazilian savanna) is one of the world's conservation hotspots and lacks of indicators for management and monitoring. We aimed to construct biodiversity surrogates for cerrado including both taxonomic and functional components of biodiversity using plants. We collected data in 2 areas covered by cerrado, in São Paulo State (Brasil). In each area we established randomly 10 plots (10m x 10m), where we identified all individuals of the tree layer to the species level. We raffle 5 individuals from each species to collect functional traits based on measure (plant height, basal area, life form) and literature (leaf phenology, reproductive



phenology, frutification, dispersal syndrome.) We calculate two taxonomic indices (Simpson and Shannon) and three widely accepted functional diversity indices (Functional Divergence, Functional Evenness and Functional Dispersion). In order to find the indicator we are applying two step analysis: TITAN (Baker and King 2010) and INDVAL (Duf rene and Legendre 1997). The preliminary results suggests that it is possible to use functional diversity to find surrogates for biodiversity and thus incorporate functional approach in conservation strategies.

FARMLAND BIRDS IN CENTRAL GERMANY: ABUNDANCE AND RICHNESS TRENDS LINKED TO SPECIES TRAITS AND LAND USE

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Farmland bird communities have been in decline in agricultural landscapes for several decades now and we were interested in the situation in a regional agricultural area (50 x 90 km) area in Saxony-Anhalt in Germany, and how this relates to regional land use and species traits. Birds were observed in six landscapes of 4 x 4 km following the point-stop count method (20 points per site) in the years 2001, 2009, 2012, 2013 and 2014. The observations are part of ongoing work within the long term monitoring initiative TERENO (TERrestrial ENvironmental Observatoria) which aims to catalogue the long term ecological, social and economic impact of global change at the regional level. We combine bird abundance and richness data with species traits, land use and landscape configuration to explain changes in bird communities of different ecological groups.

UPDATE ON THE STATUS OF THE ENDANGERED SHORT-BEAKED COMMON DOLPHIN (DELPHINUS DELPHIS) IN THE CENTRAL MEDITERRANEAN SEA

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OceanCare
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Once considered abundant, the short-beaked common dolphin (*Delphinus delphis*) in the Mediterranean Sea has been subject to a large-scale decline during the last few decades. Despite considerable efforts in the conservation of this species, to date, only a few conservation measures have been implemented. Furthermore, although Malta is recognized

as one of the few areas of conservation importance for *D. delphis* in the Central Mediterranean Sea, the most recent studies on the species distribution in Maltese waters dates back more than one decade (Bearzi et al. 2004, Vella 2005). Here we present the results from a recent survey in Maltese waters that update the information on the species' status. A transect survey was conducted from August to October 2013 and July to September 2014. During a total visual effort of 3123 nm, 11 sightings of *D. delphis* have been recorded (4 in 2013 and 7 in 2014). Average group size was 20 individuals (SD=14), with a maximum group size of 45 dolphins. On two occasions dolphin movements were tracked for 5 h 40 min, and 1 h 20 min respectively. Our study confirms the regular presence of *D. delphis* in the waters of Malta during summer and early fall and underlines the importance of this area for this species which subpopulation in the Mediterranean Sea is listed as endangered (Bearzi 2003). However, differently from previous findings by Vella (2005), our data do not confirm the presence of large groups (150-250 animals). Despite the methodological differences which do not allow direct comparisons between the two studies, our data point to a need for further investigation on the ecology and population dynamics of *D. delphis* in Maltese waters in order to ground conservation measures for this endangered species on sound and updated data.

USE OF LIDAR DATA TO PLAN FOREST MANAGEMENT MEASURES FOR BAT CONSERVATION

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Recent technological advancements in remote sensing such as Light detection and ranging (LiDAR) now allow detailed quantification of the three-dimensional structure of forest components across a hierarchy of scales. LiDAR data have rapidly become a popular tool in forest sciences, and ecologists have explored potential applications to ecology. In faunal studies, LiDAR technology was mainly applied to investigate bird response to the 3D ecosystem structure. Although bats are known to be sensitive to the vegetation structure according to their eco-morphologic traits, few studies have related bat activity and occurrence to structural components of the forest based on LiDAR. In this study, we aimed to identify key structural forest variables that affect bat guild activity and species occurrence at different scales. We collected bat acoustic data from canopy, ground and gap microhabitats at four stands within eight 1 km² landscape cells in Swiss temperate forests. Airborne LiDAR data were extracted at both forest stand and landscape scales. The relationships between forest structural



variables and bat guild activity were assessed using General Mixed Effects Models (GLMMs) and we used sites-occupancy models to relate bat species occurrence to forest variables. The main results of the study will be presented with a focus on bat conservation in harvested forests.

SYMPOSIUM 88 - BEHAVIORAL AND ENVIRONMENTAL FACTORS INFLUENCING THE VIABILITY OF TRANSLOCATED ELK IN ONTARIO

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Elk reintroduction has been repeated several times and in several places in Ontario over the past decade. Using these aggregate data, we evaluated longer-term survival probability based on Cox proportional hazard. Specifically, we used boosted regression trees to model individual differences in survival time as a function of differences between dispersal distance, settlement time, habitat use, presence of conspecifics, or age at release. 41 elk died out of 142 radio-collared elk that were tracked on average for four years post-release. 15 of these individuals had been killed by wolves, 5 drowned, 7 were hit by a car or a train or shot incidentally by hunters, 5 died of infections or starvation, and 9 death causes were unknown. Both the timing and distance of dispersal markedly affected female elk survival, with marginal mortality risk generally increasing with distance dispersed from the release site. Interestingly, mortality risk also increased steeply for individuals who had remained close to the release site. The timing of dispersal affected the probability of survival: mortality risk was lowest for individuals who dispersed soon after release months after release. Compared to the other predictors the relative contribution of the timing and distance of dispersal was 12% and 19%, respectively. The relative influence of age was 26%, with increasing risk with age. The relative influence of differences between study areas was 15%. Use of forest habitat had a relative influence of 19%, compared to 7% for use of pastures. Conspecific presence accounted for an additional relative influence of 3%, with higher mortality risk for solitary individuals.

TARUKA IN CHILE: ENDANGERED, UNKNOWN AND UNLOVED

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Taruka (*Hippocamelus antisensis*) is a Neotropical deer, which lives in the Central Andes of South America between 2,000 and 4,000 m.a.s.l., a desert biome dominated by rocks and cliffs interspersed among agricultural areas. In Chile, taruka are listed as "Critically Endangered" due to conflicts with local people, small population size (about 500 individuals), and insufficient information to develop conservation strategies. We conducted a survey between 2012 and 2014 to study habitat availability in Chile and understand the human-wildlife conflict. To assess habitat availability, we built a distribution model using data from taruka sightings and indirect signs of presence. To characterize the conflict we assessed if tarukas prefer areas close to crops using preference-availability analysis, and we studied the diet of individuals around villages conducting microhistological analysis to faeces collected during the dry and wet seasons. Finally, we assessed people's perceptions of tarukas through surveys and workshops. The distribution model estimated a total of 22,000 [ha] as suitable habitat for tarukas in Chile, 89% of which (19,579[ha]) is unprotected. We found that tarukas prefer areas close to crops (60±15.2 %) in spite of their availability (26%). In the diet assessment, we found that groups living close to villages eat alfalfa crops (*Medicago sativa*) increasing their intake during the dry season (51.3±10.6 % during dry season; 12.1±3.6 % during wet season). Through 43 surveys, we found 44% of people do not tolerate tarukas because of crop damage and cultural beliefs. They believe the best solution to this conflict is fencing their crops (75%) and killing tarukas (38%). Considering the limited information available, the high proportion of unprotected habitat, and its conflict with local communities, we conclude that it is necessary to focus management actions on understanding and reducing the human-deer conflict in order to promote their recovery in Chile.

ASSESSING THE RELATIVE IMPORTANCE OF LOCAL VS. LANDSCAPE LEVEL ACTIONS TO DEVELOP ECOLOGICAL NETWORKS

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Current actions to reconnect fragmented landscapes include creating new habitat patches and restoring, expanding and connecting existing patches to develop functional 'ecological networks' (a suite of core habitat areas connected by buffer zones, corridors and 'stepping stones' that allow movement of species or their propagules). However, there is much uncertainty on the relative importance of alternative actions (e.g. increasing habitat area vs. connectivity) to develop



ecological networks. As part of an ongoing collaborative research project (Woodland creation & Ecological Networks; WrEN) between academics, policy makers and conservation practitioners, we surveyed 100 secondary woodland patches in the UK to study how different taxa were influenced by local- and landscape-level woodland attributes related to the ecological network concept. Our surveys focused on a range of species with different life-history traits (e.g. habitat specificity and dispersal abilities), including ground beetles, small mammals and bats. Preliminary analyses indicate that taxa differ in their response to local- and landscape-level woodland attributes, depending partly on their dispersal abilities. The abundance of ground beetles (limited dispersal) was negatively related to woodland size and age, and positively to proximity to nearest woodland and amount of woodland in the landscape (< 3 km). The abundance of small terrestrial mammals (e.g. *Myodes glareolus*, intermediate dispersal) was related (positively) to woodland size, and (negatively) to woodland age and the amount of woodland in the landscape. Bat (e.g. *Pipistrellus pygmaeus*, higher dispersal) activity levels were mainly related (positively) to the amount of woodland in the landscape, and marginally to woodland age (positively). Our results suggest that local-level conservation activities are particularly important for lower-mobility species. For higher-mobility species, both local- and landscape-level actions are required.

197-LIFE IN EUROPEAN RIVERS: LEGISLATIVE FRAMEWORK AND FRESHWATER BIODIVERSITY

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European freshwaters, although on the continental range abundant and variable, are under intense pressure from multiple use, pollution and habitat degradation. Freshwater integrity but also freshwater ecosystem services to society have been reduced significantly. Ecosystem structure and function including the biota are strongly affected, with several aquatic species disappearing from entire ecoregions. Climate change will also play a significant role. In Europe, the principal legal instrument to halt the deterioration of aquatic ecosystems is the Water Framework Directive, which aims at restoring aquatic ecosystems back to good status. Together with other legislative frameworks, primarily the Fauna Flora Habitat Directive and the Wild Birds Directive, it should improve, restore and conserve freshwater biodiversity. These two directives form the basis of the so-called Natura 2000 network, which has been set up in order to protect the most seriously threatened habitats and species across Europe. The LIFE programme, an EU funding instrument for the environment, began in 1992 to co-finance best practice or demonstration projects that contribute to the implementation of the Birds and Habitats directives and the

Natura 2000 network. Here it is demonstrated and critically discussed, i) how LIFE projects do consider aquatic habitats and associated endangered species, ii) how river restoration and species conservation interact to improve freshwater biodiversity, and, finally, iii) how connectivity analyses could be used within this context to assess and improve freshwater biodiversity and integrity.

MONITORING FISHER (*PEKANIA PENNANTI*) AND OTHER FOREST CARNIVORES ACROSS A LARGE GEOGRAPHIC AREA USING CAMERA TRAPS AND HIERARCHICAL MODELS OF DETECTION/NON-DETECTION DATA

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The fisher (*Pekania pennanti*) is a forest carnivore proposed for listing as "threatened" in California and other Pacific States under the US Endangered Species Act. From 2011 to 2013 a total of 292 baited camera stations was surveyed for fisher and other carnivores across a 2.8 million ha area in northwestern California. We used hierarchical models of the detection/non-detection data to estimate occupancy at 2 survey scales (stations and pairs of stations 1.6 km apart) and abundance at the station-scale. We estimated an average occupancy of 0.418 [90%CI: 0.345, 0.492] for stations and 0.608 [90% CI: 0.515, 0.702] for pairs of stations, and an average abundance of 0.825 [90%CI: 0.581, 1.068] fishers per station. Of stations at which fisher occurred, we estimated 65% had 1 fisher, 25% had 2 fishers, and 10% had >2 fishers. Simulations calibrated from these estimates suggest that continuation of annual surveys at a rate of 100 new stations each year would provide 80% power for observing declines in occupancy as small as 1.5% per year over 20 years or 4% per year over 10 years. We also found that occupancy and abundance were associated with the percentage of the 10-km-radius area surrounding each station that had burned over the preceding 50 years. Both metrics were maximized when approximately 36% of the surrounding area had burned, which is greater than the average frequency (25%) of fire across the study area for these spatial and temporal scales. Besides furnishing a wealth of data on a single species of conservation concern, we are using the same surveys to concurrently monitor a variety of other mammals for little additional cost. In particular, by combining data from fisher and 8 other forest carnivores in a multi-species occupancy model, we estimated that 6 of these 9 species had an average detection probability > 80% after 30 days.



CASCADE EFFECT OF INSECTIVOROUS BIRDS ON ARTHROPOD ABUNDANCE AND HERBIVORY

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Birds are important predators of arthropods and may influence their abundance and diversity, which in turn can affect leaf herbivory and the adaptive value of plants. Here we tested the top-down effect of insectivorous birds in the abundance of foliage arthropods and levels of leaf herbivory in an Atlantic Forest area of southeastern Brazil, assessing the spatial effects. The study was carried out from October 2013 to March 2014 in three sites having different successional stages. We sampled abundance and diversity of birds through 12 fixed-point counts. We restrict the access to the branches by birds using exclosures in 48 trees of Melastomataceae species for four months, and to control for exclusion effects, we added an open-net treatment. The abundance and diversity of arthropods were estimated by the branch clipping methodology, and herbivory was evaluated by measuring the area of 384 leaves. Results were compared by linear multiple regression analysis. We sampled 136 arthropod-eating birds, and the exclusion of birds has resulted in a higher amount of arthropods in the branches ($p=0.0018$) as well as an increased richness of arthropod orders ($p=0$) in all studied sites. However, other factors as successional stages and abundance and diversity of birds did not significantly affect these results. The herbivory was not influenced by any of the studied parameters. Thus the exclusion of birds has affected abundance of arthropods, but not herbivory, which may be driven by other factors not evaluated here, as an increase in arthropod predators.

HIGH PARASITOID DIVERSITY IN REMNANT VEGETATION, BUT LIMITED SPILLOVER INTO THE AGRICULTURAL MATRIX IN SOUTH AFRICAN VINEYARD LANDSCAPES

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The maintenance of remnant natural vegetation in agricultural landscapes is an important component of conservation programmes that promote farmland sustainability. Demonstrating the biodiversity value of remnant vegetation can support conservation initiatives in production landscapes. We assessed the diversity and assemblage structure of hymenopteran parasitoids in fragments of native scrubland

(fynbos) within vineyard landscapes in the Cape Floristic Region of South Africa. We also aimed to detect positive effects of adjacent fynbos on vineyard parasitoids, such as elevated diversity at vineyard edges adjoining fynbos or evidence of parasitoid spillover into vineyards. Fynbos remnants had significantly higher parasitoid abundance and richness than neighbouring vineyards, and supported assemblages distinct from those within vineyards. However, proximity to fynbos had no effect on vineyard parasitoid diversity, and evidence for spillover was limited, as there were abrupt changes in assemblage structure at fynbos/vineyard boundaries. Surrounding vineyards seem to have a fragmenting effect on parasitoids in remnants, emphasising the need to increase the permeability of the vineyard matrix. Yet, our results show that remnants are important for retaining parasitoid diversity and may provide refugia for certain species within the disturbed agricultural environment. Approaches that combine natural remnant conservation with arthropod-friendly activities in vineyards may be the most effective way to support diverse and functional parasitoid assemblages at the landscape scale. Conservation of this diversity will be crucial for maintaining long-term ecological resilience in agricultural landscapes.

WHEN COMMON BIRDS BECAME RARE: HISTORICAL RECORDS SHED LIGHT ON LONG-TERM RESPONSES OF BIRD COMMUNITY TO GLOBAL CHANGES IN THE LARGEST FRENCH WETLAND

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Tour du Valat

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We propose a new method to reconstruct the past structure of a species community in a given area, based on historical naturalist literature. We think that providing that major bias are identified, details and information on the status of species provided by checklists and various reports can be relevant to identify species constitutive of a community, characterize their relative abundance, and highlight major changes in status over time. We reviewed ornithological literature dedicated to the Camargue, the largest wetland in France. It was possible to reconstruct the entire breeding bird community from 1830 to present day. Qualitative information depicting the abundance of species was translated into semi-quantitative data, allowing the calculation of a Community Commonness Index, measuring the average level of commonness of species in a community. Two other multi-species indices were used to evaluate the potential past impact of land-use and climate change on the composition of the bird community. Community Commonness and Community Specialisation Indices simultaneously dropped between 1950 and 1980, suggesting that change in land-use negatively impacted the structure and composition of the local bird community by reducing the number of individuals per species and decreasing the



representation of habitat-specialised birds. Indeed, land-cover data show a major loss in natural habitats in the Camargue at that time due to conversion to cultivated and industrial areas. This general and unsuspected decline contrasts with long-term increases shown locally by well-monitored colonial waterbirds. Our results plead for a more regular use of historical naturalist data when assessing the conservation status of a population or a species community as they allow the establishment of an older baseline and encompass more species than data issued from monitoring schemes.

33-THE IMPORTANCE OF SOCIAL NETWORKS IN EFFECTING BEHAVIOR CHANGE THROUGH POLICY

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This study explicates an innovative theoretical framework that combines the Advocacy Coalition Framework (ACF) with Social Network Analysis (SNA) to understand policy processes in environmental sectors. This approach draws on scholarship from policy and social network literatures on the management of knowledge, resource sharing, information flow and exchange, and group formation. Taken together, this literature demonstrates that both the macro-level policy context and the micro-level local social relations facilitate and limit policymaking and implementation processes in environmental policy sectors. I discuss how policy-oriented social networks, which can be observed empirically using SNA techniques, influence the exchange and acquisition of a wide breadth of policy-related information and resources, such as new innovations and reform-related political and technical knowledge. Moreover, network structures and the network location of individual actors play an important role in effecting the implementation of new policies and reforms through bridging and brokering activities. Finally, I consider the potential of SNA visualizations for designing strategies for change within and between environmental policy organizations for more effective advocacy, policymaking and policy implementation behaviors.

ASSESSING CAUSES OF THE DECLINE OF LITORIA AMPHIBIANS IN AUSTRALIA USING SPECIES DISTRIBUTION MODELS.

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Amphibians display a wide array of physiological adaptations and have colonised a diversity of terrestrial and aquatic environments. They rely on multiple habitats, generally exhibit low vagility and have permeable skin that makes them

sensitive to changes in their direct environment. Currently, the IUCN estimates that globally around 41% of amphibians are threatened with extinction. For example the Australia genus *Litoria* has 26% of its species listed in one of the threatened categories. Amphibians are often exposed to many threats simultaneously, such as disease outbreaks, habitat destruction, invasive species, pesticides and impacts from climate change. The simultaneous nature of these threats makes it particularly difficult for species to adapt and increases the chance of extinction. Devising effective strategies to assess the impacts of various threats on populations of amphibian species is therefore imperative. Species Distribution Modelling (SDM) can be used to assess current amphibian species distributions and explore different future scenarios. SDM has the advantage of being able to overlay multiple environmental factors that might affect a species distribution and can potentially help to identify areas that are in need of conservation efforts as well as to quantify what factors have the biggest impact on a species' distribution. In this study we used presence-background SDMs with bioclimatic, disease, land use and vegetation layers to explore the changes in distribution of Australian *Litoria* amphibians. By comparing historical distributions with current distributions and projecting future distributions, we explore which environmental variables have the overall biggest impact, and assess whether impacts differ across species within the *Litoria* genus.

SINGLE-SPECIES MANAGEMENT HAS LONG-TERM CONSEQUENCES FOR NON-TARGET WILDLIFE

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Habitat alterations intended to benefit a single species or suite of species are widespread, yet their effects on non-target wildlife are poorly addressed. Given the broad and increasing impact of anthropogenic activities on biodiversity, advancing our understanding of the costs and co-benefits of single-species management for other species of conservation concern is warranted. We investigated the long-term effects of mechanical forest reduction designed to benefit mule deer (*Odocoileus hemionus*), an economically important game species, on non-target bird and mammal communities in Colorado, USA. We conducted bird point counts and established wildlife cameras in sites where trees were mechanically removed forty years ago, and in undisturbed reference sites. We compared bird and mammal habitat use among these treatment and control sites using dynamic occupancy modeling, and determined the ecological parameters (e.g. vegetation structure and composition) that had the greatest influence on the probability of use. Our results suggest that forest reduction catalyzes a long-term



change-of-state from dense pinyon-juniper forest to sagebrush scrub, consequently changing the wildlife communities that use these areas. We also found that particular wildlife guilds were influenced by specific vegetative characteristics that could be factored into management decisions. For example, bark-gleaning birds were 53% more likely to use reference sites over historically disturbed sites and mean tree diameter had the greatest positive influence on the probability of their presence. Therefore, using forest-clearing techniques that retain some large standing trees may reduce the long-term impacts of mechanical disturbance on bark gleaning birds. By understanding both the short and long-term consequences of single-species management on non-target species, we can enhance our ability to protect and restore the biodiversity of natural communities.

HUNTING OF MIGRATORY SHOREBIRDS IN THE EAST ASIAN-AUSTRALASIAN FLYWAY: A REVIEW OF THE EVIDENCE

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Migratory shorebirds have declined in the East Asian-Australasian Flyway (EAAF) due to multiple threats. Evidence is accumulating that habitat loss is a key driver, though hunting may also account for the decline of particular species. However, the evidence of this activity in this flyway seems patchy both temporally and spatially. This is inadequate to inform policy, as effects of hunting can only be appraised at a flyway scale. We reviewed all the available evidence on hunting of migratory shorebirds across the flyway to (i) characterise the evidence base, (ii) assess the magnitude and spatial patterns of hunting, and 3) identify the socio-economic contexts of hunting. We searched thoroughly for relevant references and obtained 125 of the 155 located. Most references presented anecdotal evidence and corresponded to grey literature. Hunting of migratory shorebirds has been detected in 77% of the countries in the EAAF. Of all its migratory shorebird species, 73% have been hunted, including threatened and least concern species. When all figures per species are pooled, 12 species have had minimum annual harvest levels of over 1,000 individuals. This harvest has not been even, as there are differences in target species and magnitude of hunting between localities. Hunting has been practiced for sport, subsistence, and commercial purposes, with geographic variations. Migratory shorebirds have been subject to hunting at some localities for extended periods of time, warranting further research at those places with no current data. Unfortunately, the full magnitude of hunting remains unknown across the EAAF, because the evidence is largely anecdotal and not robust. This pitfall precludes any assessment of potential impacts of hunting on population dynamics, though they may

be considerable. Modelling studies and a monitoring scheme are urgently required, especially at a time when other stressors are at play on these birds in this flyway.

THE STUDY OF BEHAVIORAL ECONOMICS OF LIONFISH FISHERIES TO IMPROVE CORAL REEF MANAGEMENT EFFECTIVENESS

Nohora Galvis

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The red lionfish native from the Indo Pacific is in the Caribbean Sea as an invasive species (*Pterois volitans*). Its population has been attempted to be controlled in the Colombian Caribbean by developing an artisanal fishery. This activity resulted to be an economic alternative to the overfishing that faced the native commercial species. It represents a win-win-win policy since it provides ecological, social and economic solutions to improve coral reef management effectiveness. A detailed study has identified the behavior of the community of fishermen (SWOT Analysis and CPEU Database), media, scientists and managers since the appearance of lionfishes in the coral reef areas of Colombia until the development of a national market. This publication facilitates public action.

EXTINCTION RISK IN MIGRATORY BIRDS

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Extinction does not occur randomly and is often correlated with traits such as large body size, high specialization, small population and small geographic range size, among others. Most species extinction risk assessments are based on measures of abundance and range but both of these traits are usually problematic to obtain and evaluate for migratory species. The distribution of migrants is highly dynamic in space and time, thus monitoring their range and abundance is more difficult than it is for their sedentary counterparts. Failure to properly account for these traits in the extinction risk assessments could result in misleading threat classification and consequently leave species without the protection they need. In this study we untangle the drivers of extinction risk for migratory bird species considering a large array of correlates of extinction and phylogenetic comparative methods at two different scales: globally and in Australia. We determine whether migratory birds are more threatened than non-migrants and also discover whether different forms of



migration (full, altitudinal and nomadic) are associated with different levels of extinction risk.

IS BIGGER BETTER? UNDERSTANDING THE EFFICIENCY OF EXPANDING PROTECTED AREAS

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Protected areas remain the backbone of global conservation effort. In 2011, signatories to the Convention on Biological Diversity (CBD) agreed to increase the protected areas target from 10% to 17% for terrestrial ecosystems (Aichi Target 11). Although few countries had previously met the 10% target, many had completed conservation assessments that identified critical areas to meet this target. We investigated whether the increased CBD target would mean that plans based on 10% targets were now inefficient. We used MARXAN develop conservation plans for five countries with both 10% and 17% targets. In an ideal situation all of the priority locations in the 10% scenario would also be present in the 17% scenario. This would indicate that conservation assessments done with 10% targets remained efficient despite the target increase. Unfortunately, the average percent overlap between priority areas for the 10% scenario and the 17% scenario was only 33%, meaning that conservation plans based on 10% targets represent inefficient priorities for the revised 17% targets. This inefficiency has major implications for national protected area planning.

WITHIN AND AMONG-INDIVIDUAL VARIATION MAY DETERMINE TIGER OCCUPANCY AND CONNECTIVITY IN HUMAN-DOMINATED LANDSCAPES

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The conservation of flagship carnivores (e.g., tigers *Panthera tigris*) often catalyzes the designation and funding of reserves, co-incidentally also protecting numerous other threatened species. Hence, the persistence of these co-occurring species may be tied to large carnivore persistence. In turn, carnivores may need to use and move through mixed-use zones outside reserves to survive. Yet, the habitat and behavioral traits determining large carnivore presence in multiple-use areas are poorly studied. We evaluated four hypotheses to explain tiger presence in a human-dominated 302 km² linkage between two reserves in the Western Ghats biodiversity hotspot, India: (a) spatial habitat characteristics (b) temporal segregation of space with humans; (c) individual tiger variation in prey associations and human tolerance; and, (d) the influence of body state on prey associations and human tolerance.

We tested these hypotheses using mixed-effects logistic regression, based on 36,855 trap-days at 445 camera-trap locations from 2011 to 2013. Tiger presence was positively correlated with detection rates of the large, human-sensitive gaur (*Bos gaurus*), and distance to human infrastructure. Tigers were less active by day, regardless of distance to human infrastructure. One individual ventured significantly closer to settlements than others. When this individual was in a poor body state, it also avoided gaur-rich areas (i.e., it used more human-dominated areas), bringing it closer to crossing critical connectivity gaps than other tigers. Thus, behavioral variation among and within individual carnivores may influence use of fragmented landscapes, resulting in higher occupancy and greater functional connectivity than would be expected from studies conducted within protected areas. Greater attention to individual-level characteristics in landscape-scale monitoring programmes could help managers enhance connectivity, while also anticipating potential conflict with people.

PERCEPTIONS AND INFORMATION ON ELEPHANT IVORY TRADE IN CHINA: APPRAISAL AND RECOMMENDATIONS

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African elephant poaching has escalated to an untenable level. Western NGOs and media generally attributes the problem to China's internal ivory market. Chinese authorities often accuse international community of using inaccurate information and exaggerating Chinese demand for ivory. A solution to the poaching problem remains elusive. We contextualized the claims and counter-claims to find a new basis for effective conservation. Data came from analysis of Chinese news articles in 2003-2013, interviews and participant observation in China and Africa in 2013-2015. Our findings showed that international community and diverse interests inside China held different narratives about the ivory trade. Most NGOs and media blamed the Chinese demand for ivory's high price. Chinese, in contrast, insisted the limited supply was the price driver. Most NGOs and media considered the Chinese middle class as major ivory buyers; Chinese suggested it was the Baofahu (the "suddenly wealthy"). Most NGOs and media aimed at addressing ivory's symbolic social status value; Chinese media hyped up ivory artworks' economic value as investment alternatives. We also evaluated adequacy of the information activity (i.e., the gathering, processing, and dissemination of information) in the global dialogue about the ivory trade issue. We found that the information function at place only partially met widely accepted standards of dependability, comprehensiveness, selectivity, creativity, and availability. We suggested how to integrate reliable knowledge and improve the information activity to help all parties achieve a shared understanding of



the problem. Our recommendations encourage integration and harmony among the contending perspectives, which will potentially rehabilitate elephant conservation at both strategic and tactical levels and expand opportunities for significant international cooperation on the ivory trade issue as well as other urgent conservation matters.

VEGETATION SHIFTS AND COMMUNITY CONSERVATION ISSUES DUE TO CLIMATE CHANGE IN THE HOLARCTIC

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Corvinus University of Budapest

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Climate change is one of the most significant global challenges nowadays. Changes in temperature and precipitation pattern and increases in greenhouse gas concentration will alter numerous site factors and biochemical processes such as nutrient and water availability, fire regime, biotic interactions and invasion. As a consequence, climate change is expected to alter distribution ranges of many communities as well as boundaries of biomes. Objective of my research is to overview observed and predicted changes of vegetation distribution in the Holarctic and discuss need and possibilities of ex situ community conservation. Available literature on possible vegetation shifts in Europe, Siberia and North America was reviewed, main conclusions were summarized and potential area changes were estimated. Current and potential distribution changes are described according to geographical regions including the Alps, Scandinavia, Western Europe, Southern Europe, Central Europe, Siberia, Canada, Alaska, California, Southwestern, Eastern and Southeastern USA, the Great Lakes region, the Great Plains, intermontane basins and plateaus, the Rocky Mountains and the Cascades. Main trends are similar in Eurasia and North America: northward shift of several biomes and the tree line and upward shift of mountain communities; shrub expansion in the Arctic; reduction of boreal forests with increasing number of broadleaved species; drought tolerant species and communities becoming dominant in temperate forests; emergence of invasive species; reduction of alpine communities; structure and composition change in grasslands as well as reduction of wetland areas and marshes. Changes of vegetation patterns emphasise the need for ex situ conservation of communities besides current in situ efforts. In order to be able to help communities to migrate and adapt, different methods and tools of ecological engineering and landscape architecture are analysed and evaluated.

CURBING 'INEVITABLE' ILLEGALITY IN PROTECTED AREAS: A COLLABORATIVE APPROACH

Ch Garcia

Ya'axche Conservation Trust

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Protected areas (PAs) worldwide are under increased pressure due to encroachment from unsustainable, often illegal, human activities. In developing countries, this frequently originates from a lack of economic opportunities for the people in the surrounding area and an increased need for resources and land by growing human populations. At the same time, governments can't afford to put adequate funds towards PA management, or do not regard it as an economic or political priority. These factors can result in uncontrolled habitat destruction inside PAs. In Belize, a country just south of Mexico, a local environmental NGO has collaborated with communities, the government and the private sector to curb ongoing illegal clearcutting, farming and settlement inside PAs. By providing the opportunity to the trespassers to remain in the area under set conditions, the conflict between the goals of the PA and the communities' needs is minimized. Organized farmer's collectives can apply for a cacao-based agroforestry concession stipulating strict guidelines to minimize impact on natural systems inside the PAs, while still providing income for the farmers. Cacao is rising as a major cash crop for small-scale farmers in southern Belize, with a promising global market and a supporting local private sector. It has been grown by local populations for centuries and plays an important role in local cultures. Due to its need for sufficient canopy cover to grow, the crop is ideally suited for less disturbing farming practices, while farmers can harvest products such as timber, fruits and non-timber forest products from the farm set up. The NGO provides the training and support for efficient operation of the concession, while the private sector provides product processing and marketing. This Belizean case study is an example of how fruitful collaboration between communities, private sector, NGOs and government can successfully mediate inevitable destructive impacts on natural systems.

A NATIONAL ASSESSMENT OF THE SUCCESSIONAL STATE AND ANTHROPOGENIC PRESSURES OF TROPICAL DRY FORESTS IN COLOMBIA.

Hernando Garcia

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Tropical dry forests (TDF) have been heavily fragmented in Colombia, where 8% of the original TDF remain, and only 5% of what is left is under protection. Moreover, more than 90% of the remaining dry forests remain in private areas, making it urgent to find incentives for landowners to preserve the little TDF left. Our objective was to quantify the successional state and anthropogenic pressures of TDF at the national level. To do this, we assessed TDF structure (early, intermediate and late succession) and anthropogenic pressures (cattle, agriculture, fire, human infrastructure, mining, wood harvesting) in 800 geographic points across the six regions where TDF occurs: the Caribbean, the Cauca valley, the Magdalena valley, the Patía Valley, Northeastern Andes, and the Llanos. We found that the most fragmented dry forests are found in the Cauca Valley, where only 20% of the geographic records contained late successional forests. In contrast, 88-90% of the records from the Caribbean and Llanos regions contained late successional forests. In the Caribbean, 77% of records also contained early successional forests, while in the Llanos no records contained early successional forests. At all points we detected at least one anthropogenic disturbance, with agriculture, cattle ranching and human infrastructure being the most pressing disturbances throughout the country. Based on these data, we present conservation and management priorities for TDF in both natural and productive lands. In particular, we discuss management alternative models for private lands where the majority of TDF are found in Colombia, and conservation incentives are mostly needed.

INTEGRATING BIRD TAXONOMIC, FUNCTIONAL AND PHYLOGENETIC DIVERSITY FOR CONSERVATION MANAGEMENT IN HIGHLY THREATENED ECOSYSTEMS OF THE COLOMBIAN ANDES

Hernando Garcia

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The Colombian Andes are among the most diverse world's biodiversity hotspots. Highly threatened by human settlement, highland ecosystems in the Andes now face major pressures from gold mining, among other human activities. Paramo a unique highland ecosystem that provides water to all major cities in the country, has been recently excluded from mining by the Colombian law. Accordingly, the Colombian Ministry of Environment requested the characterization and delimitation

of paramos at the national level in 2013. In this study we focused on how bird taxonomic, phylogenetic and functional diversity of Colombian paramos increase our understanding of these highly diverse ecosystems, in addition to provide useful information for their management. Taxonomic diversity was assessed at a 1km² scale based on 800 species distribution models, while indices of functional richness (FD) and dispersion (FDiv) were measured from five traits of 6000 individuals corresponding to 399 species assessed. Phylogenetic diversity was defined as the sum of branch lengths of bird species present in each community, which was assessed using a bird global phylogeny. All indices were corrected by species number with linear regressions and species distribution null models. Our results show that the three components of diversity are decoupled. The highest levels of taxonomic diversity were found in the Eastern Cordillera and North part of the Central Cordillera, while the lowest levels were found in Central Cordillera. Only the Eastern flank of the Eastern Cordillera had higher levels of phylogenetic diversity than expected. In contrast, functional diversity did not show a significant geographic structure. These results suggest that different biodiversity components change within and between paramo complexes. Thus, integrating other components of biodiversity is crucial for future management and conservation planning of these highly diverse areas.

WHY AND HOW MIGHT GENETIC AND PHYLOGENETIC DIVERSITY BE REFLECTED IN THE IDENTIFICATION OF KEY BIODIVERSITY AREAS?

Jaime Garcia Moreno

ESiLi

Thomas BROOKS, IUCN ; Annabelle CUTTELOD, IUCN ; Dan FAITH, Australian Museum ; Penny LANGHAMMER, Arizona State University ; Silvia PEREZ-ESPONA, Anglia Ruskin University

'Key biodiversity areas' (KBAs) are defined as sites contributing significantly to the global persistence of biodiversity. Their identification builds from existing approaches based on measures of species and ecosystem diversity and process. Here, we build from the work of Sgro' et al. (2011 *Evol. Appl.* 4, 326-337) to extend a framework for how components of genetic diversity might be considered in the identification of KBAs. We make three recommendations to inform the ongoing process of consolidating a KBA standard. These include genetic diversity within species, phylogenetic diversity among species and the evolutionary processes which drive and maintain both of these, namely: (i) thresholds for the threatened species criterion currently consider a site's share of a threatened species' population; expand these to include the proportion of the species' genetic diversity unique to a site; (ii) expand criterion for 'threatened species' to consider 'threatened taxa' and (iii) expand the centre of endemism criterion to identify as KBAs those sites holding a threshold proportion of the



compositional or phylogenetic diversity of species (within a taxonomic group) whose restricted ranges collectively define a centre of endemism. We also recommend consideration of occurrence of EDGE species (i.e. threatened phylogenetic diversity) in KBAs to prioritize species-specific conservation actions among sites. Our recommendations for incorporation of components of biodiversity below the species level into existing KBA criteria span aspects of composition, structure and function of genetic diversity, and also the breadth of mechanisms for putting this into practice. We believe the implementation of these recommendations would allow confidence in the claim that such sites do indeed contribute significantly to the global persistence not just of species and ecosystem components of biodiversity but of genetic components as well.

ID 177 AZTECA CHESS AND AGRODIVERSITY: EDUCATIONAL TOOLS TO EXPLORE THE EMERGENCE OF FUNCTIONAL BIODIVERSITY IN AGROECOSYSTEMS

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El Colegio de la Frontera Sur

John PERFECTO, University of Michigan ; John VANDERMEER, University of Michigan ; Erika SPEELMAN, Wageningen University

The complexity, relevance, challenges, and beauty of many ecological and socio-ecological processes are not easily grasped by social actors collectively involved in their (mis) management. We have developed a number of original stylized board games and interactive agent based models that allow participants coming from the most contrasting social and educational backgrounds to experience and understand the nonlinear processes and the surprising properties, challenges and opportunities that emerge at different scales in biodiverse socio-ecological systems. AZTECA CHESS is a two-player table board strategic game, based on thorough, long term ecological research by Vandermeer, Perfecto and collaborators. It captures in a stylized form some of the cascading interactions that occur among a number of insects and fungi species in the mesoamerican shade coffee agroecosystem, and its practical implication for autonomous pest control. Among the species involved are *Azteca instabilis* – a keystone species ant- and *Hemileia vastatrix* which is currently producing a severe coffee rust epidemics in Latin America. AGRODIVERSITY v.2 is an agent based model in Netlogo language, in which fictional populations of a crop (strawberry), a weed, an herbivorous insect that consumes the crop, and a predator spider that consumes the insect interact in a 2D field. This interactive ABM challenges users to find the biological and management parameters with which functional biodiversity can self-organize to produce ecological and economic sustainability far from equilibrium (i.e. strawberry fields forever). We briefly describe

the tools and present initial results on learning by farmers and students who have interacted with them.

82-TRADE-OFFS AND SYNERGIES IN THE SOCIAL-ECOLOGICAL VALUES ASSOCIATED WITH DIFFERENT LAND-USES IN THE EASTERN AMAZON

Toby Gardner

Stockholm Environment Institute

Achieving more sustainable development trajectories in tropical agricultural frontiers depends partly on our ability to understand the relationships, including potential trade-offs and synergies, between forest conservation and rural development objectives. Here we extend existing work in this area using survey data from 36 landscapes and nearly 500 properties in the eastern Brazilian Amazon, and examine how such relationships are moderated by factors such as the choice of ecological and socio-economic condition measures, spatial scale (farm, catchment, region), land-use, farm-size and actor type. Understanding the suite of interactions, including both potential trade-offs and synergies, for different types of land-users can help reveal a wider range of barriers and opportunities associated with land management options that take into account additional social objectives beyond economic efficiency, such as regional food and labour security and social justice. Our preliminary results are a first step into understanding the enabling conditions at both farm and landscape levels for such a transition to occur. We reveal high levels of heterogeneity in social and ecological condition and actor characteristics within landscapes dominated by farms from both ends of the property size and wealth spectrum. This same heterogeneity suggests some scope for improving conservation and socioeconomic objectives through integrated changes in the management of both agricultural and forested lands, e.g. through conditional credit access and extension work and more inclusive certification standards. However, the highly dynamic nature of land-use, social and institutional change in forest frontier regions underscores the urgent need to consider how this landscape and actor diversity can be explicitly accounted for in fostering new approaches to land-use sustainability, including legal compliance mechanisms, conservation strategies and investments in the agricultural sector.

ON-SITE BIODIVERSITY CONSERVATION IN URBAN AREAS THROUGH BIODIVERSITY SENSITIVE URBAN DESIGN

Georgia Garrard

RMIT University



Sarah BEKESSY, RMIT University

Urban development has a substantial impact on native plants and animals and is considered one of the greatest threats to biodiversity around the world. Urbanization impacts biodiversity in a number of ways; the net effect is a reduction in the ability of native species and ecosystems to persist in urban landscapes. Traditional approaches to conservation in urban areas protect high value remnants and seek off-site compensation for losses incurred in the urban matrix through biodiversity offsets. This type of approach underestimates the role of the urban matrix in conserving biodiversity, as well as the importance of the development process and future inhabitation of the area for minimizing impacts on biodiversity. However, many of the impacts of urbanization can be reduced by improvements to urban design. We propose a new protocol for biodiversity sensitive urban design that focuses on on-site conservation of native biodiversity in urban landscapes. We investigate how biodiversity sensitive urban design can be used to create urban environments that minimize impacts on biodiversity and, in some cases, contribute to the persistence of biodiversity in urban landscapes. Using viability as a currency, we propose a 'star-rating' system in which new urban developments can be rated for their contribution to biodiversity persistence. We demonstrate this protocol using Melbourne as a case study, where sprawling urban growth presents a major threat to the conservation of native grasslands.

15-MANAGING POLLINATION SERVICES FOR SUSTAINABLE CROP PRODUCTION

Michael Garratt

University of Reading

Simon POTTS, University of Reading

Insect pollinators are a fundamental component of global ecosystems but they are also crucially important for food production. Pollinators improve the yield and quality of over 75% of crop species and contribute over \$3.61 Billion to global agriculture. Despite their importance, management of pollination services is not currently a core component of many crop production systems and in the face of changing pollinator populations and distributions this threatens food security. Here we present research identifying which pollinators are most important for crop production and how this varies between crops and regions and we discuss the importance of pollinator diversity for resilient crop production systems. We then outline potential pollinator management strategies for improved crop pollination and how these should be targeted and are often context specific, with different crops in different regions requiring different management approaches. Pollinator management can be effective and should be included as a component of integrated farming systems to maintain resilient production despite ongoing environmental change. But there

is still much to learn about the direct impact of pollinator management strategies on crop production so farmers can make sensible cost effective management decisions that pay-off in the long term. The wider benefits of crop pollinator management for biodiversity and ecosystems as a whole is discussed.

99-CONNECTING PEOPLE WITH NATURE - EXTINCTION OF EXPERIENCE: CAUSES AND CONSEQUENCES

Kevin Gaston

University of Exeter

Concern has long been held about the 'extinction of experience', the progressive loss of human interactions with nature, and its implications for the future of biodiversity. However, the extent and depth of the body of evidence that such a phenomenon is taking place, in what ways, and for whom, has grown markedly. In a similar vein, understanding has much improved of the causes and consequences of the extinction of experience. This presentation will review the state of these advances, with a particular focus on the relations between the extinction of experience and human health, and how new frameworks for understanding the relations between human health and nature bear on the extinction of experience.

CHANGES IN LARGE MAMMAL POPULATION SIZE AND EFFECTS OF VEGETATION STRUCTURE IN AKAGERA NATIONAL PARK, RWANDA

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University of Rwanda (UR)

Abstract. Systematic point counts and Distance sampling were used to estimate large herbivore population sizes and densities in the savannah habitats of the Akagera National Park (ANP), Rwanda, between 2009 and 2011. Analyses were based on 229 replicated points. The findings were compared with surveys of the park conducted in 1990, 1997/1998, 2002 and 2010. Results showed that the park currently holds about 20 species of large herbivores, including three species that are protected by CITES (African buffalo *Syncerus caffer*, African elephant *Loxodonta Africana* and Eland *Taurotragus oryx*). Estimates of the total population and density varied greatly from one species to another, reflecting the ecology and behavior of each species. The most abundant were impalas, buffaloes, topis, baboons and zebras. There were also large population sizes and densities of impalas outside the park as well as high-population sizes and densities of Ankolé cattle both inside and outside the park, posing a conservation challenge. Compared to previous population estimates of the park, the data demonstrated that most wildlife declined between 1990 and 2011 as a result of anthropogenic interference through park



reduction in size to meet the local human population needs for agricultural development and livestock grazing following the 1994 genocide in Rwanda. Moreover, the results highlighted the role of habitat structure as an important predictor of distribution and abundance of large mammals in the study area, suggesting that changes in this structure are likely to affect wildlife. The present data demonstrated that ANP, despite its recent important reduction in size, still conserves important populations of large mammals but does not have the large mammal population numbers common in other savannah parks in East Africa. Key words: density estimate, Distance sampling, East Africa, large herbivores, point count, savannah habitat.

LEADERSHIP AND COOPERATION: EXPERIMENTAL EVIDENCE FROM COMMUNITY FORESTS IN ETHIOPIA

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We use dynamic lab-in-the-field common pool resource experiments to investigate the role of leadership on cooperation and rule compliance behavior of group members. We find that leaders elected by the community members are more effective in promoting cooperation among the community members compared to the baseline scenario where there is no leadership and to a situation where leadership is exogenously imposed. The effect of leadership is striking as subjects do not have any information on past experimental behavior to choose the “right” leader for them. All but one leader decided to implement a sanctioning rule. All leaders, irrespective of the voting mechanism, increased their cooperativeness in the second game. The elected leaders tended to be relatively wealthy men. Our results do not support evidence on elite capture but highlight the importance of legitimate procedures for decentralization policies.

DNABUSHMEAT: A REFERENCE FRAMEWORK FOR THE DNA-TYPING OF AFRICAN FOREST BUSHMEAT

Philippe Gaubert

IRD
Remy DERNAT, Université de Montpellier ; Agostinho ANTUNES, CIIMAR

The bushmeat trade in tropical Africa represents illegal, unsustainable off-takes of millions of tons of wild game — mostly mammals— per year. We sequenced four mitochondrial gene fragments (cyt b, COI, 12S, 16S) in >300 bushmeat items representing nine mammalian orders and 59 morphological species from five western and central African countries (Guinea, Ghana, Nigeria, Cameroon and Equatorial Guinea).

Our objectives were to assess the efficiency of cross-species PCR amplification and to evaluate the usefulness of our multi-locus approach for reliable bushmeat species identification. We provide a straightforward amplification protocol using a single ‘universal’ primer pair per gene that generally yielded >90% PCR success rates across orders and was robust to different types of meat pre-processing and DNA extraction protocols. For taxonomic identification, we set up a decision pipeline combining similarity- and tree-based approaches with an assessment of taxonomic expertise and coverage of the GENBANK database. Our multi-locus approach permitted us to: (i) adjust for existing taxonomic gaps in GENBANK databases, (ii) assign to the species level 67% of the morphological species hypotheses, and (iii) successfully identify samples with uncertain taxonomic attribution (pre-processed carcasses and cryptic lineages). High levels of genetic polymorphism across genes and taxa, together with the excellent resolution observed among species-level clusters (neighbor-joining trees and Klee diagrams) advocate the usefulness of our markers for bushmeat DNA-typing. We formalize our DNA-typing decision pipeline through an expert-curated query database — DNAbushmeat— that shall permit the automated identification of African forest bushmeat items.

CAN PROTECTED AREAS MITIGATE CLIMATE CHANGE IMPACTS ON SPECIES AND COMMUNITIES?

Pierre Gaüzère

Université Montpellier, CNRS, IRD
Vincent DEVICTOR, Université Montpellier, CNRS, IRD

Protected areas are the mainstay of our conservation strategies. While they succeed to prevent species and habitat degradation from human disturbances, their ability to mitigate the impacts of climate change on biodiversity is debated. Numerous studies have suggested that climate-driven shifts in species distribution could question the relevance of protected area as a long-term conservation strategy. However testing the true effectiveness of protected area was limited by the absence of robust scheme and data allowing fine scale analysis of population responses to protected areas for many species across large spatial and temporal scales. We here propose one of the first comprehensive frameworks tracking both local changes in community composition and species population related to local climate changes with a particular focus on protected area effect on those dynamics. Using the French breeding bird survey, a long term and large scale standardized monitoring program on birds, we investigated this question by specifically testing two main predictions : (i) the thermal adjustment of community composition to temperature changes in a given area should be positively related to the proportion of protected sites in this area. (ii) the species that benefit most from protected area should be less impacted by temperature change. Our results support our predictions.



First, most protected areas seem to promote community adjustment to temperature changes. Second, the more a species benefits from protected areas, the less it is vulnerable to temperature changes. Moreover, we showed that protected areas were more efficient at mitigating the impact of climate change for habitat specialist and northernmost birds.

Overall, our study pleads for using integrative frameworks through different biological scales to assess the usefulness and relevance of protected areas facing climate change and suggest that protected areas are still key effective conservation strategies in a changing world.

WILDLIFE AND WAR: PATHWAYS THROUGH WHICH ARMED CONFLICT AFFECTS FAUNA

Kaitlyn Gaynor

UC Berkeley

Kathryn FIORELLA, UC Berkeley; Gillian GREGORY, McGill University; David KURZ, UC Berkeley; Katherine SETO, UC Berkeley; Lauren WITHEY, UC Berkeley; Justin S. BRASHARES, UC Berkeley

Recurrent conflict throughout the world's biodiversity hotspots continues to threaten conservation efforts and wildlife persistence. Despite a growing number of case studies documenting the effects of war and armed conflict on wildlife populations and habitats, research and policy more often focus on outcomes for wildlife populations than on understanding, addressing, and mitigating causes. Armed conflict can lead to changes in governance, economies, human livelihoods, movement and migration, and militarization, which in turn have distinct influences on wildlife populations and habitats. Understanding the nuanced interactions between humans and the natural environment in areas of armed conflicts is critical to effective biodiversity conservation during and after conflict. To fill this gap, we summarized over 200 case studies from 5 continents to identify pathways through which armed conflict affects wildlife populations. We categorized 27 distinct pathways described in the literature and classified social, economic, geographic, and biological factors for each case study to understand why armed conflict has such diverse impacts on biodiversity. Many of the pathways occur in conflicts across a range of countries and cultures, and the most common pathways included weakened institutions, an increase in subsistence hunting, and a refuge effect in militarized areas. We also evaluate geographic and taxonomic biases in the literature and conclude by outlining some potential applications of our work to help mitigate the destructive effects of conflict on wildlife conservation.

(ID 94) GOING VIRAL: INSIGHTS FROM THE ADOPTION OF TERRITORIAL USER RIGHTS FOR FISHERIES IN CHILE.

Stefan Gelcich

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Marine social-ecological systems are threatened by multiple and overlapping human pressures resulting in long-term trajectories of environmental degradation and decline. Governance and management responses to deal with these changes have generally been small, fragmented and inadequate. Recent years have seen a call for major transformational changes, but shifting from conventional approaches to new integrated, flexible management and governance approaches has proven to be difficult. The presentation explores the diffusion process and outcomes of a governance transformation, which resulted in a revolutionary national system that has allocated more than 700 exclusive territorial user rights to artisanal fisher (TURFs) associations in Chile. The presentation assesses elements which drove the adoption and diffusion of the TURFs regime and assesses the implications of the high uptake rate of TURFs over social and ecological outcomes, shedding lessons on key considerations associated to going viral. Results show the importance of designing a system which considers resource users' priorities to achieve scalability. However, lack of flexibility associated to desirable governance transformations could eventually trap the resulting social-ecological system into a certain management paradigm, with important implications over the systems' adaptive capacity and overall success. The presentation concludes by applying the lessons from the adoption of TURFs in Chile, which stress the importance of enabling conditions, adaptive capacity and human-centered design approaches, to design a new conservation program within TURFs which can have the necessary support and buy-in to result in landscape-scale biodiversity benefits. This presentation is part of the session "When conservation goes viral: Social science insights for catalyzing conservation".

A GLOBAL ANALYSIS OF THE CORRELATION BETWEEN MANAGEMENT EFFECTIVENESS AND THE BIOLOGICAL PERFORMANCE OF TERRESTRIAL PROTECTED AREAS

Jonas Geldmann

University of Copenhagen

Lauren COAD, University of Oxford; Ian CRAIGIE, James Cook University; Megan BARNES, University of Queensland; Marc HOCKINGS, University of Queensland; Stephen WOODLEY,



IUCN ; Neil BURGESS, UNEP World Conservation Monitoring Centre

Protected areas are amongst the most important conservation tools and today cover more than 15.4% of the terrestrial surface of the earth. Our knowledge on protected area performance primarily comes from understanding their location relative to biodiversity values. However, such analyses of coverage do not inform on whether protection improves the state of biodiversity compared to if the protected areas had not been established. Thus, while we are on track towards Aichi target 11, calling for 17% of the terrestrial surface to be protected by 2020 we have little knowledge on how this helps us reach the ultimate goal to halt the loss of biodiversity. We collated a database on management effectiveness with information on staffing, budgets, adequacy of management plans, and a suite of other variables from over 2,000 protected areas. We overlaid this site-specific information with the World Database on Protected Areas and the Living Planet Database containing more than 12,000 population time-series. This unique dataset allowed us to investigate the correlation between management quality and changes in biodiversity. Socio-economic factors at the national level, such as the Human Development Index played a positive role in shaping protected area performance while the role of management was more equivocal. Despite an extremely large sample of population time-series and management information we found only a small spatial overlap between these datasets. Thus while great efforts have gone into collating existing information on both management and changes in population abundance too little attention has been given to the coordination and collection of primary data on both input and outcomes in the field. This study, thus highlight the importance of national level governance structures as well as the paucity in relevant data to assess one of the key questions in conservation science and policy: to what extent do protected areas help us halt the loss of biodiversity?

MAPPING CHANGE IN HUMAN PRESSURE GLOBALLY ON LAND AND WITHIN PROTECTED AREAS

Jonas Geldmann

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Lucas JOPPA, Microsoft Research ; Neil BURGESS, UNEP World Conservation Monitoring Centre

It is widely accepted that the main driver of the observed decline in biological diversity is increasing human pressure on Earth's ecosystems. However, the spatial patterns of change in human pressure and their relation to conservation efforts are less well known. We developed a spatially and temporally explicit map of global change in human pressure over 2 decades between 1990 and 2010 at a resolution of 10 km². We evaluated 22 spatial data sets representing different components of human pressure and used them to compile a

temporal human pressure index (THPI) based on 3 data sets: human population density, land transformation, and electrical power infrastructure. We investigated how the THPI within protected areas was correlated to International Union for Conservation of Nature (IUCN) management categories and the human development index (HDI) and how the THPI was correlated to cumulative pressure on the basis of the original human footprint index. Since the early 1990s, human pressure increased in 64% of the terrestrial areas; the largest increases were in Southeast Asia. Protected areas also exhibited overall increases in human pressure, the degree of which varied with location and IUCN management category. Only wilderness areas and natural monuments (management categories Ib and III) exhibited decreases in pressure. Protected areas not assigned any category exhibited the greatest increases. High HDI values correlated with greater reductions in pressure across protected areas, while increasing age of the protected area correlated with increases in pressure. Our analysis is an initial step toward mapping changes in human pressure on the natural world over time. That only 3 data sets could be included in our spatio-temporal global pressure map highlights the challenge to measuring pressure changes over time.

CONSERVATION IMPLICATIONS OF COMPLEX SOCIAL STRUCTURE IN ADRIATIC BOTTLENOSE DOLPHINS

Tilen Genov

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Complex social structure is a prominent feature in several species of mammals, and plays an important role in population dynamics and behavioural patterns. But understanding social structure is not only interesting biologically – it may also help conservation and management efforts. This is important because although conservation actions usually target populations, not all segments of a population necessarily interact with human activities in same way, or at the same time. Social network analysis allows groups of social animals to be studied as a network of nodes and ties. When coupled with information on behaviour and interactions with human activities, it can be a powerful tool in the study and conservation of social animals. In this study, we examined the social structure of common bottlenose dolphins (*Tursiops truncatus*) in the northern Adriatic Sea, using social network metrics and association indices. We used nine years of photo-



identification data (2003 – 2011) of 38 individuals sighted ≥ 4 times and in ≥ 2 different years. We calculated association patterns and standard lagged association rates, using the half-weight index of associations and permutation tests within the program SOCPROG 2.4. Network analyses and visualisations were done in program NetDraw 2.123. We show that 1) the local bottlenose dolphin population is structured into distinct social clusters or communities; 2) that the two largest clusters overlap spatially, but not temporally (segregation being based on time of day rather than season); and 3) that the two clusters differ in ways they interact with fisheries (“trawler” vs. “non-trawler” dolphins). This study demonstrates how different segments of animal populations can have different effects on human activities and in turn respond differently to anthropogenic impacts.

HABITAT PREFERENCE MODELLING REVEALS POTENTIAL CONFLICT FOR SPACE BETWEEN AQUACULTURE AND ENDEMIC CHILEAN DOLPHINS

Tilen Genov

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Aquaculture represents an expanding anthropogenic activity with numerous environmental impacts. Mussel farming is generally considered less problematic than fish farming, but this may not hold true for all circumstances, species or ecosystems. Few studies have investigated impacts of aquaculture on marine top predators. The Chilean dolphin (*Cephalorhynchus eutropia*) is a poorly known endemic species in southern South America. Due to paucity of information it is listed as ‘Near Threatened’ by IUCN, but likely qualifies as ‘Vulnerable’. We used a long-term dataset (2001–2012) and a scale-independent modelling approach to investigate fine scale habitat preferences of Chilean dolphins. Sighting data were collected during systematic boat-based surveys in the Chiloé archipelago, one of the most aquaculture-intensive sites in southern South America. Dolphin occurrence was related to environmental and anthropogenic variables using binomial Generalized Additive Models. Chilean dolphins were strongly dependent on restricted areas and particular ecological conditions. Spatial predictions showed that this prime dolphin habitat substantially overlapped with areas intensively used for aquaculture, particularly mussel farming. This overlap likely resulted from Chilean dolphins selecting areas prized for mussel farming rather than operational interactions with the farms. The potential conflict for space may lead to habitat exclusion and consequently habitat

loss. The continuing expansion of aquaculture into relatively pristine southern Chilean fjords and archipelagos is therefore worrisome. The identification of important cetacean habitats should be incorporated into aquaculture management and impact assessments to ensure minimal impact on species and ecosystems. The demonstrated habitat selection could help explain the patchy distribution of Chilean dolphins making them vulnerable to anthropogenic disturbance.

POLLINATOR-FRIENDLY PRACTICES TO ENHANCE SUSTAINABILITY AND CROP PRODUCTION IN APPLES AND PEARS

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Facing the global challenge of agricultural sustainability, an ecological intensification of agriculture through optimization of ecosystem services has been proposed. Yet, little is known about the practices to enhance crop yield through pollination. A widely management procedure is to supply crops with honey bee colonies, but the contribution of pollination quantity (amount of pollen deposited) and quality (percentage of pollen tubes per pollen grains) to crop yield remains widely unknown. In the main fruit producing area of Argentina, we studied apple and pear pollination and analyzed the pollinator friendly practices that might make it more sustainable. Concretely, we studied the effects of crop and colony management on the a) pollinator visitation rate, b) pollinator behavior, c) stigmatic pollen load, d) ratio of pollen tube/pollen grain, e) quantity of fruits, and f) quality of fruits. Surprisingly, we did not observe any wild pollinators during the 45 days of survey. The whole pollination process relied solely on introduced honey bees, of which we observed 1300 visits on the two crops. We found that visitation rate and fruit set were positively influenced by hives quality through bee abundance and organic farming. High bee abundance also affected bee behavior with higher effectiveness of single visits. Since this pollination system rests totally on just one introduced species, developing management practices that could sustain bee populations appears crucial. We suggest management practices to improve



colony performance in regards to their development and health. This work has important general applications because it depicts a situation that might regrettably be widespread in the future, if wild bee populations continue to decline, with the service of pollination relying only on honey bees. We will discuss these results with regards to the economic costs and benefits of pollinators friendly practices for apple and pear farmers in Argentina.

ASSESSMENT OF HUMAN IMPACT ON BIODIVERSITY OF FUNGI, PLANTS AND ANIMALS AT ARMENIAN SOUTHERN REGIONS

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The Southern Armenia has rich biodiversity which undergo strong anthropogenic press. The use of bioindicators is an innovative approach for assessing various types of human impact on environment. The aim of this work is to compile multifaceted databases for assessing the current status of fungi, plants, and animals from populations of different ecological intensity: zones of pollution in vicinity of industrial cities Kapan and Kajaran and comparatively clean sites in "Shikahogh" State Reserve. During researches bioindicator species of fungi and animals were highlighted which can be used for assessment in polluted areas. This work was made possible by research grant 13-1F183 funded by State committee of science of Ministry of Education and Science of Armenia.

BIODIVERSITY AND VALORISATION OF ETHNOBOTANY IN ALGERIA: COMPARISON BETWEEN TLEMEN'S MODEL FOREST AND BIOSPHERE RESERVE OF DJURDJURA.

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Algeria is characterized by high biodiversity. Ancestral generation has a close relationship with nature, using medicinal plants (PAMs) for health purposes and others and transmitted it orally for other generations. However, Currently, only the old rural population kept it this know-How but without rational use. In fact, the biodiversity is decreasing also a disappearance of our Mediterranean phytotherapy culture. To assess biodiversity lost, was conducted a direct ethnobotanical survey (154 samples) to 68 rural people living in 14 villages localized near or inside of tow protected areas

(North and West of Algeria). The majority of questioners were illiterate women, aged between 61 and 70 years. 72 healing plants were identified and classified in 36 families. 65 plants are common and spontaneous. 160 therapies were prepared in 12 different ways for cure 50 diseases at least. Green leaf infusion is the most used, although in Tlemcen, the root part is most estimated. Additionally, those plants were found useful for food, animal feed, craft and veterinary. The study confirms the richness and close relationship between rural population particularly indigenous people and forest, but also shows the high risk of losing plant biodiversity by damage plant's root system, use of rare and endangered plants and unawareness of regulatory policies by rural people. This model showed not being effective and needs urgent development and collaboration among national institutions regarding biodiversity protection and natural resources management. Drawing guidelines and methodologies for conservation and management of NWFPs - traditional medicine for rural economy and modern phyto-pharmacy - must allow integration of this know-how in national green economy under international standards. Keywords: biodiversity, Algeria, medicinal plant, rural population, sustainable development.

PHYTODEPURATION AND GRAZING MANAGEMENT: A TWOFOLD STRATEGY TO CONSERVE BIODIVERSITY IN MOUNTAIN ECOSYSTEMS

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The European Alps have a long history of human presence and exploitation: during the last millennium, agropastoral activities determined a lowering of the treeline ecotone and shaped community composition of plants and animals, creating peculiar semi-natural habitats, on which high level of biodiversity depend on. Currently, two contrasting phenomena are occurring in the Alps: the abandonment of the traditional farming systems in most of the areas and the overexploitation of some remaining pastures. One of the principal objectives of the alpine protected areas should be the conservation of their biodiversity, also through the cooperation with the local stakeholders. In this framework, in 2013, the Gran Paradiso National Park (NW Italian Alps), started a project in an overgrazed alpine pasture (2000 m a.s.l.), located on a steep stony slope, which was historically grazed but now improperly managed, also due to the terrain harshness. A phytodepuration



system, a natural purification technique by biological treatments, has been created to reduce accumulation of organic waste and the eutrophication of nearby grasslands and creeks. At the same time, a lists of “good practices”, mainly determined by rotational grazing, have been adopted by the herder. To assess the concrete effect of such management activities on biodiversity conservation, a monitoring protocol has been developed to evaluate macro-invertebrates composition before and after the operation. Seven taxa were monitored (Coleoptera Scarabeidae, Coleoptera Carabidae, Coleoptera Staphylinidae, Araneae, Orthoptera, Lepidoptera Rhopalocera, Hemiptera) with semi-quantitative sampling techniques. The vulnerability and the responses of the different taxa to grazing pressure is evaluated at a local scale and the indicator (functional) groups most suitable for early detection of grazing impact/recovery have been identified.

PREVALENCE OF INTESTINAL PARASITIC INFECTIONS IN FREE-RANGING RED PANDA *AILURUS FULGENS*, CUVIER 1825 (CARNIVORA: AILURIDAE: AILURINAE) IN NEPAL

Tirth Ghimire

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The red panda (*Ailurus fulgens*) is a small carnivore that is adapted to a mainly herbivorous diet. The current study was conducted to find out the prevalence of parasitic infection in a free-ranging red panda population in a community forest, Gaam Village Development Committee, Rolpa District, Mid-Western Nepal. A total of 23 stool samples were collected and examined by direct light microscopy (X100 and X400) using a 2.5% (w/v) potassium dichromate solution and stool smear stained with modified acid fast stain and bisporulation assay. The parasitic prevalence rate was found to be 100% with the highest percentage being protozoa infection and the lowest being cestode infection, suggesting a significant problem for red panda health in the study area. Molecular methods should be used to further investigate the taxonomic position of the parasites and their roles in threatening the resilience of red panda populations in Nepal so that appropriate conservation approaches can be devised.

LEOPARD AND PREY DISTRIBUTION IN THE IRANIAN STEPPES SUGGESTS RESPONSE TO POACHING INTENSITY

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Large carnivores that depend on ungulates are significantly influenced by anthropogenic pressures such as direct persecution or depletion of their prey at reserve scale. As a conservation response, law enforcement in protected areas is the most common practice to battle excessive poaching. Because of financial constraints in conservation, the effectiveness of law enforcement in shaping wildlife abundance and population structure needs evaluation. We investigated abundance and distribution of urial sheep (*Ovis vignei*) and Persian leopard (*Panthera pardus saxicolor*) using a combination of participatory line transect sampling and camera trapping, in steppes of Golestan National Park, Iran. Spatial data from both species in relation to anthropogenic (distances to ranger stations, villages and park border) and environmental variables (distance to water resources, average slope and normalized difference vegetation index) were analyzed using a multivariate approach. Leopard abundance was additionally tested against the urial density, which constitutes its main prey in the steppe area. Group density and group size of urial sheep were negatively affected by distance to ranger stations, thus highlighting the effect of law enforcement on ungulate distribution and demography. However, leopard abundance was positively associated with the urial density. Our analyses suggest the importance of law enforcement initiated from ranger stations for ungulate distribution and the influence of prey densities on predator abundance at landscape level. These results have important implications for the spatial distribution of ranger stations in reserves, where poaching pressure is high. The results of monitoring efforts in this study also suggest that the use of ungulate population metrics such as density and group size may be beneficial in assessing conservation effectiveness under financial and technical limitations commonly faced by protected areas.

MISMATCHES BETWEEN ELEMENTS OF “SUCCESS” AND “FAILURE” OF MARINE PROTECTED AREAS

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Marine Protected Areas (MPAs) are the cornerstone of marine conservation strategies. Currently, more than 7,300 MPAs cover about 3% of the world's marine environment. While the biological benefits of enforced MPAs have been widely documented, best practices for effective MPA design, implementation, and management are still debatable. Comparative studies that assess factors contributing to effective MPA functioning have enabled us to explore common elements of success across marine regions. Cross-regional assessments of "failures" are less common, whereas the question of whether "failure" translates into lack of "success" has not received attention before. Twenty conservationists experienced in MPA planning and management assessed the elements attributed to MPA success and failure using a total of 28 case studies from around the world. A modified Delphi technique was applied to elicit information from experts. Our results show that the principal drivers of success and failure of MPA effectiveness were more related to socioeconomic characteristics rather than MPA design features. In accordance to a large body of literature, stakeholder engagement and its absence were identified as key factors in MPA success and failure respectively. Interestingly, all other elements considered the most important for MPA success and failure did not match. For example, the lack of surveillance was identified as a key factor for failure but the presence of effective surveillance was rarely selected as important for success. Assessment of common failures across MPAs as well as mismatches between factors attributed to MPA "success" and "failure" can provide valuable insights that can inform the development of MPA policy.

POPULATION GENETICS OF PALLAS'S CATS (OTOCLOBUS MANUL) IN MONGOLIA

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Pallas's cat (*Otocolobus manul*) is a felid species endemic to the grasslands and montane steppe of Central Asia. *Otocolobus manul* is a habitat and feeding specialist particularly sensitive to anthropogenic landscape changes. These ecological characteristics, coupled with declining populations due to direct hunting, depletion of prey base and habitat

degradation, have led to a "near threatened" classification by the IUCN. This project is the first to use non-invasive genetic techniques to study the genetic diversity of *O. manul*, and used 134 scat samples collected from three sites within their Mongolian range. Genotyping at ten microsatellite loci revealed the presence of sixty individuals, with an average heterozygosity of 0.623. A sex ratio was also procured and a haplotype network created using DNA sequences from several mitochondrial genes. Additionally, individual genotypes were used to estimate relatedness and landscape genetic tools were utilized to further examine population dynamics. Individuals within the three sites were panmictic, with no discernible genetic clustering, likely due to Pallas's cats' large home ranges and high dispersal ability. While this signifies a healthy Mongolian Pallas's cat population, the Mongolian steppe is beginning to undergo land use changes that will greatly affect this species. Due to low population densities, *O. manul* requires its high propensity for dispersal to maintain its current heterozygosity level. Dispersal ability is dependent on the availability of contiguous suitable habitat space with large amounts of protective cover and high accessibility to Pallas's cats preferred prey, the pika (*Ochotona deurica*). Efforts must be undertaken to prevent habitat fragmentation as well as to reduce rodent eradication efforts to preserve the health of this population. This study utilized non-invasive methods to investigate the health of a wild population of an understudied felid species to inform future conservation decisions.

CAN FOREST CERTIFICATION SAVE PERICOPSIS ELATA (HARMS) VAN MEEUWEN IN CAMEROON?

Shu Gideon Neba

CIFOR

Denis Jean SONWA, CIFOR ; Richard EBA'A ATYI, CIFOR

Pericopsis elata is an important commercial tree species in Cameroon, but this tree species is very restricted in its geographical distribution; mostly limited to the South Eastern part of the country. *Pericopsis elata* also appeared on Appendix II of CITES in 1992 and was equally listed on the endangered species category in the IUCN Red list of globally threatened species in 2003. Because of its global status, the government of Cameroon raised the minimum exploitable diameter for this species from 80 cm to 100 cm. Also, the forest management policy of Cameroon demands that all trees species that have a density of less 0.05 stems per hectare in a forest concession must be excluded from the list of species solicited for logging in that concession. The introduction of forest certification is expected to reinforce these existing management measures; thus improves the conservation status of *Pericopsis elata* in Cameroon. A considerable number of forest concessions in South Eastern Cameroon are under FSC certification since 2008. However, no information currently exist on the extent to which forest certification and the nationally designed measures



have influenced the exploitation of *Pericopsis elata*. The focus of this study is to investigate whether forest certification has an impact on the exploitation intensity of *Pericopsis elata* in Cameroon. The study will analyse the production statistics of *Pericopsis elata* in certified and uncertified concessions for the period 2008-2013. The rationale is that a downward trend in the production statistics of this species in the certified concessions compared to the uncertified concessions signifies that forest certification has a positive impact on the species by enhancing its conservation.

91-ASSESSING THE USE OF SCIENTIFIC EVIDENCE IN THE MANAGEMENT OF BRAZILIAN PROTECTED AREAS

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Protected areas are crucial to maintain global diversity. Yet, management of protected areas has to match available resources with effective conservation actions. Effective management depends on the application of knowledge, coming from both scientific evidence and the manager's own experience. However, it is still unknown how much scientific evidence is used during management of protected areas, especially developing, highly diverse countries such as Brazil. We sent a questionnaire to Brazilian protected area managers to assess the extent to which they relied on scientific information or self-acquired experience for their management decisions. The set of selected managers were employed by the national government and worked mostly at the local-level. We scored each practitioner's overall use of scientific evidence (a combination of the frequency of use and the scientific content of distinct sources) to identify characteristics of the managers, their protected area, or of the evidence that restrict the use of scientific evidence to guide the management of protected areas. The 267 managers who responded our questionnaire used experience and information sources with intermediate levels of scientific evidence, such as management plans, most frequently to guide their management decisions. We found that even though managers use and recognize the importance of scientific evidence (50% use one highly scientific source at least once every month), poor accessibility and lack of technical training were the main limitations to its wider use. In addition, we found no deviation in managers' scores of scientific use across distinct characteristics of protected areas, managers' roles, and the information sources itself. Based on our results, we suggest that both open access to scientific evidence and governmental actions, such as scientific training, are necessary to increase the use of scientific evidence and to improve efficiency in the management of protected areas in Brazil.

GENETIC DIVERSITY AND POPULATION STRUCTURE OF THE ORPHAN LEAFLESS VANILLA HUMBLIOTII RCHB. F. (ORCHIDACEAE, VANILLOIDAE) AT THE SCALE OF THE COMORO ARCHIPELAGO (INDIAN OCEAN)

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The rate of deforestation in the Comoro Archipelago is the highest worldwide and nowadays, no in-depth investigation of the genetic diversity distribution of an endemic plant is available at this scale. "Vulnerable" in Mayotte, the endemic orchid *Vanilla humblotii* is only known of few primary forest populations, with an uncertain status at the archipelago scale. Using 11 polymorphic microsatellite markers, we conducted analyses of 290 *V. humblotii* plants distributed throughout the archipelago in 21 discrete populations. After clone exclusion, we evaluated on 175 genotypes, population genetic diversity indices and genetic structure, and studied the influence of physical barriers in population isolation. The expected heterozygosity ($H_e = 0.20-0.45$), reveals a moderate to high level of genetic diversity, even for small populations. All populations comply with Hardy Weinberg expectations, except one in each Mayotte and Moheli islands. Bayesian and discriminant analyses methods identify three clusters at the archipelago scale differentiating Mayotte, Grande Comore islands and a composite cluster of Anjouan and Moheli islands. The low gene flow among those clusters ($N_m \leq 1.073$, estimated following bayesian, F_{st} and private allele methods) and evidences of isolation-by-distance are mainly responsible for this structure of the genetic diversity. Our results highlight the high degree of isolation of *V. humblotii* populations at the archipelago scale structured by geographic distance, although past gene flow or similar events of colonisation seem to unite the two central islands Anjouan and Moheli islands. At the population scale, it seems that some small remnant *V. humblotii* populations are able to maintain a high degree of genetic diversity, but consanguinity and drift can threaten at least two of them. Such a large scale study is going to make



echo with conservationists in helping to design priorities to *V. humblotii* populations in the wild.

ARE WHITE STORKS ADDICTED TO JUNK FOOD? CONSEQUENCES OF LANDFILL CLOSURE FOR WHITE STORK (*CICONIA CICONIA*) BREEDING SUCCESS AND HABITAT USE

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The White Stork (*Ciconia ciconia*) was a wholly migratory species in Europe. Since the 1980s, guaranteed, year-round food at landfill sites has enabled resident populations to establish in Iberia. Currently 10,000+ individuals winter in Portugal alone. 80% of wintering storks concentrate on landfill and preferentially nest close by. Landfill also influences migratory decisions and has facilitated colonization of new areas. However, due to EU directives, open-air landfills are being replaced by facilities inaccessible to birds, likely causing important consequences for White Stork habitat selection, breeding and migratory decisions. This project uses newly developed, high precision GPS/GSM data loggers to i) understand reliance on landfill versus non-landfill habitats in winter (November-March) and breeding (March-June); ii) to assess the consequences for productivity and iii) to estimate non-landfill habitat foraging preferences. This allowed speculation on the possible impacts of landfill closure for Iberian White Stork population dynamics and distribution. A total of 47 resident adult storks were caught on landfill sites in Portugal in winter 2012 and 2013 and fitted with GPS/GSM loggers programmed to transmit 5 high-precision (3m) GPS locations per day, allowing unprecedented observation of White Stork behaviour and habitat selection. Results include first confirmation of year-round nest use, a recent behaviour that has arisen as a result of residency. Storks make specific, long distance trips of over 58km to visit landfill and concentrate most non-landfill foraging close to the nest throughout the year. Birds were more dependent on landfill during winter than during breeding. In most years colonies close to landfill breed earlier and experience on average 30% fewer nest failures and raise 0.5-1.0 more chicks per successful nest than colonies further away. The consequences of landfill closure on future population dynamics are also assessed.

NOVEL PRESSURES AND THE POPULATION DYNAMICS OF A PIVOTAL GRASS SPECIES IN THE MEDITERRANEAN ECOSYSTEM OF SOUTHERN AUSTRALIA

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Mediterranean-climate ecosystems have among the highest biodiversity of any biome worldwide. Although covering less than 5% of the world's land area they account for 16% of all plant species, many of which are endemic. Yet despite being regions of high conservation concern they are also one of the most imperilled; due to increasing human-induced threats, such as clearing, altered fire regimes, grazing and climate change. To reduce the rate of biodiversity loss and ensure species long-term persistence an understanding of the dominant processes driving ecosystem function will be crucial for guiding effective management. We present a case study using *Triodia scariosa*, a pivotal grass species within the Mediterranean biome of southern Australia. To understand which processes drive the species population dynamics we used long-term monitoring data and modelled key life-history parameters. Results show that although long-lived and capable of resprouting after fire, the species' dynamics are sensitive to the irregular rainfall and to a synergistic effect between introduced herbivores and prescribed fire. Therefore a key aspect for management will be accounting for the interaction between fire recurrence and the environmental conditions post-fire. This will be especially pertinent if rainfall decreases as forecast under climate change scenarios, and herbivore populations increase. Using parameters from the statistical models we develop a stochastic population model to predict long-term impacts of alternative management scenarios on population persistence. Quantifying the effect of key processes and pressures on the population dynamics of *T.scariosa* provides information relevant to the conservation of multiple species in the system and highlights the processes to target for effective management.

SOLVING THE MYSTERY OF MPA PERFORMANCE: LINKING GOVERNANCE TO ECOLOGICAL OUTCOMES

David Gill

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Marine Protected Areas (MPAs) are increasingly being employed as a tool to promote biodiversity conservation and maintain flows of ecosystem goods and services to coastal communities; however, their implementation has had varying levels of success. Results from numerous case studies suggest that protected area governance is a major factor in explaining the variation in ecological outcomes, but few studies have sought to examine the linkages between MPA governance and impacts at a global scale. This research utilized a cross-disciplinary theoretical framework to test our central hypothesis that positive ecological outcomes from MPAs are associated with good governance: inclusive decision making arrangements, active and accountable monitoring and enforcement systems, equitable resource user rights, and accessible conflict resolution mechanisms. Using datasets that were never previously combined, we compiled ecological data from over 14,000 underwater surveys and governance data from over 300 MPAs to explore the relationship between MPA governance and ecological outcomes at a global scale. While controlling for potentially confounding factors, preliminary analyses of over 250 MPAs/MPA zones demonstrate (on average) increases in fish population metrics (e.g. species richness, total biomass) within MPA boundaries. Preliminary analyses also suggest that designating part or all of the MPA as a no-take zone enhances these metric levels even further. Detailed governance data were available in approximately 50 MPAs, and from that sample, the results show a positive relationship between governance attributes such as inclusive and established decision making arrangements and well-defined resource use rights, and fish biomass and species richness. These preliminary results appear to confirm and extend previous research on the relationships between MPA governance and performance, providing novel insights for evidence-based ocean policy.

SYMPOSIUM #20: IDENTIFYING HOTSPOTS FOR ZONOTIC TRANSMISSION: QUANTIFYING FINE-SCALE MOVEMENT OF DOMESTICATED ANIMALS RELATIVE TO CHIMPANZEES AT GOMBE STREAM NATIONAL PARK, TANZANIA

Thomas Gillespie

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Domesticated animals are an important source of pathogens to endangered wildlife populations, especially when anthropogenic activities increase their overlap with humans and wildlife. Recent work in Tanzania reports the introduction of protozoan and bacterial enterics into wild chimpanzee populations and the increased risk of ape mortality associated with SIVcpz-enteric co-infection. Here we describe the application of novel GPS technology to track the mobility of domesticated animals (27 goats, 2 sheep and 8 dogs) with the goal of identifying potential routes for enteric pathogen introduction into Gombe National Park. Goats and sheep were infected with *Cryptosporidium*, *Salmonella*, and enterotoxigenic *Escherichia coli*; and dogs were infected with enterotoxigenic *Escherichia coli*. Analysis of GPS tracks indicated that a crop field frequented by both chimpanzees and domesticated animals was a potential hotspot for enteric transmission. This study demonstrates the applicability of GPS data-loggers in studies of fine-scale mobility of animals and suggests that domesticated animal-wildlife overlap should be considered beyond protected boundaries for long-term conservation strategies.

EVIDENCE OF A FINE-SCALE GENETIC STRUCTURE FOR THE ENDANGERED PYRENEAN DESMAN (GALEMYS PYRENAICUS) IN THE FRENCH PYRÉNÉES

François Gillet

University of Liège - University of Toulouse Paul Sabatier III ; Maria Teresa CABRIA GARRIDO, University of Liège ; Mélanie NÉMOZ, Conservatoire d'Espaces Naturels de Midi-Pyrénées ; Frédéric BLANC, Conservatoire d'Espaces Naturels de Midi-Pyrénées ; Christine FOURNIER-CHAMBRILLON, Groupe de Recherche et d'Etudes pour la Gestion de l'Environnement (GREGE) ; Eric SOURP, Parc National des Pyrénées ; Corinne VIAL-NOVELLA, Laboratoires des Pyrénées et des Landes ; Rafael ZARDOYA, Museo Nacional de Ciencias Naturales ; Stéphane



AULAGNIER, *Comportement et Ecologie de la Faune Sauvage (CEFS)*; Johan MICHAUX, *University of Liège*

The Pyrenean desman (*Galemys pyrenaicus*) is a small semi-aquatic mammal endemic to the Pyrenean Mountains and the northern half of the Iberian Peninsula where it lives in mountain streams of cold and well-oxygenated flowing waters. This species is currently considered as vulnerable in the IUCN Red List and has been suffering from habitat loss and fragmentation for decades, inevitably impacting its distribution. The ecology and biology of this species are poorly known, notably because of its elusive behavior and its primarily nocturnal activity. Its distribution area is even not definitively established. Furthermore, a recent genetic study, based on mitochondrial and intronic sequences, showed that the genetic variability of the Pyrenean desman is very low in the Pyrenees. In this study we investigated the potential existence of a genetic structure and gene flow at a smaller scale using 24 polymorphic microsatellites loci. As the Pyrenean desman is a very elusive species, we completed our sample collection of tissues with faeces samples coming from the French distribution area of this species. Doing so, we successfully identify 70 individuals out of 355 faeces samples. Bayesian analyses revealed a cryptic genetic structure in our data set. Three clusters were evidenced (one western, one central and one eastern) and gene flow appears to be limited between these clusters (min. *F_{st}* value of 0.2).

SYMPOSIUM 65 - MAKING SENSE OF CITIZEN SCIENCE DATA: A REVIEW OF METHODS

Olivier Gimenez
CNRS

Data collected through citizen science programs allow addressing many important questions in conservation biology related, e.g., to the shift in species range, the ecology of infectious disease or the effects of habitat loss and fragmentation on biodiversity. However, citizen science data are subject to serious statistical challenges when it comes to their analysis and the reliable extraction of the information they contain, mainly due to sampling biases generated by variation in the observation process. Numerous methods have been proposed to address this issue that can be split into two main strategies: either a new approach is developed to deal with a specific problem or an existing approach is used pending some pre-treatment of the data or post-processing of the results. I review these various methods, trying to make the links between them and emphasizing their advantages and drawbacks with respect to the question. I illustrate my talk with two case studies drawn for the research conducted in our group, one on the mapping of the distribution of brown bear in Greece and the other on the assessment of the recolonization

dynamics of wolves in France. Based on this review, I end up this contribution by recommendations on the use of existing methods and by suggesting perspectives on future developments.

SPACE USE PATTERN OF THE ASIATIC WILD ASS (EQUUS HEMIONUS): COMPLEMENTARY INSIGHTS OF RECURSION IN MOVEMENT PATTERN AND HABITAT SELECTION ANALYSES.

Nina Giotto

Jacob Blaustein Institutes for Desert Research
Jean-François GERARD, *Institut National de la Recherche Agronomique*; Shirli BAR-DAVID, *Jacob Blaustein Institutes for Desert Research*; Amos BOUSKILA, *Ben-Gurion University of the Negev*

The way in which animal moves and use the landscape is influenced by the spatial distribution of resources, and is of outmost importance when considering the conservation of a species. Movement patterns and habitat selection of the endangered Asiatic wild asses were studied in the Negev Highlands, Israel, using GPS monitoring technique. We developed a new approach for characterizing animals' temporal space use dynamics, based on the analysis of individuals' recursive movement patterns (i.e. return to previously visited areas). Mean distance performed per hours was higher in summer than in winter (440.13 ± 6.85 mvs 323.31 ± 4.44 m) due to summer greater twilight peaks of displacement and night performed distances. During summer days, activity was reduced and individuals selected high-altitude and north-exposed area, that are windier and receive less sun radiation. At night they selected areas with a high NDVI score, favourable for feeding. In winter, no NDVI selection was observed. Summer home ranges were aggregated around the water point and smaller than in winter (mean \pm SE, 95% Movement Biased Kernel Estimation: 24.02 ± 5.47 km² vs 42.26 ± 7.24 km²). Recursion rate was higher in summer than in winter. Most of recursions occurred on high NDVI areas (during night in summer and day in winter) and on favorable resting sites. Habitat selection, displacement and recursion movement pattern analyses suggest thermoregulation purpose and water dependence as factors affecting wild ass space use and movement patterns. Characterizing recursion areas provided complementary insights suggesting that movements are driven by environmental factors (such as food availability and resting sites), but also by psychosocial factors (such as site fidelity - territorial males returning regularly on their summer home range during winter). The information gained in this study will assist in the development of management strategies to protect the Asiatic wild ass population.



IMPLEMENTING REDD+: POLICY AND PRACTICAL ISSUES FROM THE LOCAL TO NATIONAL LEVELS

Mwangi Githiru

Wildlife Works

REDD+ is an idea mooted from the 2007 Bali UNFCCC meeting (COP-13), where an agreement was reached on “the urgent need to take further meaningful action to reduce emissions from deforestation and forest degradation”. In practice, a REDD mechanism would seek to provide incentives for developing countries to make those reductions where, in many situations, forest are considered worth more when harvested than standing. At its core therefore, REDD aims to change incentive structures in favour of protecting forests so as to reduce greenhouse gas emissions, but also deliver “co-benefits” including biodiversity conservation and social improvement. But how does it work on the ground? How do you deal with the intractable drivers of deforestation while retaining local community support and enhancing their livelihoods? Does this essentially render the social and biodiversity co-benefits, core benefits? What are the some of the key issues, opportunities and challenges involved in actual implementation, and how do they scale from the local (project) level to national or jurisdictional scales? This talk will broach some of these issues besides the general logic around REDD+ in practice, then illustrate how market-driven REDD+ projects actually function, using an example from the first dual (VCS and CCB) validated REDD+ project in the world: the Kasigau Corridor REDD+ Project that is administered by Wildlife Works. This project has been running for four years and has accumulated cutting-edge and vital lessons that can be interesting and useful for other players in the REDD+ fraternity, and conservation practitioners in general.

99. A SOCIAL-ECOLOGICAL APPROACH TO RECONNECT URBAN PEOPLE WITH THE REST OF THE BIOSPHERE

Matteo Giusti

Stockholm University

Stephan BARTHEL, Stockholm University

In postindustrial societies urban design has to face the challenges imposed by unprecedented rates of urbanization in combination with local and global sustainability requirements. So far, the political agenda has adopted quite unanimously urban densification as the strategy to cope with such extraordinary events. Such approach uses a socio-technical lens that seems indeed to appropriately limit energy consumption and mitigate green house gases, but is increasingly questioned (Neuman 2005), especially when a social-ecological lens is used to understand the urban system. A social-ecological approach to urban design sees the urban system inclusive of its

required ecological resources (Folke et al., 1997). This approach has shown how urban densification erodes some ecological dynamics (Seto et al., 2012), and we now use it to understand how dense urbanization patterns remove perceived and experienced links to ecosystem dependence. The “extinction of experience” is embedded attribute of most modern human habitat and produces over time routines characterized by missing or altered natural interactions. Nature-poor routines negatively impact both personal (Giusti et al., 2014) and social (Bendt et al., 2013) fundamentals of sustainable behavior and ecological stewardship. In these regards the presence of Urban Green Commons (UGCs), that are green spaces collectively managed, allow “the mental processes of human perception, memory and reasoning that people acquire from interacting frequently with local ecosystems, shaping peoples’ experiences, world views, and values towards local ecosystems and ultimately towards the biosphere” (Colding and Barthel, 2013). We discuss how the results of Giusti (2014) and Bendt (2013) intertwine connecting practices that consider a more heterogeneous ground for the emergence of sustainable lifestyles. In light of these findings, urban densification is once more a limiting assumption for the creation of sustainable urbanities.

CROSS-SITE COMPARISONS OF WILDLIFE IN EXURBIA: DOES GEOGRAPHY MITIGATE DEVELOPMENT IMPACTS?

Michale Glennon

Wildlife Conservation Society

Heidi KRETSEK, Wildlife Conservation Society; Sarah REED, Wildlife Conservation Society

Exurban residential development is characterized by low housing densities and large lot sizes that fragment natural landscapes. Expanding globally in areas of high amenity value, exurban development is impacting habitats within and near protected areas worldwide. We compared the relative impact of exurban development on bird communities in two contrasting geographies – the Adirondack Park in northern New York State and the Greater Yellowstone Ecosystem in Montana, USA – to determine how land-use decisions shape human impacts on biological communities. We examined bird communities in 7 exurban subdivisions and 7 control sites in each landscape in order to determine (1) the relative roles of human disturbance versus habitat alteration in controlling avian community structure and reproductive success in exurban subdivisions, and (2) the extent to which the magnitude of the effects of exurban development on avian communities across diverse landscapes can be explained by the large-scale connectivity and resilience of the encompassing regions. We found that response to development was similar in the East and West, with Neotropical migrants, low-nesters, and area sensitive species being negatively impacted and edge specialists



benefitting. The direction and magnitude of change in the avian communities between subdivisions and controls was similar in both regions for all guilds but one. Our findings suggest that human behaviors may play an underappreciated role in structuring wildlife communities in exurban areas, with strong similarities across varying geographies. We believe an improved understanding of this relationship can lead to better land management and ecologically healthier landscapes.

BEYOND ECOSYSTEM SERVICES: MECHANISMS LINKING BIODIVERSITY CONSERVATION AND HUMAN WELL-BEING.

Louise Glew

World Wildlife Fund (US)

Daniel, C. MILLER, World Bank ; Michael, B. MASCIA, Conservation International

Recent conservation policy and practice has emphasized the central role of ecosystem services in shaping human well-being. But ecosystem services do not represent the only pathway linking biodiversity conservation and human well-being. Scholars have long recognized the potential for impacts to emerge from the restructuring of resource rights and the infrastructure linked to conservation interventions, as alternative pathways by which conservation efforts may affect local communities. Despite these efforts, no holistic framework exists for examining how these various pathways operate, independently or in concert, to affect human well-being or for analyzing how they interact with contextual factors to generate household and community impacts. This paper examines the multiple pathways that link conservation interventions to human well-being, drawing on empirical examples from Indonesia, Kenya and Niger. We find evidence for multiple pathways that generate complex impact arrays that vary across space, time, and social domains. We examine the synergies and trade-offs among pathways, exploring how the relative importance of individual pathways may vary. In so doing, we shed new light on incentives, opportunities, and constraints to the long-term sustainability of conservation interventions, highlighting the need for a more nuanced understanding of the conservation-poverty relationships as the basis for more effective conservation policy and practice. This presentation is part of a set of contributed papers organized by L. Glew, M. Mascia, and D. Miller. If accepted, please include this presentation in the ICCB scientific program immediately before the presentation by Daniel Miller. If you have any questions, please contact me directly. Thanks.

ESTIMATED IVORY STOCKPILE ACCUMULATION IN AFRICAN ELEPHANT RANGE STATES

Kathleen Gobush

Vulcan Philanthropy

Iain DOUGLAS-HAMILTON, Save The Elephants

Since the international ban on the sale of ivory went into effect in 1990, the governments of many African elephant range states have maintained ivory stockpiles originating from illegally-traded tusks seized by authorities and tusks collected from elephants dying as a result of natural mortality, as problem control animals or other management activities. We report current probable ivory stock volume of 38 range states by assessing available stockpile data since 1990 to 2013 from CITES reports and sales proposals along with estimates of possible accumulation on the basis of an annualized accumulation model. Empirical research informed parameter assignment for mortality rate (low: 1.0% and high: 4.71%), average tusk mass (5.0 kg), average number of tusks per elephant (1.88); a "pick up" rate" of 20% and IUCN African Elephant Database population estimates were applied. The estimated ivory stock accumulation from 17 range states was 449 to 605 tons, using low and high natural mortality rates respectively; only 12 states are likely adding to ivory stockpiles annually, totaling 9.5 to 44.5 tons each year. The remaining 21 range states are likely not accumulating ivory stocks because of low national herd size, small volume of ivory seized, stockpile leakage or other apparent stockpile management deficiency. These results are useful for realistically tempering expectations related to sustainable use scenarios.

116: A WILDLIFE COMEBACK IN EUROPE?

Laurent Godet

LETG-Nantes Géolittomer, CNRS

Conservation is desperately looking for good news. Large herbivores and carnivores, as well a few set of other iconic species and habitats have been recognized as recovering throughout Europe during the last decade. This tendency is such that the beginning of a "wildlife comeback" has been proposed. The extent, meaning and consequences of this trend remain however to be investigated. Here, we performed an extensive literature review to clarify what is actually taken as a sign of wildlife comeback. In other words, what are we talking about, how this comeback is quantified and mapped, and at what spatial and temporal scale is it studied? Through various examples in Europe, we demonstrate that working on wildlife dynamics raises the difficulty to define wildlife, wilderness and other related concepts. We highlight why the spatial and temporal references are also crucial and yet often arbitrarily defined issues to identify a potential comeback or recovery of wildlife. Our review also raises important debates on the future of conservation in Europe: where, when and how should we let nature go; do we have to assist wildlife recovery; does European biodiversity is experiencing a real turning point that should or must be encouraged to meet conservation targets?



SIGNS OF EROSION IN THE IBERIAN LYNX GENOME

José A. Godoy

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The Iberian lynx (*Lynx pardinus*) is the only felid classified as “critically endangered” by the IUCN. A first annotated draft of the Iberian lynx genome has been recently produced, along with re-sequencing data for 11 Iberian and one Eurasian lynx. The analysis of SNP variation based on this dataset has uncovered extensive signatures of genetic erosion in the Iberian lynx genome. The species shows the lowest heterozygous SNP rate reported to date in mammals. Low diversity extends to coding variation with extremely low synonymous diversity and high ratios of non-synonymous to synonymous diversity (π_N/π_S) and substitution rates (dN/dS), indicating the accumulation of potentially deleterious variants. Loss of genetic diversity has been more intense in the X chromosomes (X) than in autosomes (A), resulting in X/A diversity ratios of 0.35 in intergenic sequences, well below the neutral expectation of 0.75. Regions of the genome with maximal or minimal difference in heterozygosity between Eurasian and Iberian lynx are enriched for genes related to olfactory perception, while regions of smallest difference tend to concentrate in telomeres. The distribution of long runs of homozygosity (ROHs) reflects the higher incidence of recent inbreeding and small effective population size in Doñana, and a history of ancient bottlenecks shared by both remnant populations. Indeed, the reconstructed demographic history comprises a series of three bottlenecks that predate the documented decline in the 20th century. Extreme levels of genetic erosion in Iberian lynx might thus be the consequence of the latest decline acting on an already genetically eroded species. The Iberian lynx is one of the first endangered genomes to be analysed and its study may yield novel insights on the evolutionary processes acting on declining populations and their consequences for fitness and population persistence, an information that may help to optimize current conservation efforts.

THE ECTOPARASITE PISCICOLA GEOMETRA (HIRUDINEA: RHYNCHOBDELLIDA) REPORTED IN THE PRUSIAN CARP (CARASSIUS GIBELIO) (CYPRINIDAE) IN THE SMALL RESERVOIRS LOCATED WITHIN THE LOWER BASIN OF THE JIU RIVER (ROMANIA)

Ionelia Claudia Goga

The Oltenia Museum

Piscicola geometra (Linnaeus, 1761) is the most common fish leech affecting a wide range of host fish in case of both natural and bred populations. In March 2014, we made a field trip as a result of monitoring fish populations in the small reservoirs located within the catchment basin of the Preajba Valley, a small tributary of the Jiu River, where there were caught 47 fish specimens belonging to the species: *Scardinius erythrophthalmus*, *Lepomis gibbosus*, *Abramis brama*, *Carassius gibelio*, *Perca fluviatilis*. The collected fish samples were subjected to ichthyopathological examination, namely clinical examination and parasitological examination, in the parasitology laboratory of the Sanitary Veterinary Directorate of Dolj County. The ectoparasite was detected only at *Carassius gibelio* on the gills and the ventral side of the body as parasitic sites, causing bleeding and ulcerations due to the suction cups. An important factor in causing this parasitosis is water temperature; the invasion decreases when the water temperature increases. The destruction of the macrophyte vegetation and the prevention of fish species ingress from one basin to another, given that they communicate through rubble surge tanks, are some prophylactic measures meant to prevent piscicolosis.

HAS SUSTAINABILITY PELAGIC FISHERIES IN THE BLACK SEA TURKISH COAST EVER BEEN ACHIEVED?

Didem Gokturk

Istanbul University

Tomris DENIZ, Istanbul University ; Muammer ORAL, Istanbul University

Of all the inland seas, the Black Sea is almost completely isolated from the world oceans. It is a semi-closed basin with relatively great depths, and high bio-productivity of the shelf zone. In this inland sea, the main fishery was targeted on small and medium pelagic fish for the Black Sea Turkish coast which is an important spawning ground for some migratory pelagic fish species such as bonito, anchovy, bluefish and herring. However, the coastal and marine biodiversity also fish stocks of the Black Sea was already under stress through a combination of heavy fishing, pollution, eutrophication, climatic fluctuations and the invasion of alien species due to the pressures exerted by mankind. Example of the Black Seafish



stock collapse is numerous and the unsustainable harvest of many fish species continuous today. Turkey is the most important country as to realize maximum fish production from the Black Sea. Pelagic fish species dominate marine landings in Turkey. Especially the Black Seacoast is the most important landing area for this species production for Turkey, particularly *Engraulis encrasicolus* (anchovy), *Sarda sarda* (Atlantic bonito), *Trachurus trachurus* (Atlantic horse mackerel), *Pomatomus saltatrix* (bluefish) and *Clupeidea* species (Herrings). Among these commercial pelagic fish species anchovy takes first place with the rates of % 60.85, following this with the rate of % 11.41 herrings, % 9.63 horse mackerel, % 4.46 Atlantic bonito, % 1.77 bluefish respectively. In this work, we aimed to evaluate pelagic fisheries in the Black Sea Turkish coast in terms of sustainable fisheries management by the commercial fish stocks, number of fishing boats and fishing gears.

ID 7: WILDLIFE'S IMPORTANCE TO HEALTH AND LIVELIHOODS IN MADAGASCAR

Christopher Golden

Wildlife Conservation Society/Harvard School of Public Health

Wildlife consumption can be viewed as an ecosystem provisioning service because of wildlife's ability to persist under sustainable levels of harvest. We used the case of wildlife harvest and consumption in northeastern Madagascar to identify the distribution of these services to local households and communities adjacent to protected areas to further our understanding of local reliance on natural resources. We used longitudinal survey methods, micro-economic analytical techniques, and robust epidemiological study designs to determine the health and economic value of subsistence wildlife harvest. Heightened monitoring and enforcement of hunting could increase the costs of harvesting and thus elevate the price and reduce consumption of wildlife. Effective monitoring would incur a 66% reduction in the biomass of wildlife consumed. Increased enforcement would therefore be beneficial to biodiversity conservation but could limit local people's food supply. On average, the value of wildlife provisioning represented 57% of annual household cash income in local communities from the Makira Natural Park and Masoala National Park. In past work, we have demonstrated a nearly 30% increase in the incidence of anemia given loss of access to wildlife resources. In our current work, we will be investigating the value of wildlife to micronutrient status (vitamin A, vitamin B12, iron, zinc and fatty acid profiles). By explicitly estimating the welfare effects of consumed wildlife, our results may inform targeted interventions by public health and development specialists to improve protected area effectiveness as they allocate sparse funds to support regions,

households, or individuals most vulnerable to changes in access to wildlife.

PROTECTED AREA DOWNGRADING, DOWNSIZING, AND DEGAZETEMENT (PADDD) IN THE UNITED STATES, 1900-2014

Rachel Golden

George Mason University

Roopa KRITHIVASAN, Indian School of Business ; Michael MASCIA, Conservation International

Traditionally, protected areas have been considered permanent means to conserve biodiversity and safeguard natural and cultural resources. However, widespread evidence of protected area downgrading, downsizing, and degazettement (PADDD) demonstrates that legal changes affect protected areas worldwide. Legal changes to reduce the status or size of protected areas have been linked to higher levels of deforestation, carbon emissions, and habitat fragmentation. Drawing on the legal, peer-reviewed, and grey literature, we identified patterns, trends, and causes of PADDD in the United States' protected area system that occurred from 1900 to 2014. During this period, the United States enacted 265 PADDD events (242 downgrades and 23 downsizes) affecting an area of 747,456 km² across 145 protected areas. In addition, we identified 1,841 PADDD proposed events, 1,166 of which are currently active. These 1,160 downgrades and 6 downsizes may affect an area of 990,358 km² across 1,118 protected areas. A large proportion of the documented PADDD events were systemic, wherein one legal change affected multiple protected areas simultaneously. The most common proximate causes of these legal changes were infrastructure construction, subsistence-level extraction, and other industrial-scale resource extraction. Events occurred in every decade and across all federal agencies that manage public lands. Evidence of PADDD in the United States demonstrates that protected areas in developed countries are not immune to legal changes. Further, the magnitude of PADDD across space and time suggests that protected areas should not be regarded as permanent conservation interventions, but instead recognized as dynamic systems. Strategic planning for protected areas should considering systematic accounting for PADDD in the future.

AFRICAN ELEPHANT SOCIAL STRUCTURE IS RELATIVELY ROBUST TO POACHING-INDUCED MORTALITY

Shifra Goldenberg

Colorado State University

Iain DOUGLAS-HAMILTON, Save the Elephants ; George WITTEMYER, Colorado State University

Social structure forms in populations as individuals attempt to maximize the benefits or minimize the costs of social



association. Whether social structure is robust to perturbation in wild populations remains an open question, but may provide insight into the evolution of social systems and the function of social structure. Over the last five years, African elephants (*Loxodonta africana*) have experienced severe poaching-induced mortality, often disproportionately directed toward older age cohorts for their larger tusks. As a result of this harvest pressure and resulting demographic alterations, social structure within this complex society may be changing, with the potential for associated loss of structural function. Here we use a sixteen-year dataset on social associations of adult female elephants to compare social structure between periods of low and high levels of illegal killing. We find that the most tightly bonded levels of hierarchical association in elephant society—core and bond groups—are robust to harvest pressure despite a high degree of turnover in the individuals included in the sample over the course of the study and the disproportionate loss of matriarchs. In contrast, clan groups, the coarsest social level, were only discernable in undisrupted periods. Although core and bond groups were present throughout the study, core groups were larger in the disrupted period, potentially related to greater predation pressure during this time. We discuss the role of social strategies in maintaining hierarchical structure in elephant society and the implications of social reconstruction for population persistence. Our study contributes to understanding of the evolution of social systems and provides a unique behavioral approach to the quantification of anthropogenic impacts on wildlife.

AICHI TARGET 11: IT IS NOT ALL ABOUT NUMBERS

Barbara Goncalves

German Centre for Integrative Biodiversity Research (iDiv)
Silvia CEASU, German Centre for Integrative Biodiversity Research (iDiv) ; Laetitia NAVARRO, German Centre for Integrative Biodiversity Research (iDiv) ; Max HOFFMAN, German Centre for Integrative Biodiversity Research (iDiv) ; Rafael LOYOLA, Departamento de Ecologia, Instituto de Ciências Biológicas, Universidade Federal de Goiás ; Henrique Miguel PEREIRA, German Centre for Integrative Biodiversity Research (iDiv)

Target 11 of the Strategic Biodiversity Plan for 2011 – 2020 calls for the expansion of global protected area network, from the current 13% to at least 17%. The target also states that the selection of such land should be ecologically representative, well-connected to the existing systems of protected areas and take into account the wider landscape. Their conservation should be achieved through effective and equitable management. Hence, target 11 holds two very different components: one very specific and quantifiable, related to the amount of area to be protected, and another component, relatively subjective and open to interpretation, related to the type of conservation management implemented

in the Protected area. Adhering to these goals will challenge countries in different ways. We look at Europe 28 and Brazil and try to assess to what extent how these two regions are meeting, on the ground, the management component of target 11. We look at the distribution of IUCN protected area categories as well as at the legislation for protected areas in order to realize the challenges for meeting the management goals of target 11. We assess how current conservation policies and actions respond to biodiversity needs in our two case studies and we discuss how the future policy decisions should consider global environmental change and the international political, economic and environmental contexts. Focusing on quantitative goals for conservation offers a truncated image of conservation progress and we argue here that more attention should be given to the management aspects of conservation.

ECOLOGICAL NICHE MODELING AS A TOOL FOR PREDICTION OF AN EXTINCT MAMMAL: THE CASE OF THYLACINUS CYNOCEPHALUS (TYLACINAE)

Lucas Gonçalves Da Silva

PUCRS Brazil

Kristofer HELGEN, National Museum of Natural History ; Eizirik EDUARDO, PUCRS Brazil

Actually, one of the greatest threat to biodiversity is the increase of extinction rates due to anthropogenic activities. The human is documented as the responsible for the many of mammals extinctions in the last centuries. One of the most emblematic examples is the case of the Tasmanian Tiger (*Thylacinus cynocephalus*, Tylacinae), a carnivorous marsupial that originally occurring in Oceania continent, especially in Australia and Tasmania islands, and not confirmed in nature since 1930. Moreover, the species is currently recognized in the category 'extinct' by IUCN. The main objective of this project was to develop a prediction model for Tasmanian Tiger occurrence, aiming to identify suitable areas for their persistence in nature. Through ecological niche modeling using Maxent software and environmental and bioclimatic predictors, we generate a potential distribution model for the species, comprising 36 geographic occurrence records from museums around the world, with correct origin of each sample. The prediction model has reached great accuracy and showed the expected distribution of the species in Oceania. Additionally, the model predicts a possible occurrence of the species in remote areas of Papua New Guinea, an possible habitat for a Tylacinae to be rediscovered in nature. This work is the first to address niche modeling as a tool to identify habitats of mammals considered extinct by science and can elucidate areas where extinct animals can persist.



COASTAL WILDLIFE RESERVE OF TIBAU DO SUL (REFAUTS): NURSERY OF GUIANA DOLPHIN, SOTALIA GUIANENSIS, IN RIO GRANDE DO NORTE, BRAZIL

Diana Gonçalves Lunardi

Federal Rural University of Semiárid - UFERSA

Vitor DE OLIVEIRA LUNARDI, Federal Rural University of Semiárid - UFERSA

Coastal Wildlife Reserve of Tibau do Sul (REFAUTS), Pipa Bay, Brazil, is a protected area of sustainable use, created in 2006 with the main objective of conserving Guiana dolphins, and other marine species in the region. In this study, we investigated the fidelity of Guiana dolphins photo-identified at Curral and Madeiro Beaches, REFAUTS, and the presence of calves in these beaches. Photo-identification and behavioral records were made from the beach, above 2m sea level, to avoid that our presence modified the behavior of the Guiana dolphin. Sampling occurred between March 2013 and November 2014, during for 13 sampling days. Guiana dolphins were recorded in all sampling days, and the groups, often cohesive (>1m between dolphins), were an average size of approximately 3 individuals (SD=1.4, mode=2, min=1, max=6). We photo-identified 23 adults: 2 dolphins identified (ID) were present in 46% of samplings, 1 ID in 40% of samplings, 1 ID in 31% of samplings, 2 ID in 15% of samplings and 4 ID in 8% of samplings. Two adults (L2 and L3) were recorded accompanying calves or juveniles for more than a year in the two beaches. A recurrent association (n=3) between two adults (L6 and L7) was also recorded. From the behavioral frequency analysis and presence of calves (present in 62% of samplings), Guiana dolphins used the Curral and Madeiro Beaches mainly for feeding and parental care. Dolphin watching at REFAUTS is growing disorderly in recent years and the code of conduct is not being fulfilled. We recorded up to five boats simultaneously under the same dolphin group. The REFAUTS have been used as nursery for Guiana dolphins, and it is necessary to implement a continuous program of monitoring immediately and a control to ensure the protection of these animals in the Reserve.

RECREATIONAL USES SPATIO-TEMPORAL DISTRIBUTION IN A CONTEXT OF DEMOGRAPHIC INCREASE, IMPLICATION FOR MPA MANAGEMENT

Charles Gonson

Ifremer / IRD

Dominique PELLETIER, Ifremer ; Jocelyne FERRARIS, Ird

All around the world, coastal areas are subject to increase and diversification of recreational activities linked to demographic and touristic development (Duedall & Maul 2005, Davenport & Davenport 2006, Chaboud et al. 2004). Thus conservation implies that managers of marine protected areas find a balance

between environmental protection and visitor access (Cole & Daniel 2003). Unfortunately, recreational uses in natural settings have not been much studied (Gray et al. 2010, Sutton 2005) even though management needs to better account for the needs and impact of recreational users as well as the factors structuring their spatio-temporal distributions (Eagles 2002, Christie et al. 2003). Near Nouméa, the main city of New-Caledonia, monitoring of boat count was conducted between 2005 and 2013 per location site, activities, boat type and type of anchorage. The study site comprises islets and intermediate reefs including 5 no-take long-established reserves. Information gathered through this monitoring was used to calculate indicators of user pressures at each location (e.g. number of anchored boats). We analyzed the influence of temporal, weather (i.e. years, season, type of the day, meteorology) and spatial factors (i.e. protection status, distance to the coast) on these indicators. General results indicate an increase of boating pressure at all sites whereas short-term temporal variations depend on indicators. For example, the number of boats observed on week-end trips increased over years irrespective of boat type whereas it remains stable over years for week days. These results in increased peak pressures which might require specific management measures. These could be identified by characterizing practices of users and their impacts. Based on these outcomes, we will discuss management issues and further research needs.

101-RIPARIAN ZONES: HIGHLY DYNAMIC SYSTEMS THAT REQUIRE ACTIVE CONSERVATION

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Riparian zones (RZ) lay at the ecotone between aquatic and terrestrial systems. They are dendritic linear corridors in the landscape, but their importance greatly exceeds their area. They contribute disproportionately to biodiversity and provide many ecological services such as wildlife habitat, recreation, water purification and water provision for economic activities. With increasing anthropogenic demands and global warming, water availability for riparian biota is not guaranteed. Many RZ have been dramatically reduced in size and their structure changed; most world rivers are also regulated (dammed or flood protected), altering the natural hydrogeomorphic regime to which riparian systems are adapted. Being open systems, the occurrence of invasive species is common. Very altered biotic communities and reduced ecosystem function



follow. Restoring historical flow regimes is the most effective strategy to restore RZ. Dam removal and environmental flows are being implemented in various world regions but usually create political and social conflict. Legislation is more prone to conserve static features such as successional endpoints or physical boundaries rather than promoting the recovery of river dynamism and resilience. Geomorphic processes have received too little attention in the legislation protecting RZ, with a traditional emphasis on water (e.g., European Water Framework Directive). Other legislation affecting RZ may have antagonistic goals (e.g., reducing flood risk) with policies for conservation. Local communities need to be involved in the conservation of RZ, but people may be attracted to high aesthetic value of landscapes with low ecological value if scientific results are not efficiently disseminated. Thus our role as scientists includes communicating effectively with policy makers and the public, while investigating alternatives to historical flow regimes where possible and creating alternative ecosystems where it is not.

INTEGRATING TAXONOMIC, FUNCTIONAL AND PHYLOGENETIC DIVERSITY IN REDD+ INITIATIVES IN THE PACIFIC COAST OF COLOMBIA, A BIODIVERSITY HOTSPOT.

Mailyn Gonzalez

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The Choco region in the Pacific coast of Colombia is considered one of the most diverse world's biodiversity hotspots. This region is covered by a largely unexplored tropical rainforest and faces accelerated habitat degradation mostly driven by illegal logging and mining activities, therefore REDD+ projects may represent sustainable development alternatives for local communities. However, REDD+ projects mostly focus on carbon stocks and plant species diversity, without accounting for the importance of forests as major repositories of animal species and genetic diversity. In this study, we assessed the taxonomic, functional and phylogenetic diversity of trees, and estimated the taxonomic diversity of birds and mammals in four 1ha plots of lowland tropical forest with different levels of disturbance along the Pacific coast of Colombia. Functional diversity was based on wood density, tree height, specific leaf area and matter content, whereas mammals were quantified with camera traps, and birds with sound-meters. Local communities were trained in the use of camera traps, sound registration,

tissue sampling, and functional trait measurements. We found a total of 200 tree species, and increasing values of phylogenetic and functional diversity in less disturbed forests. In addition, we detected 16 species of mammals including emblematic and endangered species such as *Panthera onca* and *Puma concolor*. This study shows the importance preserving forests not only for their role in carbon sequestration, but also for holding unique species and ecological processes. Camera traps and bioacoustics revealed to be a major tool for monitoring the success of REDD+ initiatives in conserving forest biodiversity.

TROPHIC ECOLOGY, NURSERY AREA & FISHERY OF SMOOTH HAMMERHEAD SHARK (*SPHYRNA ZYGAENA*) IN PERU

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EcOceanica

Pepe ESPINOZA, Instituto del Mar del Peru

Peru has the highest accumulated historical shark landings in the Pacific Ocean and the smooth hammerhead shark is the third shark specie most captured. Its situation is vulnerable and is included in CITES. However, their fishery lacks management and its biology and fishery is poorly understood. This study aims to know the trophic ecology, identify and characterize their nursery areas and its fishery in northern Peru, through analysis of stomach contents, fishing areas, size composition and sex ratio, umbilical wound status and catch per unit effort, in the years 2013 and 2014. To determine its trophic ecology, 212 stomach contents were sampled; the sharks measured between 56 and 139 cm in total length (TL). Fifteen prey species were identified being the most important commercial species of squid (*Doryteuthis gahi*, *Dosidicus gigas*). The hammerhead shark is a specialized predator with a trophic level of 4.7. They have different diets depending on its size, sex and location. Smaller sharks fed on coastal prey; whereas larger sharks fed on oceanic prey. So, it is posited that sharks change their distribution and habitat according to their ontogeny. To determine their nursery and fishery areas, 897 sharks were sampled. Three nursery and fishery areas were identified in northern Peru located in coastal and oceanic zones. Pregnant females appear in December and January to give birth. Thus, in December the smallest sharks were measured (53-70 cm TL) which showed open umbilical wounds. As months passed their size increased (80-95 cm TL) and the umbilical wounds were healed. In May the sharks leave the nursery areas. In northern Peru the fishery of hammerhead shark is composed by neonates, juveniles and adult females. In Peru sharks are fished without management; thus, this study will contribute to the design and implementation of conservation plans that include an ecosystem-based fishery management.



SENSORY ECOLOGY OF NECTAR-FEEDING BATS: OLFACTION AND ECHOLOCATION

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Marco TSCHAPKA, University of Ulm

Nectar-feeding bats are among the most important pollinators in dry tropical ecosystems, which belong to the globally most threatened habitats. Chiropterophilous flowers generally provide a combination of strong floral scents and conspicuous acoustic echoes. While floral scents are assumed to attract bats over long distances, acoustic properties of flower structures may provide an echolocating bat with detailed information at closer ranges. Nevertheless, no study has yet focused on the relative importance as well as on the combination of these cues for detection and precise localization of open flowers. To understand better the significance of olfaction and echolocation in the foraging behavior of nectar-feeding bats, we conducted two-choice experiments with *Leptonycteris yerbabuenae* (Phyllostomidae: Glossophaginae). We tested the bats' performance in three scenarios: olfaction vs. echolocation, echolocation vs. echolocation & olfaction, and olfaction vs. echolocation & olfaction. We used the floral scent of a bat-pollinated cactus (*Pachycereus pringlei*) as olfactory and an acrylic paraboloid as acoustic cues. We recorded 1) first reaction; 2) choice and 3) total number of reactions to each cue per bat and trial. When only single cues were offered, bats showed no significant preferences. However, bats reacted first to and chose more often the coupled cues. Our study provides first evidence that nectar-feeding bats integrate over different sensory modalities for detection and precise localization of flowers. We suggest that scent is not only a long-distance indicator for the presence of open flowers but has also an important function on close range. In current anthropogenously modified habitats efficiency of olfaction and echolocation might be increasingly affected by air and noise pollution. Further studies on how these side effects of urbanization affect the foraging efficiency of these bats will contribute to developing robust conservation plans.

IMPALAS ON THE ROAD: ASSESSING UNGULATE BEHAVIORAL RESPONSES TO THE HETEROGENEOUS ROAD-NETWORK OF KRUGER NATIONAL PARK

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The world is experiencing a fast increase in road development and motorized traffic, which threatens biodiversity. Road impacts can be particularly significant within protected areas, especially when human activities are centered on wildlife sightings from motorized vehicles, as is the case in many African parks and

reserves. Paradoxically road ecology studies have been rarely conducted in these areas. To reduce this knowledge gap we studied the behavioral response and local spatial distribution of impala *Aepyceros melampus* along the heterogeneous (with variation in road substrates and traffic intensity) road-network of Kruger National Park (KNP, South Africa). We observed relatively few flight responses, suggesting impala may be partly habituated to the disturbance caused by passing vehicles. In fact, impala were largely unaffected by the presence of unpaved roads. However, impala did avoid the close proximity of paved roads, especially those with more traffic revealing a negative, albeit small, effect within this protected area that has a long history of tourism. Effective management of protected areas, particularly those where touristic activities are largely based on driving, requires careful assessment and management of road development and use to keep a sustainable balance between protecting biodiversity, satisfying visitors and optimizing the profitability of the park.

SCOPE OF CITIZEN SCIENCE DATA SHARED THROUGH THE GLOBAL BIODIVERSITY INFORMATION FACILITY

Alberto González-Talaván

Global Biodiversity Information Facility (GBIF)

Siro Masinde, Global Biodiversity Information Facility (GBIF)

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The Global Biodiversity Information Facility (GBIF) is an international open data infrastructure that currently provides access to more than 500 million records of about 1.5 million species making it the largest online biodiversity database. About one third of GBIF records comprise citizen science data. Citizen science data publishers are able to mobilize large volumes of digital data records and share them rapidly. We analyse the citizen science data types currently shared through GBIF, and also examine their taxonomic, geospatial and temporal scope, as well as the various routines used to validate records. We discuss the changing landscape of biodiversity data publishers and how GBIF and the science community could engage further with citizen science organizations to leverage emerging opportunities to mobilize large-scale, high quality data.

MANAGING BLACK RHINOCEROS POPULATION RECOVERY IN KWAZULU-NATAL, SOUTH AFRICA: AN ASSESSMENT OF POPULATION PERFORMANCE AND PROGRAMME OUTCOMES

Peter Goodman

Wildlife Conservation Soutions



Anthony CONWAY, Ezemvelo KZN Wildlife ; Jacques FLAMAND, WWF

Following the successful recovery of the white rhino population in KwaZulu-Natal (KZN), Ezemvelo KZN Wildlife, in partnership with WWF Netherlands, embarked on a programme to enhance the much smaller black rhinoceros population in the Province. The programme is designed around three components: securing protected areas containing populations of black rhino; range expansion onto suitable communal and private lands; adaptive management supported by rigorous population monitoring. The long term goal of the programme is to secure 740 black rhino on protected lands in the province and a population growth rate of 5 % per annum towards achieving this. At the heart of the programme is the live harvest of rhino from donor populations in protected areas and the relocation of these animals to large, secure properties under private or communal ownership. Under a custodianship agreement, the founder population remains state property for 25 years, but as part of the incentive to manage effectively, the custodial partner assumes ownership of half of the progeny surviving to the age of 5 years. To encourage the appropriate level of monitoring, a monitoring plan was developed along with regular status reporting of every population in the province. Timely and accurate monitoring data allowed managers to respond quickly to unexpected events such as lowered productivity due to drought, increases in poaching deaths or cohort die-offs often experienced in small populations. After 11 years of implementation, seven new populations have been established on private and communal land in KZN and one in Limpopo Province, and 2015 will see the first removals of state-owned progeny from the newly-established populations which will act as founders for an additional population. Despite an increasing poaching mortality rate and an extended drought, the black rhino population has continued to grow from 411 in 2003 to over 500 by December 2014.

RECOVERY OF RESIDENT LARGE MAMMAL POPULATIONS IN THE WESTERN SERENGETI: SPECIES RESPONSES TO INCREASED PROTECTION, HABITAT MANAGEMENT AND COMMUNITY OUTREACH

Peter Goodman

Wildlife Conservation Solutions

Brian HARRIS, Grumeti Fund ; Matt PERRY, Grumeti Fund ; Philemon MNENEY, Grumeti Fund

The Grumeti Fund established in 2003, is a Tanzanian non-profit organisation which works with other Tanzanian institutions to manage and rehabilitate the Grumeti and Ikorongo Game Reserves and the Ikona Wildlife Management Area concession lands. This concession lies adjacent to the western boundary of the Serengeti National Park. Management undertaken by

the Fund focusses on four areas: ensuring that the Tanzanian Wildlife Laws were being upheld, controlling wildfire to meet predetermined management targets, the control of alien and invasive plants and investing in and implementing an extensive community outreach programme in the neighbouring village lands. Since it was important in realising the tourism potential of the concessions, the recovery of the resident large herbivore community was used as an indicator of project success. Fifteen herbivore species were considered largely resident (non-migratory) and their population recovery was monitored through annual population surveys between 2003 and 2014. Three population responses were evident: 1. Continuous exponential growth, 2. Initial exponential growth levelling at 'carrying capacity' and 3. An initial phase of rapid growth followed by decline. Overall the biomass density of the large herbivores increased from 13 kg ha⁻¹ in 2003 to 51.3 kg ha⁻¹ in 2014. This biomass was dominated (> 90%) by the same six species at the beginning and end of the time series namely: buffalo, elephant, eland, giraffe, impala and topi. The monitoring yielded useful data on two large predators namely spotted hyena which showed no trend over time and lion, whose population grew exponentially at 21% per annum. Domestic herbivores on the periphery of the concessions also increased dramatically as did expansion of agriculture. The conservation programme established without doubt that clearly focussed and executed management interventions can yield positive results for ecosystem rehabilitation and maintenance.

124-THE USE OF MODEL-BASED APPROACHES FOR EVALUATING THE EFFECTIVENESS OF NO NET LOSS POLICIES

Ascelin Gordon

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The increasing decline of biodiversity globally has resulted in many governments, banks and corporations developing policies designed to achieve "no net loss" of biodiversity or ecosystem services in the face of development. Evaluating the outcomes of such policies poses significant challenges. This is due to the different time scales involved in the processes generating biodiversity losses and gains, along with a lack of resources to collect evaluation data at appropriate temporal and spatial scales. In these cases the use of ex-ante evaluation—designed to predict the future outcomes of a policy—is the only viable evaluation option, and necessitates the use of modelling and simulation approaches. This is because predictive models are the only way to evaluate future policy impacts on decadal time scales and provide the only hope for capturing some of the complex array of environmental, social, and economic factors which may



determine the success or failure of no net loss policies. Here, we provide an overview of issues arising from the application of model-based ex-ante evaluation approaches to these policies. This includes: (i) the importance of clearly defining modelling objectives and metrics to be used along with the baselines or counterfactuals against which the policy is being evaluated; (ii) the need for integrated modelling approaches; (iii) the types of insights model-based approaches can provide; (iv) the utility of applying strategic foresight techniques in conjunction with model-based evaluation; and (v) the importance of rigorously assessing the robustness of policies to uncertainty. We illustrate these issues using a range of studies from around the world that have utilised model-based evaluations for no net loss or biodiversity offset policies. We discuss the types of modelling techniques applied and the software tools used. Finally we discuss of the outstanding challenges in applying model-based approaches for evaluating no net loss policies.

TREMATODE-ASSOCIATED MORBIDITY AND MORTALITY OF TADPOLES IN ISRAEL

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Amphibians stand at the forefront of a global biodiversity crisis. The causes of their decline are diverse, and include a rise in amphibian malformations due to various factors, especially trematode infection. However, linking amphibian mortality and morbidity with trematode infection has proven to be challenging due to the complex life cycle of the trematodes, and the fact that trematodes are non-fastidious in their choice of definitive hosts. In Israel the decline in local amphibian populations has been mostly attributed to the loss and degradation of wetlands and riparian habitats. Recently, however, there have been several reports of morbidity and mortality of tadpoles with signs of edema and malformations from various localities in Israel. We collected dead and morbid tadpoles and metamorphs of *Hyla savignyi* and *Pelophylax bedriagae*, and we showed that the morbidity and the deformations observed in the field are the result of infection by trematodes. We also isolated an echinostomatid trematode from the malformed and edematous tadpoles, and from the freshwater snail *Bulinus truncatus*, all from the same site. We further succeeded in experimentally infecting *H. savignyi* tadpoles by echinostomatid cercariae that were shed from the snails, and we showed that infection had significantly increased the mortality rates of these tadpoles. The combination of high trematode prevalence and their pathogenic effects suggest that in nature, the effect of echinostome infection on amphibians may be substantial and could become an emerging disease in Israel.

IMPACTS OF DISTURBANCE ON AN ENDANGERED LIZARD OF AUSTRALIAN HIGHLAND SWAMPS

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The Blue Mountains Water Skink (*Eulamprus leuraensis*) is known only from around 40 fragmented sites within the montane region of south-eastern Australia. It is endemic to a highly specific swamp habitat that is federally listed as an Endangered Ecological Community. Genetic studies show very low rates of lizard dispersal and thus gene flow between these swamps. Climate change is expected to cause hotter and drier weather conditions in the area, resulting in increased fire frequency and reduced water availability. Urbanisation and mining practices may cause further disturbance, potentially degrading habitat quality for this endangered reptile. We conducted standardised surveys of lizard distribution and demography in the majority of these swamps, and quantified habitat attributes associated with lizard occurrence at both a macro- and micro-scale. In combination with GIS-based mapping, our results indicate a lower lizard abundance in swamps that are urban-associated, and have experienced major, frequent fires over the last 40 years. Our monitoring of burnt swamps relative to adjacent unburnt swamps, has clarified the nature and rate of post-fire recovery of both vegetation and lizards. Surveying disturbed relative to undisturbed swamps, has revealed lizards are absent from swamps experiencing severe groundwater disturbance. Therefore, to conserve the Blue Mountains Water Skink in the wild, its rare, fragile and distinctive swamp habitat must be protected from the impacts of threatening processes such as frequent fire, groundwater loss, urbanisation and longwall mining.

EFFECTS OF HONEY BEES (*APIS MELLIFERA*) ON LOCAL PLANT AND BEE COMMUNITIES IN THE ISRAELI RIFT VALLEY

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Bees contribute to the pollination of both wild plants and agricultural crops, and fulfill a fundamental role in the function of many ecosystems. The intensive agriculture in the Israeli Rift Valley is using large amounts of the commercial Honey Bee (HB) for successful crop pollination. However, the HB is not a local species in the desert due to insufficient bloom year round. It is present in the area only due to the agricultural practices. HBs do not limit themselves to the agricultural plots, and go out to forage in the surrounding natural habitat. There are



several known cases globally of HBs disturbing and displacing local wild bee species, and affecting reproduction success of different plant species, which is why we decided to examine its local effects. We found that the HB is the single most abundant bee species in the natural habitat surrounding the Israeli Rift Valley's agriculture. It was found on most plant species visited by bees in the area, and was the most common visitor in many of them. It managed to deplete food resources very early in the day, and failed to pollinate some of the plants it visited while boosting the pollination of others. We also found differences in HB foraging patterns between years, so that better blooming seasons increased its foraging radius and intensity, thereby increasing its effects on local bee and plant species according to its preferences.

94 THE SPREAD OF LOCALLY MANAGED MARINE AREAS IN THE SOUTH PACIFIC

Hugh Govan

LMMA Network

Alifereti TAWAKE, LMMA Network

The South Pacific has experienced a remarkable proliferation of Marine Managed Areas (MMAs) in the last decade. These protected areas, implemented by over 500 communities spanning 15 independent countries and territories represent a unique global achievement. The approaches being developed at national levels are built on a unique feature of the region, customary tenure and resource access, and make use of, in most cases, existing community strengths in traditional knowledge and governance, combined with a local awareness of the need for action, resulting in what have been most aptly termed Locally Managed Marine Areas (LMMAs). The main driver in most cases, is a community desire to maintain or improve livelihoods, often related to perceived threats to food security or local economic revenue. In the South Pacific, conservation and sustainable use are often seen as inseparable as part of the surviving concepts of traditional environmental stewardship. Here we explore the potential drivers and spatial pattern of spread of the LMMAs.

110-WE CHALLENGE YOU TO CREATE: A NEW CITIZEN SCIENCE MODEL (CONTRIBUTORY, COLLABORATIVE, CO-CREATED)

Yogani Govender

Para la Naturaleza

Lee Ann Rodriguez, Para la Naturaleza

The primary goal of the Citizen Science projects (CS) of the Conservation Trust of Puerto Rico (CTPR) was to engage citizens in nature so they can become stewards of nature. While the conventional model for CS is a participant attending a workshop or training session, learn standard methodologies to measure and assess species, habitats and ecosystems from

a scientist and then go off to collect data on their own and share data with the scientist. The CTPR propose an alternative model that includes the scientist with citizens, throughout the spatial and temporal long-term data collection. In this model, the citizens are mentored by the scientist or scientific assistant to pass through the different phase of the Informal Science Education model (contributory, collaborative, co-created). The main goal is to enable the citizens to develop the skills of scientific inquiry as they participate with the scientist so as to develop their own research question and experiment to address STEM concerns within their community. This approach challenges the project team to provide opportunities such as field trips, workshops, dissemination for participants to interact with scientists in more intimate manner to stimulate dialogue about experiments or research that they would be interested in developing through this project. Based on the criteria set by scientists, these vary from the numbers of times participants contributed to data collection, skills on equipment use, ability to do data entry and analysis and confidence to disseminated information about project citizens are able to move through the different phases of the model. Currently of the 900 citizens we have 25 that have passed the contributory phase of the model and have developed a community based science project.

UNEXPECTED CONSEQUENCES OF POPULATION MANAGEMENT: STRONG GENETIC IMPACT OF HISTORIC REINFORCEMENTS ON A POPULATION OF THE ENDANGERED SPUR-THIGHED TORTOISES.

Eva Graciá

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The majority of the western Mediterranean distribution of the spur-thighed tortoise (*Testudo graeca*) lies in North Africa, with a few small and isolated western European populations confined to the Iberian Peninsula (Doñana and south-eastern Spain) and a few islands (Mallorca, Sardinia and Sicily). In the Iberian Peninsula, recent studies identified an ancient North African origin for the south-eastern Spanish population, which was dated to an age of 20,000-30,000 years ago. Here we use molecular data to shed light on the origin of the other Iberian population, located in the Doñana National Park. The earliest references of tortoises inhabiting Doñana trace back to the 18th century, but several introductions of Moroccan animals during 20th century are also well-documented. As a consequence, this population could have mixed ancestries



due to its historic management. We sampled 88 tortoises from Doñana to obtain mitochondrial sequences from the cytochrome b gene and genotypes derived from thirteen microsatellite loci. This dataset was analysed together with molecular data from previous works which involved south-eastern Spanish and North African tortoises. We mainly used population genetic descriptors, haplotype networks and Bayesian clusters analyses to assess the differentiation among the tortoises from Doñana, south-eastern Spain and North Africa. Both mitochondrial and microsatellite data confirmed that historic population reinforcements used the subspecies *T. g. marokkensis* from Morocco, which were introduced to an original population of the subspecies *T. g. graeca*. Sixteen individuals were identified as hybrids, all of them males (sex ratio of 2.18 males per female in our sample). Our results indicate that the recent management of the species had strong effect on the initial genetic composition, and could have altered the sex ratio of the population. This is unexpected since the species is considered to have a temperature-dependent sex determination.

EMPIRICAL EVALUATION OF SPATIAL AND NON-SPATIAL CMR METHODS TO ESTIMATE POPULATION SIZE USING NON-INVASIVE GENETIC SAMPLING

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Application of genetic capture-mark-recapture (CMR) approaches for estimating population size and sex ratio has great potential for aiding effective conservation management of rare or elusive wild animals. To date, no study has explored the reliability of this approach by directly comparing population size estimates obtained via genetic CMR with the known actual size of a population. Here we used a wild community of almost 200 eastern chimpanzees (*Pan troglodytes schweinfurthii*), for which all individuals are known and genotyped, to evaluate the accuracy and precision of population estimates obtained using autosomal microsatellite genotyping of fecal samples. We used samples collected opportunistically over three years within the known territory of the community to explore the impact of lengthened sample periods, which increase sample sizes but also increase chances of deaths or births and consequent violations of population closure assumptions. We compared the effects of using spatial and non-spatial models as well as equal or heterogenous capture probabilities upon estimates. We found that using all of the available data, which represented 79% of the known number of individuals, leads to up to 90% decrease of the relative bias and over 40% improved precision, despite violation of population closure. We found non-spatial

methods estimated community size accurately. However, this community size estimate represented only adult and adolescent individuals, as comparison of genotypes collected for the census with those from known individuals revealed that infants and juveniles are very rarely sampled in a census. In sum, this study suggests that accurate and precise population size estimates may be obtained provided substantial effort is allocated to sample collection and genotyping, that violations of closure assumptions may not be problematic, and emphasizes that not all age categories of individuals will necessarily be sampled or consequently estimated.

ENVIRONMENTAL-ECONOMIC ACCOUNTING AND PROTECTED AREAS: CASE STUDY FROM PERU

Hedley Grantham

Conservation International
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Protected areas, and the biodiversity and ecosystems within, provide many benefits for people. This includes protecting biodiversity's intrinsic values, but also safeguarding human-use values, such as the provision and regulation of water sources, and the climate benefits of stored carbon. Because of this, protected areas are now acknowledged as an important component of sustainable development. It is imperative to monitor networks of protected areas and their surrounds to ensure sustainable management of our landscapes and seascapes. The System of Environmental and Economic Accounts (SEEA) is based on an internationally agreed standard concepts, definitions, accounting rules and provides internationally comparable statistics on the environment and its relationship with the economy. As part of this approach is recognizing that biodiversity and ecosystems are key assets of a country. The approach encourages the measurement of statistics on landuse, including protected areas, which can indicate how these form a key component of managing these assets. Ecosystem accounts are often based on spatially explicitly data. This allows measurement of the flows of benefits from assets to different economic sectors and communities, providing statistics, such as, how protected areas provide benefits to those in the landscape or seascape around them. Conservation International is currently piloting a set of ecosystem accounts within a subregion of Peru (San Martin) in partnership with the national and state governments. Here we report on the science underpinning the set of ecosystem accounts, and how these accounts link to key policies and decision-making processes, particularly protected areas



monitoring and assessment but also more broadly landuse planning, REDD+ and sustainable development strategies.

TALKING TO THE REST OF THE WORLD: LESSONS FROM THE FULLER SCIENCE FOR NATURE FUND ON COMMUNICATING YOUR SCIENCE TO NON-SCIENTISTS

Kate Graves

WWF-US

Robin ABELL, Freshwater Biologist

Successful dissemination of science to non-scientists requires even the most cutting-edge thought leaders to be strong communicators. In this age of TED Talks, policy makers and other audiences may expect a scientist's presentation skills to be on par with his/her research and expertise. Many scientists recognize that there are barriers to uptake of their work; for instance, a recent AAAS/Pew Research Center public opinion poll found that "only 15% of scientists say they believe policy choices about land use are guided by the best science most of the time or always." Yet, some scientists continue to communicate their work in traditional ways, hoping that it might be taken up and regularly frustrated when it isn't. Others are keen to improve but may be intimidated by more seasoned presenters on the 'talk circuit.' Based on the Kathryn Fuller Science for Nature Fund's seven-year history of researching, evaluating, inviting, and ultimately hosting scientists to talk about their science, we will discuss the skills scientists must demonstrate to receive speaking invitations, and the presentation design and style that make a scientist an effective communicator to non-scientists. We will cover the importance of an online footprint, social media, simplifying, storytelling, images and the pitfalls of slides, use (and overuse) of video, fit to audience, and common sense. We will highlight relatively easy improvements that individuals can make to their oral communications and provide advice for becoming a 'go-to' speaker, so that the results of scientists' hard work are heard by those who make decisions affecting conservation.

DO TERRESTRIAL PROTECTED AREAS MITIGATE HUMAN PRESSURES? A GLOBAL ANALYSIS OF LOCAL BIODIVERSITY WITHIN PROTECTED AREAS USING THE PREDICTS DATABASE

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Protected areas (PAs) are widely seen as central to biodiversity conservation efforts. Their importance is reflected in the Convention of Biological Diversity's Aichi Biodiversity Target 11, which commits nations to protect 17% of the global land area by 2020. However, few studies have quantified the effectiveness of protection for local biodiversity on a global scale. We present a global analysis of whether and how PAs mitigate human impacts on local biodiversity using a new database (PREDICTS - Projecting Responses of Diversity In Changing Terrestrial Systems: www.predicts.org.uk) that provides unprecedented geographic and taxonomic coverage, with over 2 million biodiversity records, representing 35,000 species from nearly 20,000 sites, 88 countries and more than 450 PAs. Analyses accounting for confounding variables (elevation, slope and agricultural suitability) found positive effects of protection on local species richness, abundance and endemism. However, these positive impacts are partially explained by differences among land uses, as the impact of protection was weaker when sites were matched by land use. These results suggest that a major way in which PAs conserve local biodiversity is by preventing land use change. However, additional benefits of protection were also detected within some land use types, in certain geographic regions and/or particular taxonomic groups. We also assessed the impact of PA characteristics, specifically PA size, age and IUCN category. We did not find a strong effect of IUCN category on local biodiversity, but there were small increases in local species richness with increasing PA size. The effect of PA age varied among geographic realms and biodiversity metrics. Our results provide evidence that PAs are an effective conservation tool, but also highlight that the impact of protection is context-specific and varies with PA characteristics and among taxa, geographic regions and land uses.

NEW PATHWAYS FOR CONSERVATION PLANNING: VALIDATING THE IMPORTANCE OF LAND USE IN SPECIES DISTRIBUTION MODELS

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Species distribution information is often required for strategic conservation planning. Due to limited empirical information about landscape composition and wildlife movement, conservation professionals often rely on modeled distributions. Species distribution models are often constructed using presence-only (PO) collection records from museums. Maxent is one model that predicts species distributions using PO and environmental datasets. Although the built environment can reduce wildlife movement, human land use is rarely included as



input in these models. Few studies have done post-calibration model validation using independently collected presence/absence (P/A) data for mammalian carnivores – informative focal species because of their sensitivity to fragmentation. To test whether including land use improves the predictive ability of a species distribution model derived from PO data for a carnivore, we used Maxent to construct, compare, and verify two gray fox models: an experimental model that included land use variables and a control that did not. We created both models using a single set of gray fox PO museum records (n=68), as well as environmental and animal co-occurrence input. We confirmed each model's predictions with independently collected gray fox P/A data. Including land use resulted in a stronger model, as measured by the area under the receiver operating characteristic curve (AUC); point biserial correlation; and kappa as an index of Type I and II errors. Validation of model predictions revealed limitations of this commonly used modeling approach. This research can provide conservation professionals with a new tool for collaborative conservation planning in an era of habitat fragmentation. Further, as mid-sized carnivores, foxes have an optimal body size and demography for habitat connectivity models. Understanding land use by these charismatic fauna can help the public conceptualize and prioritize landscape pathways for conservation.

MENTAL MODELER: INCORPORATING SCIENTIFIC AND LOCAL EXPERTISE INTO CONSERVATION PLANNING THROUGH A FUZZY-LOGIC COGNITIVE MAPPING SOFTWARE TOOL

Steven Gray

University of Massachusetts

There is a growing interest in, and use of, Fuzzy-logic Cognitive Mapping (FCM) as a methodological tool for participatory conservation planning. In recent years, FCM has been applied to a diverse set of natural resource case studies, ranging from fisheries management to agricultural development, in an effort to generate predictive models that can support environmental decision-making by illuminating the core presumptions of different stakeholders and integrating both scientific and local expertise. This increase in popularity is due in no small part to FCM's "bottom-up" approach and its ability to represent community-level knowledge in a standardized and dynamic way. Although the method has grown in popularity, software tools that facilitate developing FCM with stakeholders in conservation contexts still remain limited. In this presentation I will present the architecture and various uses of a new freely available FCM-based software tool called Mental Modeler (www.mentalmodeler.org). Using case study data developed from community-driven models of the bushmeat trade in Tanzania and community-based land conservation in the USA, this

presentation will outline the usefulness and limitations of the participatory modeling software as a way to engage in scenario planning and to promote learning among stakeholders. I will also discuss using the FCM data collected as a basis to explicitly engage stakeholders in a discussion about managing resource systems toward desirable or undesirable states and evaluating trade-offs in competing conservation policy options.

SYMPOSIUM #156: SEARCHING FOR SAOLA: HOW IDNA SUPPORTS CONSERVATION OF ASIA'S ELUSIVE UNICORN

Thomas Gray

WWF Greater Mekong

Anh Hoa Anh NGUYEN, WWF Vietnam ; Doug YU, Kunming Institute of Zoology ; Andrew TILKER, Saola Working Group

Saola *Pseudoryx nghetinhensis* is one of the most phylogenetically distinctive and threatened mammals in the world. Only discovered in 1992 saola have never been observed in the wild by scientists and have been recorded from camera-traps only once in the 21st century. Understanding the species' distribution is critical for effective conservation action either in-situ or ex-situ through capturing individuals for a captive breeding program. The recent documentation of the effectiveness of extracting mammalian DNA from haemophagous leeches provides a possible opportunity to survey, and thus detect, saola populations. Between January 2012 and December 2014 more than 50,000 leech samples were collected from protected areas in the saola's range in Vietnam and Laos. Mammalian DNA was extracted from these samples using a number of techniques. At least 20 species of mammal were detected including 5 listed by the IUCN as threatened and 3 Annamite endemic species. Saola have not yet been detected from analysed leech samples. Whilst analysis of haemophagous leeches is able to provide data on mammal communities the methodologies effectiveness for detecting rare and elusive species remains unclear. As a result of a combination of extensive delays in receiving genetic results and insufficient representation of Annamite species in GenBank the advantages of this methodology, compared to camera-trapping, for field conservationists in Asia requires further research.

GENDER DIMENSIONS OF CLIMATE CHANGE ADAPTATION IN COASTAL COMMUNITIES OF THE PHILIPPINES

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Richard POLLNAC, Dept. of Marine Affairs and Coastal Resource Center, University of Rhode Island ; Patrick CHRISTIE, School of Marine and Environmental Affairs, University of Washington

Climate change is expected to have a broad range of impacts on social and ecological systems. In developing countries, climate change will affect and engage men and women differently. However, the type, extent and implications of these differences for the most part lack contextual, empirical support. This study examines the gender dimensions of climate change adaptation (CCA) and marine resource dependency in fishing villages of the Philippines. It seeks to 1) Identify and challenge assumptions about women and climate change 2) Examine beliefs, values, perceptions of risks, resource dependency, and awareness associated with climate change and marine resource management, and 3) Evaluate the implications of gendered relationships with fisheries and the environment. Social surveys were administered randomly to marine resource users in 30 coastal villages within three Philippine provinces (Palawan, Occidental Mindoro, and Batangas). Findings indicate that women felt less connected to nature, were more risk tolerant, and were equally inclined to conservation attitudes as men. Women were more aware of climate change and CCA plans, but less likely to attend outreach activities. Men and women were equally likely to participate in mangrove planting restoration activities for CCA. The results offer insights that dispel certain generalizations and present opportunities for improved integration of both men and women in effective and equitable CCA, as well as marine resource management.

PREDICTIVE MODELS OF SEAGRASS CONNECTIVITY TO INFORM CONSERVATION PLANNING

Alana Grech

Macquarie University

Robert COLES, James Cook University ; Michael RASHEED, James Cook University ; Len MCKENZIE, James Cook University ; Jolan WOLTER, Université catholique de Louvain ; Emmanuel HANERT, Université catholique de Louvain

The rate of exchange, or connectivity, among populations affects their ability to recover after disturbance events. However, our understanding of the extent to which populations are connected is poor, especially in coastal and marine ecosystems. Our research exploits the advanced computational power of new hydrodynamic models to predict the connectivity of seagrass habitats in the iconic Great Barrier Reef of Queensland, Australia. We used the 2-dimensional advection-diffusion Second-generation Louvain-la-Neuve Ice-ocean Model (SLIM) to simulate the dispersal of seagrass fragments and propagules. The simulation outputs were used in a network analysis to identify both the location and intensity of connections between discrete seagrass meadows. The network analysis was also used to explore changes to the

structure and functioning of the seagrass network when one or more discrete meadows were removed due to two disturbance events (cyclones and coastal development). The outputs of our analysis enabled the development of quantitative objectives and conservation strategies that are critical to the management of seagrasses in the Great Barrier Reef, including the identification of critical stepping stones and source meadows. In addition, this project enabled an improved understanding of the potential impact of cyclones and existing and proposed coastal developments on the functioning and health of the Great Barrier Reef.

OPTIMIZING ECOLOGICAL BENEFITS AND ECONOMIC COST OF INVASIVE SPECIES CONTROL: THE CASE OF INDO-PACIFIC LIONFISH REMOVAL ON ATLANTIC REEFS

Stephanie Green

Oregon State University

Elizabeth UNDERWOOD, Reef Environmental Education Foundation ; Bernard CASTILLO, University of the Virgin Islands ; Reale-Munro KYNOCH, University of the Virgin Islands ; Ian LUNDGREN, US National Park Service ; Lad AKINS, Reef Environmental Education Foundation

Many invasions occur at a scale and magnitude that outstrips the conservation and management resources available to eradicate them, setting up a long term battle for control. For these invasions, two key questions arise: What level of control is sufficient to mitigate ecological impacts in high-priority management areas? What resources are required to achieve a sufficient control? An ongoing marine invasion for which there is an urgent need to devise efficient control strategies is that of predatory Indo-Pacific lionfish into the Western Atlantic. Lionfish occupy virtually all marine habitat types in the region, and are causing precipitous declines in the biomass of Atlantic coral reef fishes. Using the lionfish invasion as a test case, we develop a general quantitative model for identifying the marginal value of invasive species control activities, in terms of achieving ecological protection of the invaded community. Specifically, we link a predictive ecological model identifying threshold densities at which lionfish overconsume native fish with an economic model of the cost of removal required to suppress lionfish below threshold levels. We parameterize the model with data from a 2 year experiment at 58 invaded coral reefs in South Florida and St. Croix, USVI, in which we tracked the effort and success rate of culling by divers removing lionfish from half of the sites bi-monthly, and the response of native fish communities at the removal and reference non-removal sites over time. Our analysis reveals that the level of lionfish control required (in terms of cost and removal frequency) to achieve maximum ecological benefit (maintenance of native fish biomass) is highly variable across



the system, with some sites requiring far less effort than is allocated under current management regimes, and some far more. Our work provides a predictive method for efficiently allocating resources to invasive species control from estimates of removal cost and ecological response.

THE IMPORTANCE OF ADDRESSING ALLELIC RICHNESS IN CONSERVATION: THE CASE OF FOUNDER EVENTS AND THE 'ONE MIGRANT PER GENERATION' RULE

Gili Greenbaum

Ben-Gurion University

Alan TEMPLETON, Washington University ; Yair ZARMI, Ben-Gurion University ; Shirli BAR-DAVID, Ben-Gurion University

Two main measures are used to assess genetic diversity: heterozygosity and allelic richness. While both measures have ecological and evolutionary significance, they differ in their implications as well as in their mathematical formulation. While heterozygosity is more significant for a population's short-term viability, allelic richness is more indicative of long-term potential for adaptability and persistence. Although allelic richness is of high importance in conservation, it is less commonly used than heterozygosity, partially because it is more mathematically difficult to take into account the stochastic process of genetic drift for allelic richness. Founded populations (e.g., reintroduced populations) are scenarios where the distinction between the two measures is especially important since such populations are vulnerable to loss of genetic diversity. In this work a stochastic model for allelic richness of a newly founded population experiencing genetic drift and gene flow is presented. The model follows the dynamics of alleles lost during the founder event, and simulates the effect of gene flow on maintenance of allelic richness. The applicable method in which the probability of allele presence can be used in combination with a population's allele frequency spectrum to provide predictions for allele recovery is shown. The model's analysis provides insights into the dynamics of allelic richness following a founder event, taking into account gene flow and allele frequency spectrum. Furthermore, the model illustrates that the 'One Migrant per Generation' rule, a commonly used conservation guideline related to heterozygosity, may be inadequate for preserving diversity at the allelic level. Hence, population genetic studies and conservation efforts aimed at preserving genetic diversity should consider both measures, as focusing merely on preserving heterozygosity might not preserve allelic richness, which is crucial for species persistence and evolution.

PREDICTING DISEASE-INDUCED EXTINCTIONS IN AMPHIBIANS USING HOST TRAITS AND EVOLUTIONARY HISTORY.

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Conservation practitioners require methods to predict species' responses to threat processes even when data are scarce. The global decline of amphibians represents an urgent case in point. In many regions the fungal pathogen *Batrachochytrium dendrobatidis* (Bd), which causes the disease chytridiomycosis, is a major driver of local extinctions. While epidemics of chytridiomycosis result in a great loss of local species diversity, there are many species that manage to survive these events. Why do some species decline while others persist during a disease epidemic? Host traits are likely to influence several facets of a species' disease susceptibility, and therefore may represent a way to predict extinction outcomes during disease epidemics a priori. To examine this possibility we gathered a global dataset on Bd infection prevalence for over 300 species of amphibians from 85 different sites. We examined how different life history and ecological traits may predict susceptibility to infection using phylogenetic comparative methods. Subsequently, we tested whether these traits similarly correlate to patterns of local extinction during disease epidemics with an independent data set. We found that patterns of Bd infection prevalence in amphibians are phylogenetically non-random, with certain clades bearing high levels of infection while others display very low infection prevalence. This strong phylogenetic signal (Pagel's $\lambda = 0.82$, $p < 0.01$) in infection prevalence suggests that phylogeny alone is a significant predictor of Bd susceptibility in amphibians. Using commonly available data on host traits and phylogeny may represent an effective method to prioritize species for conservation management in the event of future disease epidemics.

OIL AND GAS COMPRESSOR NOISE IMPACTS FECUNDITY OF A THREATENED SPECIES OF PRAIRIE-GROUSE

Andrew Gregory

Bowling Green State University

Thomas LIPP, Bowling Green State University ; David HAUROS, Kansas State University

As a result of precipitous population declines over the last 30 years, in April, 2014 the Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*; hereafter LPC) was listed as threatened under provisions of the United States Endangered Species Act. Due to this listing, the Western Association of Wildlife Management



Agencies created the Lesser Prairie-Chicken Range Wide Conservation plan. One aspect of the plan is to understand and mitigate for impacts of oil and gas energy development on LPC populations. For this study, we assessed the influence that oil and gas compressor station noise had on LPC nest placement on a 500km² landscape in west central Kansas, USA. There are two types of gas pumping compressors used on our study landscape, electric and natural gas. To the human ear, electric compressors produce less noise; however, this is due to less noise at higher frequencies (>300Hz). Prairie-grouse communications occur at a frequency of 30-100Hz. We characterized anthropogenic noise associated with electric and gas compressor stations using Larson Davis Lxt-L1 SPL meters and modeled oil and gas sound propagation across the landscape using SPreAD GIS. On average, additive oil and gas compressor station noise (noise significantly >ambient noise) propagates 1,253.4 meters; thus, additive oil and gas compressor noise impacts ~37% of our study landscape. Over the frequency range at which LPC vocalizations occur (~30-80Hz), additive noise from electric compressors was found to be propagates 25% further than does natural gas powered compressor noise ($P=0.03$). We then plotted the location of 186 LPC nests from 56 GPS collared female LPC's on the soundscape. Of 186 LPC nests observed, only 27 (15%) were placed in areas that were impacted by oil and gas compressor noise. These data suggest that the current mitigation recommendation, of electric compressor stations, may actually be worse for LPC's than the standard gas compressors currently in use.

PREDACIOUS ARTHROPOD DIVERSITY OF AGRICULTURAL LANDSCAPES IN GRASSLANDS.

Bianca Greyvenstein

The North - West University (Potchefstroom, South Africa)
Johnnie VAN DEN BERG, The North - West University (Potchefstroom, South Africa) ; Stefan SIEBERT, The North - West University (Potchefstroom, South Africa)

Biodiversity is a resource that has important ecological and evolutionary potential, and is essential to sustain many vital ecosystem services. Biologically diverse ecosystems are threatened by disturbances such as agricultural activities that reduce levels of biodiversity with extensive monoculture crops. Pesticide resistance within cultivated areas threatens global food security. Predator species are becoming increasingly important for pest regulation. However, current knowledge is lacking regarding the diversity and abundance of predators in fields and their movement patterns to and from fields. We selected a set of predaceous arthropods, namely Lacewings (Chrysopidae), Praying mantids (Mantodea), Spiders (Araneae) and Ladybugs (Coccinellidae) to assess the diversity and species assemblages in and around agricultural fields in the extensively cultivated Highveld grasslands of South Africa. We

sampled fields and field margins four times a day to develop an understanding of the movement patterns of these arthropods within the agro-ecosystems. Our results indicated that field margins (30m) are the most diverse and abundant in terms of predaceous arthropod diversity along a maize field-field margin-untransformed grassland gradient. Predators are drawn to edges of cultivated land to improve hunting success. Our results support the Natural Enemies' Hypothesis which states that predators are more effective in such heterogeneous plant environments. Field margins therefore play an important role in the maintenance of predaceous arthropod diversity and have an important role in strategies to achieve food security. Pesticides remain crucial for the control of pest outbreaks and our findings suggest that mornings (7 A.M.) are better for spraying pesticides as this is the time of day when predator populations were almost absent from maize fields.

REVEALED AND STATED PREFERENCE CHOICE EXPERIMENTS TO ASSESS BEACH MANAGEMENT PRIORITIES

Caroline Griffin

University of Stirling

Nils BUNNEFELD, University of Stirling ; Nick HANLEY, University of St. Andrews ; Andre GILBURN, University of Stirling

A major problem with land management can occur due to necessary trade-offs between different ecosystem services. Should the areas be managed for biodiversity or for people? This is a global problem and examples can be found from a variety of different environments and ecosystems, i.e. agriculture, forestry, fisheries and coastal areas. One solution to this problem is to try and place a monetary value on the natural environment and biodiversity. This is incredibly challenging due to the complexities of the natural world, which cannot easily be represented using a linear economic model. This method of valuing nature polarises opinion and poses a number of moral and ethical questions. However, placing a monetary value on nature does, at least, ensure the environment can be accounted for in any decision making processes involved in management. Choice experiments are one method used to try and overcome some of the problems associated with nature valuation. These economic tools can be used to try and discover the value that society places on an environmental good or service. We carried out stated and revealed preference choice experiments to discover the valuation people placed on features found at tourist beaches on the east coast of Scotland. We found that the majority of people chose excellent bathing water quality and high levels of biodiversity over beach awards. This has implications for how coastal regions are managed and suggests there should be an emphasis on an ecosystem services approach rather than spending time and resources attempting to achieve an award status based on aesthetics and poorly valued services.



95 - ROAD IMPACTS: THE HISTORY SO FAR

Clara Grilo

Universidade de Aveiro

Daniel SMITH, University of Central Florida, USA ; Rodney VAN DER REE, Australian Research Centre for Urban Ecology, Royal Botanic Gardens Melbourne and The University of Melbourne, Australia

The global network of roads, railways, trails, artificial waterways and utility easements is extensive in its length and spread worldwide. The global rate of linear infrastructure construction will continue to rise for the foreseeable future, accentuated by accelerated rates in many developing countries – 90% of the expected 25 million lane km to be added by 2050 will be in non-OECD countries. Traffic volume is expected to more than double by 2050 from 870 million vehicles to 1.7 to 2.8 billion. The combined impacts of linear infrastructure and traffic are significant threats to the persistence of species and functioning of healthy ecosystems through wildlife mortality, habitat loss and degradation, as barriers or filters to movement, avoidance, attraction, provision of habitat and/or corridors for movement, affecting individual wildlife, populations, communities and landscapes. However, the nature and severity of these effects vary among species because of their different morphological, ecological and behavioural traits, and depends on the location, density and configuration of the road network. Many governments and communities around the world have developed strategies to avoid, minimise, mitigate and offset many negative effects. However, not all impacts can be fully mitigated and not all mitigation measures are equally effective. The challenge currently facing society is to build a more efficient transportation system that facilitates economic growth and development, reduces environmental impacts and protects biodiversity and ecosystem functions. Supporting good quality research and collaboration between scientists and practitioners can steer the development and management of effective transportation systems toward establishing long-term environmental sustainability. The broad aim of this symposium is to provide the history so far of road impacts and mitigation and to discuss the latest findings on this issue.

EARLIER TIMING, LOWER SUCCESS: DOES THE SPATIAL SCALE OF CLIMATIC CONDITIONS MATTER IN A MIGRATORY PASSERINE BIRD?

Annegret Grimm

Helmholtz-Centre for Environmental Research

Brigitte M. WEIß, University of Leipzig, Institute of Biology, Behavioural Ecology Research Group ; Lars KULIK, University of Leipzig, Institute of Biology, Behavioural Ecology Research Group ; Jean-Baptiste MIHOUB, Helmholtz-Centre for Environmental Research ; Roger MUNDREY, Max-Planck-Institute for Evolutionary Anthropology, Department of Primatology

; Ulrich KOEPPEN, Beringungszentrale Hiddensee ; Tomas BRUECKMANN, Grüne LIGA Kohrener Land ; Ruth THOMSEN, University of Leipzig, Institute of Biology, Behavioural Ecology Research Group ; Anja WIDDIG, University of Leipzig, Institute of Biology, Behavioural Ecology Research Group

Following over 20 years of research on the effects of climate on biodiversity, we now have strong evidence that climate change affects phenology, fitness, and distribution range of different taxa, especially birds. Although scale-related effects are common in ecology, the vast majority of studies analysing effects of climate change were accomplished using climatic information at a single spatial scale. Using data from a migratory passerine, the double-brooded barn swallow (*Hirundo rustica*) from Eastern Germany, we investigated the scale dependent sensitivity to climate change of the breeding phenology and performance. We investigated effects of the local weather (small scale) and the North-Atlantic-Oscillation-index (NAO) (large scale) on the breeding timing and success of both annual broods. In line with previous studies in migratory birds, we found that these barn swallows bred progressively earlier but showed reduced breeding success over time in response to recent climate changes. Responses were observed on both small and large climatic scales, but they differed with respect to the ecological process considered. Specifically, we found that breeding timing was primarily influenced by the large-scale NAO variations and to a lesser extent by local weather on the breeding ground. Conversely, breeding success of both broods was exclusively driven by climatic conditions on the local scale. The temporal decrease of the breeding success is likely a consequence of mismatches between climatic conditions and different breeding phases resulting from diverging scaling processes. Our findings corroborated numerous evidences of previous studies dealing with biodiversity response to climate change. However, by disentangling climatic conditions acting at different scales, we emphasise that responses of ecological processes to climate change need to be studied in the context of scaling in order to better understand the complexity of climate change effects on biodiversity.

ENVIRONMENTAL VARIABLES DETERMINING THE OCCURRENCE OF THE RED-LISTED CARBONICOLA ANTHRACOPHILA AND C. MYRMECINA IN BOREAL FORESTS- RECOMMENDATIONS FOR NATURE CONSERVATION AND FOREST MANAGEMENT

Fiona Grossmann

Swedish University of Agricultural Sciences

Göran THOR, Swedish University of Agricultural Sciences ; Victor JOHANSSON, Swedish University of Agricultural Sciences

In this study the species-substrate relationship of two red-listed forest-fire dependent lichen species *Carbonicola anthracophila*



and *C. myrmecina* is investigated as well as the environmental variables determining their occurrence. 3 dead wood types (snags, stumps, logs) of *Picea abies* as well as “ordinary” and “resin-rich” *Pinus sylvestris* were sampled. 24 forest stands of different forest types (8-19 years old, 20-64 years old, >65 years old, nature reserves & voluntary set-asides) were inventoried in boreal forests in Hälsingland, Sweden. To record the frequency of potential *Carbonicola* harbouring substrates a dead wood inventory was conducted using a 200 x 10 m sample plot. Lichen occurrence probability was modelled based on the explanatory variables using a generalized linear mixed model with a logit link function. The number of suitable dead wood objects in a stand was modelled based on stand categories using a zero-inflated Poisson regression. Substrate characteristics were the most important variables in species occurrence and therefore confirm the strong substrate specificity of *Carbonicola anthracophila* and *C. myrmecina* towards resin rich, hard, charred, dead pine wood without bark. Both lichen species were found within all stand categories, which demonstrates that stand level characteristics such as forest age or management type are not per se important for lichen occurrence. Resin rich pine dead wood was found more often in nature reserves and voluntary set asides than in middle-aged stands. Due to the high substrate specificity of *Carbonicola* effective conservation measures should aim at (i) the preservation of suitable substrates currently existing in managed forests and (ii) the creation of suitable *Carbonicola* harbouring substrates in the future with a focus on protected areas.

SCIENCE FOR NATURE AND PEOPLE INITIATIVE - MULTIDISCIPLINARY TEAMS SOLVING PROBLEMS AT THE NEXUS OF CONSERVATION AND HUMAN WELL-BEING

Craig Groves

The Nature Conservancy

Most of the world’s most serious nature conservation issues require a breadth of disciplinary expertise to solve. In 2013, three major institutions (The Nature Conservancy, Wildlife Conservation Society, and the National Center for Ecological Analysis and Synthesis at the University of California, Santa Barbara) collaborated to launch the Science for Nature and People Initiative or SNAP (www.snap.is). SNAP has an annual call for proposals from which we have approved and funded 19 interdisciplinary working groups spanning a range of global issues but typically focused on both biodiversity and ecosystem services across three major areas of activity – Food and Water Security, Nature and Economics, and Disaster Risk Reduction. Working group members include a diversity of scientists, policy makers, and conservation practitioners across a variety of institutions. Typical working groups collaborate for two

years, synthesize existing data (e.g., global database of nature-based defense projects) and develop products (e.g., Green Investment Guide indicating the top 25 Latin American cities in which natural infrastructure could play a role in improved water quality) that are used in implementing conservation strategies and actions in existing conservation initiatives. Participants in working groups to date represent 38 countries, over 80 universities, 60 non-governmental organizations, 17 US federal government agencies & 10 non-US government agencies, and 19 private sector organizations. In 2015, the total funding for working groups was \$US 2 million with nearly 2/3 of that funding leveraged through matching funds. The results of four working groups will be highlighted – Infrastructure Development and Freshwater Resources in western Amazonia, Managing Data Limited Fisheries, Nature-based Coastal Defenses, and Conserving Nature for Water Security.

PROVIDING MORE PROTECTED SPACE FOR TIGERS PANTHERA TIGRIS: A LANDSCAPE CONSERVATION APPROACH IN THE WESTERN GHATS, SOUTHERN INDIA

Sanjay Gubbi

Nature Conservation Foundation

Kaushik MUKHERJEE, Government of Karnataka ; M. H. SWAMINATH, Indian Forest Service (Retd) ; H. C. POORNESHA, Nature Conservation Foundation

Conservation of large carnivores is challenging as they face various threats, including habitat loss and fragmentation. One of the current challenges to tiger *Panthera tigris* conservation in India is the conversion of habitat to uses that are incompatible with conservation of the species. Bringing more tiger habitat within a protected area system and in the process creating a network of connected protected areas will deliver dual benefits of wildlife conservation and protection of watersheds. Focusing on the southern Indian state of Karnataka, which holds one of the largest contiguous tiger populations, we attempted to address this challenge using a conservation planning technique that considers ecological, social and political factors. This approach yielded several conservation successes, including an expansion of the protected area network by 2,385 km², connection of 23 protected areas, and the creation of three complexes of protected areas, increasing the protected area network in Karnataka from 3.8 to 5.2% of the state’s land area. This represents the largest expansion of protected areas in India since the 1970s. Such productive partnerships between government officials and conservationists highlight the importance of complementary roles in conservation planning and implementation.



95. THE CONSEQUENCES AND OPPORTUNITIES OF RAPID EXPANSION OF LINEAR INFRASTRUCTURE IN THE DEVELOPING WORLD.

Sanjay Gubbi

Nature Conservation Foundation

Wendy COLLINSON, The Endangered Wildlife Trust ; Kylie SOANES, Australian Research Centre for Urban Ecology, The University of Melbourne

Global road-rush is largely related to economic goals and escalating demands for natural resources. This is especially true in the developing world where there is a confluence of economic growth, biodiversity richness and high species endemism. Nine-tenths of the 25 million kilometers of new road development, that are anticipated to be built by 2050, are expected to occur in developing nations. The opening up of relatively pristine and frontier areas for development increases colonization, habitat fragmentation, overexploitation of wildlife and other natural resources. In countries like India and South Africa the challenge comes primarily from the conversion of existing small roads with low-volume traffic into high-speed highways. Coupled with road improvement is the increase in vehicle numbers and their ability to travel at higher speeds due to improved technology resulting in higher wildlife-vehicular-collision mortalities. In many parts of Asia and Africa, new roads have also contributed to overhunting of endangered species as well as fueling bushmeat trade. Many developing nations lack policies to make road-development wildlife compatible. Hence it is important to establish ecologically sound policies and practice to avoid or minimize the negative impacts on wildlife and their habitats. In countries with developed policies, wildlife concerns are often given insufficient attention during the design, planning and construction of roads. There are, however, some examples where science-conservation initiatives have been successfully implemented to reduce impacts on wildlife and the integration of ecological knowledge and engineering into the development of roads is being recognised. To ensure the conservation of species and ecologically sustainable development, it is imperative that multi-lateral lending and development assistance agencies administer the implementation of biodiversity guidelines to mitigate impacts of roads at the design and planning phases.

USING A SOCIO-ECOLOGICAL SYSTEM FRAMEWORK TO ANALYZE THE RESILIENCE OF A PROTECTED AREA

Chloé Guerbois

CNRS/NMMU

Hervé FRITZ, CNRS

Long-term research is the prerequisite to the in-depth study of socio-ecological systems (SES) and their diverse inner processes at various scales. The diversity of ecological and historical contexts often challenges the direct translation of pre-established conceptual models from one SES to another, and in particular for SESs including protected areas. The French Long Term Ecological Research program Zone Atelier Hwange focuses on the functioning of the Hwange SES (Zimbabwe) including Hwange National Park and its periphery. Started over 15 years ago targeting ecological processes, the program has expanded to develop interdisciplinary research. It offers an original study case to analyze the resilience of protected areas and their associated SESs. Since the creation of Wankie Game Reserve in 1928, the Hwange SES has experienced multiple disturbances and transformations. Colonization, interventionism, decolonization, resettlement, political and economic crises, and droughts constitute the main drivers of several regime shifts : e.g. from a wet season wildlife area to a dry season wildlife area through the surface water provisioning, from a culling driven to an elephant driven ecosystem, from a traditional pastoral and cultural area to an international tourism outfit. However, nowadays Hwange remains an emblematic example of semi-arid wooded savannas with high mammal diversity. In this paper we analyzed the properties and processes behind the apparent resilience of the system, elaborating a transferable conceptual framework underlying interdependencies between its social and ecological components. The main contrasts with existing conceptual approaches are the explicit links between biodiversity and well-being, through the notions of values and attitudes. Illustrative and prospective narratives, one on elephant management and the other on the extension of mining, describe how this model can help thinking the resilience of a SES including a protected area.

DIVERSITY OF WATERBIRDS AT CHOTT EL-HODNA (ALGERIA)

El-Yamine Guergueb

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A study was carried out on the waterbirds of Chott El-Hodna (Central High Plateaus of Algeria), a wetland of international importance under the Ramsar Convention, situated in a strategic part of Algeria, with a surface exceeding 362,000 ha. The avifauna of this wetland remains very poorly studied and the biological and ecological roles of the species



remain unknown. In this pioneering work we present results obtained through the monthly bird counts from September 2010 to September 2012. In total, 39 species of waterbirds, representing 12 families, were recorded. The duck family is the best represented, with 10 species. Some species were observed in relatively large numbers, such as the Greater Flamingo, *Phoenicopterus roseus* (2800); Shoveler, *Anas clypeata* (1640); Ruddy Shelduck, *Tadorna ferruginea* (643); Teal, *Anas crecca crecca* (2250); and Common Shelduck, *Tadorna tadorna* (2750). Out of all the species, 20 are wintering, 12 are migrants, six are breeder-resident species, including the Ruddy Shelduck, *Tadorna ferruginea*, and the Black-winged Stilt *Himantopus himantopus*. Only one species, the White stork, *Ciconia ciconia*, has breeder-migrant status. Eleven species are protected under Algerian law and one species (Marbled teal, *Marmaronetta angustirostris*) is listed in the vulnerable (VU) category of the Red List of endangered species by the International Union for the Conservation of Nature (IUCN). Overall, this wetland is exploited as a wintering ground, a stopover during migration and as a breeding site for several waterbird species. However, Chott El Hodna is under heavy pressure from man, due to such as sand extraction and habitat fragmentation and is in urgent need of protection measures.

SYMPOSIUM 24. ACHIEVING SOCIAL-ECOLOGICAL FIT THROUGH COLLABORATIVE GOVERNANCE

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Örjan BODIN, *Stockholm Resilience Centre*; Ryan MCALLISTER, *CSIRO*; Wilson KERRIE, *The University of Queensland*

Most of the world's most pressing environmental problems are directly affected by the problem of fit – when governance systems do not fit or align with the characteristics of the biophysical system. Yet empirical explorations of governance approaches that could ameliorate fit challenges are rare. Collaborative forms of decision-making are considered a possible solution to the problem of fit. We conduct the first empirical investigation of the problem of fit and assess the capacity for a collaborative conservation initiative to address two specific fit challenges: spatial scale mismatch and the management of interconnected ecological units. Employing new theory and methodological approaches for network analysis, we identify social-ecological network configurations that capture the hypothesised ways in which collaborative arrangements could address these challenges. For a large-scale conservation initiative in Australia, we determine how well observed the pattern of stakeholder interactions reflect these arrangements. We find that collaboration between stakeholders is evident when they manage the same locations, but not when they manage different, yet connected, locations. In addition, we find that the collaborative arrangement is structured in a way that promotes multi-scale management.

Our approach allows social-ecological interdependencies to be incorporated to evaluate the benefits and constraints afforded by collaboration. The information obtained provides a unique evidence-base for the design of future collaborative arrangements that might be better suited to solve environmental problems.

DYNAMIC OF THE BLACK-TAILED GODWIT, LIMOSA LIMOSA AND FIDELITY TO SENEGALESE WINTERING GROUNDS.

Khady Gueye

UCAD

Cheikh Tidiane BA, UCAD ; Ibnou NDIAYE, UCAD

The black-tailed godwits population, *Limosa limosa*, breeding of Western Europe that winters in West Africa is declining. The black-tailed godwit is classified on the IUCN Red List as near threatened species and is currently the subject of a plan of international actions of AEWA? This action plan has retained Senegal and Guinea-Bissau as the two most important countries for storage of the bird population. However, there are few data on the distribution of birds counted in the middle of the rainy season (January), when a large part of the population is expected back in the West. A 2008 study showed that only 10% of the population is observed in southern Senegal (Casamance) and Guinea-Bissau, so more than 100,000 people remained uncounted. Recent findings suggest that opportunistic birds are not limited to rice fields and are also in uncultivated wetlands near Dakar and Saint-Louis. The main purpose of this study is to better know the ecology and biology of the barge. The specific objectives are to know the phenology and the movements of the bird in the Senegalese wintering sites. We make statements barges found in each site, and a reading of color combinations and rings (or) flag banded individuals. We send the barges codes banded to manager databases. The presence of *Limosa limosa* is recorded from June to January from which the numbers begin to decrease. Distribution dynamics within Senegalese habitats is now well known with the maximum in October. The barges are very loyal to their wintering sites for Senegalese individuals banded comments are repetitive since 2012. Indeed by this reading of the rings, the movement of barges in the Senegalese wintering sites is revealed. This study is a first in Senegal. It is crucial to bridge the knowledge gap on the ecology, wintering sites and species migration strategies.

PUNAN PATHS FOR BIOCULTURAL CONSERVATION: TRAILING FOREST USES AND TREE DIVERSITY IN BORNEO

Maximilien Gueze

Universitat Autònoma de Barcelona



Community-based conservation schemes are largely based on the assumption that indigenous people enhance biodiversity in the environment they live. However, research on the impacts of indigenous peoples on biodiversity in tropical forests has mostly focused on land-use and cover change analyses – emphasizing uses that modify the canopy, such as shifting cultivation- and tends to ignore uses with more subtle effects, such as those involving cryptic or below-canopy disturbances, whose impacts on biodiversity are not necessarily visible on satellite images. In this study, I explore the association between tree diversity and structure in Borneo old-growth forests and the intensity of non-agricultural use by an indigenous group, the Punan Tubu of East Kalimantan. I asked people from two villages to carry a GPS tracking them during their daily subsistence activities – hunting and foraging of wild edibles and other non-timber forest products– and obtained one-year data on the intensity of use. I also inventoried and measured the diameter of trees (dbh>2.5cm) in 20 0.1-ha (50x20m) plots in the old-growth forest surrounding the two villages, where these activities took place. Analyses relied on multi-variable models at the plot level. I then constructed a 300-m buffer area around each of the inventoried plots to associate the intensity of use (proxied as the number of track points in each buffer area) with tree alpha diversity measured with different indexes (Fisher’s Alpha, Sorensen and Steinhaus indexes). This study represents an attempt to associate fine-scale indigenous impacts with real measures of biodiversity. Results will have important implications to determine what the actual impacts of indigenous peoples on their ecosystems are, at a time where development and resource demand constantly increase. Results will also allow a better understanding of the value of indigenous-used forests for future conservation strategies.

SHALL SURVEYS FOR OCCUPANCY ESTIMATION CONTINUE AFTER THE FIRST DETECTION?

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During the last ten years, occupancy-detection models (MacKenzie et al. 2002, Ecology 83) have become standard tools in wildlife monitoring, ecological inference and the study of species distributions. In order to account for imperfect detection, the key is to collect the species data in a way that allows modelling the detection process. This is often achieved by sampling each site repeatedly (or at least some of them), recording species detection/non-detection in each visit separately. When it comes to designing a survey protocol, a natural consideration is whether sites should continue to be surveyed after the species is detected (‘standard design’) or whether surveys at a site should be discontinued after first detection (‘removal design’). At a first glance, removal design

seems best because it allows spreading a given budget of survey effort across more sites: once the species is detected at a site, effort can be redirected to surveying other sites, which appears to be a more efficient use of available resources. However concerns exist regarding the ability of removal design data to deal with scenarios where detectability is heterogeneous (MacKenzie & Royle 2005, J. App. Ecol. 42); this could compromise its expected efficiency gain. By analysing simulated datasets and drawing on statistical theory, we provide a thorough examination of the benefits and limitations of the removal design in comparison to those of the standard design, under a range of plausible scenarios.

RESPONSES OF OCTOPUS VULGARIS (LAMARCK, 1798) TO ATTACHED ELECTRONIC TAG

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Egemen NEMLI, Ege University ; Ali ULAS, Ege University

Electronic tags help to determine behaviors and movements of marine animals. By this way, scientists make an effort to understand ecological process and to find solution for problems. However, attaching tags commonly cause of differences of animals behaviour. Response of animal should known, especially before field experiments. Unlike other marine animals, octopus has arms and suckers to touch and to grasp anything. Easy learning ability is also makes difficult to attach tag and ensure that it remains on octopus. In this study, 8 individuals of *Octopus vulgaris* were tagged with artificial tag at controlled pool area. Process were conducted under anesthesia and the tag were placed different parts of body. Response of individuals, during and after tagging, were monitored continuously. Results shows that, the octopuses does not accept the existence of tag. After recover from anesthesia, they immediately began to try to remove tag from body. Some individuals achieved that just in hours. Longest tag remain time was almost one week. Tag remove response commonly resulted in a permanent injury, lose a body part or sometimes led to death.

WHEN TO EXPLORE A NEW HABITAT? A MICROCOSM EXPERIMENT TO EXAMINE HOW HABITAT AND TRAVEL ROUTE CONDITIONS AFFECT EXPLORATION BY TERRESTRIAL ISOPODS

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Thompson Rivers University

Karl W. LARSEN, Thompson Rivers University

When do animals ‘decide’ to explore or relocate? Despite the importance of this process to conservation and ecology, the importance of conditions within the “home” environment and those encountered while travelling to other habitats have been rarely quantified. We focused on these questions



using microcosm experiments on two closely-related but morphologically-dissimilar species of terrestrial isopods (*O. Isopoda: Armadilidum vulgare* and *Porcellio dilatatus*). We conducted two studies looking at movements out of home habitats: the first focused on the effect of conditions in the home environment, and another examined the role of conditions within the travel corridor. In each study, 45 trials were conducted on each species (with $n = 16$ animals per trial) and isopods were measured and individually marked to track them through webcam 'checkpoints' along the travel corridor. In the first study, we manipulated moisture (3 levels) and food (3 levels) in the home environment. We found that the number of animals departing from home and the total distance traveled in the corridors were primarily influenced by moisture. Further, *Porcellio* showed a greater tendency to depart from the home environment. In the second experiment, we manipulated moisture (3 levels) and corridor permeability (obstacle density - 3 levels) within the travel corridor. In this study, we found that the less-mobile *Armadilidum* travel distances were mostly affected by the permeability of the corridor, whereas *Porcellio* travel was mainly affected by the humidity, likely due to a relative intolerance to lower humidity. Post-hoc examination also suggested that body weight and sex of individuals played a role in determining movement tendencies. Although not surprising, our results are some of the first concrete depictions of how different conditions factor into the movement 'decisions' of animals out of habitat patches, furthering our ability to predict the response of animals to environmental changes.

CAN WE TRANSLATE ECOSYSTEM SERVICES LANGUAGE ACROSS CULTURAL AND RELIGIOUS BARRIERS?

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"Ecosystem services" (ES) is increasingly used as the reference point of a common language intended to focus research and unite conservation efforts and policies around the world. However, this language does not always translate successfully into different cultural settings, and even within the scientific community there is disagreement about the merits of this conceptual language. The Faith-in-Scholarship Working Group on Ecosystem Services (FISWES) is exploring how a reformational-Christian perspective may assist in

communicating across cultural barriers and clarifying the overall goals and methods of conservation agendas. Using a non-reductionistic philosophical framework, it seeks to enrich the concept of ES and make it more robust to cross-cultural translation. As well as comparing classifications and nomenclature for ES, we offer a conceptual map of interactions among scientists, policy-makers, practitioners and the general public, designed to improve mutual understanding across societal spheres and international cultures.

SPECIES-SPECIFIC EFFECTS OF GROUND VEGETATION ON BIRDS OCCURRING IN VINEYARDS IN THE CANTON OF VALAIS

Claire Guyot

University of Bern

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Habitat degradation due to post-war agricultural intensification has triggered a dramatic decline in farmland biodiversity. Farmland birds suffer from massive application of agrochemicals, which is likely to affect them indirectly by modifying food supply and availability. Many of them forage on the ground making ground vegetation structure (height and cover) a key component in foraging site selection. However, the relevance of this optimal balance between food abundance and availability for other bird species and foraging guilds still deserves more attention. Intensively cultivated vineyards most remain bare, especially in places where the climate is hot and dry. Consequently, vineyards may often not deliver sufficient food supply because of lacking ground vegetation. We used transect monitoring of ten sites in south-western Switzerland (Valais) and mixed effects regression models to investigate habitat preferences of multiple bird species that use vineyards as feeding sites. We aimed to get species-specific preference curves over a whole year to highlight the importance of ground vegetation at the parcel scale. Here I will present overall, species-specific and if possible foraging guilds' specific habitat preferences with respect to ground vegetation structure and management types in vineyards. After backward model selection based on AIC, predicted bird occurrence and density will be plotted against significant habitat variables. These data will form a basis for future management recommendations of vineyards for specific times of the year. Because of a likely trade-off between food abundance and accessibility, we generally expect species-specific optima concerning ground vegetation structure (quadratic relationships), especially for ground foraging species.



ASSESSMENT OF THREATENED FISH SPECIES WITH AN ELECTRIFIED BENTHIC FRAME TRAWL IN THE DANUBE RIVER - EXPERIENCES OF THE THIRD JOINT DANUBE SURVEY (JDS3)

Ágnes Irma György

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There are many fish species that are conservationally important in the Danube, yet they are especially difficult to collect with conventional fishing gears (e.g. trammel nets, gillnets) used to sample deep habitats in slow flowing large rivers. Additionally, entangling nets and hook and line (i.e. long line) sampling can injure fish seriously. Until now the most comprehensive fish assessment method is night time shoreline electrofishing, however this method is not suitable for detecting sterlet (*Acipenser ruthenus*), the only native sturgeon species still present in the upper and middle Danube, but also facing increasing population decline due to overfishing and habitat loss. Other rather rare native bottom dwelling fish species (e.g. Zingel streber) are also usually underrepresented in shoreline catches. Previous studies proved the broad applicability of the recently developed electrified benthic frame trawl (EBFT) in monitoring benthic fishes in the Danube thus it was adopted by the core team of the JDS3. Samples were collected at 32 sites between rkm 15 and 2420. Results on the occurrence of sterlets in the middle Danube region were alarming; while in the lower reaches it was caught regularly, no individuals could be detected above the inflow of Tisa River. The abundance of gobies and zingels were also lower than expected. Overall we found that offshore areas were intensively used by a variety of species which were distributed relatively homogeneously in the river, at least regarding their occurrence, because their abundance can vary largely at the mesoscale (i.e. between 500 m long sampling stretches). The survey again proved the importance of using different methods, especially the EBFT, since it gave a completely different picture in case of rare species, and it also revealed the alarmingly low abundance of sterlet and the urgent need for certain active conservation measures, such as the restoration of spawning grounds and the control of cormorants.

RECENT INCREASING IN THE NUMBER OF RED-BREASTED GEESE (*BRANTA RUFICOLLIS*) IN THE HORTOBÁGY (HUNGARY)

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University of Debrecen

Ibolya CSÍDER, University of Debrecen

The wetlands and fishponds of the Carpathian basin have a great importance in the migration and wintering of several Eurasian goose species. The Hortobágy region is a traditional stopover site along the flyway of many migrating birds and several goose species population have increased in the last years. The White-fronted Goose (*Anser albifrons*) is the most numerous in migration but two globally endangered species the Lesser White-fronted Goose (*Anser erythropus*) and the Red-breasted Goose (*Branta ruficollis*) are regularly observed each year. The breeding population of Greylag Goose (*Anser anser*) also has increased, this is the only breeding goose species in the wetlands of the Hortobágy. Since a few decades the Red-breasted Goose became a regular annual visitor in small number between October and April but in recent years we observed a significant increase in the migrating and overwintering population. In November 2014, 1733 Red-breasted Geese were counted in the area, this is a remarkable increase and an important proportion of the declining world population which is about 37 000 birds. In the Hortobágy National Park the geese can find safe resting places and hunting pressure is relatively low in the protected areas. This increase is presumably caused by shifting migration routes or favourable climatic condition changes in migrating and wintering seasons. The management of the wetlands and the feeding habitats in the national park can have a positive impact on the population growth of these rare goose species.

PERSONALITY AND SURVIVAL IN CONSERVATION RESEARCH - REINTRODUCTION OF EUROPEAN MINK (*MUSTELA LUTREOLA*)

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Stockholm University

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Animal personality is defined as consistent behavioural differences between and within individuals, repeatable over time or contexts/situations. Personalities have been identified in numerous species and empirical data indicates a connection to fitness, making personality a relevant but little studied aspect in conservation. The first steps towards implementing personality in conservation efforts include examining the structure and expression of personality in a species, and



developing measuring techniques. The next steps involve testing if personality type affects fitness and the success of a conservation effort. Here we investigated personality in the critically endangered European mink and how the expression of personality was affected by situation (season) and context (test environment). Three personality trait domains were identified; boldness, exploration and sociability. Furthermore, test environment influenced which personality trait domain that was expressed, showing the importance of proper measuring technique in order to avoid misinterpretation. Personality also changed plastically over seasons, indicating that potential fitness effects in the wild could vary depending on season. After this a field experiment was made to test the impact of personality on survival in reintroductions. Animals were personality tested in captivity and post-release survival was monitored via 60 days of radio-tracking in two years. Boldness had a positive impact on personality whilst the influence of exploration was more complex; the correlation was negative or positive depending on year. Sociability had no effect, which is expected in a solitary-living species. Overall the results show the importance of personality on survival and additionally give insights on the evolution of personality as spatiotemporal variation was influential. Future studies should assess if integrating personality with existing conservation methods, e.g. in reintroduction, can enhance success rates.

A CONCEPTUAL STUDY FOR CONSERVATION AND ECOLOGICAL RESTORATION OF THE DEGRADED ARID STEPPE-LANDS IN THE HAOUZ PLAIN, WEST CENTRAL MOROCCO

Nawal Hachimi

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As other ecosystems, the arid steppes, which mainly constitute rangelands, are subject to significant alterations, especially under the effect of chronic drought and overgrazing. This is the case of the *Zizyphus lotus* steppes of the Haouz plain, West central Morocco. The aim of this study was to assess conservation and restoration potentials of this ecosystem and to propose development scenarios for a better use of the resources in the future. Conservation and restoration options proposed for key species populations, and more specifically *Z. lotus*, and for the entire arid steppe ecosystem including the abiotic (water and soil) and biotic (vegetation and wildlife) components, would return to alternative stable state (relatively to the historic state) on the one hand, according to the degree of degradation of the steppe and the demographic

status of populations, by improved resources management (conservation and reinforcement declining populations) and on the other hand, by rehabilitation through reintroduction of extinct plant and animal species. A preliminary diagnosis of the state of the steppe ecosystem was carried out through examination of vegetation, including the *Z. lotus*, and some elements of threatened wildlife that depend on such as the Moorish tortoise, a strictly herbivorous species. It is assumed that the local population will support the conservation and restoration project proposed at the regional level, and especially livestock breeders and grain producers who depend on the steppe rangelands during most of the year. Thus, the proposed measures should be of a direct (and indirect) benefit to these people. Measures would lead, on a large scale, to the improvement of groundwater recharge. However, this latter would not be directly available (accessible) in the grazing areas (for plants and livestock); It would indirectly assist in the protection of the region by providing water for irrigation for the production of fodder plants during dry periods.

91-THE ROLE OF SYSTEMATIC REVIEWS IN EVIDENCE-BASED CONSERVATION: CHALLENGES AND DEVELOPMENTS

Neal Haddaway

MISTRA EviEM

Conservation practitioners and policy-makers must regularly make decisions on which actions are most appropriate. Decision-makers know these choices must be made on the best available evidence, and this evidence may include; local indigenous knowledge, personal experience, expert opinion, and scientific research. Scientific research, available through reports and published papers, is the most readily documented and critically appraisable form of evidence. However, decision-makers often cannot access all of the relevant published research on a topic. Furthermore, the volume of published research papers is increasing at a rate that makes full assessment of the evidence challenging. Evidence reviews, including systematic reviews (SR) and systematic maps (SM), are transparent, objective, and repeatable methods for reliably summarising extensive bodies of evidence on specific topics of concern to conservation stakeholders. Originally developed within the field of medicine, evidence reviews have now been successfully translated into environmental management and conservation. These methods aim to minimise bias that can significantly affect traditional forms of review, providing concise summaries for decision-makers on the state of the documented evidence. The Collaboration for Environmental Evidence (CEE) has been established to promote the use of SRs and SMs in conservation and guide those wishing to undertake these reviews. In the years since the CEE was formed evidence synthesis has progressed significantly and is now seen as an



industry standard, with methods for improving these reviews progressing rapidly. Several challenges still exist, however, that limit the uptake of evidence reviews. Despite this, key success stories in the production of evidence reviews in conservation are emerging that demonstrate how this knowledge brokering plays a vital role in bridging the gap between research and practice.

POSITIVE EFFECTS OF ECOLOGICAL RESTORATION ON A RARE AND THREATENED GROUP OF INSECTS: THE FLAT BUGS (ARADIDAE).

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Highly efficient forest management carried out from mid-20th century and onwards has decreased the state of biodiversity in many boreal forest landscapes. As dead wood, historically created by natural disturbances such as forest fire and small scale gap dynamics, is disappearing from the landscapes, saproxylic insects experience declining populations. One such group are the rarely studied flat bugs of the *Aradus* genus. Approximately one third of the 23 flat bug species present in Fennoscandia are red-listed in either Finland and/or Sweden. In response to declining biodiversity, efforts to improve habitat quality for disturbance dependent species such as flat bugs have to be intensified. Although forest restoration practices mimicking natural disturbances have been conducted, their impacts on these rare taxa have been poorly evaluated so far. This study aims to evaluate if such restoration actions are appropriate in improving habitat conditions for flat bugs. By conducting two restoration experiments with prescribed burning of standing forests (Finland and Sweden), artificial gap creation (Sweden) and untreated controls (Finland and Sweden) we addressed this question. Flat bug abundances and species richness increased in both Finnish and Swedish forest stands that were exposed to prescribed burns. Our study also suggests that more flat bug species than previously believed can be regarded as fire favoured. *Aradus betulae* and *A. betulinus* respond with higher abundances in burned stands compared to artificial gap cuttings and untreated controls. In order to maintain viable flat bug populations we recommend prescribed burning as an important tool in boreal forest management.

DEGRADATION IN MATRIX IS ASSOCIATED WITH BIOTIC HOMOGENIZATION IN PROTECTED AREAS

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University of Jyväskylä

Merja ELO, University of Jyväskylä ; Eric LETORTOREC, University of Jyväskylä ; Risto TORNBORG, University of Oulu ; Mikko MÖNKKÖNEN, University of Jyväskylä

The main goal of protected areas is to maintain species diversity and the integrity of biological assemblages. For the integrity, functional and phylogenetic diversities are at least as important as taxonomic diversity. Functional diversity refers to the functioning of ecosystems, which has a direct effect on ecosystem services on which human welfare strongly relies. Phylogenetic diversity consists of evolutionary lineages, the maintenance of which ensures that future evolutionary potential is safeguarded. The process where taxonomic diversity is maintained but parts of functions and evolutionary history are lost is called biotic homogenization. Human population growth and pressures to intensify land use in the surrounding matrix create a challenge for biodiversity conservation based on protected areas. Earlier studies have mainly focused on taxonomic diversity and characteristics within the protected areas. However, functional and especially phylogenetic homogenization are less studied phenomena, especially with respect to matrix effects on protected areas. We studied whether intensity in land use in the surrounding matrix has an effect on bird community assemblages in protected boreal forest areas. We used line-transect count data from 91 forest reserves in Northern Finland collected between 1980's and 2002, and land-use data from buffer zones surrounding the reserves. We studied if the intensity of forest management has a consistent effect on taxonomic, functional and phylogenetic diversities. We found that forest management intensity in the surrounding matrix may have strong effects on the diversity of bird assemblages in protected areas. This indicates that boreal forest reserves are not able to maintain integrity if embedded in severely degraded matrix. We also point out the importance to focus on several different aspects of biodiversity when studying biotic homogenization.

#208: EXTREME CITIZEN SCIENCE: SOCIO-POLITICAL IMPACT OF CITIZEN SCIENCE

Muki Haklay

UCL

Jerome LEWIS, UCL

UCL's extreme citizen science group is dedicated to creating the tools, methodologies and techniques that will allow the creation of situated, bottom-up practice that takes into account local needs, practices and culture and works with broad networks of people to design and build new devices and knowledge creation processes that can transform the world. In other words, we are aiming to facilitate a process that will allow any community, regardless of literacy, to initiate, run and use the results of citizen science activities. Current Citizen Science practice assumes that educated citizens can participate



in scientific data collection, but not in its analysis or in formulating research questions. However, the greatest impact of science can be gained when participants use scientific tools to improve their environment locally and share the knowledge globally. Thus, 'extreme' in this case refers both to the extent of the scientific engagement and to formerly excluded environments in which it can be used. The talk will explore the extent in which such practice is transformative to both society and scientific practice.

HABITAT SELECTION OF THE GREAT BASIN SPADEFOOT (*SPEA INTERMONTANA*) ON THE TERRESTRIAL LANDSCAPE

Jo-Anne Hales

Thompson Rivers University

Karl LARSEN, Thompson Rivers University

Understanding habitat selection and how animals respond to abrupt change (i.e. habitat loss) is crucial in the creation and implementation of conservation plans for species at risk. The Great Basin Spadefoot (*Spea intermontana*) is a burrowing at-risk anuran in western Canada, where outside of a short breeding season, it occupies hot arid grasslands. Radio-telemetry has revealed that during the summer adult spadefoots travel through the grasslands, using a 'network' of daytime retreat sites. Individual animals often return to specific retreat sites, travelling up to 400 m between various sites before returning to their original site. We investigated the properties of these retreat sites to determine if specific characteristics make them favourable to the animals. A comparison of soil moisture at the retreat sites to that at neighbouring (5 m distance) random sites revealed no significant difference (correlation $r = 0.6882$). Vegetation percent cover comparisons also show little variation between used and available sites. These analyses suggest that, at least at the fine scale, adult spadefoots are not basing their selection of these retreat sites on these parameters. We also investigated habitat preferences of recently-metamorphosed spadefoots that are at a presumably much-higher risk of desiccation as they leave their aquatic environment. The small size of these animals precludes telemetry, so we conducted simple habitat selection trials within artificial enclosures. After 36 hours, 79% of metamorphs were located in moist bare habitat rather than dry bare, dry cover or moist bare habitats. Our work suggests that favourable habitat attributes for metamorphic spadefoots are quite different than that of adults, requiring a more complex approach to habitat management for this species. Specific management plans for each life-stage may be vital to the conservation of spadefoot populations on this landscape.

SYMPOSIUM 90: RESOURCE SHRINKAGE AND EXTINCTION DEBT: SOME THEORETICAL CONSIDERATIONS

John Maxwell Halley

University of Ioannina

Gabor LOVEI, Aarhus University, Flakkebjerg Research Centre

If an ecological community suffers isolation or loss of area, it may find itself with a large extinction debt. This is typically associated with oceanic islands or fragments of forest. But it may also happen in situations where an ecological community is dependent on a common resource that suffers shrinkage. Typically, this process will occur in a patchy fashion, so that areas that were once prime habitat become dead zones, leaving behind a fragmented ensemble of resources. Typically a community will reestablish equilibrium at a lower level of biodiversity, a process which proceeds according to a relaxation time. It may be possible to reverse the habitat losses before extinctions occur so that irreversible damage to the community is forestalled. However, there is a short time horizon for such interventions. With the use of a simple extinction model for the community, we show how this is likely to happen in a case where land usage changes over a widespread area creating an archipelago of habitat islands separated by inhospitable landscape.

MODELING POPULATIONS VERSUS SPECIES UNDER CLIMATE CHANGE: IMPLICATIONS FOR CONSERVATION DECISIONS

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The basic approach in ecological studies is to treat a species as a single entity although populations may occupy different environments and vary in their environmental tolerances. Also in species distribution modeling (SDM), a species' future distribution is predicted by considering the full range of current occupancy. Not taking population level differences into account, however, could lead to erroneous management decisions, in case the populations are locally adapted. Often, nevertheless, we do not know the degree to which populations are locally adapted. In lack of experimental evidence, we need to evaluate niche differentiation within a species' range in



order to make appropriate conservation decisions. We explored the effects of climatic niche differentiation on SDM using two species that have spatially separated populations and thus may be locally adapted: the Karner blue butterfly (*Lycaeides melissa samuelis*;) and the Siberian primrose (*Primula nutans* ssp. *finmarchica*). PCA and niche tests indicated that the two main populations of both species occupy distinct climatic environments. We constructed Maxent models based on occurrences of 1) the whole species and 2) distinct populations of the species, and projected them under climate change. Our results indicate different predicted suitable areas for the populations. We explore the magnitude of difference that the two approaches give and discuss the conservation implications and repercussions of making a type I or type II error in this context, i.e. assuming local adaptation when there is none or assuming no local adaptation when the populations actually are differentiated. We also present a workflow for dealing with similar situations, where disjunct populations may be locally adapted but experimental studies are lacking.

COMING TO TERMS WITH ASSISTED MIGRATION

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Intentional moving of species threatened by climate change is actively being discussed as a conservation approach. The debate, empirical studies, and policy development, however, are impeded by an inconsistent articulation of the idea. The discrepancy is demonstrated by the varying use of terms, such as assisted migration, assisted colonisation, or managed relocation, and their multiple definitions. When discussing and studying any topic, it is important that everybody involved is consistent with and aware of what terms and definitions refer to a specific idea. Since this conservation approach is novel, and may for instance lead to legislative changes, it is important to aim for terminological consistency. The objective of this study is to analyse the suitability of terms and definitions used when discussing the moving of organisms as a response to climate change. An extensive literature search and review of the material (868 scientific publications) was conducted for finding hitherto used terms (N = 40) and definitions (N = 75), and these were analysed for their suitability. Based on the findings, we argued that an appropriate term for a conservation approach relating to aiding the movement of organisms harmed by climate change is assisted migration defined as

follows: Assisted migration means safeguarding biological diversity through the translocation of representatives of a species or population harmed by climate change to an area outside the indigenous range of that unit where it would be predicted to move as climate changes, were it not for anthropogenic dispersal barriers or lack of time. We discuss the differences between assisted migration and other conservation translocations. A wide adoption of the clear and distinctive term and definition provided would allow more focused research on the topic and enable consistent implementation as practitioners could have the same understanding of the concept.

WHY DO RETENTION TREES DIE? FACTORS DRIVING TREE MORTALITY IN RETAINED FOREST FRAGMENTS

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Green tree retention, the retention of living trees on harvested forest stands, is, due to law and certification requirements, nowadays often applied in forests harvested by modern forestry. Tree retention contributes to a continuity of live trees in the new generation of a forest, and increases the amount of large-diameter dead wood. Since this management practice started relatively recently, few studies have made an assessment of what happens to retention trees over a longer time period. We assess the survival of the trees left on clearcuts by analyzing mortality rates in relation with tree and clearcut characteristics after a time period of between one and 20 years after clearcutting. The mortality rates were 12 % for pine, 25 % for spruce and 16 % for birch. Mortality rates were only successively increasing for the first four years after felling. There was no significant increase in mortality over 20 years. Mortality rates thus did not accumulate on the long run but most of the mortality took place within the first four years after clear-felling. Higher tree volumes in retention groups, less exposure to wind, a former position at the forest edge compared to the stand interior reduced tree mortality. Wetter soils reduced mortality for pine and spruce but increased mortality of birch. Surprisingly, the time since clear-felling was not significantly increasing mortality and generally clearcuts had surprisingly low mortality rates of no more than 19% on average (10-20 year old). The practice of retaining trees on clearcuts successfully retains trees and thus biodiversity on clearcuts and leads to mortality rates that are increased compared to closed forests but still moderate on average. The benefits of tree retention are thus long-reaching. A focus on retaining high tree volumes in less wind exposed positions and preferably retaining trees on forest edges that are used to wind exposure may further increase longevity of retention tree forest patches.



HUNGARIAN MEADOW VIPER (*VIPERA URSINII* RAKOSIENSIS) CONSERVATION PROJECT

Bálint Halpern

MME BirdLife Hungary

Tamás PÉCHY, MME BirdLife Hungary ; Endre SÓS, Budapest Zoo ; Chris WALZER, Wildlife Ecology Institute

In order to stop the decline of Hungarian meadow viper (*Vipera ursinii rakosiensis*), we started a complex conservation program in 2004, supported by EU LIFE-Nature fund. Hungarian Meadow Viper Conservation Centre was started with 16 adult individuals, collected from 6 different populations. By 2014 number of vipers bred reached nearly 2000. First reintroduction took place in March 2010, releasing 30 snakes into a reconstructed habitat in Kiskunság National Park. Since that altogether 300 vipers were reintroduced to 5 different locations, including sites in Fertő-Hanság National Park. In order to develop a remote tracking method, pre-programmed radio-tags with a detection range of 100-150m were implanted surgically into the abdomen of vipers. These tags also operate as temperature loggers, recording data every five minutes for a year-long operation period. After successful testing during 2010 and 2011, we released 6 tagged individuals in July 2012. All 6 snakes survived until November, even though wild boars dig large part of the site in September. We detected regular movements within the area, with tendencies to higher parts later in the season. On sunny spells of mid-November and late December, after emerging for basking, 3 and later 2 snakes disappeared, very likely due to predation by raptors like Common Buzzards or Hen Harriers. One tag was found on the site and logged temperature data proved our theory. In parallel surface and ground environmental temperatures were recorded, therefore we can figure out daily activities of the tracked individuals, beside general assumptions about their average optimal body temperatures.

SYMPOSIUM 108: INTEGRATING OCEAN OBSERVING DATA TO MODEL MARINE ANIMAL DISTRIBUTIONS AND DENSITIES: CONTEMPORANEOUS VERSUS CLIMATOLOGICAL CONSIDERATIONS

Patrick Halpin

Duke University

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Forecasting the distribution and density of marine animals requires accurate characterization of dynamic oceanographic habitats. The characterization of these habitats often relies on development of environmental covariates from remotely sensed earth observing data. The development of environmental covariates raises many considerations concerning the appropriate oceanographic indices to

be developed and the spatial and temporal scales of assessment. These considerations include the appropriate use of contemporaneous versus climatological covariates in the development of explanatory models. This presentation will focus on the choices and implications considered in the development of environmental covariates for the prediction of cetacean species along the US Atlantic coast. Many highly migratory marine animals in this region are vulnerable to human interactions such as ship strikes, fishing gear entanglement, and ocean noise habitat disruption. Cetaceans (whales and dolphins) are protected by the Marine Mammal Protection Act (MMPA) as well as the Endangered Species Act (ESA). These legal protections require federal agencies to estimate the potential impacts of activities on cetacean populations. These assessments require density estimates of the potential number of cetaceans expected to be found in different regions and different time periods. We have been working with federal agency partners to develop forecasting models and decision support tools to assist in the understanding and management of these migratory species. We combine times series of remotely sensed earth observing data with ship and aircraft observer data to create temporally dynamic forecasting models of species distributions and densities. In this presentation we depict the process from data collection, data aggregation, oceanographic feature development to forecast modeling.

POTENTIAL BIODIVERSITY IMPACTS OF FOREST BIOFUEL HARVEST: LICHEN ASSEMBLAGES ON STUMPS AND SLASH OF SCOTS PINE

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Harvest of stumps and logging residues for energy production has increased rapidly due to a growing demand for renewable energy sources. This biofuel harvest may have negative impacts on forest species, especially those associated with dead wood. We assessed the potential impact of biofuel harvest on epiphytic lichens by studying the lichen assemblages on stumps and downed fine woody debris (FWD) of Scots pine in clear-cut, mature managed and old-growth forest stands in eastern Finland. We also examined the impact of tree retention level (10m³/ha, 50 m³/ha or clear-cut) and prescribed burning on these assemblages. A total of 102 lichen species, 13 of which red-listed, were observed; 95 on stumps and 69 on FWD. Composition of the species assemblages differed between stumps and FWD, and between stumps of different age. Tree retention (in comparison to clear-cut sites) and prescribed burning resulted in a slightly higher species richness on cut stumps 12 years after harvest, but did not affect the assemblages on FWD or older stumps. We conclude



that stumps and FWD of Scots pine can host high numbers of lichen species, including red-listed ones. Most of the observed species were generalists, found to occur on various substrates, and thus not likely to be significantly affected by biofuel harvest. However, stumps and FWD hosted also several dead wood-dependent lichen species: for these species, intensive biofuel harvest is potentially harmful, though the severity of this impact likely depends on the landscape-level availability of other woody substrates. The impact of stump harvest is likely to be more pronounced than that of FWD harvest, as stumps were found to host more diverse lichen communities. To mitigate this negative impact, we suggest leaving part of the cut sites completely outside biofuel harvest. In addition, applying tree retention on these sites could further increase the lichen species richness.

BROWN BEARS IN THE GHIZER DISTRICT, PAKISTAN: STATUS AND CONFLICTS

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The Ghizer district in northern Pakistan falls in the Hindu Kush range and its landscape represents a good habitat for brown bears. It also forms a connection of brown bear populations in Pakistan with that in Central Asia. In the present study, multiple methods were used to gather the aforementioned information. Questionnaires surveys were conducted in the entire district by dividing area into seven blocks on the basis of watersheds. Public sighting reports were divergent across the district, and higher sightings were reported in the western part of the district. We focused two western valleys (Phandar and Qurumber) for further investigation. The sign based occupancy survey was conducted in the Phandar valley, which yielded a low estimate of occupancy ($0.0916 \pm 0.0537SE$), despite the highest sighting reports in this valley. However a direct sighting of a brown bear female with a cub strengthened the evidences of presence and reliability of sightings reports from the area. Camera trapping was conducted in the Qurumber National Park (QNP) (the north-western valley of the district) and its adjacent Broghil National Park (BNP). The brown bear was photo-captured at two camera stations in BNP. Other threatened carnivores photo-captured included snow leopard,

grey wolf, and the Pallas's cat. The human-carnivore conflict surveys indicated brown bears to be the least dangerous to livestock and other public property in a predator community comprising of snow leopard, grey wolf, and the Himalayan lynx. Ironically, local communities had lower acceptance for bears as compared the snow leopard, which was otherwise more dangerous to livestock. This probably explains rarity of the species in the area. All of the three methods employed are in agreement and suggest that the Ghizer district has a small and scattered population of brown bears, which is experiencing multiple threats including competition with livestock in alpine pastures, and illegal shooting.

ACCOUNTING FOR MARINE ECOSYSTEM SERVICES AND BENEFITS TO PEOPLE TO IMPROVE CONSERVATION PLANNING: IT'S NOT JUST ABOUT FISHING

Mélanie A. Hamel

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Incorporating meaningful social and economic information into conservation planning is challenging but critical to minimize impacts of conservation actions on livelihoods, thereby maximizing compliance. The social impacts of reserves are often reduced to the socioeconomic impacts only, typically included in planning through opportunity costs. In many places where people are strongly connected to marine ecosystems, opportunity costs are often only measured for fishers. However, the services and benefits people gain from their marine environment go beyond just the food and income from fishing. People access and value marine ecosystems for benefits that include recreation, aesthetic enjoyment, spiritual connections, medicine, and culture. Therefore, designing reserves with approaches which aim to minimize lost fishing opportunities might not address impacts on other uses of the marine environment. We explore how conservation planning can be optimized and informed with data on how people value ecosystem services and benefits they gain from accessing their marine environment. We interviewed heads of households in Riwo, a coastal community of the Madang Lagoon, Papua New Guinea. We first developed a method to identify and map places of value (including fishing) to households, actively engaging with the community. Then, we proposed a novel way to incorporate these values into spatial prioritization exercises. We found that different places in the Madang Lagoon are valued for different reasons, and that designing reserves based only on opportunity costs to fishing will likely have incidental impacts on the other ways people benefit from their marine environment. Our results suggest that we need to move beyond solely accounting for socioeconomic costs



of conservation actions and to develop more comprehensive approaches to involving communities and estimating conservation costs for small-scale community conservation.

EXPERIMENTAL STUDY OF THE NEGATIVE EFFECT OF THE INVASIVE EXOTIC SHRUB FRANGULA ALNUS ON THE GROWTH OF PLANTED UNDERSTORY TREE SEEDLINGS

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Glossy buckthorn (*Frangula alnus*) is an invasive exotic shrub that has become dominant in several Eastern North American ecosystems, and it appears to have a negative effect on the regeneration of native tree species. The objectives of this study are to (1) test if buckthorn has a negative effect on the survival and growth of understory tree seedlings in eastern Canada, and (2) to determine how this effect varies depending on the seedling species and on overhead canopy type. In May 2014, seedlings of 2 species, *Acer saccharum* and *Quercus rubra*, were planted in the understory of a 15 year-old hybrid poplar plantation (with 3 replicate blocks). Five different hybrid poplar clones were used for the canopy types. In fall 2013, herbicide was applied to half of each experimental plot, and in April 2014 all remaining buckthorn stems were cut for a complete removal effect. This experimental design reduces confounding factors to a minimum (ex. canopy composition and structure, age of seedlings), and many factors were controlled (ex. transplantation, deer exclusion). Also, many environmental factors were quantified (light availability, soil nutrients, poplar biomass, understory vegetation biomass, buckthorn density and biomass (with a predictive allometric relationship developed using basal diameter of harvested buckthorns) to measure their effects on tree seedlings, and their possible interactions with the effects of buckthorn. After one growing season, mean height and diameter increments of both species of seedlings were higher in herbicide plots than in control plots, where buckthorn was significantly more abundant (density and biomass) and light availability was significantly lower. A significant statistical difference in growth was found only for diameter increment. Tree seedlings will be measured again in fall 2015, after 2 growing seasons, and growth differences between treatments are expected to be higher and all statistically significant.

HOW TO CONSERVE TAXONOMIC COMPLEXITY: GENETIC AND ECOLOGICAL INTERACTIONS IN SORBUS

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Species based conservation relies on being able to delineate and identify species, and gather data on distributions and threats in order to develop management plans. Many plant taxa, particularly those of conservation concern, have complex taxonomy, often derived from hybridisations and associated with polyploidy and mixed mating systems; sexual and uniparental (apomictic). These groups present particular challenges for conservation and there is a need for greater understanding of these processes and the spatial scale over which they operate. The genus *Sorbus* is an example of such a taxonomically complex group. There are high levels of endemism within this genus and the southwest UK is a 'hot spot' for *Sorbus* diversity within Europe. Many species are of conservation concern with threats primarily from changing land management, browsing and invasive non-native species. To investigate evolutionary relationships and interactions on a spatial scale we studied a group of seven apomictic and two sexual *Sorbus* species, found in the south west UK, with the aim of elucidating some of the important factors that may affect short term survival and long term evolutionary potential. Using nDNA microsatellite markers to determine the evolutionary relationships of this group we found complex relationships between clusters that represent taxonomic entities. Investigations of pollen flow between apomictic species of different ploidy levels showed a pollen limited system with reliance on interspecies pollination to maintain seed production. This suggests that we should consider these groups of species as a network of partially interacting units. Conservation action should seek to enhance the opportunities for future speciation and diversification across the core range of this group with particular priority given to areas of high diversity where there is evidence of continuing evolutionary activity.

185 - CONSERVATION DECISION-MAKING ON CHRISTMAS ISLAND: MANAGING ECOSYSTEMS USING LIMITED INFORMATION

Yi Han

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Invasive cats and rats are perceived to have a major impact on native species on Christmas Island. There is an attempt to control these pests to protect species of concern. However, the presence of multiple invasive species and their interactions with native species can complicate the management issue. Without sufficient planning, managements may cause



unforeseen and unwanted effects. The problem is exacerbated by a lack of knowledge about ecosystem structure and species interaction dynamics. We use a qualitative modelling approach to make predictions of system wide impacts of alternative management strategies for cats and rats, and consequently compare these strategies. The outcomes of our research shows that cat management will benefit most of the species we consider; however the potential of rat population increase is likely to present predation pressure on numerous species of concern, hampering the population persistence or recovery. Cat eradication with rat control efforts are more likely to benefit the native species of Christmas Island, and reduce the potential for perverse outcomes for native bird of prey, some of which only occur on Christmas Island. The model also shows unexpected outcomes for some species for which positive responses were anticipated. Qualitative modelling approaches, which focus on model structure and omit problem specific quantitative details, can be very useful when little information is available to model an ecological system – like we see on Christmas Island. It provides a way of identifying potential risks and benefits of management plans, allowing more informed decision-making in the face of limited knowledge.

LINKING ECOLOGICAL AND SOCIAL DATA TO INFORM BIODIVERSITY CONSERVATION IN FARMING LANDSCAPES

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Farming landscapes present an arena where human activities and ecological processes are tightly interlinked. Especially landscapes shaped by low intensity farming often support high biodiversity while also providing goods and services to local people. However, the dual process of land use intensification and abandonment is threatening species and ecosystems in many low-intensity farming systems. To facilitate effective biodiversity conservation in such systems a holistic understanding of local characteristics and social-ecological dynamics is critically important. Here, we report on an original, regional scale dataset on richness patterns, land use, topography and socio-demographic variables in a 7440 km² study area in Southern Transylvania (Romania). We surveyed the distribution of breeding birds, butterflies, and vascular plants in 150 sites distributed across arable land, pasture and forest around 30 randomly selected villages. We modelled species richness using generalized linear mixed effect models and predicted it to the whole study area. Richness then was aggregated to the village level and related to land use, topographic and socio-demographic characteristics

of the villages using multivariate methods. Based on this, we developed a typology of villages, and for each “village type” assessed the threats and opportunities for biodiversity conservation. Our findings highlight the importance of pursuing conservation strategies that consider local social and ecological characteristics. Our approach can be applied to other systems, and thus could help inform biodiversity conservation in farming landscapes around the world.

CAPTIVE BREEDING AND REINTRODUCTION OF AMPHIBIANS - HOW FAR HAVE WE COME?

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Although captive breeding and reintroduction programmes are still very much focussed on mammals and birds, the Amphibian Conservation Action Plan of 2007 stimulated renewed interest in ex situ approaches to conservation for amphibians. Here we review progress that has been made since this time. The number of conservation breeding programmes for amphibians has increased by 30% over the past seven years. Geographically, the largest increase in programmes was in South America, where 40% of projects are now carried out. Likewise, there was a combined increase of 12% for captive breeding and reintroduction programmes in the Caribbean and Central America. Although habitat destruction remains the main threat to species in conservation breeding programmes, the relative number of species threatened by disease that are now in captive programmes has increased since 2007. Critically Endangered amphibians in captive breeding and reintroduction programmes have increased from 18% pre-2007 to 38% of species in 2013. These results indicate that as amphibians become increasingly threatened captive breeding as a conservation tool has become more prevalent. Although amphibians possess many characteristics that make them favourable candidates for captive breeding and reintroduction programmes, many of the threats that they face are difficult to mitigate or neutralise. This poses significant challenges for many future reintroductions.

HABITAT HETEROGENEITY AND SPECIES RICHNESS UNDER THREE CONTRASTING AGRI-ENVIRONMENT SCHEMES

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Agricultural intensification tends to reduce the availability of foraging and nesting resources for wildlife, and reduce habitat heterogeneity. Agri-environment schemes (AES) are currently our main policy mechanism in Europe for limiting



the negative impacts of agriculture on biodiversity. Restoring habitat heterogeneity has been suggested as a conservation priority in the farmed landscape, however the mechanism by which this should be achieved, and the scale that is most appropriate for different taxonomic groups is not clear. We compare the effectiveness of three AES in England, for creating habitat heterogeneity at different spatial scales: (1) Entry Level Stewardship is the baseline scheme, which all farms in the study are in, covering 67% of England's agricultural area but showing limited impact so far, (2) Organic farming is a holistic scheme with restrictions on synthetic inputs, which tends to support higher plant diversity and habitat diversity than non-organic farms, (3) Conservation Grade is a novel market-based AES in which sown margins for insects and birds are created alongside intensively managed crops. We characterise how habitat heterogeneity varies between the three AES at the patch, farm, local-landscape and wider-landscape scales. We evaluate how strongly habitat heterogeneity predicts the species richness of bees, butterflies and birds, at different scales. Initial results show the highest patch diversity occurs on organic farms, which is positively correlated with species richness of butterflies. The findings will help inform at what spatial scale AES should be targeted, and how the patterns of heterogeneity created by different approaches to AES relate to species richness of different taxonomic groups.

SURVIVAL AND MOVEMENT OF TRANSLOCATED HOUBARA BUSTARDS IN A MIXED CONSERVATION AREA

Loïc Hardouin

UMR 7204 MNHN-CNRS-UPMC

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For endangered species that are hunted, the establishment of mixed conservation areas including both hunting zones and sanctuaries to complement translocation actions (i.e., reinforcement) can improve both hunting yields and population sustainability. However, the effects of this type of management on the demography of the exploited species are not well understood. We used multi-event capture-recapture modelling in a population of captive-bred houbara bustards (*Chlamydotis undulata*) translocated into a mixed conservation area in Morocco. The specific management practice of our system (hunting regime varying in time and space) led to a quasi-experimental situation that allowed the differentiation of "natural" from "hunting-induced" mortality and movement between areas. The analysis uncovered strong asymmetries in both movement and survival that were not only due to direct hunting effects. First, movement probabilities were higher from the sanctuary to the hunting areas than vice versa,

even in years without hunting. Second, in addition to a direct effect of hunting on mortality in hunting areas, our results uncovered permanent differences in both areas (even outside the hunting period). Overall, our results were consistent with predictions under a source-sink dynamic model but illustrated that mixed conservation areas should not merely be treated as homogenous systems with spatially heterogeneous hunting pressure but rather as fully heterogeneous systems. The patterns observed may be related to (1) the choice and design of hunting and sanctuary areas by managers, which might not be neutral with respect to habitat quality, or (2) to indirect consequences of hunting via an effect on local growth rate and density.

COMPLEXITY AND UNCERTAINTY IN THE APPLICATION OF PRIVATE LAND CONSERVATION REVOLVING FUNDS

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Protecting biodiversity on private land is a growing part of worldwide conservation efforts. Amongst the most prominent mechanisms used for private land conservation are in-perpetuity agreements such as conservation covenants and easements. Conservation organisations use a number of approaches to establish these agreements, including "revolving funds". In this approach private land with conservation value is purchased, protected with a permanent conservation agreement and then on-sold to conservation-minded owners. The proceeds from the sale including any profit are then reinvested to purchase and protect additional properties, thereby "revolving" the funds to continually add to the extent of protected private land. However, decisions about which properties to buy are inherently complex, involving tradeoffs between multiple and potentially competing financial, social and conservation objectives. These decisions often need to be made quickly, opportunistically and also under high uncertainty in order to purchase important properties as they become available. The dynamic, sequential nature of this approach also means the outcome of each property bought and sold has consequences for subsequent purchases, thereby affecting conservation success. Using semi-structured interviews, this research seeks to understand how conservation organisations in Australia currently apply their revolving funds and the main factors that influence their decisions. We find that decision makers are reasonably confident in their ability to identify properties of conservation value, but are heavily constrained by the need to balance this with the financial sustainability of their funds, with uncertainty over the ability to recoup costs within an acceptable timeframe posing a considerable challenge. Given these high levels of uncertainty,



we outline how a more structured approach to property purchase decisions will improve both revolving fund efficiency and conservation outcomes.

THERMAL LANDSCAPES AND THE MIGRATION OF RATTLESNAKES IN CANADA

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Understanding habitat selection on multiple scales is fundamental in the conservation and management of wildlife species. Selection of habitat based on thermal attributes may be of particular importance for ectothermic species, particularly in colder climates. In western Canada, rattlesnakes (*Crotalus oreganus*) reach their northern limits. While commonly associated with low-elevation, hot grasslands, recent work shows that some populations of these animals use higher elevation forests. We investigated the reason(s) for this phenomenon by monitoring the migratory movements of the snakes away from 10 different den sites, and comparing it to thermal-landscape GIS maps generated for different periods of the active season. We found that snakes utilizing the higher-elevation forests not only moved relatively further, but were associated with landscapes receiving on average higher amounts of solar insolation compared to other available areas. However, this correlation only appeared during the latter stages of migration, when the animals were reaching their destination. Interestingly, snakes that did not move towards the higher-elevation forests tended to come from dens located in less rugged, less variable landscapes where heat may not be a limiting resource. Prey availability and/or outbreeding may also be at least partially responsible for these patterns, but at this time we have limited data to test this. Regardless, snakes utilizing the higher-elevation forests had better body condition, indicating a definite advantage to this strategy. Insight into these behavioural differences between neighbouring rattlesnake populations will allow managers to tailor management strategies to specific dens. Not only that, these local and landscape scale patterns have obvious repercussions for snakes using forest habitats in the event of shifting ecosystem boundaries and thermal regimes under various climate change scenarios.

134 EXPLORING TRADE-OFFS AMONG SPATIAL PLANNING SCENARIOS: A MULTIVARIATE APPROACH

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Conservation decisions are often required to be made under uncertainty. However, scenario planning (constructing and comparing multiple scenarios) can be useful to guide decision-making. Even though systematic conservation planning can generate protected-area networks for multiple and complex reserve-design scenarios, planners rarely compare different reserve networks explicitly, or quantify trade-offs among scenarios. We demonstrate the use of multivariate statistics traditionally applied in community ecology to compare reserves designed under different scenarios, using conservation planning for beaches in South Africa as an example. Twelve reserve-design scenarios were run in Marxan in a hierarchical experimental design with three levels: including/excluding the probability of site destruction; two different cost types; and three different configurations of existing terrestrial and marine reserves. Through our case study we show that multivariate statistics can be useful tools in the conservation planning context. They revealed that the trade-off associated with including the probability of site destruction during coastal reserve design depended on the cost type: if the cost is related to the site-destruction probability, then reserves are significantly larger; if not, then reserves are significantly more costly. In both cases, the configuration of existing reserves locked a priori into the solutions was more important and resulted in significantly larger and more costly reserves. Ultimately, we demonstrate a novel application of multivariate statistical tools to robustly quantify potential trade-offs among diverse sets of reserve-design scenarios. These statistics can be applied: to support negotiations with stakeholders and decision makers regarding reserve configurations in the face of uncertainty; in reserve-design sensitivity analyses; and in priority setting for future research and data collection to improve conservation plans.

SPATIAL AND TEMPORAL DYNAMICS OF THE CONSERVATION ESTATE

Nyeema Harris

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Our primary strategy in conservation across all biomes remains the formal protection of land and ocean. And yet, this global conservation estate is not a static feature but is in a constant state of flux with protected areas being established, abolished and changed in spatial extent. Here, we use 14 annual versions of the World Database of Protected Areas to understand how



the global conservation portfolio has changed - through establishment, degazettement, expansion, or downsizing - over space and time. From having just over 40,000 records in 1998 the database has evolved dramatically to contain over 217,000 records by the end of 2014. This increase reflects a number of factors; from improved technical capacity in countries to digitise and manage their national data sets and improved delivery of this data to the WDPA to responses to national, regional and global obligations (e.g., increase in the number of protected areas in Estonia prior to EU accession). The greatest increase in sites corresponded to IUCN management categories IV, V, and "Not reported", whereas Ia and Ib remain relatively static. Tracking these dynamics is necessary to evaluate progress towards conservation targets as well as understand opportunities for protected areas to contribute to other societal priorities such as global sustainable development goals.

PROTECTED AREAS VERSUS ENVIRONMENTAL CONDITIONS: A CASE STUDY FROM SMALL MAMMALS IN GHANA

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Luc Hoffmann Institute

Reuben GARSHONG, University of Ghana ; Morgan GRAY, University of California Berkeley

Distangling the synergistic effects of climate and land use requires intensive sampling over large spatial extents. Here, we investigate the influence of these perturbations on the spatial distribution and composition of animal communities. Specifically, we sampled small mammals within and outside three protected areas located in distinct ecoregions throughout Ghana, simultaneously incorporating gradients of land protection and environmental conditions. We captured 221 individuals across 23 species; most species were captured only within one ecoregion. Both capture rate and species richness were highest at sites located in a protected area. Additionally, community composition was more similar for sites sampled within the same ecoregion irrespective of corresponding land uses (i.e. protection). Our findings suggest that disrupting climates will have greater influence on small mammal community attributes than dynamics associated with land protection.

118-RESEARCH TO ACTION: ESTABLISHING WHO IS POACHING AND WHY TO IMPROVE CONSERVATION INTERVENTIONS AT BWINDI NATIONAL PARK, UGANDA

Mariel Harrison

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Goodall Institute ; E. J. MILNER-GULLAND, Imperial College London

Unauthorised resource use is a threat to biodiversity in protected areas. In the developing world, interventions aimed at reducing unauthorised resource use by tackling poverty have had limited success. To be effective, we need to better understand who is offending and why, so that we can target interventions at the right people for the right reasons. However, this is rarely achieved because of the challenge of investigating sensitive behaviour. Working with Uganda Poverty and Conservation Learning Group (U-PCLG), we used a mixed-methods approach including household surveys, indirect questioning and focus groups, to find out who was involved in unauthorised activity at Bwindi Impenetrable National Park, Uganda. We found that, overall, offenders tended to display characteristics of poorer and marginalised people, living in larger households very close to the Park boundary but far from markets. However it was not just poverty that drove unauthorised resource use, but also resentment towards the park authorities at the perceived inequity of revenue sharing, lack of employment for local people and lack of support over crop raiding. U-PCLG is using the research to advocate for improving both conservation policy and practice. So far successes include the Uganda Wildlife Authority increasing the communities' share of the \$600 mountain gorilla viewing fees from \$5 to \$10 per permit. U-PCLG members are also trialling community-based monitoring of revenue sharing aiming to benefit those suffering from crop raiding, and conducting further research into local employment opportunities. This experience suggests that researchers, advocates, policy makers and practitioners can achieve real change by working more closely together. This ensures that research is targeted towards addressing relevant questions, the answers to which can translate into rapid and real change in conservation policy at the local level, for both biodiversity and people.

CONTRIBUTION OF SNARE REMOVAL TO CHIMPANZEE CONSERVATION: THE KANYAWARA CASE

Jessica Hartel

Aarhus University

Emily OTALI, Kibale Chimpanzee Project ; Rachel ELLIS, Bates University ; Sonya KAHLENBERG, Gorilla Rehabilitation and Conservation Education Center ; Martin MULLER, University of New Mexico ; Peter KJAERGAARD, Aarhus University ; Richard WRANGHAM, Harvard University

Chimpanzees living in Kibale National Park (KNP) in western Uganda have been ranked by the IUCN as a high priority for conservation. At over 1400 individuals, it is the largest population in Uganda and one of the largest for the eastern subspecies (Plumptre et al. 2010). The chimpanzees'



home is also an immensely important forest habitat with significant scientific and conservation value because of its high biodiversity and its history of long-term research and successful conservation initiatives (Wrangham & Ross 2008). The growing neighboring human population presses hard against the park's boundary with poachers entering illegally to snare small ungulates for bushmeat. While not the intended targets, chimpanzees' hands and feet become entangled in wire snares. In response to the long-term negative effects snaring has on chimpanzees, the Kibale Chimpanzee Project started the Kibale Snare Removal Program (KSRP) in 1997. At any given time, an estimated 15,000 snares are set in KNP, resulting in a 3.7% risk of a chimpanzee being snared each year (Wrangham & Mugume 2000). To date, two individuals in the study population have died from snare wounds and historically around half have lasting snare injuries, including a young male who lost both of his feet. Data collected by KSRP has been analyzed in relation to the Kanyawara chimpanzees' snare injuries. The initiation of KSRP is associated with a significant increase in the length of time between observed chimpanzee snare injuries, indicating that the patrol efforts are offering meaningful protection to the chimpanzees. Snares are now more commonly found near the park boundary and outside of the Kanyawara chimpanzee home range. Human interventions to remove snares from injured chimpanzees resulted in fewer permanent injuries than when no intervention attempts were made. While snares can cause serious physical damage, in general they offer much lower known mortality risk relative to orphaning, disease, and aging.

151-LANDSCAPE-SCALE PROTECTION OF BIODIVERSITY AGAINST THE DEVASTATING PLANT PATHOGEN PHYTOPHTHORA CINNAMOMI

Renée-Claire Hartley

N/A

Christopher DUNNE, Ecosystem Biosecurity & Management ; William DUNSTAN, Murdoch University

Phytophthora cinnamomi is one of the most destructive plant pathogens worldwide. This invasive species leads to changes in species composition, plant community structure and ecosystem function. In south-western Australia invasion by the pathogen has resulted in a permanent loss of biodiversity in more than one million hectares of native plant communities. In recent years, novel approaches to preventing the spread of the pathogen, reducing the impact of the disease, and containment or eradication of infestations have been developed through applied research within conservation management projects. The work has focussed on biodiversity assets and specific sites identified as the highest priority for protection. Management strategies were tailored for characteristics of each disease centre and the hazard/threat profiles of individual priority protection areas. The projects

used a catchment-based strategy that aimed to reduce the risk associated with the four modes of pathogen spread; autonomous spread in surface and subsurface water; root-to-root transmission between plants; animal vectoring; and human vectoring. Management techniques have included fine-scale surveying of infestations, in-situ baiting, hydrological modelling, hydrological engineering, fencing to exclude animal vectors, installation of root barrier membranes, destruction of host plants, and soil fumigation. Over four years of monitoring at the containment and eradication sites within the Fitzgerald River National Park (an International Biosphere Reserve) and Cape Arid National Park has demonstrated that these techniques can be successful, or show promise of success with further work. These strategies and techniques have broad applicability in the management of *P. cinnamomi* and other soil-borne plant pathogens for a range of other scenarios and are currently being employed where most needed, to protect threatened species and ecological communities.

SYMPOSIUM 163: CAN ECOSYSTEM-BASED ADAPTATION ADDRESS THE ADAPTATION NEEDS OF SMALLHOLDER FARMERS? INSIGHTS FROM SMALLHOLDER COFFEE AND SUBSISTENCE FARMERS IN CENTRAL AMERICA

Celia Harvey

Conservation International

Francisco ALPIZAR, CATIE ; Jacques AVELINO, CIRAD [INSTITUTE] IICA-PROMECAFE ; Pavel BAUTISTA, CATIE ; Jose Mario CARDENAS, CATIE ; Camila DONATTI, Conservation International ; Ruth MARTÍNEZ-RODRÍGUEZ, Conservation International ; Bruno RAPIDEL, CIRAD ; Milagro SABORIO-RODRIGUEZ, University of Costa Rica ; Raffaella VIGNOLA, CATIE ; Bárbara VIGUERA, CATIE

In many regions, climate change is having significant adverse impacts on the agricultural production and livelihoods of smallholder farmers, with important consequences for global food security. Helping smallholder farmers adapt to climate change has therefore become a priority for many of donors and governments. Ecosystem-based Adaptation (EbA, defined as the use of ecosystem services and biodiversity as part of an overall adaptation strategy to help people adapt to the effects of climate change) is one approach that could help smallholder farmers, yet there is still limited knowledge on whether EbA can meet the adaptation needs of smallholder farmers. Here, we provide an overview of what EbA means in the context of smallholder agricultural production. Drawing on expert surveys, field work and household surveys of smallholder coffee and subsistence farmers in Central America, we provide examples of EbA strategies that are suitable for smallholder farmers, characterize how farmers are implementing these strategies, and provide insights into the



perceived advantages and drawbacks of different practices for reducing farmer vulnerability. Our study highlights that many agricultural practices that smallholder farmers already use (e.g., agroforestry systems, soil conservation practices, live fences) can be considered EbA, as they are based on the management of biodiversity and ecosystem services and help and enhance the resilience of agricultural systems. Most smallholder farmers are aware of the relative benefits of EbA practices, but also acknowledge important constraints, such as the cost of setting up the practices and maintenance, and limited financial, technical and political support. Scaling up the use of EbA through targeted government policies, extension services and farmer programs could not only help smallholder farmers adapt to climate change, but also ensure healthy, sustainable agroecosystems that sustain local livelihoods.

LESSONS LEARNED IN MARINE PROTECTED AREA ESTABLISHMENT? THE CASE OF KOH RONG ARCHIPELAGO MARINE PROTECTED AREA, CAMBODIA

Jesse Hastings

National University of Singapore

For the last several years, Cambodia has been creating a large-scale marine protected area around the Koh Rong archipelago. Called the Koh Rong Archipelago Marine Fisheries Management Area (KRA MFMA), it has already seen several markers of progress including gathering biophysical data for use in zoning decisions, conducting community consultations on draft zoning maps, conducting private sector consultations on zoning and management, and creating a provincial management committee and a technical working group. 2015 is expected to bring the official governmental proclamation of the MFMA. The Cambodian government has indicated a desire for and movement towards establishing a representative MFMA network across its coastal provinces. Like with the Koh Rong Archipelago MFMA, future MPAs in this network will use community fisheries – marine areas where communities are empowered to govern their own fisheries resources – as the foundation of the effort. This presentation presents research which analyzes the enabling conditions and barriers to the establishment of the KRA MFMA. Data for this research was gathered through participant observation, semi-structured interviews with key stakeholders from across sectors, and a collaborative workshop (to be) held in May 2015. Preliminary results indicate that a governmental willingness to move away from historic mindsets, involvement of communities and the private sector in zoning consultations, and creation of targeted governance mechanisms all played an enabling role in the KRA MFMA's establishment. Meanwhile, barriers to establishment included a lack of intergroup trust and difficulty in balancing different perspectives on shared governance. With Cambodia

on the cusp of an expansion in marine management, this presentation begins a productive dialogue with the wider conservation community with the aim of informing Cambodian marine conservation planning.

SYMPOSIUM 24: USING SOCIAL NETWORK ANALYSIS TO UNRAVEL COMPLEXITY IN AGRICULTURAL BIODIVERSITY GOVERNANCE

Jennifer Hauck

Helmholtz Centre for Environmental Research - UFZ

Jenny SCHMIDT, Helmholtz Centre for Environmental Research - UFZ

In 2013 the EU launched the new EU Green Infrastructure Strategy to make another attempt to stop and possibly reverse the loss of biodiversity until 2020 (EC 2013), by connecting habitats in the wider landscape. This means that conservation would go way beyond current conservation practices to include landscapes that are dominated by conventional agriculture, where biodiversity conservation plays a minor role at best. Thus, for exploring the options of the green infrastructure implementation we consider it important to identify, analyse and include a) actors at the implementation levels (regional and local levels), b) other affected policy sectors and c) the vertical and horizontal interplay, between actors at different levels and from different policy sectors. We used the Net-Map tool for our analysis as it combines measures of attributes of actors – especially concerning their perceived influence and their goals – with structural measures. Further it provides vast information on institutional backgrounds and governance settings in particular for agricultural policy. The investigation started with interviews with key informants on the regional level in the German Bundesland Saxony-Anhalt such as regional planners, representatives of relevant federal ministries and continued at the local level with farmers and other members of the community. Concerning network concepts, multiplexity is considered important to uncover the diverse relations that connect actors and centrality and associated different roles provide important insights in combination with the notion of agency. Last but not least, the concept of cognitive social structure allows conclusions about diverging network perspectives and resulting learning opportunities.

TOURISTS' PREFERENCE FOR SENSE OF PLACE AND LESS CHARISMATIC BIODIVERSITY: UNVEILING NEW OPPORTUNITIES FOR CONSERVATION

Anna Hausmann

University of KwaZulu-Natal



Rob SLOTOW, *University of KwaZulu-Natal*; Iain FRASER, *University of Kent*; Enrico DI MININ, *University of Helsinki*

The 'Big Five', as well as other charismatic megafauna, are considered key flagships for ecotourism and conservation marketing in sub-Saharan Africa. However, this approach has neglected the value of broader biodiversity as well as the ecosystem services of sense of place that protected areas provide to people. By using a choice experiment approach followed by latent class modelling, this study investigated tourists' perception of biodiversity and sense of place experiences alternative to charismatic megafauna in South African protected areas. Sense of place experiences were mostly defined by outdoor activities and wildlife viewing, which were attributes driving choices for holiday destination. Results showed heterogeneity in preferences for a range of less-charismatic biodiversity, including small-body mammals, reptiles, birds, amphibians, insects and vegetation, depending on individuals' experiences and socio-economic background. All tourists expressed feeling of attachment, identity and dependence to the natural environments of protected areas. By understanding the demand for sense of place and less charismatic biodiversity, the results can be used to promote new ecotourism market segments alternative to charismatic megafauna. This is particularly important to unveil new opportunities for protected areas, which have high biodiversity and sense of place values, but lack charismatic species.

CHALLENGES IN SEED SOURCING FOR RESTORATION IN A CHANGING WORLD

Kayri Havens

Chicago Botanic Garden

Shannon STILL, *Chicago Botanic Garden*; Andrea KRAMER, *Chicago Botanic Garden*; Pati VITT, *Chicago Botanic Garden*; Jeremie FANT, *Chicago Botanic Garden*

Proper sourcing of seed for ecological restoration has never been straightforward, and it is becoming even more challenging and complex as the climate changes. For decades, restoration practitioners have subscribed to the "local is best" tenet, even if the definition of "local" was often widely divergent between projects. However, given our increasing ability to characterize habitats, and rapid climate change, we can no longer assume that locally-sourced seeds are always the best or even an appropriate option. We discuss how plants are responding to changing climates through plasticity, adaptation, and migration and how this may influence seed sourcing decisions. We show using species distribution modeling how plant species ranges may change and find drastically different responses in the eastern and western United States. Continued research is needed to better understand appropriate current and future seed transfer zones.

Banking native seed now is necessary to maintain these future options.

EFFECTS OF HIGHWAY NOISE ON GLUCOCORTICOID LEVELS OF THE GULF COAST TOAD (*INCILIUS VALLICEPS*) IN CENTRAL TEXAS

Aaron Haynes

St. Edwards University

Marsha BARNES, *St. Edwards University*; Michael WASSERMAN, *St. Edwards University*

Soundscapes are defined by the variation and interaction of sounds within a landscape, whether natural or anthropogenic. For many species, competition within the soundscape may influence physiology, morphology, behavior, and fitness. In this study, we addressed the physiological and morphological effects of anthropogenic highway noise on the Gulf Coast toad (*Incilius valliceps*) of Wild Basin Wilderness Preserve in Central Texas. To do so, we quantified the soundscape by recording sound intensity (decibels) using SoundMeter (an iPhone app that meets the National Institute for Occupational Safety and Health standards) while walking four transects across the preserve three times and mapping the sound data using ArcGIS. We then captured and released toads, measured body size, and quantified urinary corticosterone levels, the major stress hormone of amphibians, in individuals across the preserve. Using spatial analysis and multiple regression, we examined relationships between urinary corticosterone levels, body size, sound intensity, distance to highway, and distance to nearest water source. We documented variation in sound intensity across the preserve and displayed this using a heat map generated by ArcGIS. Our results have important implications beyond our study species, including the endangered Houston Toad, as well as other species in the Wild Basin community, such as the white-tailed deer, endangered golden-cheeked warbler, coyote, and bobcat. By understanding the sources of and spatial and temporal variation in noise pollution through quantification of soundscape, conservation and environmental management practices, particularly in urban protected areas, will be more able to effectively reduce the negative effects of chronic stress on species of concern by alleviating anthropogenic noise pollution. This will ultimately help to restore or conserve the abundance and distribution of the species the parks are intended to protect.

BARRIERS TO DIVERSIFYING THE ENVIRONMENTAL WORKFORCE: STUDENT PERCEPTIONS OF ENVIRONMENTAL CAREERS

Nia Haynes

University of Florida



Susan JACOBSON, *University of Florida*

The environmental workforce does not reflect the racial diversity of the U.S. population. This study analyzes barriers and opportunities for increasing diversity in environmental careers. We present a meta-analysis of literature on underrepresentation of racial/ethnic minorities in environmental careers. We used constructs from the Social Cognitive Career Theory (SCCT) to identify barriers and supports influencing career choices (personal, contextual, self-efficacy, and outcome expectations) across 4 age groups. The number of cited barriers differed significantly among age groups. Personal influences included race/ethnicity, gender, age, and perceptions or predispositions toward nature. The latter was the most cited barrier for youth. Contextual influences included social, familial, structural, and experiential, and varied significantly between age groups. Exposure to nature was the most cited contextual barrier for all groups. Self-efficacy was emphasized in studies referencing youth, high school and college age groups, while outcome expectations were only discussed in literature related to the career group. Based on these findings, we conducted a survey of undergraduates from environmental and non-environmental majors using a comparative cross-sectional design. This study focuses on the college age group and uses a modified SCCT framework. Students were asked about their perceptions of environmental careers, career-related self-efficacy and outcome expectations, and the strength and influence of contextual factors on their interest in environmental careers. Results show that perceptions of environmental careers vary significantly by major and along racial/ethnic lines. Findings provide recommendations for improved recruitment for a diverse environmental workforce.

VOLES AS BIOINDICATORS.

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George PAPOV, *Yerevan State University* ; Astghik GHAZARYAN, *Yerevan State University*

The development of mining operation in Southern Armenia weakly equipped with cleaning plants, application of intensive agricultural methods, lack of systems for neutralization and etc. had a negative impact on the environment. Developing an understanding of how natural animal populations will respond to anthropogenically caused environmental changes has become one of the major challenges in conservation and evolutionary biology. The study of level of influence of pollution on voles will use for environmental monitoring. The main objectives of the work were study of distribution, ecological and morphological diversity of voles (Rodents) and their relationship with ecosystems. Voles were discovered in unpolluted territories unlike the polluted territories where no voles were found. This work was made possible by a research

grant from the Armenian National Science and Education Fund (ANSEF) based in New York, USA

LEVERAGING NON-TRADITIONAL FUNDING TO FILL CRITICAL INFORMATION GAPS IN ENDANGERED SPECIES RECOVERY: A CASE STUDY ON MEXICAN SPOTTED OWLS AND THE COLLABORATIVE FOREST RESTORATION PROGRAM

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Christina WAMPLER, *United States Forest Service*

Shifting priorities and unpredictable budgets often make prioritizing conservation issues or filling critical information gaps in species recovery difficult, particularly for large-scale efforts or for species which primarily fall under the umbrella of land management agencies. Biologists and conservationists are now forced to look beyond customary avenues for funding conservation work, and leverage funds which may be considered non-traditional. The Collaborative Forest Restoration Program (CFRP) is a United States Forest Service grant program intended to provide funding for forest restoration and for creation of forest-products jobs in New Mexico, USA. Here we describe the CFRP program and a project utilizing CFRP funds to implement forest treatments in habitat of the federally-listed Mexican spotted owl (MSO). This project adheres to the guidelines of the CFRP program, while also providing funding for scientifically sound post-treatment monitoring of owls and their prey base. Mexican spotted owls are a driver of management activities in the Southwest, as forest-treatment guidelines from the MSO Recovery Plan currently restrict efforts to restore forests known to be departed from historic fire regimes. Problematically, research funding to determine impacts of forest treatments on owls and their prey base has proven difficult to obtain. Leveraged funding through the CFRP program has provided for implementation of restoration activities and post-treatment study which, to date, has shown no immediate demographic or habitat use response in owls or their prey. This information should prove critical to scientists and managers as they attempt to balance between species recovery and landscape-scale forest restoration in designated Mexican spotted owl habitat in the Southwest United States.

CONSERVATION OF DEEPOP BEEL, THE LONE RAMSAR SITE OF ASSAM(INDIA) ,THROUGH COMMUNITY PARTICIPATION

Arup Kumar Hazarika

Cotton College



Apurba Kumar DAS, Centre for Environment, Education and Economic Development ; Prakash CHETRY, Centre for Environment, Education and Economic Development

Deepor Beel wetland which is the lone Ramsar site of Assam in India is facing danger from various angles. In this study, attempt has been made to identify the current conservation threats to biodiversity of this Ramsar site. Field observation shows that Deepor Beel wetland is facing both natural as well as anthropogenic threats. Rapid urbanization, illegal settlements, industries, invasive species are the major cause of this wetland decline. It has been found that massive decline occurred between the period 2012 to 2014. Community consultation and participation are critical in the management and conservation of wetlands. However, wetland management is still based largely on 'protection' and 'law enforcement approach' and there is considerable confusion over both the meanings and implications of terms such as decentralized management and participation. By working together with local communities around the wetland, this project aimed to restore severely degraded wetland. The study followed an approach of combined environmental rehabilitation and socio-economic improvements, placing greater emphasis on the process than on outputs, and facilitating initiatives of the community, rather than ideas of the project team. It focused its main activities on strengthening community organisation, building environmental awareness; wetland rehabilitation through hydrological restoration, support to alternative livelihood initiatives, and information dissemination. Thus, our study could find that giving wetland stakeholders the opportunity to present, analyse and share their experiences was also a means of empowering their social capital through strengthening indigenous knowledge networks and adaptive capacity. Lastly, to protect the wetland from habitat loss, fragmentation and alteration recommendations like, monitoring, continuous environmental awareness, proper enforcement of the policies, eradication of invasive species and weeds at regular interval are put forwarded.

151-ENVIRONMENTAL REFUGIA AND CONNECTIVITY SUSTAIN AMPHIBIAN METAPOPULATIONS AFFLICTED BY DISEASE

Geoffrey Heard

University of Melbourne

Chris THOMAS, Department of Biology, University of York ; Jenny HODGSON, Department of Evolution, Ecology and Behaviour, University of Liverpool ; Michael SCROGGIE, Arthur Rylah Institute for Environmental Research ; David RAMSEY, Arthur Rylah Institute for Environmental Research ; Nick CLEMANN, Arthur Rylah Institute for Environmental Research

Metapopulation persistence in fragmented landscapes depends on habitat patches that can support resilient local

populations, plus sufficient connectivity among patches. Yet epidemiological theory for metapopulations has largely overlooked the capacity of particular patches to act as refuges from disease, and has suggested that connectivity can undermine persistence. Here, we show that relatively warm and saline wetlands are refuges from chytridiomycosis for an endangered Australian frog, and act jointly with connectivity to sustain frog metapopulations. We coupled models of microclimate and infection probability to map chytrid prevalence, and demonstrate a strong relationship between expected chytrid prevalence and frog population extinction. Simulations confirm that frog metapopulations are likely to go extinct when they lose connectivity and lack wetlands in which chytrid prevalence is low. This study demonstrates that environmental variables can mediate host-pathogen interactions in fragmented landscapes, and provides evidence that connectivity only facilitates the persistence of species afflicted by facultative pathogens.

195 AN ASSESSMENT OF THE FEASIBILITY OF INSURANCE SCHEMES TO MITIGATE HUMAN-ELEPHANT CONFLICT IN SUMATRA, INDONESIA

Simon Hedges

Wildlife Conservation Society

Insurance schemes aimed at mitigating human-wildlife conflict are related to compensation schemes but by making payments (either in cash or kind, such as rice) contingent on payment of a premium (and potentially also contingent on guarding of crops and crop type) one of the most serious problems affecting compensation schemes is reduced, i.e. the potentially reduced incentive for self-defense by farmers. Nevertheless, work by the Wildlife Conservation Society and Greenomics in Sumatra, Indonesia, found that commercial insurance against crop depredations by elephants was impracticable because (1) the premiums proposed by insurance companies were high relative to the cost of the damage done by elephants and (2) the difficulties of meeting commercially acceptable risk management standards for reinsurance. However, insurance schemes arguably lend themselves to small-scale micro-finance or village-credit schemes that do not have the administrative burden typical of state- or province-level compensation schemes. The advantages and disadvantages of such locally run, micro-finance based schemes are reviewed in the context of other approaches to reducing human-wildlife conflict.



THREATENED FOSSORIAL SKINKS POSE AN INTERESTING CHALLENGE TO CONSERVATION STRATEGIES: THE CASE OF SCELOTES GRONOVII AND SCELOTES KASNERI (LACERTILIA: SCINCIDAE) FROM THE WESTERN CAPE COAST, SOUTH AFRICA.

Neil Heideman

University of the Free State

The evolutionary relationships among populations of two threatened Red Data Book fossorial skinks, *Scelotes gronovii* and *Scelotes kasneri*, were investigated along the Western Cape coast of South Africa. Four localities of *S. gronovii* and seven of *S. kasneri*, encompassing all of their documented distributions. Sequence data derived from three mtDNA (16S ribosomal RNA, cytochrome b and nicotinamide adenine dinucleotide dehydrogenase 1 unit) and two nuclear (dynein axonemal heavy chain 3 and the natural killer tumor recognition) gene regions were used to reconstruct the evolutionary relationships within each taxon, under the hypothesis that cryptic diversity is likely prevalent in both species. Phylogenetic results inferred from combined evidence analyses using Bayesian and parsimony methods, recovered two well-supported reciprocally monophyletic groups representing all localities north and south of the Berg River drainage, respectively. In both of these clades we found co-distributed populations classified as *S. gronovii* and *S. kasneri* as sister groups, suggesting that these two morphotypes have evolved multiple times. Within each of the two clades we further observe multiple sympatric lineages delineated by both mtDNA and nDNA. These results support the hypothesis that cryptic speciation has occurred within these fossorial skinks. It is suggested that the conservation status of these and possibly other low vagility fossorial taxa should be based on molecular studies because their morphology may hide significant evolutionary diversity. From a conservation perspective it is proposed that all these populations be protected considering their genetic distinctiveness.

68: RETENTION FORESTRY, PRESCRIBED BURNING AND SAPROXYLIC BEETLES IN EARLY FOREST SUCCESSIONS

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Petri MARTIKAINEN, University of Eastern Finland ; Jari Kouki, University of Eastern Finland

Intensive forest management and effective prevention of natural disturbances have caused fragmentation and loss of natural forest habitats. Prescribed burning and retention forestry are methods developed for bringing the biological legacies of harvesting closer to the legacies of natural

disturbances. However, the long-term effects of these methods on species assemblages and functional properties are still mainly elusive. We established a large scale empirical study in 2000 to explore the effects of prescribed burning and four levels of tree retention (0, 10 and 50 m³ ha⁻¹ and control) on saproxylic beetle diversity during ten post-harvest years. Not only species richness but also the proportions of different functional groups of saproxylic beetles were monitored. Both fire and logging increased the species richness in first post-harvest year. At burned unharvested stands the number of species was still raised after ten years, but decreased to about the pre-treatment level at the burned and unburned stands with retention trees, and even lower at clear-cuts. Furthermore, there were clear differences in the assemblages between different treatment combinations. In ten year period, increasing logging intensity decreased the amount and proportion of fresh wood feeders. All logging methods and burning increased the mean body size of the beetles and the proportions of late-stage xylophagous, but decreased the proportions of mycetophagous species. Burning increased also the number of rare and red-listed species, but only at unharvested stands. Our results emphasize the difference in functional legacies between logging and natural disturbance, but also suggest that prescribed burning and retention forestry are effective methods in order to alleviate the negative effects of forest management also in longer term.

CONSERVING THE LEGACY OF EUROPEAN BEECH FORESTS - THE CASE OF WOOD-INHABITING FUNGI.

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Nerea ABREGO, Norwegian University of Science and Technology ; Claus BÄSSLER, Bavarian Forest National Park ; Morten CHRISTENSEN, Grontmij

Wood inhabiting fungi represent an important aspect of forest biodiversity, both in their own right, and as ecosystem engineers recycling carbon, and opening dead wood as a resource for other organisms. Fungal communities in dead wood are highly diverse, and many species are poorly known, both in terms of ecological functions and with regard to conservation needs. This is the case globally, and in relation to the highly fragmented and degraded temperate forests of Europe. Based on two decades of research in European beech forest reserves it is evident that local habitat factors, especially relating to wood decay stage and log size, are crucial and consistent drivers of species richness and community composition at resource level. At the continental scale climate is an important factor affecting species composition at site level, and as forest history and climate is strongly correlated at the European continental scale, it has been a challenge to disentangle effects of forest history and climate on fungal communities. However, ongoing research strongly suggests



severe effects of forest fragmentation and lack of naturalness on fungal communities. These effects include changes in guild structure, loss of specialist species and decreasing beta diversity in conservation areas situated in degraded forest landscapes. These findings highlights the importance of protecting larger remains of little disturbed forest in Central and Southeast Europe, and to enlarge conservation areas around remaining old growth forest patches in northern and western Europe, rather than expanding conservation efforts in areas lacking natural forest heritage.

ID142 THE EUROPEAN GREEN BELT INITIATIVE - CHALLENGES, EXPERIENCES AND ACHIEVEMENTS

Anne Katrin Heinrichs

EuroNatur Foundation

Gabriel SCHWADERER, EuroNatur Foundation ; Tomáš RUZICKA, Nadace Partnerství ; Uwe RIECKEN, German Federal Agency for Nature Conservation (BfN) ; Karin ULLRICH, German Federal Agency for Nature Conservation (BfN) ; Liana GEIDEZIS, Friends of the Earth Germany (BUND) ; Melanie KREUTZ, Friends of the Earth Germany (BUND)

The European Green Belt is an initiative which builds on the division of Europe, for around forty years, into the Eastern and Western bloc during Cold War times. This high security, border fortifications and restricted access, offered an excellent opportunity for nature to persist and recover without much disturbance. As a result, a zone of conflict has turned into an opportunity to protect a Green Belt of high-value natural and cultural landscapes, running through Europe from the Barents Sea in the north to the Black Sea in the southeast. It is more than 12,500 km long and traverses eight biogeographic regions and 24 countries. Since the fall of the Iron Curtain governmental and non-governmental organizations from most of these countries have joined the European Green Belt Initiative to jointly conserve the natural treasures along the Green Belt - a great variety of mostly well preserved European landscapes ranging from alpine peaks, arctic tundra, forests, mires, bogs, rivers and flood plains to coastal areas, grasslands and agricultural landscapes. Goals of the initiative are to conserve and restore the function of the European Green Belt as an ecological network and to enhance sustainable regional development based on the specific natural, historical, and cultural heritage of the border regions. The high political commitment of 17 countries of the European Green Belt was demonstrated by a Declaration of Intent. The latest step in order to advance governance has been the establishment of the European Green Belt Association. Eventually, this step will also help to secure continuous funding. The European Green Belt with its variety of landscapes and habitats is predestined to function as the backbone of a Green Infrastructure network across Europe. The European Green Belt Initiative demonstrates

that good will and cooperation do exist and can be clustered to support Green Infrastructure and to reduce land-use conflicts.

95 THE ROLE OF ROADSIDE HABITATS FOR THE CONSERVATION OF BIODIVERSITY

Jan Olof Helldin

Calluna AB

Andrew BENNETT, La Trobe University

Roadsides provide habitat for a wide range of plants and animals, most of them common but also some species that are threatened in the landscape as a whole. There is a growing understanding and appreciation worldwide of the role and value of the grasslands, forest strips, treerows, hedgerows, live fences and other linear vegetation structures that skirt road networks. Pervasive through most landscapes, the green network formed by natural or semi-natural vegetation along roads has been labelled "a centrepiece of conservation". Strips of roadside vegetation may range from just a few metres in width to 100m or more, and together cover immense areas. Moreover, in agricultural regions, urban areas and other highly modified environments that increasingly occupy Earth's surface, roadsides may harbour the only natural or semi-natural vegetation that remains. The characteristics of roadside vegetation vary greatly, influenced by historic transportation and land uses, and reflecting its value as both a natural and cultural asset. Roadsides can contribute to biodiversity conservation: 1) by the value of the soil and vegetation at a particular site as habitat; 2) by the value of the overall linear network, representing a large component of natural or semi-natural vegetation, or contributing to connectivity through the landscape; and 3) by the interactions with surrounding land, either positive, where species of conservation concern move to and from nearby farmland, or negative, where invasive species spread along roadsides or invade adjacent environments. The value of roadside vegetation is influenced by its width, the composition and structural complexity of the vegetation, roadside management, traffic intensity, road structure, interactions between species, and landscape configuration. We summarise these concepts with particular reference to roadside vegetation in contrasting environments, and illustrate with examples from northern Europe and Australia.

193-REWILDING IN PRACTICE

Wouter Helmer

Rewilding Europe

Rewilding Europe was founded in 2011 to develop a new conservation strategy for the European continent. Large scale land abandonment - often perceived as a major socio-economic and ecologic problem - can also be used as the start of new rural economies, based on wild values. Giving more



space to wildlife and natural processes will lower the costs of conservation and at the same time improve conditions for wildlife and nature related enterprises. Human interventions are only done if nature can ultimately take over (i.e. act now, in order to act less in future). Out of more than 30 nominations, Rewilding Europe has selected 9 areas of at least 100.000 ha each, to be the showcases for this new approach. These areas represent different ecosystems in different parts of Europe, from the Coa-Valley in Portugal to the Danube Delta in Romania, and from the Central Apennines in Italy to Greater Laponia in Sweden. In all these areas the comeback of natural processes goes hand in hand with the support of rewilding enterprises. European wide marketing and communications help to attract people towards these new nature destinations. At the same time local involvement is improved, for example by training bear ambassadors, bison rangers, wildlife guides or other rewilding entrepreneurs. Innovative tools as the European Wildlife Bank, Rewilding Europe Capital, the European Safari Company and the Rewilding Europe Travel Club are key in reconnecting man and nature in a modern context. Results from the first four years of Rewilding Europe will be presented.

THE DYNAMIC OF LOCAL COMMUNITY RESPONSE TOWARDS MARINE CONSERVATION AREA (CASE STUDY : THE MARINE CONSERVATION AREA OF BATANG, INDONESIA)

Alfian Helmi

Hokkaido University

Arif SATRIA, Bogor Agricultural University ; Ilham TAWAKAL, Bogor Agricultural University

Reconciling fishers –while sometimes regarded as enemy by conservation managers—becomes critical issues in developing marine conservation area in Indonesia. Conflict between fishers and the managers is rooted on establishment of conservation area that avoiding interests among the social actors. However, local community members have multiple perspectives in regard to the marine conservation areas and their impact. This paper seeks to analyze local community response (especially for fisher's response) towards marine conservation area in Indonesia. The local responses consist of zonation, rule of the game, sanctions, monitoring and evaluation, authority and the bundle of rights. The research involved in-depth interviews, observation and household questionnaires. It was found that over all the data indicated that local community member support marine conservation area. Nevertheless, it was also found that there were considerable difference responses among local government, community, and conservation managers. The reasons for those differences are outlined.

OPTIMAL THREATENED SPECIES TRANSLOCATIONS: HOW MANY, HOW OFTEN, AND FOR HOW LONG

Kate Helmstedt

University of California Berkeley

Hugh POSSINGHAM, University of Queensland

One primary aim of biodiversity conservation is to halt the extinction of threatened species. A common requirement in threatened species recovery plans is the establishment of multiple self-sustaining populations. Species translocation from either a successful captive breeding program or from a robust existing population can be an effective way to reintroduce locally extirpated populations into the wild. When individuals become available for release over the span of multiple years conservation managers must decide where to release these animals, a decision complicated by the presence of more than one potential release site. We present a method for determining an optimal schedule for threatened species translocation into multiple potential release sites using population modelling and mathematical optimization techniques. Our model takes into account both monetary and temporal setup costs as well as ongoing management costs. The optimal schedule for releasing individuals over multiple years strongly depends on the cost of maintaining infrastructure, staff and management actions at active release sites. Suboptimal choices can be very costly and can jeopardize the outcome of the recovery program. By ensuring the best management practices are followed, conservation decision-makers can maximize the biodiversity benefit achieved from their dollar.

WHO TO TRUST? ASSESSING AND IMPROVING EXPERT PERFORMANCE IN CONSERVATION BIOLOGY.

Victoria Hemming

The University of Melbourne

Expert opinion is routinely relied upon in conservation biology, particularly when data are absent, rare or unreliable. Expert opinion is used to inform model parameters, make predictions and judgements, or in advisory role on committees and expert panels. The quality of judgements made by experts can influence the quality of conservation decisions. However, there is tantamount evidence that experts, like lay people, are subject to a range of heuristics and biases that can affect their ability to make accurate judgments. Susceptibility to these heuristics and biases differs between experts. Given that not all experts are equal how should we pick an expert? My research examines 1) how experts are selected in conservation biology, 2) whether we may be able to test expert performance before selecting those experts we entrust with crucially important judgements, 3) can we improve expert performance via feedback from



ongoing testing of experts. My research has found that experts are typically chosen based on perceived predictors of expert performance, including years of experience, peer recommendation, professional affiliations, and age. These traits are unreliable predictors of expert performance, and can be akin to a leap of faith. Could assessing expert judgements against a set of test questions be a more reliable indicator of expert opinion? Testing expert performance has been trialed in engineering and public policy, however, conservation biology adds its own nuances. For example, what the type of questions, elicitation procedures, the scoring protocols, the limitations of the method and the costs and benefits of the method. Furthermore, deliberate practice and feedback have been shown to improve expert performance. Feedback in conservation is often absent, rare, or delayed. Could repeated testing of expert performance create feedback loops that eventually improve performance? Thus creating more experts?

EFFECT OF CHEMICAL STRESSORS ON CRAYFISH FOOD CUE RESPONSE

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Atrazine, a triazine herbicide used to kill broadleaf weeds in agricultural and roadway applications, is one of the most widely used pesticides in the United States. While this herbicide is meant for landscape use, rain and other storm events often carry the chemical from terrestrial to aquatic systems, where it has been associated with several negative effects. A number of studies have related Atrazine exposure to reduced olfactory reception in fish and suggest that Atrazine acts as an endocrine disruptor in fish and amphibian species that come into contact with this chemical at ecologically relevant levels. As aquatic species sense most of their information about environmental conditions through olfaction, this is particularly important for crayfish, who only replace their olfactory cells during molting. In this study we examine the impacts of the herbicide Atrazine on crayfish responses to food cue and pursue possible explanations for behavioral changes based on observation of olfactory structure surface morphology utilizing scanning electron microscopy. Because Atrazine has been observed to be an endocrine and olfactory disruptor in other species, its non-lethal effects in crayfish could potentially disrupt the food web dynamics of aquatic systems. We hypothesize that exposure to ecologically relevant concentrations of Atrazine will result in irregular behavior in crayfish presented with chemical cues indicating the presence of a food source. Behavioral changes in response to these chemical cues may indicate a need to further

consider the non-lethal effects of Atrazine, in addition to other understudied pollutants.

188_ BARRIERS TO BIODIVERSITY IN FLUVIAL ECOSYSTEMS-SYSTEMATIC PLANNING OF DISCONNECTION TO ENHANCE CONSERVATION SUCCESS IN A MODIFIED WORLD

Virgilio Hermoso Lopez

Centre Tecnologic Forestal de Catalunya

Stephanie R JAMUCHOWSKI-HARTLEY, Texas A&M University ; Simon LINKE, Griffith University

Maintaining connectivity within and between systems is often desired in conservation to foster ecological processes and the persistence of biodiversity. However, conservation practice in human-modified environments can benefit from existing or prescribed disconnection through the implementation of barriers. These barriers can help reduce the pressure of threats, create refuge areas for native biodiversity and help reduce economic losses caused by invasive species. Here we propose that the use and implementation of barriers for conservation should be systematically planned, considering trade-offs between ecological pros (easing threats) and cons (interruption of ecosystem processes) for multiple species and economic cost/benefits, rather than using ad-hoc opportunistic criteria or accommodating conservation needs for individual species. However, any implementation of disconnection for conservation should be cautiously considered if uncertainty and ecological risk are high. Monitoring programs are needed to learn from previous successes and failures and enhance the use of this conservation tool. Systematic planning methods should guide future decisions about the retention and allocation of barriers to maximize ecological benefit and minimize negative impacts across terrestrial, freshwater and marine realms.

ECOLOGY AND CONSERVATION OF AN ENDANGERED CARNIVOROUS MARSUPIAL IN A SEMI-ARID ENVIRONMENT: INVASIVE PREDATOR IMPACT

Lorna Hernandez Santin

University of Queensland

Diana FISHER, University of Queensland ; Anne GOLDIZEN, University of Queensland

As with many carnivores throughout the world, populations of marsupial carnivores in Australia are declining. Once abundant, quolls (*Dasyurus* spp.) are the largest native mammalian predators on mainland Australia. Of the three species remaining in Australia, the northern quoll (*D. hallucatus*) is in the most imperilled IUCN's category of 'endangered', because of a rapid and severe population decline of >50% in the last



decade in most of its range. They appear to have declined recently and to still be declining in the semi-arid region of the Pilbara in Western Australia, which represents a potential refuge from invasive threats (especially the cane toad). This project aims to determine why this species has declined in grassland and retreated to rocky habitats in the Pilbara. The species recovery plan suggests a hypothesis- that feral fox, cat and / or dog activity is greater in grassland. Using live and camera trapping, and focusing on two sites with both rock outcrops and spinifex grassland, we test if outcrops in rocky habitat provide a haven from introduced predators. We have caught and photographed 103 quolls. This represents 17 individuals (5 photos and 12 trapped) at Millstream Chichester National Park, and 86 quolls (46 photos and 40 trapped) at Indee Station. These two sites have different management. Millstream National Park does not cull dingoes, while Indee Station – a cattle station with tourism activities - does. In areas surrounding trapping sites, we have caught 46 invasive predators. In Millstream we have photographed 13 cats and 8 dingoes, while at Indee Station we have caught 20 cats, 3 dingoes, and 2 foxes. By collaborating with WA Department of Parks and Wildlife, this project contributes to a management plan for the conservation and recovery of the species. Understanding trends of decline of this species contributes to the general pool of knowledge of carnivore ecology.

BELOWGROUND COMMUNITY RESPONSES TO GRASSLAND MANAGEMENT INTENSIFICATION IN MONTANE AND SUBALPINE REGIONS

Chantal Herzog

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Nowadays, montane and subalpine European grasslands are confronted to different pressures due to changes in agricultural practices. The application of liquid manure instead of solid manure and the progressive replacement of traditional ground irrigation by aerial irrigation with sprinklers are two examples of novel practices. Their effects on plant and numerous animal communities have already been studied. However, there is a lack of knowledge about belowground responses. Belowground communities and particularly arbuscular mycorrhizal fungi (AMF) play a fundamental role in ecosystem functioning and are crucial drivers of vegetation dynamics and ecosystem services such as nutrient cycling. This study investigates the response of diverse belowground components to different intensity levels of fertilisation and irrigation in montane and subalpine meadows. It is part of a long-term project conducted in mountain grasslands with the main objective to find the best trade-off between biodiversity

conservation and hay production. Our different study sites consist of eleven extensively managed hay meadows situated in the Central Alps of Switzerland (Valais). Six different intensity levels of irrigation and fertilisation are experimentally applied to 314 m² plots in all sites (n = 11 replicates). We hypothesise that intensification of farming practices, especially the broad use of fertilisers, is causing negative effects on soil microbial communities and their activities. We will focus on AMF, plant root architecture, as well as on litter breakdown and nutrient uptake as important ecosystem processes. Finally, we will link above- and belowground grassland communities regarding their reaction to agricultural intensification. This study will consequently provide management recommendations for farmers in order to promote sustainable agriculture in montane and subalpine grasslands.

HABITAT LOSS FROM HYDRAULIC FRACTURING LOWERS AVIAN NEST SURVIVAL IN A WESTERN NORTH AMERICAN LANDSCAPE

Matthew Hethcoat

University of Wyoming

Anna CHALFOUN, University of Wyoming

Addressing the impacts of habitat loss, fragmentation, and alteration embodies a primary challenge in conservation biology. An emerging source of anthropogenic disturbance globally is from energy development activities. Global energy demand has doubled since 1970 and is forecast to increase 40% by 2030. As a consequence, habitats have been increasingly reduced and fragmented by road networks, pipelines, drill pads, and other components associated with energy extraction. However, research on wildlife impacts has tended to focus on economically important game species of western North America. We assessed the influence of habitat loss from hydraulic fracturing activities on a critical component of fitness (nest survival) for three species of sagebrush-obligate songbirds that are of conservation concern in western North America. In addition, we tested the hypothesis that energy development influenced nest predation rates via increases in local predator abundance. During 2008-2009 and 2011-2012 we monitored 887 nests within two natural gas fields in western Wyoming, USA. In 2011 and 2012, we identified predators using infrared cameras and assessed predator abundance via point counts, scent stations, and live-trapping. Daily nest survival rates decreased with habitat loss for Brewer's sparrows (*Spizella breweri*) and sage thrashers (*Oreoscoptes montanus*) during 3 of 4 years, while the null model of constant nest survival was most supported for sagebrush sparrows (*Artemisiospiza nevadensis*). Diurnal and nocturnal rodents comprised 70% of predation events. Concordant with decreased nest survival, rodent detections increased with energy development intensity; suggesting energy development activities modified local predator assemblages.



North America is anticipated to develop 200 000 km² of new land for energy development by 2035. Thus, an important next step requires understanding why certain predators increase in areas with increased habitat loss from hydraulic fracturing.

RECOGNITION OF INVASIVE ALIEN PREDATORS BY TADPOLES OF THE AGILE FROG (RANA DALMATINA)

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Invasive alien species (IAS) can have devastating ecological effects. Their success may be due to a lack of a shared history of coexistence with native species: IAS may not be recognized as potential predators. Empirical tests of this prey naiveté hypothesis have obtained equivocal results, perhaps because many ignored ecological differences and phylogenetic relationships among the studied predators, while others did not take the recent history of coexistence with the prey population into account. We performed a comprehensive test of the prey naiveté hypothesis. We investigated how tadpoles of the agile frog (*Rana dalmatina*), originating from hill-land or floodplain populations, decrease their activity when exposed briefly to chemical cues from either endemic, earlier invasive, recent invasive or allopatric fish predators. We used four percid, four silurid and two cyprinodontid fish species, and fed fishes either with conspecific tadpoles, bloodworms or spinach. Our results indicated that predator-naïve tadpoles reduced their activity only when exposed to endemic or earlier invasive percid predators that had been feeding on tadpoles, but not in response to recent invasive or allopatric percids, or to any of the silurid or cyprinodontid fishes. Also, tadpoles originating from isolated hill-land populations responded weaker than their conspecifics from floodplain populations co-existing with predatory fishes. These results provide evidence that the lack of a shared history of coexistence can prevent prey recognizing predatory IAS. However, less than 40 generations are sufficient for tadpoles to evolve the ability to recognize predatory invasive fish species. Finally, our results suggest that the responsiveness of prey to predatory IAS may depend on several ecological factors, including the recent feeding history of predators, the ability of predators to conceal chemical cues

of predation, and whether prey populations coexisted with ecologically similar predators.

DEMOGRAPHIC DECLINE AND POTENTIAL VULNERABILITY TO EXTINCTION IN THE SOUSS VALLEY TORTOISE, TESTUDO GRAECA SOUSSENSIS PIEH, 2001 (CHELONII: TESTUDINIDAE) IN CENTRAL JBILET MOUNTAINS, WEST CENTRAL MOROCCO

Nawal Hichami

Cadi Ayyad University, Faculty of Science-Semlalia
Safaa Bendami, Cadi Ayyad University, Faculty of Science-Semlalia ; Mohammed ZNARI, Cadi Ayyad University, Faculty of Science-Semlalia ; Moulay Abdeljalil AIT BAAMRANE, Cadi Ayyad University, Faculty of Science-Semlalia ; Mohamed NAIMI, Cadi Ayyad University, Faculty of Science-Semlalia

The Moorish tortoise, *Testudo graeca*, is the only terrestrial chelonian species in Morocco. It is listed on Appendix II of CITES and is considered “vulnerable” (IUCN, 2008). In the central Jbilet, west central Morocco, in an arid and overgrazed steppe-land, one of the largest populations of the endemic subspecies, the Souss valley tortoise, *T. g. soussensis*, at regional level, has been in decline during the last 10 years due to a combination of climatic and human factors. Indeed, an estimate of the spring population size by Mark-Recapture method from 2003 to 2012, showed that the population size was reduced to more than 50% (from 196 to 88 ind. within a central area of 33 ha) with a mean density of less than 3 ind./ha vs. 6 ind./ha. The degree of stress in this population was assessed by fluctuating asymmetry (FA) defined as the random deviation of perfect bilateral symmetry at the plastron, used as an indicator of developmental perturbations. This asymmetry has proved to be in relation to the instantaneous growth rate and is more important than that of more supportive tortoise’ environments. Using the VORTEX software, we carried out a preliminary population viability analysis (PVA) on the basis of the last known population size, longevity and demographic parameters. Based on the estimated mortality rates between 2003 and 2012, it appears that the population of central Jbilet mountains would face a potential risk of extinction in the forthcoming 30 years. Finally, and taking into consideration conservation issues identified by the AVP along with different identified direct and indirect threats, a population and habitat management plan is proposed including a captive-breeding programme for population reinforcement and ecological restoration of the degraded and overgrazed steppe-lands in the study area.

TESTING A NEW METHOD FOR AN UNBIASED ABUNDANCE ESTIMATE OF MOUNTAIN GORILLAS (GORILLA BERINGEI BERINGEI) IN THE VIRUNGA MASSIF, CENTRAL AFRICA

Jena R. Hickey



International Gorilla Conservation Programme

Population estimates of the endangered mountain gorilla (*Gorilla beringei beringei*) need to be as accurate as possible in order to understand trends and achieve high stakes conservation across 3 countries with recent history of transboundary conflicts. Methodology for estimating mountain gorilla abundance has changed over the past 2 decades, such that robust trend estimates are not yet possible. Mountain gorillas exist in two populations: Bwindi Impenetrable National Park, Uganda and the Virunga Massif of the Democratic Republic of Congo, Rwanda, and Uganda. The first use of DNA samples to identify the minimum number of mountain gorillas (302) occurred in Bwindi in 2006; whereas, the first application of DNA-mark-recapture for an un-biased abundance estimate (400-430) occurred in Bwindi in 2011. This study builds on previous work by estimating mountain gorilla abundance in the Virunga Massif using DNA-mark-recapture, with important adjustments to previous study designs. For each gorilla group, samples of DNA from every nest at 3 nest sites (rather than 1 nest site) were analyzed to unique individual. Intra-group detection probability was then estimated treating nest sites as a given group's occasion history. Summing the unbiased estimates of group size across all groups allowed for the first unbiased estimate of gorilla abundance in the Massif. Next steps will include a second full survey of the Massif within the year, in order to calculate population-level detection probability, to complement the intra-group detection probability shown here. Multiple occasion histories per group, as well as for the entire population, lend insights into primary sources of error and ways to further improve mountain gorilla population estimates. With future DNA-mark-recapture studies planned in Bwindi for 2016, robust estimates of gorilla abundance can be compared over time to build estimates of population trends that include confidence intervals and that acknowledge sources of error.

194. LEAVING EDEN: SOCIAL SCIENCE AND THE QUEST FOR SUSTAINABILITY IN THE ANTHROPOCENE

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Science Center ; Melissa POE, NOAA Northwest Fisheries Science Center [INSTITUTE] University of Washington ; Satterfield TERRE, University of British Columbia ; Kevin ST MARTIN, Rutgers University ; Phillip LEVIN, NOAA Northwest Fisheries Science Center

Contemporary environmental problems are intentionally and unintentionally caused by humans, harm humans, and can only be solved by humans. Social science is therefore central to the quest for sustainability in the Anthropocene. We describe six concepts, which capture the social processes that influence how people behave, and are thus fundamental to charting a path to a sustainable future. First, the different ways in which the world is understood and knowledge is created must be embraced if we are to engage with the complexity of science for the Anthropocene. Second, culture and values shape our identity, actions, and aspirations and as such should be at the core of any sustainable future. Third, governance is about far more than government, and engagement with the myriad of informal rules, norms, and processes that together influence behavior will be necessary to bring about change. Fourth, people act purposefully to achieve what they perceive as desirable, and a failure to consider the ability of people to make dynamic choices in response to social and environmental changes can generate unintended outcomes that may undermine the goals of sustainability. Fifth, societal responses to environmental change can alter how ideas, organizations, and people influence each other. Likewise, when policies threaten existing powers of influence those policies are likely to be subverted with potentially disastrous consequences or conflict. Finally, inequities in the distribution of knowledge, wealth, resources, opportunities and influence exert social pressures and tensions that exacerbate negative environmental impacts. Equity is therefore both a moral imperative and central to achieving sustainability. Together these six concepts can help science for the Anthropocene embrace a diversity of preferences, interests, and epistemologies and chart a path to a just and equitable future.

DRIVERS OF FISH SPATIAL VARIATION ACROSS THE SUNDA BANDA AND BIRD'S HEAD SEASCAPES, INDONESIA

Ismu Hidayat

Conservation International

Mikaela Provost, World Wildlife Fund ; Purwanto PURWANTO, The Nature Conservancy ; Gabby AHMADIA, World Wildlife Fund ; Estra DIVARI, World Wildlife Fund

Multiple environmental and social variables together drive the distribution of fish populations. Knowing which covariates primarily explain spatial variation in fish abundance and biomass across large seascapes provides useful broad picture information for stakeholders and managers and captures



the current ecological state. Furthermore, looking at both environmental and social covariates can help to disentangle the contribution of habitat characteristics and human influences. In Indonesia, the Bird's Head Seascape and Sunda Banda Seascape are two regions spanning more than 1.79 million square km in the heart of the Coral Triangle. Both seascapes house highly productive coral reefs for artisanal and commercial fisheries and are well known for having some of the healthiest, most diverse reef ecosystems in the world. Using best available data for a suite of environmental (e.g. reef type, exposure, slope, and distance to mangroves and deep water) and social (e.g. distance to nearest fishing village, primary market, and pollution risk) contextual variables and fish biomass data collected from nearly 300 sites across 2010-2014, we found that distance to primary market explained the most variation in fish abundance and biomass compared to all other covariates. Even compared to critical habitat covariates, reefs in close proximity to a primary market had much lower density and abundance than more remote sites. This suggests that fishing pressure is the most important factor explaining patterns of fish abundance and biomass throughout the seascapes, reinforcing the need to strengthen fisheries management in these regions.

VARIATION IN ECOSYSTEM RESPONSE FOLLOWING MARINE PROTECTED AREA ESTABLISHMENT IN RAJA AMPAT MPA NETWORK, INDONESIA

Nur Ismu Hidayat

Conservation International Indonesia

Defy Nataniel PADA, Conservation International Indonesia ; PURWANTO, The Nature Conservancy ; Gabby N AHMADIA, World Wildlife Fund ; Muhammad Erdi LAZUARDI, Coral Triangle Center ; Andreas H MULJADI, Coral Triangle Center ; Christine L HUFFARD, Monterey Bay Aquarium Research Institute ; Helen E. FOX, Rare

The rich coral reefs of Raja Ampat, Indonesia located in the heart of the Coral Triangle, supports some of the highest fish biodiversity in the world. Unfortunately, with rapid development in the region, this has led to increasing threats to coral reef ecosystems. To mitigate these threats and maintain biodiversity and sustain fisheries in the region, local community, governments and partners developed a conservation agenda that led to the establishment of a network of Marine Protected Areas (MPAs). To measure the performance of MPAs, a large scale underwater monitoring program began surveying coral reef fishes populations in seven MPAs during MPA establishment, and have since all been repeated 2-4 years later. Initial results indicate that ecological performance varies among MPA with stable, increasing and decreasing trends. We specifically focus on changes in fish abundance, fish biomass and fish community structure of different trophic groups and key fisheries species. Further

analyses are currently investigating the relationship between the frequency of infringements of MPA regulations and corresponding changes in fish populations.

ALLOMETRY AND THE EXTINCTION VULNERABILITY OF BIRDS AND MAMMALS: WHY ARE LARGER SPECIES MORE VULNERABLE TO EXTINCTION?

Jelle Hilbers

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Although extinction risk is known to be positively associated with body size, a consistent process-based framework that explains this relationship is still lacking. Here, we address the key scientific question why larger species are more vulnerable to extinction than small species. We present a new framework that systematically quantifies extinction risk based on allometric relationships between various wildlife demographic parameters and body size. These allometric relationships have a solid theoretical and ecological foundation. Extinction risk indicators included are the probability of extinction, the mean time to extinction and the critical patch size. We applied our framework to assess the global extinction vulnerability of terrestrial carnivorous and non-carnivorous birds and mammals. Irrespective of the indicator used, large-bodied species were found to be more vulnerable to extinction than their smaller counterparts. Carnivorous mammals had higher extinction risks than non-carnivores, while birds were more prone to extinction than mammals. These results are explained by the allometric relationships predicting vulnerable species groups to have lower intrinsic population growth rates, smaller population sizes, lower carrying capacities or larger dispersal distances, which in turn increase the importance of losses due to environmental stochastic effects and dispersal activities. Our study is the first to integrate population viability analysis and allometry into a novel, process-based framework to quantify extinction risk. The framework facilitates a better understanding of the key underlying factors that determine how extinction vulnerability varies with body size compared to findings of correlative studies. It may be applied to forecast extinction vulnerability in response to a changing environment, by incorporating quantitative relationships between wildlife demographic parameters and environmental drivers like habitat alteration, climate change or hunting.

197. MOVING TOWARD A NATIONAL STRATEGY IN THE UNITED STATES

Jodi Hilty



Independent consultant

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Many agencies and entities across the US implicitly or explicitly support the support conservation through land management. Although these land protection efforts represent a significant investment in conservation, they have been necessary but insufficient to stem the tide of biodiversity loss and degradation of ecosystem services. What is needed now is a cohesive and comprehensive vision and framework for designing this cornerstone strategy. We discuss the current state of conservation, the historic precedent for such a system in the US, and discuss the challenges toward moving to a comprehensive strategy across the US. Given the different global models, what approaches might best suit the US for moving forward?

TRANSLOCATION OF A PARTIAL MIGRANT BIRD: WHAT, WHERE AND WHEN TO RELEASE?

Yves Hingrat

Reneco Wildlife Preservation

Bénédicte MADON, Reneco Wildlife Preservation

The efficiency of translocation programmes requires sound knowledge on the ecology and behaviour of the targeted species and accurate estimations of the survival and breeding performances of released individuals. Such estimations, generally challenging, become seriously puzzling in the case of partial migrant species. A first prerequisite is a good knowledge on the genetic structure of populations in order to define suitable population management strategies, especially in the context of captive-breeding and reinforcement. To maximise survival and breeding performances of released populations, it is essential to define where and when to release, as these choices may have opposite outcomes for resident compared to migrant individuals. Beyond the difficulties in gathering data, this theoretical approach relies on the assumption that migration behaviour is mainly genetically controlled and that captive-bred released individuals will behave according to their genetic origin, the location and timing of release. The Asian houbara bustard, *Chlamydotis macqueenii*, is a partial migrant bird whose decline led to the creation of a network of captive breeding programmes designed to reinforce wild populations in Central Asia and the Middle East. Migrant and resident wild populations have been intensively monitored since 1994 with more than 550 wild individuals tracked using satellite transmitters. Besides, about 1000 captive-bred houbara (CBH), from migrant and resident origins, have also been released and monitored via satellite tracking. Here we present our current knowledge on the genetic and movement behaviour of wild Asian houbara (migrant and resident), provide original

results on the behaviour of released CBH (migrant and resident origins), highlighting the importance of understanding “what, where and when to release” for the success of a translocation programme.

HETEROGENEITY IN CONSUMER PREFERENCES FOR ORCHIDS IN INTERNATIONAL TRADE AND THE POTENTIAL FOR THE USE OF MARKET RESEARCH METHODS TO STUDY DEMAND FOR WILDLIFE.

Amy Hinsley

University of Kent

Diogo VERISSIMO, Georgia State University ; David ROBERTS, University of Kent

The demand for wildlife products drives an illegal trade estimated to be worth up to \$10 billion per year, ranking it amongst the top transnational crimes in terms of value. Orchids are one of the best-selling plants in the legal horticultural trade but are also traded illegally and make up 70% of all species listed by the Convention on the International Trade in Endangered Species (CITES). To study consumer demand for horticultural orchids we use choice experiments to survey 522 orchid buyers online and at large international orchid shows. Using latent class modelling we show that different groups of consumers in our sample have distinct preferences, and that these groups are based on gender, genera grown, online purchasing and type of grower. Over half of our sample, likely to be buyers of mass-produced orchids, prefer white, multi-flowered hybrid plants. Of greater conservation interest were a smaller group consisting of male hobbyist growers who buy their orchids online, and who were willing to pay significantly more for species that are rare in trade. This is the first in-depth study of demand in the international orchid trade and our findings confirm the importance of rarity as a driver of hobbyist trade. We show that market-research methods are a new tool for conservationists that could provide evidence for more effective conservation of species threatened by trade, especially via campaigns that focus on demand reduction or behaviour change.

IDENTIFYING THE GAPS IN ACCESS AND BENEFIT SHARING IN THE SOUTHEAST ASIAN ORCHID TRADE

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The equitable sharing of benefits from natural resources was emphasised as being important in 1992 by the Convention on Biological Diversity and has relevance to the commercialisation and trade of wildlife products. Horticulture is one industry that relies heavily on wild genetic resources for the development of new products but little attention has been paid to sharing the benefits of this trade with the range states of traded plant



species. Using a regional case study of Southeast Asia we analysed the online sales of orchids, one of the most important horticultural products in trade, to determine to what extent countries are benefitting from trade in their own native and endemic plants. We found that 20.8% of Southeast Asian orchid species and almost 9.9% of national endemics were being traded, with species from every country represented in trade. Although their species were traded widely, we found that the three lowest income countries in the region (Lao, Myanmar and Cambodia) had little or no trade. Lao in particular contributed 52.1% of its native species and 21.4% of its endemic species to trade but was selling none of these species itself. Further, we found endemic species on sale outside the country of origin for which no CITES permits seem to have ever been issued. Orchids are traded illegally in the region and although this can bring economic benefits to those who collect and trade them, these benefits are often unsustainable and the conservation implications can be serious. We conclude that the most effective way to tackle the gaps in access and benefit sharing observed in the region would be to build both the botanical and horticultural capacities of those countries currently benefitting least from their own species. This may also help to provide an incentive to address the issue of illegal trade.

A 3000 HA SPATIAL EXPLICIT FIRE HISTORY ILLUSTRATING THE MOSAIC STRUCTURE OF BOREAL LANDSCAPES IN NORTHERN EUROPE

Julia Hjalmarsson

Mid Sweden University

Bengt Gunnar Jonsson, Mid Sweden University ; Evan LARSON, University of Wisconsin ; Yingyue YANG, Mid Sweden University ; Per LINDER, National Property Board of Sweden

Although with some regional variation and differences among forest types, fires have been the major natural disturbance throughout the boreal forests of Northern Europe. As a consequence, several forest types and a large range of forest species are dependent on the natural fire regime. Since the late 19th century efficient fire suppression and changes in land use have basically excluded fires from a large part of the region. For that reason efforts are now taken to re-introduce fire as a management tool in protected areas as a mean to secure fire dependent forest types and species. However, there is limited knowledge of the natural fire regime calling for detailed studies on the spatial and temporal pattern of historical fires. This was done in a 3000 hectare large nature reserve in central Sweden, and by using fire scarred trees we were able to reconstruct the fire patterns for more than 600 years. The results show that fires has been very common in the area and on average, seen over the entire area, one fire occurred every 8 years. We identified in total about 100 individual fires out which 12 fires are considered as large. The fire pattern over time showed three distinct periods. Prior to the 18th century the area was

dominated by a few relatively rare but large fires. Between 1700 and late 19th century many small fires dominated the pattern, while from late 19th century to modern times, fires have basically been excluded. This pattern is likely linked to changes in human land use and potentially to climate variation.

SYMPOSIUM #68: RESTORATION OF NATURAL FOREST DYNAMICS TO PROMOTE INSECT DIVERSITY: A TEST OF DIFFERENT STRATEGIES

Joakim Hjältén

SLU

Ruaridh HÄGGLUND, SLU ; Therese JOHANSSON, SLU ; Jörgen OLSSON, SLU ; Jean-Michel ROBERGE, SLU ; Mats DYNESIUS, Umeå Universitet

Because of world-wide forest degradation, eroding biodiversity and ecosystem services, ecological restoration has become a global priority. Today, the importance of natural disturbance regimes, natural habitat structures for biodiversity, and ecosystem processes in forest is widely recognized. The aim with this project is to evaluate ecological effects of two different ecological restoration methods (prescribed burning and gap cutting) in low quality voluntary set-asides on saproxylic (wood living) beetles, a group of insects severely threatened by forestry. We used a before-after experimental study in 21 spruce dominated stands in Sweden. The stands were randomly subjected into one of 3 treatment groups 1) prescribed burning 2) gap cutting 3) no treatment control. Saproxylic beetles were trapped in window traps before and directly after treatment. Abundance, species richness and assemblage composition did not differ between the treatment groups prior to treatment. However, treatments resulted in an higher abundance and species richness of saproxylics in burned stands and differences in assemblage composition between all stands. Strongly fire favoured species e.g. *Stenotrachelus aeneus*, *Henoticus serratus* and *Placusa atrata* increased dramatically after burning. However, some fire favoured species, e.g. *Corticaria rubripes* and *C. ferruginea* also increased after gap cutting. Both burning and gap cutting resulted in changes in assemblage composition, favouring saproxylic species otherwise disfavoured by modern forestry. Both methods are recommended as cost efficient restoration methods for voluntary set-asides as some of the trees were removed to cover cost for the restoration treatments. Voluntary set-asides provide excellent opportunities for restoration due to the large area that they cover in many countries.

THE BUTTERFLY HIGHWAY: CONNECTING PEOPLE AND NATURE

Angelique Hjarding

University of North Carolina Charlotte



Citizen science is becoming widely recognized as a valuable tool for collecting species observation data. Online citizen science reporting tools, such as eBird (<http://ebird.org>) and iNaturalist, (<http://www.inaturalist.org/>) make it easy for backyard nature enthusiasts to report species they observe visiting their yards. In theory, this network should provide equal access for anyone wishing to participate in citizen science biodiversity monitoring. But is there truly equal participation? A correlation between income, race and participation in citizen science biodiversity monitoring has been observed and these populations participate the least in this type of activity. Potential factors that could contribute to low participation are lack of conservation and biodiversity knowledge, a weak connection to nature and access to data reporting tools such as smart phones and computers. Additionally, residential urban areas could be experiencing a reduction in biodiversity due to the effects of urbanization resulting in a reduced number of species to observe. I will present a project called the Butterfly Highway that was designed to address these issues. The project is a university-community partnership focused on biodiversity monitoring and environmental restoration in urban residential neighborhoods in Charlotte, NC. The project consists of two primary activities: developing a community-based citizen science butterfly monitoring program and the creation of the "Butterfly Highway" in urban residential areas. The Butterfly Highway is a network of sustainable perennial pollinator gardens that have been installed in neighborhood resident's yards, parks and other pockets of under utilized green space. The project has faced many challenges including recruitment, sustainability and participant safety and it is hoped that our learned experiences can be used to create a model for establishing meaningful and sustainable university-community conservation partnerships.

195 LESSONS FROM 15 YEARS OF HUMAN-ELEPHANT CONFLICT MITIGATION: MANAGEMENT CONSIDERATIONS INVOLVING BIOLOGICAL, PHYSICAL AND GOVERNANCE ISSUES IN AFRICA

Richard Hoare

Independent Consultant

The further researching, refinement and re-assessment of Human-Elephant Conflict (HEC) mitigation methods that has occurred since 2003 can be summarized into biological, physical and governance categories. The most important distinction is between those measures applied against animals and used within the conflict zone, which are mostly used in the shorter term (except some fencing), and those measures working with people in the longer term, which rely heavily on official policy and administration often situated beyond the conflict zone. Effective HEC mitigation is difficult to understand

and problematic to implement; it remains a complex package of apparently disparate measures that have to be used in combination and flexibly, at different scales, for both animals and people. Future HEC mitigation will be as much an art as a science, but since we now have a solid research foundation, we can proceed with some confidence to address the inherent socio-political difficulties.

SAVING SEEDS: HOW TO IMPROVE THE EFFECTIVENESS OF SAMPLING PROTOCOLS FOR EX SITU CONSERVATION SEED COLLECTIONS

Sean Hoban

University of Tennessee

Allan STRAND, College of Charleston ; Scott SCHLARBAUM, University of Tennessee

In the face of continued environmental change, conservation and natural resource agencies are initiating or expanding ex situ seed collections from natural plant populations. The purpose of these seed collections may be long-term conservation, habitat restoration, or study of plant germination and ecology. In all cases it is advisable to capture as much phenotypic and genetic diversity from the natural populations as possible. General and widely-used guidelines for sampling strategies were developed in the 1990s, but these guidelines may be ad hoc and/or suboptimal for genetic representation. In this talk, I will explain and demonstrate a new approach to optimize sampling protocols for a conservation collection. I use spatial, demographic and genetic data from three species, as well as simulated data under an individual-based model, to lead to tailored collections that maximize diversity while minimizing collection size. I find that characteristics of plant reproduction and dispersal, as well as logistical factors, significantly influence the genetic diversity captured in seed collections. As one example, a highly self-pollinating, low dispersal species needs sample sizes five times larger than current guidelines. Results show that minimum collection protocols should be customized for the target species, rather than commonly implemented "rules of thumb." It is possible to improve planning and implementation of conservation practice by quantitatively integrating current knowledge of plant biology, spatial distribution and genetics into collection design. This work is important and timely knowledge for managers and policy makers because: (1) optimizing when, where and how to sample will influence restoration and conservation success, and (2) limited resources in restoration ecology and rare species preservation demand effective, efficient investment.



126-REWILDING BRITAIN: INDICATORS FOR ECOSYSTEM FUNCTION COULD PROVIDE EFFECTIVE MEASURES FOR PRIORITISING SITES FOR WILDERNESS RESTORATION

Peter Hobson

Writtle College

Lisa BIBER-FREUDENBERGER, Center for Development Research, Department for Ecology and Natural Resources Management, University of Bonn, ; Monika HOFFMANN, Centre for Economics and Ecosystem Management, Eberswalde University for Sustainable Development, ; Pierre IBISCH, Centre for Economics and Ecosystem Management, Eberswalde University for Sustainable Development,

The recently established organisation, "Rewilding Britain", has stated in its vision a commitment to support initiatives to create at least 300,000 hectares of wilderness within the UK by 2030. Notwithstanding, many scientists and conservationists remain unconvinced because of what they perceive to be unrealistic objectives given the radical alteration to the countryside and the loss of all natural ecosystems in the UK. Furthermore, there is deep scepticism amongst scientists about the principles and evidence used to support wilderness conservation. Currently, wilderness is classified on the basis of size, intactness, biodiversity and limited levels of human activity. In this study indicators for ecosystem growth and function are used to determine potential areas for rewilding based on principles of ecosystem theory and non-equilibrium thermodynamics. Landscapes are analysed at local scale using plant functional traits and microclimatic surface temperature, and at macro-scale by adopting six global indices that include vegetation density, plant species and functional diversities, and carbon storage. The findings indicated 'semi-natural' woodlands and wetlands unmanaged for more than 50 years supported more stress-tolerant and competitive plants, and local temperatures were significantly attenuated when contrasted with human disturbed landscapes dominated by ruderal plant species. Above ground and soil biomass was also higher in the manage-release sites. A global map of ecosystem functionality indicated higher values for upland areas across the west of Scotland and also for patches of western sea-board hill land in Wales although many of these areas were under secondary woodland. Apart from the north-west of the country there was little evidence for ecosystems with high functional value in England. Combined with data for roadless areas the results of this study can provide valuable information for use in prioritising areas across the UK for rewilding.

THE LEGAL BACKGROUND AND GENETIC CONFLICT OF PRESERVING WALL LIZARDS IN CENTRAL EUROPE

Axel Hochkirch

Trier University

Joscha BENINDE, Trier University ; Ulrich SCHULTE, Trier University

The common wall lizard (*Podarcis muralis*) is listed on annex IV of the European habitats directive. Therefore, a strict protection regime must be applied across its entire European range. In Germany, the species naturally occurs along the rivers Rhine, Neckar and Moselle. However, intended introductions of this species by hobby herpetologists and non-intended translocation by transport systems (particularly rail traffic) has led to a large number of non-native populations outside the natural range of this species. Due to its legal status, compensation payments and translocations of (non-native) populations of this species took place, often with high costs (200,000 € for a translocation in Mainz). We studied the genetics of natural and non-native populations of the common wall lizard in Germany, using nuclear markers (microsatellites) and a mitochondrial marker (cytochrome B). Our aim was to compare genetic diversity of native and non-native populations and study the effects of non-native lineages on natural populations. For the latter purpose, we sampled 800 individuals from four cities in Germany, which are known to have a high density of the common wall lizard, two cities with only native lineages and two cities with both native and non-native lineages. We identified eight different source regions (mainly from Italy, France and the Balkans) of introduced populations. Mixed populations of native and non-native lineages showed a strong admixture despite the strong genetic differentiation of the lineages. The degree of hybridization between native and invasive lineages poses a serious threat to the native lineage. Our results show that a nonreflective application of the habitats directive could have negative consequences on regional biodiversity.

MIND THE GAP - PUTTING INVERTEBRATES ON THE CONSERVATION AGENDA

Axel Hochkirch

Trier University

Invertebrates are by far the most species-rich group of biota on earth. However, they are rarely considered in conservation practice, even though their contribution to biodiversity is sometimes acknowledged. The International Union for the Conservation of Nature (IUCN) aims at assessing the IUCN Red List status of 160,000 species by 2020, including a global target of 45,344 invertebrate species. Currently, a total of 17,218 species has been assessed for the Red List, but the



yearly progress is much too slow to reach the 2020 target. Red List assessments of invertebrates are mainly driven by the IUCN SSC Specialist Groups or by funded projects (e.g. the European Red Lists). Hence, there is a need for more Specialist Groups focusing on invertebrates and the identification of enthusiastic people, who are able and willing to lead such groups and provide data and knowledge for more Red List assessments. Furthermore, there is a need for better data sources, particularly concerning the geographic distribution of invertebrates. A better representation of invertebrates will assure a more comprehensive function of the IUCN Red List as a “barometer of life”, but it will also allow to identify priority species for conservation. The IUCN Red List status is an important criterion for several funding mechanisms and political decisions. Invertebrate conservation will thus profit from the voluntary involvement of entomologists and other invertebrate experts.

LAND-USE AFFECTS THE RATE AND PATTERN OF RANGE EXPANSION IN BRITISH MOTHS

Jenny Hodgson

University of Liverpool

Chris SHORTALL, Rothamsted Research ; Zoë RANDLE, Butterfly Conservation ; Tom OLIVER, NERC Centre for Ecology and Hydrology

There is widespread concern that habitat fragmentation exacerbates climate change threats to species. Models predict that species will fail to track the climate if habitat is too scarce or insufficiently connected. However, until now there is very little direct evidence on how the pattern of habitat is affecting expansion at species’ cool range margins. We analysed the colonisation events that have occurred in continuously monitored locations for 54 species of southerly distributed moths in Britain between 1985 and 2011. Whether or not a continuously monitored trap was colonised, and the time until colonisation, could be related to the baseline distribution of each species (1965-1985), the characteristics of landcover in-between the trap and the baseline distribution, and the landcover immediately around the trap. Continuously monitored locations were the light traps in the Rothamsted Insect Survey network. Baseline distributions were defined by combining Rothamsted data with the National Moth Recording Scheme database. When all species were analysed together, we found that woodland-associated species were on average expanding slightly more rapidly than other species, but only where there was a relatively high proportion of woodland in the landscape. Traps located in suburban areas were less likely to be colonised, even by “wider countryside” species (associated with gardens, parks or farmland). Wider countryside species were on average expanding faster, but non-woodland species were impeded through landscapes with high proportions of woodland. When we only analysed the 36

woodland-associated species, we found that range expansion rate was better predicted by a metric of landscape resistance calculated from the pattern of woodland, than by the simple proportion of woodland in the landscape. We conclude that habitat availability is an important factor controlling the rates of range expansion even for relatively mobile, non-threatened species.

ARE WE RESTORING ENOUGH? SIMULATING THE IMPACTS OF CLIMATE CHANGE, BOREAL FOREST MANAGEMENT AND RESTORATION ON FUTURE HABITAT SUITABILITY FOR A THREATENED WOODPECKER.

Anouschka Hof

Swedish University of Agricultural Sciences

Joakim HJÄLTÉN, Swedish University of Agricultural Sciences

Intensive forestry has altered and continues to alter boreal forest ecosystems. To mitigate negative effects of intensive management practices habitat restoration is often implemented, and it will likely increasingly be adopted in future to alleviate possible additional effects of climate change on ecosystems and their biodiversity. We simulated the effects of climate change and different management and restoration practices on the forest dynamics in boreal Sweden to assess the level of mitigation that is needed to allow viable populations of species in need of conservation. We focused on a large and long-running restoration project in Sweden that aims to restore forest ecosystems to allow the re-colonization of an umbrella species, the white-backed woodpecker (*Dendrocopos leucotos*), which is critically endangered in Sweden. Its protection may serve the protection of a range of other species. We found that whereas it may be relatively easy to fulfil certain goals in the project plan, such as acquiring high levels of dead wood, other goals, such as increasing the proportion of deciduous forest, require considerable more effort. Simulations are never perfect. We however show that forest landscape simulation models like LANDIS II can give valuable information with regard to the required levels of management or restoration that are needed to fulfil project goals. Their use may prevent the misuse of large amounts of time, effort and money when simulations can indicate whether or not current efforts are sufficient to fulfill project goals.

INVASIVE ANTS: CLIMATE CHANGE PREDICTIONS AND CONTROL PROSPECTS

Ben Hoffmann

CSIRO

Invasive ants among the world’s worst invasive taxa and are well known globally for their severe ecological impacts. The issue of invasive ants is so great because there are hundreds



of species being accidentally dispersed by people due to us having a poor history of preventing their spread, coupled with a poor history of eradicating them after they arrive. Opinion is that invasive ants are predicted to increase their influence with climate change. However, I will present recent work that has shown that this is not necessarily the case for most of the current suite of invasive species, and instead changing conditions may lead to a rise of a new suite of invasive ants. Similarly, species dispersing into new environments and experiencing climate change may also experience adaptive change. I will present recent work showing dramatic morphological change at a global scale for the African big headed ant, which will “set the scene” for what to expect for other species. Despite a very poor history of dealing with ant invasions, recently more than 100 eradications have been achieved, making ants one of the most eradicated taxa in the world. These successes are expected to increase exponentially in the near future. I will provide a broad overview of all ant eradications, detail what information, technologies and techniques are needed to improve ant eradications, and provide insight into what is predicted to provide the greatest change for all invasive species management, including ants, within 10 years.

INVASIVE ANTS AND ISLAND CONSERVATION: THE INCREASING NEED, MANAGEMENT RECORD, AND FUTURE PROSPECTS

Ben Hoffmann
CSIRO

Invasive ants among the world’s worst invasive taxa and are well known globally for their severe ecological impacts. Recently we conducted an analysis of the distribution of the six worst species on islands. We found 5,909 records on 711 islands globally, predominantly throughout the Pacific. We then crossed this information with the distribution of threatened species on islands that ants may affect to demonstrate the issue posed by invasive ants. We also compiled a database of ant eradication attempts since the banning of organochlorines. We found 244 eradication attempts, of which only 105 (43%) were successful. 63 successful eradications were on islands, but predominantly only on a portion of an island. We then demonstrated patterns that resulted in success or failure. We then compared all of these results with similar analyses of rodents, which are now the most eradicated taxa on islands. We identify clear differences and similarities in the distribution and management of ants and rodents, and specify what information, technologies and techniques are needed to improve ant eradications. We envisage that ant eradications on islands are likely to rapidly improve and increase in the near future as the management need becomes greater, and technologies improve.

156-BLOW FLIES AS URBAN WILDLIFE SENSORS

Constanze Hoffmann

Robert Koch-Institute

Kevin MERKEL, Robert Koch-Institute ; Pablo RODRIGUEZ, Parque Zoológico Buin Zoo ; Fabian Hubertus LEENDERTZ, Robert Koch-Institute ; Sébastien CALVIGNAC-SPENCER, Robert Koch-Institute

Detection of wildlife in urban areas is a challenging task. Conventional monitoring techniques based on e.g. direct observation, are faced with the limitation that urban wildlife is extremely elusive and shy. It was recently shown that blow fly derived DNA can be used to assess wildlife diversity in tropical rainforests. As blow flies are ubiquitous it is conceivable that this new molecular invertebrate-DNA based tool could also be used to detect wildlife in urban areas. However the overwhelming quantity of domestic mammal DNA sources could mask the presence of wildlife species in the urban context. To test whether it is possible to use blow flies for urban wildlife detection we captured blow flies in ten different parks in the city of Berlin, Germany. Their DNA was screened using various pan-mammal PCR assays with different combinations of blocking primers to maximize the ratio of wildlife/domestic animal sequence. The corresponding amplicons were sequenced using a MiSeq sequencing platform. As expected domestic animal sequences were dominant. Nevertheless wild mammal sequences could also often be retrieved. We conclude that it is indeed possible to use blow fly derived DNA for the detection of wild mammals in urban settings. This very cost-efficient tool may be used for quick scans of urban wildlife diversity and, possibly, for more in-depth study of species distribution and abundance across urban landscapes.

76-THE DIFFERENCE CONSERVATION MAKES

Michael Hoffmann

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Previous studies show that conservation actions have prevented extinctions, recovered populations, and reduced declining trends in global biodiversity. However, all studies to date have substantially underestimated the difference conservation action makes because they failed to account fully for what would have happened in the absence thereof. We undertook a scenario-based thought experiment to better quantify the effect conservation actions have had on the extinction risk of the world’s 235 recognized ungulate species. We did so by comparing species’ observed conservation status in 2008 with their estimated status under counterfactual scenarios in which conservation efforts ceased in 1996. We



estimated that without conservation at least 148 species would have deteriorated by one International Union for Conservation of Nature (IUCN) Red List category, including 6 species that now would be listed as Extinct or Extinct in the Wild. The overall decline in the conservation status of ungulates would have been nearly 8 times worse than observed. This trend would have been greater still if not for conservation on private lands. While some species have benefited from highly targeted interventions, such as reintroduction efforts, most benefited collaterally from conservation such as habitat protection. We found that the difference conservation action makes to the conservation status of the world's ungulate species is likely to be higher than previously estimated. Increased, and sustained, investment could help achieve further improvements.

210 A GLOBAL MAP OF ROADLESS AREAS BASED ON THE FREELY AVAILABLE OPENSTREETMAP DATA SET

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Mapping roadless areas on continental and global scales has recently become achievable through enhanced efforts of road mapping and the provision of easily accessible data platforms. Due to the fast and dynamic nature of road expansion, a global assessment ideally would become an ongoing and decentralized process, based on crowd-information sourcing and citizen science. Therefore, we used the OpenStreetMap data set to create a global map of roadless areas including all road categories. For the purpose of the study, "roadless areas" are defined as terrestrial areas that are not dissected by roads and whose boundaries are within at least 1 km to the nearest road. As expected, the highest concentrations of large roadless areas are found in the most remote places on the planet such as deserts, polar and boreal regions. Still, there are also considerably large roadless blocks in the tropics. In general, mapping quality in industrialised, densely roaded regions is better than in economically developing countries. In many tropical countries, this can easily lead to underestimating road impacts. Additional criteria are needed to reflect the critical role of roads in contributing to ecosystem degradation, directly and indirectly. In the poorest countries, precarious dirt roads can have a much higher impact on biodiversity than some paved roads in industrialised countries. In scarcely roaded regions in developing countries, roads often trigger more intensive and

less regulated pressures on biodiversity, which, in addition tends to be characterized by higher richness and uniqueness.

WHITE NOSE SYNDROME, WIND TURBINES, AND BATS OF THE DELMARVA PENINSULA

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Salisbury University

Andrew MCGOWAN, Salisbury University

Bats hibernating in or migrating along the Appalachian Mountains have been heavily impacted by White Nose Syndrome (WNS) and wind turbines, respectively. The extent to which these impacts extend to summer resident bats along the east coast of the United States is not fully known, particularly on the Delmarva Peninsula, which forms the eastern border of the nation's largest estuary, the Chesapeake Bay. Since bats are ecologically and economically important regulators of insect populations, including insect pests on agricultural lands (the peninsula's largest industry), it is important to understand what impact these emerging threats will have on local bats. With the recent expansion of WNS onto the peninsula, and several proposed wind turbine facilities, a peninsula-wide assessment of the bat fauna was urgently needed. We surveyed bats at 280 sites along 28 18 km driving transects across the peninsula. One transect was sampled per night June-August, 2015, starting a half hour after sunset on nights with no rain, temperatures above 10° C, and wind speeds below 20km/hr. Sampling sites were located 2km apart and surveyed for 12 minutes using a MiniMIC microphone extended 4 meters above ground, and connected to a tablet running SPECT'R software. An additional 23 sites were monitored in randomly selected habitats over night to compare results with transects. 4,448 bat passes were recorded in 248 hours of recordings, representing 8 species, the largest ever recorded on Delmarva. While most species were well-represented, only 16 passes could be attributed to the three *Myotis* species known to occur on the peninsula, none of which were *M. septentrionalis*, currently being considered for listing as endangered under the Endangered Species Act. This suggests the heavy mortality experienced by these bats from WNS in the region may have affected summer populations on the peninsula. Additional data on habitat selection and the potential impact of wind turbines will be discussed.

163. A RAPID INTRODUCTION TO ECOSYSTEM-BASED ADAPTATION AND ITS POTENTIAL ROLE IN CONSERVING EARTH'S BIODIVERSITY

David Hole

Conservation International

Ecosystem-based adaptation (EbA) is generally defined as "the use of biodiversity and ecosystem services as part of an



overall adaptation strategy to help people adapt to the adverse effects of climate change". Over the past 5 years interest in EbA has increased exponentially and it now draws on strong support from international bodies (such as the UNFCCC and CBD), to conservation and development organizations, to multi-lateral funding agencies. Indeed, it is increasingly being seen as a win-win for meeting both human adaptation needs and biodiversity conservation goals. However, although EbA has significant potential for reducing the continuing loss of biodiversity, conservation is not the principle goal of EbA – the goal is "to help people adapt". As such, EbA is usually implemented as the targeted management, conservation or restoration of an ecosystem (or ecosystem component) in order to maintain or restore the delivery of a specific ecosystem service(s), as a means of increasing the resilience of, or reducing the vulnerability of, a target group of human beneficiaries. Hence it is largely blind to the conservation value of the ecosystem stock. This has important ramifications for its potential to contribute to biodiversity conservation. We explore some of these ramifications and highlight why a significant focus on biodiversity should nevertheless be a key element of any EbA project. We then explore mangrove ecosystems as a case study to demonstrate the potentially significant role that EbA can play, both in helping people adapt to climate change and in providing a new pathway for conservation.

TROPHIC CASCADES FOLLOWING DISEASE-INDUCED DECLINE OF THE TASMANIAN DEVIL

Tracey Hollings

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Hamish McCallum, Griffith University ; Menna JONES, University of Tasmania ; Nick MOONEY, Environmental Consultant

Infectious diseases of wildlife can have consequences beyond the species they infect. Tasmanian devil facial tumour disease is a host specific infectious cancer that continues to spread across Tasmania, with population declines of up to 90% in affected populations. The Tasmanian devil is the apex mammalian predator in Tasmanian ecosystems and its decline has the potential to cause trophic cascades, including mesopredator release and impacts on prey populations. Two independent lines of evidence, a spotlighting time series and surveys comparing sites with different extents of disease-induced devil decline, provide strong evidence that introduced feral cat numbers have increased concomitant with devil decline. There is evidence that mammal communities are increasingly dominated by invasive species, cascading effects of mesopredator release of cats on prey and decline of the native eastern quoll, a predator smaller than the cat. Further, toxoplasmosis, a parasite for which cats are the obligate definitive host, occurs in wallabies at higher prevalence where devils have declined. Effects on devil prey species are less

obvious, likely because of the influence of bottom-up factors such as food supply, but giving up density experiments show brushtail possums become bolder following devil decline. Tasmania maintains populations of at least four mammal species that are extinct on the Australian mainland because of feral cat and European red fox predation. Foxes were illegally introduced to Tasmania a decade ago, but remain at very low numbers. Disease induced devil decline in Tasmania threatens to cause increases in both cat and fox numbers, leading to declines or extinctions in native species. Tasmanian devils were widespread on the Australian mainland until about 5000 years BP. Our work suggests that reintroduction of disease free devils to the Australian mainland may produce biodiversity benefits beyond those to the devil itself, by suppressing introduced feral predators.

117 PRIVATE PROTECTED AREAS AND MARKETS IN CONSERVATION IN SOUTHERN CHILE

George Holmes

University of Leeds

This paper examines the diversity and complexity of initiatives labelled as market-based conservation, particularly expanding our ideas for what constitutes market-based conservation, and the implications this has for how we consider the perils and promises of this trend. It does so through an exploration of private protected areas - conservation areas owned and managed by NGOs, businesses, individuals and co-operatives - in southern Chile. Here over 300 private areas cover over 4% of land surface area, including large extensions of endangered habitat. They display a broad range of approaches to markets and making money, from businesses using ecotourism and carbon markets to generate profits to those funded by philanthropic largesse and which consciously minimise commercial activities. Yet all these areas have been made possible by government structures, particularly property rights and land market reforms, designed to foster investment in land. Ironically, these reforms were intended to foster the extractive industries and plantation forestry, but have been used by conservationists to buy land and prevent such exploitative uses. By using free markets in property, private protected areas can be considered a form of market-based conservation, even if they contain no other commercial activities. The paper argues that market-based conservation should be thought of not just in terms of how money for conservation is generated, or through creating incentives for pro-biodiversity behaviour, but through wider political and economic context in which they occur, such as property rights, government policies and broader social attitudes towards markets and conservation, and that our assessment of its perils and promises should reflect this.



WHO HAS CONTROL? ASSESSING THE SIGNIFICANCE OF SELF-DETERMINATION IN CONSERVATION

Danielle Holstein

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With the shift to ecosystem-based management (EBM) there are increasing calls to assess how human wellbeing is related to ecosystem health and conservation success. Research in the social sciences suggests that self-determination, or the power and freedom to control one's life and one's choices, is a fundamental requirement for wellbeing, enabling independent economic decisions, cultural expression, lifestyle choices, and political participation. While there is growing documentation of the material and cultural benefits of ecosystem services, self-determination as a domain of human wellbeing has received less attention in ecosystem assessments. This paper discusses the significance of self-determination in the context of conservation and EBM, and models a method for assessing key dimensions of self-determination using measurable indicators. Self-determination can be conceptualized via a typology that accounts for how power and freedom operate at different scales (personal vs. widespread) and at varying levels of influence (daily life vs. political power). Based on an exhaustive literature review, over 50 potential indicators of self-determination relating to marine and coastal management of the US West Coast were evaluated according to predefined screening criteria. Top-scoring indicator categories included stakeholder participation in decision-making, formal co-management arrangements, and tribal rights and sovereignty. With self-determination as an example, this paper introduces a systematic and transparent method for selecting a suite of human wellbeing indicators to inform ecosystem-based management in a range of contexts. Ultimately, an understanding of self-determination suggests how the process of ecosystem assessment can itself improve wellbeing by ensuring that local stakeholders guide definitions of wellbeing, resources of interest, and the final selection of indicators.

WORKSHOPS 217 : PROPAGATION OF NATIVE TREES BY LOCAL COMMUNITIES IN THE FORESTS OF KETOU: A NEW CHALLENGE FOR HABITAT RESTORATION IN BENIN REPUBLIC

Alfred Hounnon

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This work, supported by the Rufford Foundation, is a pragmatic, substantial and long lasting contribution to nature conservation. It aims at including the contributions of the stakeholders in the sustainable management of natural resources from a remnant forest in Ketou region (Benin

Republic). Ketou region has a long history of cultures combined with its biodiversity, including endemic plant species, concentrated in the unique Ewe-Adapklamey fragment forest. An exploration of available plants from this forest allowed to establish a preliminary list of useful tree species. So, knowledge of their current status would be updated and improved for conservation priority in Benin. In order to understand how the stakeholders can participate to the conservation activities, Farmer Field Schools known as a Group Extension Method based on adult educations method have been used to assess and take into account the expectation of local population. It consists to test an inexpensive Vegetative Propagation method, reproducible by local communities. We will present this group-based learning process and how it allows us to collect data from the current indigenous conservation practices. This study gives us an instance to understand how indigenous people can participate to the conservation function and the sustainable management of plant resources at local scales. It would be of the utmost interest if our project could beneficiate of collaborative Web tools and we will discuss the requirement to setting up.

THE POPULATION TRENDS OF EUROPEAN MIGRANT BIRDS: UNDERSTANDING THE DRIVERS ON BOTH THE BREEDING AND NON-BREEDING GROUNDS

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Philip A STEPHENS, Durham University ; James W PEARCE-HIGGINS, British Trust for Ornithology ; Stephen G WILLIS, Durham University

Over recent decades a trend has emerged, whereby migratory species are experiencing more rapid population declines than their resident counterparts, a phenomenon increasingly being attributed to changes in climate. However, the relative contribution of climate and/or habitat changes on species' breeding and non-breeding ranges is contentious and has not been satisfactorily addressed to date. Here, we evaluate the relationship between changes in climate suitability across the breeding and non-breeding ranges and the long term population trends of 108 resident, short, and long-distance migratory species of European breeding birds. We demonstrate a striking relationship between recent changes in climate and trends in population sizes at a supranational level. Moreover, we identify significant variation in the relative importance of climate and habitat between a species' breeding and non-breeding grounds for determining population sizes and that the strength of these relationships varies between short and long distance migrants. With the current focus of conservation activity principally on these species' breeding grounds, our findings provide important insight into how to stem the decline of migrants.



DEMAND-SIDE APPROACH TO DELIVERING THE BENEFITS FROM ECOSYSTEM SERVICES

Caroline Howe

UCL

Georgina MACE, UCL

Ecosystem services (ES) are the biophysical processes of ecosystems that provide benefits for human well-being. Most ES assessments explicitly assume spatial and temporal connections between ES provision and beneficiaries. However, most ES are only consumed after input of natural, social and manufactured capital (conversion to benefits). To date ES research has focused predominately on the supply of ES, with little attention on the demand for the benefits they provide. ES projects for human well-being also often focus on achieving 'win-wins', despite the fact that many social, economic and ecological goals are competitive. Previous research has shown that there are a number of predictors for a trade-off but no generalisable profile of a win-win. In this paper we take a novel approach to ES research by focusing on demand for benefits produced, through looking at the trade-offs between benefits and their respective beneficiaries. Using systematic mapping of the literature from 2000 to 2013, we identified 1324 potentially relevant papers, 92 of which were selected for the review, creating a database of 231 actual or potential recorded ES trade-offs and synergies. Firstly, we looked at observed ES trade-offs curves across these multiple ES studies, at both the ES level and the benefit level. Secondly we explored the metrics of biodiversity that underpin these different benefits, using counterfactuals that explore how benefits alter under natural and managed ecosystems. We find that there are key thresholds and tipping points between different ES and benefits, as well as specific regions where trade-offs are more likely to occur, which often overlap with regions of high poverty. By looking at the biodiversity metrics underpinning these trade-offs it is possible to identify regions that are critical to maintaining the supply and flow of benefits and to prioritise areas for conservation or development.

99-CONNECTING PEOPLE WITH NATURE

Helen Hoyle

University of Sheffield

James HITCHMOUGH, University of Sheffield ; Anna JORGENSEN, University of Sheffield

What sort of designed urban planting makes the average person happy? Is the most biodiverse urban planting the least attractive to people or can designed urban planting that is attractive to people also be beneficial to 'wildlife'? How do the general public react to urban planting with an unfamiliar character which might be better adjusted to our warmer future? To answer these questions we surveyed 1403 members of the public using site – based questionnaires, whilst

walking through woodlands (n=13), shrub planting (n= 8) and herbaceous sites (n=10) of varying structure and species character in relation to the semi – natural vegetation of the UK. Semi – structured, in – depth interviews were then carried out with 34 of the questionnaire respondents. A model is proposed linking perceptions and preferences to planting stimuli, human socio – demographic factors and underlying values. 'Preference' in relation to the structure and species character of the planting is then explained in terms of both perceived attractiveness and potential to induce relaxation and well – being. The relationship between the perceived attractiveness and perceived biodiversity value of planting is explored. This research shows that ordinary people can appreciate diverse urban planting. Both perceived attractiveness and potential to induce relaxation and well – being were positively related to perceived biodiversity value of the planting. People can prefer planting which is better adapted to future climates, yet reactions were varied, complex and largely dependent on existing beliefs and values relating to climate change.

MONITORING WILD MAMMALS IN COUNTY DURHAM WITH A CITIZEN SCIENCE WEB PLATFORM

Pen-Yuan Hsing

Durham University

Steven BRADLEY, Durham University ; Vivien KENT, Durham Wildlife Trust ; Russell HILL, Durham University ; Mark WHITTINGHAM, Newcastle University ; Philip STEPHENS, Durham University

Changing land uses, the spread of invasive species and disease, and anthropogenic climate change have exacerbated the loss of habitat and biodiversity. Tackling these issues require effective ecological monitoring over large spatial and temporal scales. The ease with which such monitoring can be implemented varies among taxa. Many mammal-monitoring methods, such as track or scat counts, line transects, or mark-recapture studies, require intensive effort and are seldom employed over large scales. This is problematic, because good monitoring data are essential to managing these species of ecological, economic, and cultural importance. We developed a wildlife monitoring network, named Mammal Web, consisting of motion sensing camera traps, which are non-intrusive and need little user intervention. We started with a core set of monitoring sites established by student volunteers on Durham University grounds. To scale the network over a larger geographical area, we augmented our camera traps with those volunteered by citizen scientists in County Durham, U.K, a first for a citizen science website. Resultant photographs are uploaded to the Mammal Web website, where users can collectively classify the imaged fauna. To attract and retain citizen scientists, we are implementing (1) an achievement system based on user metrics such as the number of images classified, and (2) interactive graphs showing outputs from



the project. The achievement system could identify the most skilled users, who would be invited for advanced work such as resolving uncertain classifications, or classifying the age and sex of animals. Also, we are developing quantitative techniques based on mark-recapture or random-encounter models for deepening ecological understanding within the monitoring network. It is hoped that these efforts will provide Mammal Web with high scalability, and supplant existing wild mammal monitoring in the U.K., which is low intensity and reliant on direct sightings.

GAINS AND LOSSES FOR BIODIVERSITY IN THE LARGE-SCALE REFORESTATION UNDER CHINA'S GRAIN-FOR-GREEN PROGRAM: REGIONAL INSIGHTS FROM SW CHINA

Fangyuan Hua

Princeton University

Xiaoyang WANG, Kunming Institute of Zoology, Chinese Academy of Sciences ; Douglas W. YU, Kunming Institute of Zoology, Chinese Academy of Sciences ; Scott K. ROBINSON, University of Florida ; Ya TANG, Sichuan University ; David S. WILCOVE, Princeton University

China's Grain-for-Green Program (GFGP), among the world's largest PES programs, has established >20 million hectares of forest on former farmland and scrubland since 1999. The enormous scale of ensuing land cover change suggests potentially massive biodiversity implications, but our understanding of GFGP's biodiversity impacts and their determinant factors remains minimal. We aim to assess the biodiversity impacts of GFGP reforestation on farmland and understand factors determining such impacts in west-central Sichuan Province, a region with high biodiversity value that has undergone substantial reforestation under GFGP. In five habitat types involved on large scales in GFGP (farmland, mixed forest, eucalyptus forest, bamboo forest, and Japanese cedar forest) and in natural forest, we used point and transect count and fluorescent pan trapping to survey for bird and native bee biodiversity in summer and winter 2014. We combined metabarcoding techniques (for bee identification) with robust abundance modeling to estimate species abundance and richness. Our finding suggests that while the four types of reestablished forests do harbor forest-dependent bird and bee species not found on farmland, they support 30~70% fewer such species and 40~80% lower species abundance compared to natural forest. Open-habitat species associated with farmland are minimally represented in reestablished forests, suggesting a biodiversity tradeoff in converting farmland to forest habitats. Importantly, reestablished mixed forest harbors far more biodiversity than monoculture forests, accounting to ~60~80% of that found in natural forest. Given that households decision making in tree species choice and forest use crucially

determines the type of reestablished forest particularly between mixed and monoculture forest, our finding suggests the great, but not yet utilized, potential of GFGP to benefit biodiversity by incentivizing and influencing reforestation approaches.

#134 - NON-SPATIAL USES OF MARXAN AS A CONSERVATION PLANNING TOOL

Patrick Huber

University of California Davis

Symposium number 134 Marxan is a conservation planning tool used in a variety of reserve selection contexts. Typically these are spatially-explicit landscape assessments for the identification of a complementary set of reserves that address a full suite of conservation goals. However, the algorithm driving the tool is not inherently spatial in nature; it is a general optimization process. Therefore, it has potential uses for conservation planning in non-spatial contexts as well. Here I present two examples of the use of Marxan in such situations. The first is an effort to identify short lists of sustainability indicators for agricultural sourcing that address a wide array of sustainability issues. Each indicator was linked to the issues that it could be used to measure. Then the issues were treated as "species" and the indicators as "planning units". Marxan was used to reduce the total set of 2,064 indicators to 23-31 which fully covered the 369 issues, depending on the specifics of the scenario. This dataset of issues and indicators coupled with an optimization tool such as Marxan can then be used to identify small sets of indicators across a wide variety of sustainability assessment efforts. The second project used this approach to identify a potential plant palette for a riparian restoration site that would provide a wide variety of ecological resources. The 1.3 ha Lower American River Mile 0.5 Aquatic Riparian Habitat Enhancement Project in Sacramento, California, USA is an effort to restore 335 m of river to a historic riparian condition. We linked 172 native plant species to resources such as bloom periods, pollinator use, and bird use. Then, treating the plant species as planning units and the resources as species we identified suites of 32-42 species that could potentially provide the full set of resources at the site. These novel examples demonstrate the utility of Marxan in contexts outside those for which it was designed, and we believe could be replicated in many new ways.

THE LOIRE NATURE RESOURCES CENTER AS A RESEARCHERS - CONSERVATION PRACTITIONERS LINKING TOOL

Stéphanie Hudin

Fédération des Conservatoires d'espaces naturels



The Loire nature program has since 1992 given great opportunity to natural areas practitioners for working together on wider scale conservation projects. At the end of the second phase of the program (2006) they identified a need to collect non edited literature, know-how and to present their work in a common project. The natural areas Conservancies Federation was a partner of the coordination from the start and initiated a project of a resources center. It collects the relevant literature, reports and documentation of all sorts, to inform the community of managers in the Loire catchment. The meta data presented in a single website helps the collectivities to find the information on the wetland and biodiversity of the basin. The associated team also organizes events to link the research and practitioners communities, focusing on certain topics of common interest: e.g. natural heritage, protocols and indicators, sedimentary transport and alluvial forests. The resources center has been involved in following research project on the ecosystems, as a bridge for collaboration as well as a diffuser of the results. It has also been included in research projects to coordinate the work with the practitioners, some research results being translatable in change of practices by the managers, or tool to prioritize actions. As a tool mainly aimed at practitioners and with more than 1500 contacts registered to the newsletter, is it still little known by a wider audience. The fourth phase of the Loire nature program (2015-2020) will give new opportunities to reach the public and facilitate the link with the research.

NEAR REAL-TIME LAND CHANGE AND PHENOLOGY MONITORING USING A DATA PROCESSING MIDDLEWARE: EXAMPLES FROM AFRICAN FOREST CONSERVATION AREAS

Christian Huettich

Friedrich-Schiller-University Jena

Jonas EBERLE, Friedrich-Schiller-University Jena ; Ralph ADEWOYE, Friedrich-Schiller-University Jena ; Victor ODIPO, Friedrich-Schiller-University Jena

Earth Observation data are available around the globe and can be used for a wide range of applications. Dependent on the spatial resolution local and regions conservation projects can facilitate from global Earth observation (EO) data. A lot of applications are reasonable with the use of vegetation time-series information based on EO data. To support local stakeholders in the usage of information from space existing barriers – especially in data processing – need to be limited. Therefore a web-based earth observation data middleware infrastructure (Earth Observation Monitor - EOM) provides automated and operational time-series access and analysis of several EO data. Data is being automatically downloaded and processed. Time-series analysis tools (breakpoint and trend

detection, phenological analyses) were integrated to extract Essential Biodiversity Variables (EBV) relevant information (phenology, habitat change). Two EOM applications of land cover change and vegetation phenology monitoring are demonstrated for afro-montane forests in Nigeria and the savanna ecosystem of the Kruger National Park in South Africa. Time-series data from NASA MODIS sensor from the year 2000 to 2014 were analysed using the Break For Additive Season and Trend (Bfast) model to detect deforestation patterns of the forests of the Mambilla Plateau in Nigeria. Results from the web based EOM analysis showed that deforestation started in 2002 ongoing from the surrounding settlements. A retrospective survey of the deforestation patterns could be realized using web-processing techniques of MODIS time series. Applications of phenological monitoring of savanna vegetation types are demonstrated for different disturbance regimes in the Kruger National Park in South Africa. This presentation is linked to the round table discussion Essential Biodiversity Variables for Conservation needs (147) where the presenting author is involved in.

#134: STRATEGIC CONSERVATION PLANNING FOR THE POLAR REGIONS

Falk Huettmann

Uni of Alaska Fairbanks

The polar regions are essential for mankind and the globe. Three Poles exist (Arctic, Antarctic and the Hindu Kush-Himalaya), and the maintenance of (cold) temperature unites them across borders. Here I show a refined Strategic Conservation Planning run how areas relevant for ice and world temperature can be maintained and optimized, and be put onto the global agenda. Based on Marxan and OpenGIS I use 'biodiversity' as one metric for assessment and success of the model runs. High latitude and altitude show as focus areas, but also the ocean shelf region play a role. While the human population is not well included yet, together with other stakeholders and socio-economic data, such gaps are to be filled in subsequent efforts involving agencies and NGOs. The current state of the poles shows a striking disconnect with the global community, and which is to be overcome further.

HOW HAS CARRYING CAPACITY OF PANTHERA TIGRIS CHANGED FROM 2008-2013 IN BARANDABAR CORRIDOR FOREST ? A PREY SURVEY ANALYSIS OF P. TIGRIS IN THE BUFFER ZONE OF CHITWAN NATIONAL PARK IN SOUTHERN NEPAL.

Audra Huffmeyer

University of Michigan

Chitwan National Park (CNP), in southern Nepal, is home to one of the highest population densities of Royal Bengal tigers



(*Panthera tigris*). Isolation of tigers within CNP threatens the future of this species. Thus, a bufferzone, Barandabar Corridor Forest (69 km²), was created to provide additional habitat. The goal of this study is to estimate the current carrying capacity of tigers in Barandabar Corridor Forest and determine how carrying capacity has changed from 2008-2013 in order to better understand how tigers use the buffer zone and if the bufferzone is important for tiger conservation. Since the local people claim forest quality has improved over time, I hypothesized there will be an increase in prey abundance each year and an increase in tiger carrying capacity each year. Ungulate survey data was collected each spring from 2008-2013 and analyzed using Program DISTANCE 5 to estimate ungulate densities. Data analyses revealed Barandabar Corridor Forest is, currently, able to support three adult tigers and from 2008-2013 the carrying capacity of Barandabar Corridor forest increased by one whole tiger. The results of this study are identical with the 2010 national camera trap data, which revealed three adult females occupy the bufferzone

CAN COCOA IMPROVE CONSERVATION OUTCOMES? ASSESSING THE AVIAN DIVERSITY OF A TROPICAL FOREST/AGRICULTURE LANDSCAPE IN WEST AFRICA

Mark Hulme

RSPB Centre for Conservation Science

Fiona SANDERSON, RSPB Centre for Conservation Science ;

Juliet VICKERY, RSPB Centre for Conservation Science

Agricultural landscapes in the tropics often incorporate or lie alongside tropical forest, a declining habitat of high biodiversity value. Wildlife populations may be dependent on habitat connectivity between and around forest patches and assessments of wildlife in forest and associated human-altered landscapes can indicate which land uses might result in improved connectivity. We present findings from the first stage of a three year project aimed at determining the impact encouraging cocoa production might have on wildlife in and around the Gola Rainforest National Park (GRNP) in Sierra Leone, part of the Upper Guinea Forest Ecosystem, a top priority region for conservation due to high levels of endemism. GRNP consists of three forest blocks making connectivity particularly important and we must also find win-win solutions for wildlife and the very poor human population, which benefits from cocoa as one of the few sources of income locally. Cocoa may represent a better habitat for wildlife than other agriculture, often requiring less tree-felling activity. We investigated how best to quantify avian diversity across habitats, from slash-and-burn agriculture, active and abandoned cocoa, community forest outside GRNP and forest inside GRNP, using bird point count data collected between 2013 and 2014. We estimated encounter rate by habitat for each bird species and grouped these by forest dependency to compare between habitats using geometric means. We found

that forest dependency can highlight differences between GRNP and human-impacted habitats whilst differences between human-impacted habitats might be better described using variations in use by generalist species. The greater use of slash-and-burn by generalists suggests that this may not represent a good substitute habitat for forest. We finish by discussing some possible impacts of the Ebola outbreak on conservation and agriculture in West Africa.

LANDSCAPE GENETICS OF GREY WOLVES AT THE RANGE EDGES IN CENTRAL EUROPE

Pavel Hulva

Charles University in Prague

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Local extinctions and range fragmentation of the grey wolf, followed by recent re-expansion is raising many controversial conservation issues. At the range edges of re-expanding populations, many biological processes affecting fitness may play the role. For example, due to recurrent bottlenecks, founder effect and drift, reduction of genetic variation may occur. Loss of heterozygosity may result in inbreeding depression, Allee effect in low density populations may affect reproduction success. Hybridization with feral dogs and introgression of "domestic" alleles can affect the species as well. These phenomena may be partly compensated by high mobility and gene flow typical in large carnivore populations, however, it may prevent evolution of local adaptations as well. These issues are especially pronounced in Central Europe. We describe the genetic structure of the species within this region using nuclear microsatellites and mitochondrial sequences. This region is connecting relatively large population in the east and fragmented ones in the west and may serve as a bridge between the East-European and Balkan populations via Carpathian mountains. Also different ecological forms of the species including lowland and mountain ecotypes are present here. Moreover, wolves of both mitochondrial haplogroups, which possibly represent lineages with different ecology, can meet in this region, providing further options for increasing of the genetic variability. Central Europe thus represents a diversity hotspot and a crossroad of potential dispersal corridors of grey wolves with urgent need of respective conservation management.

IMPACTS OF NITROGEN ADDITION ON PLANT BIODIVERSITY IN MOUNTAIN GRASSLANDS DEPEND ON DOSE, APPLICATION DURATION AND CLIMATE: A SYSTEMATIC REVIEW

Jean-Yves Humbert



University of Bern

John DWYER, The University of Queensland ; Aline ANDREY, University of Bern ; Raphaël ARLETTAZ, University of Bern

Although the influence of nitrogen (N) addition on grassland plant communities has been widely studied, it is still unclear whether observed patterns and underlying mechanisms are constant across biomes. In this systematic review, we use meta-analysis to investigate the influence of N addition (here referring mostly to fertilisation) upon the biodiversity of temperate mountain grasslands (including montane, subalpine and alpine zones). 42 studies met our criteria of inclusion, resulting in 134 measures of effect size. The main responses of mountain grasslands to N addition were increases in phytomass and reductions in plant species richness, as observed in lowland grasslands. More specifically, the analysis reveals that negative effects on species richness were exacerbated by dose (ha⁻¹ year⁻¹) and duration of N application (years) in an additive manner. Thus, sustained application of low to moderate levels of N over time had effects similar to short term application of high N doses. The climatic context also played an important role: the overall effects of N addition on plant species richness and Shannon index were less pronounced in mountain grasslands experiencing cool rather than warm summers. Furthermore, the relative negative effect of N addition on species richness was more pronounced in managed communities, and was strongly negatively related to N-induced increases in phytomass. Altogether, this review not only establishes that plant biodiversity of mountain grasslands is negatively affected by N addition, it also demonstrates that several local management and abiotic factors interact with N addition to drive plant community changes. This synthesis yields essential information for a more sustainable management of mountain grasslands, emphasizing the importance of preserving and restoring grasslands with both low agricultural N application and limited exposure to N atmospheric deposition.

SYMPOSIUM #20: TRACKING TECHNOLOGIES AND GREAT APE TRANSLOCATION: CHALLENGES AND POTENTIALS

Tatyana Humle

Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, University of Kent
James ROBINS, Tabin Orangutan Project, Tabin Wildlife Reserve

Great ape rehabilitation centres across Africa and Asia continue to witness an increase in residents, often orphans of the bushmeat and pet trade or victims of people's intolerance towards sharing resources and space with their closest living relatives. As wild populations decline, releasing individuals back to the wild is increasingly perceived as a viable conservation option. However, post-release monitoring

can oft be challenging, and information on predictors of rehabilitation and release success remain scarce. Tracking technologies can provide an effective means to facilitate post-release monitoring; however, several factors challenge their application and usage across great ape species and different habitat types. This paper aims to review different systems used or piloted to date among great apes and their advantages and disadvantages. Lessons will be drawn especially from the Tabin Orangutan Project, Sabah, Malaysia and the Chimpanzee Conservation Center (CCC). The CCC is the only sanctuary caring for chimpanzee orphans in Guinea, West Africa and has released 16 rehabilitants since 2008 in the High Niger National Park where it is located. Post-release monitoring of released chimpanzees at the CCC involves distance monitoring using simple VHF and/or ARGOS and GPS store-on-board radio collars. GIS data generated has yielded useful information on release individuals' social dynamics, habitat preferences, day and home range use. Tabin was the first field project to trial implanted VHF radio transmitters developed at the University of Vienna in 2009. This new method for relocating reintroduced individuals has to date enabled behavioural data collection on nine orphaned orangutans. However, implants suffer from reliability and range issues. Our results highlight the costs and benefits of different tracking technologies, species-specific challenges, and the scope and importance of developing novel systems for effective post-release monitoring of great apes.

EFFECTS OF PASTURE BASED DAIRY FARMING ON GRASSLAND BIRD SPECIES IN SOUTHWEST MICHIGAN, USA

Lindsay Hunt

Michigan State University
Brian MAURER, Michigan State University ; Gary ROLOFF, Michigan State University

Changes in land use, agricultural practices, and the subsequent reduction of mosaic grassland, which vary spatially and temporally in structure, have resulted in dramatic and range wide population declines of grassland birds. These grassland species have exhibited more substantial and continuous population declines than any other behavioral or ecological guild. To understand the impact of agricultural practices, we investigated if grassland bird communities differed on dairy pastures and grassland fragments and if vegetation structure and composition contributed to bird community differences in southwest Michigan, United States. Rather than relying on bird counts, we created utilization distributions to analyze these bird communities. Correspondence analysis indicated that pasture and grassland bird communities differed. Based on this analysis, specific species were shown to be more strongly associated with dairy pastures or grassland fragments. Canonical correlation analysis confirmed that vegetation structure and composition contributed to variation in species



distributions, suggesting that the species-specific associations found in the correspondence analysis were at least partially due to the vegetation structure of the dairy pastures and grassland fragment. Species-specific models indicated that some grassland birds were associated with unique vegetation characteristic. We concluded that species-specific habitat requirements are generally fulfilled through mosaic grasslands and that both grasslands and agriculture fields should be managed to maintain mosaics vegetation structure that varies spatially and temporally in order to maintain a diverse community of grassland bird species.

REINTRODUCING TASMANIAN DEVILS TO MAINLAND AUSTRALIA CAN RESTORE TOP-DOWN CONTROL IN AREAS WHERE DINGOES HAVE BEEN EXTIRPATED

Daniel Hunter

University of New South Wales

Mike LETNIC, University of New South Wales ; Thomas BRITZ, University of New South Wales ; Menna JONES, University of Tasmania

Loss of strongly interactive species, particularly large carnivores, is a global phenomenon that can be a catalyst for species extinction and ecosystem degradation. Restoring missing ecological interactions by reintroducing locally extinct or surrogates for extinct species has been mooted as an approach to restore degraded ecosystems. Australia's apex predator, the dingo, is subject to population control in order to prevent attacks on livestock. Dingo control has been linked to ecological cascades evidenced by irruptions of herbivores and introduced mesopredators and declines of small and medium mammals. Maintenance of dingo populations is untenable for land managers in many parts of Australia due to predation on livestock. However, it may be possible to fill the apex predator niche with the Tasmanian devil which has less impact on livestock. Devils once occurred throughout Australia, but became extinct from the mainland about 3000 years ago. To explore the feasibility of reintroducing devils to mainland Australia we used a species distribution model (SDM) and fuzzy cognitive mapping (FCM) to determine if suitable climatic conditions for devils exist and predict the effects of devil reintroduction, respectively. Based on devil distribution in Tasmania, our SDM indicates suitable areas for devils exist in south-eastern Australia. In our FCM we tested ecosystem responses to predator control scenarios by manipulating the abundances of devils, dingoes and foxes. Our FCMs showed devils have cascading effects similar to, but weaker than those of dingoes. Devil introduction was linked to lower abundances of invasive mesopredators and wallabies. Small and medium mammals and understory vegetation increased with devil introduction. However, threatened species vulnerable to fox predation benefited little from devil introduction in our

simulations. Our study suggests that reintroducing ecological surrogates for apex predators can yield benefits for biodiversity conservation.

101 AN INTRODUCTION TO CONSERVING SMALL NATURAL FEATURES WITH LARGE ECOLOGICAL ROLES

Malcolm Hunter

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Many places have small natural features that are far more important for maintaining biodiversity or providing ecosystem services than their size would indicate, thus making them keystone elements in landscapes. Examples include springs in a desert, rock outcrops, and temporary pools and waterways. The importance of some of these features, most notably riparian zones, has long been recognized. In other cases, our recognition of their role is just emerging: e.g., caves that harbor large bat colonies known to effect widespread control of insect pests. Even single large, old trees have disproportionate value. A diverse set of conservation tools has emerged to conserve these features, but these tools lack strategic coordination and ecological coherence. These landscape elements arguably are too small and scattered to be effectively managed at the usual scale of ecosystem management. Furthermore, the usual tensions between private property rights and public rights to environmental protection are exacerbated in these cases by a spatial mismatch between regional accrual of beneficial services and local costs of protection. Nevertheless, small natural features present novel opportunities because they can usually be protected while allowing traditional activities such as forestry, fishing, and grazing to continue nearby and they are often owned by a single landowner, thus avoiding difficult multi-landowner coordination. We will examine seven examples of these features, asking: 1) why are these features important, both ecologically and economically; 2) what are the current management challenges; and 3) what are some innovative approaches to conserving these features. We will then detail one emergent example of an innovative approach to conserving small features and, finally, take a synthetic look at the socio-economic issues that underlie their conservation.

WAITING TO SPEND CAN BE AN OPTIMAL STRATEGY, EVEN IN A CRISIS DISCIPLINE

Gwenllian Iacona

University of Queensland

Michael BODE, University of Melbourne ; Hugh POSSINGHAM, University of Queensland

Biodiversity conservation is a crisis discipline, plagued by increasing threats and chronic funding constraints. We explore the consequences of conservation organizations



reacting to this state of crisis by rushing to spend money as soon as possible after they secure it. "Front-loading" of spending on conservation goals is understandably common because agencies want to address imminent threats. Rapid spending may also be driven by funding sources' demands for demonstrable outcomes within a few years, and conservation agencies desire to use successful projects as justification for further funding. We demonstrate that this approach may not always be the best strategy for promoting conservation outcomes. Waiting to spend has a range of benefits that can justify conservation inaction under the right conditions. Delays allow for time to invest in capacity building or to leverage additional money. We developed a theory of conservation investment that outlines the costs and benefits of two manager options: spend now or invest to spend later. Our modelled system allows manager actions to counteract declining biodiversity decreases with time but also includes the potential for available funds to increase if spending is delayed. We find that waiting to spend can be the optimal strategy, regardless of interest rate, if funding is limited and the regional biodiversity decline is not instantaneous after local degradation. The optimal timing of spending represents a balance between the rate at which conservation funds appreciate in value (e.g., through interest rates), and the rates of biodiversity decline. Competing rates of biodiversity decline and potential funding increase are present in many systems, but we illustrate an application where restoration can counteract an extinction debt in forest dwelling birds. We show that with feasible interest rates, greater conservation outcome can be achieved by front-loading only a small proportion of available funds.

210 WHERE THE ROADS DON'T GO: ECOLOGICAL CHARACTERISTICS AND PROTECTION STATUS OF THE WORLD'S ROADLESS AREAS

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We present the first comprehensive global assessment of roadless areas (excluding Antarctica and Greenland), based on OpenStreetMap data, that revealed almost 600,000, mostly very small patches of roadless areas (e.g., mean patch size in Europe is 26.5 km² vs. >500 in Asia). Following the 'anthromes approach' of land classification (Ellis et al. 2010), worldwide, 26% of the roadless areas are associated with 'uninhabited or sparsely inhabited treeless and barren lands,' 21% correspond with 'natural and remote semi-natural woodlands,' and just 17% are 'wild woodlands.' Roadless areas were also recorded for cultural landscapes including a third of the world's rangelands, suggesting the correlation between roadless areas and naturalness is not consistent. For the biomes, 'Tundra,' 'Rock and Ice-Covered' regions are almost 100% roadless, whilst 'Temperate Broadleaf and Mixed Forests' record lowest values of <40%. In the Tundra also a relatively high share of roadless areas are strictly protected (10% IUCN I or II). In comparison, in 'Tropical Moist Broadleaf Forest' around 6% and in 'Temperate Broadleaf and Mixed Forests' less than 2% of the roadless areas are strictly protected. In general, protection efforts do not seem to give special attention to roadless areas. Protection coverage of roadless areas is particularly low in Asia and Africa (2.5 and 3.9%, respectively). The detailed analysis of land cover and biodiversity values as well as protection coverage of roadless areas provides concrete guidance to global conservation priority-setting and action.

ADAPTATION OF OASIS OWNERS TO THE ERG CONSTRAINTS, AN ANCIENT PROCESS OF STRUGGLE AGAINST SAND DUNE CASE STUDY OF TAGHOUI OASIS - SOUTHERN LIMITS OF THE GREATEST WESTERN ERG

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Considered as one of the largest stretches of sand in the world, the Greatest Western Erg covers a large areas of the south-western part of Algeria. Despite multitude constraints it poses to through and operate its surfaces, farmers were able to adapt with these conditions and to settle on its southern border. This installation, which began since many centuries, is conditioned by the mastery of struggle against the sand dunes. The choice of these sites for the occupation results of hydrogeological conditions characterized by groundwater found less than 1 meter deep, it is the Erg water table which is easy to use in inter-dune areas and allows a culture without irrigation. In parallel, a huge job to be carried out during the year to fight



against the silting of cultivated land. In this context we have tried to schematize the process of creating an oasis in this hyper-arid area, without using technical means and modern equipment. The choice of our oasis is mainly based on the possibility of finding a model that can be used to improve the presentation and diagnosis of this oasis system. Our work was based on a survey together with the field observation that allowed us to highlight the steps for creating the oasis of Erg, this creation is accompanied by three types of fight against sand dune siltation: dredging that lasts along the quiet period of the year, mechanical control by the dune-affreg and biological control through the implementation of the palm and other crops in the form of strata. It is through these control methods, depend on a very specific socio-economic organization, that oasis of Erg could resist the centuries.

CAN AMPHIBIANS BE USED AS UMBRELLAS FOR BIODIVERSITY CONSERVATION IN PONDS?

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Amphibian decline led to worldwide conservation efforts, including the prioritization of sites for their protection. These sites could also contribute to the conservation of other freshwater taxa. Our study aimed to test whether amphibians could act as a potential umbrella for biodiversity in ponds, a particular type of freshwater ecosystem often characterized by a rich and diverse fauna and flora. We assessed the role of amphibians as surrogate for dragonflies, aquatic beetles, gastropods and aquatic plants in 89 ponds belonging to the Swiss amphibian breeding sites of national importance. Cross-taxon correlations in species richness and conservation values between the amphibians and the four other taxonomic groups were low in the studied ponds. Significant but weak congruence in community composition was found between the amphibians and the dragonflies, aquatic beetles and plants. The use of amphibians as surrogate for pond biodiversity is therefore questionable. Further, some ponds of low interest for amphibian conservation were important for the other freshwater taxa. A global pond biodiversity conservation strategy should therefore also consider ponds poor in amphibians. Furthermore, we suggest considering several taxonomic groups both for pond biodiversity evaluation and selection of sites for biodiversity conservation.

24: SUSTAINING THE USEFUL LIFE OF NETWORK GOVERNANCE: LIFE-CYCLES AND DEVELOPMENTAL CHALLENGES IN WATERSHED PARTNERSHIPS

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Governance networks for large landscape conservation are important because they are used to make collective decisions, set shared policies or priorities, improve coordination, and find new ways for members to productively work together. This paper focuses on the dynamic nature of governance networks reflected by the way they form, disappear, or change in response to new programs, problems, capacities, funding opportunities, and leaders. This paper presents a 4-stage life-cycle model is used to describe the cluster of challenges confronting network members when designing and sustaining healthy and useful governance processes. The model is then used to contrast the development of governance networks in 4 watersheds in the United States – Delaware Inland Bays, Narragansett Bay, Tampa Bay, and Tillamook Bay. These cases demonstrate that advice related to sustaining healthy and useful network processes must consider where the network is in its developmental process. The concept of a healthy and useful life is draws attention to the constant nurturing that network processes require. The cases also demonstrate that while some networks are designed to endure for long periods of time, this is not always the case. Networks, like other organizational forms are a functional enterprise and have a useful life. When the useful life has passed, it is time to disband, re-orient, or re-create the network to allow its resources to be redeployed in more productive public purposes. Just as we believe that network processes are best left to develop at their own pace, they should also be allowed to die when their useful life has passed. This frees up scarce network resources that can be deployed to better address landscape conservation problems.

EFFECTS OF HABITAT FRAGMENTATION ON THE DIVERSITY OF INSECT PARASITOIDS

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Habitat fragmentation is one of the main drivers affecting parasitoid diversity. Although many empirical and theoretical studies have elucidated the effects of habitat fragmentation on the third trophic level, little attention has been paid to the impacts of this driver on more generalist groups of non-hymenopteran parasitoids. Here, we used the highly-diverse group of tachinid flies as an alternative model to test the effects of landscape fragmentation on insect parasitoids. Specifically, we evaluated the relative importance of habitat area and connectivity losses and their potential interaction on tachinid diversity, and we tested whether the contribution of different semi-natural habitats to the local tachinid community



composition in the agricultural matrix changes according to landscape composition. Our results demonstrate the negative effect of habitat loss on the diversity of tachinid parasitoids, but the strength of this effect depends on the degree of habitat connectivity as the processes of habitat loss and loss of connectivity significantly interacted. This suggests that management practices aimed to mitigate the negative effect of habitat loss at the local scale need to consider the surrounding landscape. Specifically, the conservation of habitat connectivity needs to be particularly considered in landscapes with small remnant habitats. In addition, our results demonstrate that the community of tachinids was affected not only by the proportion of semi-natural habitats in the landscape, but also by the specific type of semi-natural habitats. Therefore, strategies to conserve semi-natural habitats in agricultural landscapes needs to take into account the area, connectivity and type of habitats.

117-IMPACTS, OPPORTUNITIES AND CHALLENGES OF USING MARKET BASED MECHANISMS FOR SECURING CONSERVATION OUTCOMES: WHEN, WHERE AND WHY DO THEY WORK, FAIL OR LAND SOMEWHERE IN BETWEEN?

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Increasingly, the use of market-based approaches for securing biodiversity and ecosystem services is viewed as critical for meeting global conservation funding needs. Many observers maintain that market based approaches may be more efficient than other conservation tools for meeting biodiversity and ecosystem protection goals. Thus, in recent years, multiple market-based instruments, such as Payments for Ecosystem Services (PES), nature-based enterprises and biodiversity offsets, have been implemented to help conserve biodiversity and ecosystem services (BES). Yet, the interest in using such approaches may have outpaced scientific understanding on the effectiveness of different market-based instruments for conserving various aspects of biodiversity and/or enhancing specific ecosystem functions, especially in many tropical, developing countries where these mechanisms have high potential for reconciling the tradeoffs between conservation and economic development. Because of these knowledge gaps, a paucity of guidance exists on the types and combinations of market-based mechanisms that are most useful for achieving conservation goals in different social, environmental and economic contexts. Thus, it's important to examine how well various market-based instruments work for conserving biodiversity and ecosystem services across a range of conditions. This research reviews and evaluates market-based instruments such as PES, nature-based enterprises and

biodiversity offsets and asks: 1) what is the state of knowledge related to the effectiveness of market-based instruments for conserving various components of biodiversity and enhancing different ecosystem services; 2) how are positive or negative impacts on BES measured; and 3) under what conditions do different mechanisms effectively conserve BES? From this analysis, we will identify major challenges and opportunities that should be addressed to better leverage market-based instruments for achieving conservation outcomes.

INDIGENOUS COMMUNITIES IN THE EASTERN HIMALAYA, THEIR PERCEPTIONS AND ADAPTAION STRATEGIES TO CLIMATE CHANGE

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Studies in the Himalayas indicate that climate change has significantly impacted biodiversity and the indigenous communities of the region, and that they have been actively adapting to the cascading impacts of climate change. Although there is limited scientific data on climate change on the Himalayas, there is a wealth of information in the form of traditional ecological knowledge (TEK) of the people of the region, based on their observations, perceptions and coping strategies over the years. We used an interdisciplinary approach complementing participatory tools with ecological plots and remote sensing, in the Lachen and Lhonak valleys of the Indian eastern Himalayas to assess local perceptions and adaptations to climate change. Their observations were very detailed and provided numerous insights into local concerns. Additionally, we were able to validate these perceptions using vegetation plots and geographic information systems (GIS). The data clearly suggests that local people have been experiencing changes in their climatic conditions and their resource landscape, including their grazing pastures and agriculture. We also documented their response and their adaptation strategies, particularly adaptation strategies implemented by their traditional governing institution the Dzumsa. The study suggests that indigenous people have much to offer to the regional and global discourse on and strategies to address climate change. It is important that such local perceptions, adaptations, responses and solutions are kept in mind, while also being inclusive of traditional institutions, to effectively develop and implement adaptation and mitigation strategies.

PEOPLE, TIGERS AND THE SUNDARBANS: EXPLORING THE HUMAN DIMENSIONS OF HUMAN-TIGER CONFLICT IN BANGLADESH.

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The negative impacts of endangered species, such as tigers (*Panthera tigris*), on people can be financially and emotionally devastating. Likewise, local communities' low levels of tolerance for these species can undermine conservation efforts and impact species presence and persistence. Across tiger range countries, rapid human and livestock population growth, increasing rates of habitat conversion, and widespread poverty and natural resource dependence, mean that even small increases in tiger populations can significantly increase negative human-tiger interactions and (further) reduce local tolerance for the species. Effective human-tiger conflict (HTC) reduction and prevention is therefore imperative for securing tiger populations long-term. However, even when wildlife impacts on people have been reduced, engendering tolerance for, and halting the killing of, species by local communities has proven challenging. A better understanding of the people who live along-side tigers, and of lethal control behaviour, is, therefore, urgently required if global efforts to double tiger numbers are to be effective. Using a combination of qualitative and quantitative data this research provides insight into three important aspects of the human dimensions of HTC in the Bangladesh Sundarbans, the site of the most severe HTC range-wide. First, the cultural and socio-economic context of HTC in this area is described and its influence on local community members' perceptions of the risk tigers present discussed. Second, local levels of tolerance for tigers are quantified and the experiential and psychological basis of tolerance examined. Finally, the drivers for tiger killing behaviour and the factors that render this behaviour socially acceptable are identified. The research makes apparent the complexity of the human dimension of HTC and the relevance and importance of in-depth social research to the conservation of species which come into conflict with local communities.

BIRD BIODIVERSITY IN THE NEVA BAY: THE POSITIVE INFLUENCE OF THE ST. PETERSBURG FLOOD PROTECTION BARRIER AND PROBLEMS OF ITS CONSERVATION IN URBAN CONDITIONS

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The St. Petersburg Flood Protection Barrier (FPB) is a unique object by its structure and size (length of 25.4 km with 22.2 km across water, width of 30 m and height of 6.5 m above sea level). The construction includes dams, water sluices, navigation structures, a six-lane motorway on the crest of dams with bridges, tunnel, and navigation channels. It separates the Neva Bay from the rest of the Gulf of Finland, being a part of the city of five million people. Owing to its location (the

most eastern part of the Baltic Sea and on the White Sea-Baltic flyway), climatic, landscape and habitat features, the Neva Bay is an important territory for stopovers of migratory waterfowls and shorebirds. The creation of artificial sandbars and wetlands, favourable for breeding and used as stopover sites, is a significant positive aspect of the FPB. 11 stone and earthen embankment dams of two or three-tiered structure are suitable nesting sites for the different birds. In 2012, two large colonies of Charadriiformes (including 7 rare species of terns, waders and ducks) were found on two dams. FPB is the only regular breeding site of the Little and Arctic Terns, Terek Sandpiper and Ringed Plover in the city. The Little Gull and range-expanding Gadwall nest there in high numbers. At the same time the dams of FPB are new recreational zones for the people of St. Petersburg, whose presence has negative consequences for birds. The analysis of monitoring stopovers in the Neva Bay during the period of building and functioning of FPB and the study of features of breeding on dams in 2012–2014 allow us to estimate biodiversity changes and to reveal main limiting factors and problems of conservation in urban conditions. Some preliminary measures were elaborated for conservation of biodiversity with special attention on rare species. To protect the Neva Bay stopovers and breeding sites it is necessary to establish a federal protected area of cluster type.

CONFLICT BETWEEN GUANACO POPULATION AND LIVESTOCK FARMING IN THE SURROUNDING OF A PROTECTED AREA IN PATAGONIA

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Expansion of wild ungulates outside protected areas often conflicts with human activities. Guanaco population of Torres del Paine National Park, Chile, was near extinction in the early 80s, but it has recovered and expanded to surrounding livestock ranches in the last decades. Nowadays there is a large population of guanacos established and living outside the National Park. To evaluate the intensity of conflict between wild herbivores and livestock, owners of the ranches surrounding the National Park were interviewed. Surveys included questions about the effect of herbivores on livestock, estimated losses and their willingness to assume them and alternatives to resolve the conflict. Guanaco is perceived as a threat to livestock farming due to its presence in all ranches, their relative abundance (grade of "abundant- very abundant") and its competitive ability (assessed as 5.7 out of 10). Farmers estimate that they lose (mean \pm SD) $14.8 \pm 15.2\%$ of production (range 0-52%) due to the presence of guanacos.



Moreover, 64.7% of the owners were willing to assume some level of economic losses in livestock farm in exchange for the benefits (tangible or intangible) provided by the presence of wildlife in their ranches. In parallel, 43.8% of farmers stated that the presence of the National Park provides economic benefits, either directly by owning accommodation or tourist activities, or indirectly through increased sales. Finally, the common perception (88% of owners) is that is necessary to control guanaco population growth and integrate wildlife management and socioeconomic development.

65 - BIAS, INFORMATION, SIGNAL AND NOISE IN CITIZEN SCIENCE DATA

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Citizen science has tremendous potential to produce large quantities of information about the state of the natural world, at scales relevant to both scientific and policy applications. Drawing inference about biodiversity over large spatial scales usually requires the collation of data from a multiple sources, usually with different protocols. Thus, collated datasets contain a number of spatial and temporal and sampling biases. These biases have limited the application of citizen science data and led to criticism about the inferences on which they are based. Fortunately, the growth of citizen science has been paralleled by the development of statistical techniques for modelling biodiversity using heterogeneous and biased data. In particular, Bayesian Occupancy-Detection models have been proven to be robust to many biases associated with citizen science data. I will present examples of how these methods can be used to test current ideas about biodiversity change and the drivers thereof. The hierarchical nature of these models forces us to think about the data generation process, the assumptions of the model and whether the data are fit for purpose. The suitability of any given dataset reflects not just the sampling biases, but also the 'information content', i.e. the degree to which new data contribute to reducing uncertainty in the parameter of interest. These issues highlight the need for better capture and storage of meta-data about the sampling protocol, especially in data repositories (e.g. Dryad, GBIF).

POPULATION ESTIMATION AND GENETIC INFERENCES OF MARKHOR (CAPRA FALCONERI) IN CHITRAL, PAKISTAN USING NON-INVASIVE SAMPLING

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The wild goat markhor (*Capra falconeri*) is national animal of Pakistan, distributed in the mountainous regions. The IUCN Caprinae Specialist Group considers markhor as endangered. Management of markhor will be necessary for several reasons. Its population is facing threats to extinction due to genetic isolation, low reproductive rates and various anthropogenic causes, including trophies hunting, meat and the indigenous medicines. So far, the population estimates of this wild goat are based mostly on observational studies lacking the scientific validation. So, this study will address major threats to markhor population using non-invasive genetic sampling techniques. Furthermore, it will demonstrate that non-invasive fecal DNA sampling is feasible for wild goat population genetic structure analysis. Host species will be confirmed by designing species specific primers. The goal of such an experimental validation is to distinguish markhor species feces from those of others, potentially occurring in the study area. Extracted DNA will further be amplified using microsatellite markers to genetically count their individuals. By obtaining the genetic variability data from this research we will be able to determine if any of the markhor has been subject to hybridization. Survival of most endangered wild goats may depend on breeding programs where sex identification plays an important role. Sex-linked DNA markers can also provide significant insights into demographic history and phylogenetic relationships among populations. Screened markhor DNA samples will be used for animal sexing, exploiting sex linked molecular markers. In particular, polymorphic Y chromosome markers are useful in tracing paternal lineages in wild populations. This study will help to evaluate existing population of markhor is breeding properly or it's facing certain ecological pressures. So it's critically important to design the active conservation strategies for an endangered markhor population.

CHANGES IN SPECIES COMMUNITIES OF DIVING BEETLES (COLEOPTERA: DYTISCIDAE) WITHIN OMBOTROPHIC PEATLAND PONDS ALONG A HUMAN IMPACT GRADIENT.

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The ombotrophic peatlands of central and northern Europe act as vital habitats for aquatic species living open Sphagnum communities. Thus, regional and national conservation status of whole species communities is often dependent on the persistence of these peatland habitats. During the last



century, the hydrological cycle of European peatlands has been extensively modified by human activities and climate change. In many ombrotrophic peatlands this has caused a persistent lowering of the water table increasing tree growth and a succession towards forest-type ecosystems. Even though these processes are well studied little is known about changes in aquatic species communities following habitat degradation of peatland ponds. In this study we explore the changes in community patterns of diving beetles in 50 ponds along a continuous degradation gradient within an ombrotrophic peatland in western Lithuania. We document that species richness and the abundance of the entire beetle communities decreased with an increase in tree coverage. However, community diversity (measured as Fisher's alpha) remained constant across the gradient. These changes were caused by a shift from communities in the central and pristine ponds dominated by Northern range species towards communities dominated by generalist and ubiquitous species along the borders of the study area. In contrast, Southern range species were uniformly distributed across the gradient. Our work, though focused on a single assemblage, indicates that human alterations of ombrotrophic peatlands change diving beetle communities by replacing specialist species of Sphagnum habitats with generalist species. Furthermore our results suggest that the presence of species expanding their Northern range border is neither restricted nor promoted by human activities within our study area.

MODELING AND STAKEHOLDER ASSESSMENT OF UPLAND WOODLAND CREATION IN CUMBRIA, UNITED KINGDOM

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Woodland cover in the UK has declined from once being the prevailing land cover to current levels of 12%. International agro-environment policies are proposing a significant increase in woodland creation and expansion to the benefits of society and biodiversity. Cumbria, in the North-west of the United Kingdom, is an upland landscape heavily influenced by agricultural and stakeholder land-use interests. The area comprises a National Park, Areas of Outstanding National Beauty, large water reservoirs, a forestry sector, a popular tourist industry, mining operations and an upland farming industry. The region's current land management is currently being debated due to an increasing emphasis on agro-environment schemes and subsidies in national and international policy. As a result, stakeholder interests and the farming industry, culture and sense of place of a unique upland region in the North-west of England are challenged. It is

suggested that there is a need for a review into stakeholder and land owner perspectives on potential land use diversification. The aim of this research is to assess stakeholder and landowner perspectives and approaches to woodland creation in the upland regions of Cumbria. Furthermore, A GIS model is applied to combine biological and social data in a spatial setting to assess woodland creation in Cumbria. Preliminary results of GIS modelling of indication differences in stakeholder perspectives and approaches to woodland creation. These results are provided and discussed in the framework of international agro-environment policy and subsidy provision within the UK and internationally.

MANAGING COFFEE AGROFORESTS FOR ECOSYSTEM MULTIFUNCTIONALITY: ROLE OF FARM MANAGEMENT AND LANDSCAPE CONTEXT

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Agriculture comprises the largest land use globally; it is therefore critical to incorporate these areas into our conservation planning. Doing so requires working with farmers and determining management strategies that provide both livable incomes and that are compatible with biodiversity conservation. We addressed this challenge through an assessment of ecosystem multifunctionality and biodiversity on Puerto Rican and Mexican coffee farms. We measured how several ecosystem services and organisms were influenced by local-level (farm management-related) and landscape-level environmental variables. We assessed various taxa, including plants, insect natural enemies, lizards, and birds, as well as the ecosystem services of biocontrol of the primary coffee pests, disease regulation, carbon storage, and farm yield and profit. Central to this research is whether plant diversity or simply vegetation structure has a stronger influence on service provision and biodiversity conservation, and whether or not these depend on the landscape context. We found that the various services and taxa responded differentially to local and landscape heterogeneity. However, when considering these coffee farms for ecosystem multifunctionality, farms that had intermediate levels of shade tree biomass provided high yields of coffee with lower input costs and lower toxicity (e.g. herbicides, pesticides), while providing high levels of other ecosystem services. Furthermore, these farms harbored relatively high levels of biodiversity. In general, vegetation structure played a larger role than plant diversity and landscape elements were less important than local management. These results likely reflect the diverse and highly complex (forested) landscape backdrop in which these farms



were embedded. Our results also confirm the importance of considering multiple taxa and services when developing conservation strategies.

USING SOCIAL VALUES FOR GREEN OPEN SPACE TO ENHANCE URBAN CONSERVATION OUTCOMES

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Urban biodiversity outcomes are largely dependent on the distribution, design and management of green space networks. While standards and metrics exist for green open space planning, there is little research on the drivers of values people have for these areas. This is a significant gap since urban conservation outcomes will depend greatly on the social acceptability of conservation actions. In this study, we spatially quantified residents' values for green space in four suburbs from the Lower Hunter Valley of New South Wales, Australia by enabling participants to mark their values for specific open spaces on interactive paper maps. The survey was designed to evaluate the effect of spatial scale by providing maps of residents' local areas at suburb and municipality scales. Modelling of data from 418 survey respondents revealed that mapped values were a function of (i) park environmental characteristics, (ii) socio-demographics, and (iii) general values for open space. Spatial scale also had a significant effect; all value types recorded a greater abundance of marker dots at the finer (suburb) scale compared to the coarser (municipality) scale. However, this pattern was more pronounced for some values than others (e.g. physical exercise value). Finally, analysis of the co-occurrence of value marker dots within individual parks revealed different levels of compatibility between conservation values and more traditional green space values (e.g. active recreation), depending on the characteristics of the space. These results indicate that the social acceptability of conservation actions in urban landscapes will depend on the individual, but it can be enhanced through careful planning and management. Further, biodiversity conservation values are not restricted to parks zoned as 'natural' areas, suggesting that many conservation opportunities may exist that are not being fully exploited.

NEW APPROACHES OF CONSERVATION PLANNING FOR MIGRANTS

Takuya Iwamura

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8,000 of animal species are migratory. Migratory species provide unique ecological functions through their seasonal journey by connecting far places otherwise not related. The

protection of these migrants is thus highly important and affect diverse habitats extending globally. Their unique behavior requires special attention for their management in the sense where migratory network must be protected carefully considering their behavioral traits. Understanding their migratory patterns and applying such knowledge is highly important not only for conservation but also for wide range of questions. For example, migratory birds are responsible bird influenza (H5N1) which affects both Asia and European health care system and agricultural production. However, so far conservation efforts are limited to either breeding or "wintering (more precisely, non-breeding)" habitats where migrants are most often observed. Recent developments in analyzing migratory flyways indicate both the shortcomings of such traditional breeding habitat management for migrants and also propose novel methods to solve management problems for conservation of migratory species. While these new approaches are useful, it is not necessarily straight-forward when and how to apply them for real-world conservation planning. Here, I present our approach to the migratory bird conservation using a maximum flow algorithm to incorporate the impacts of habitat loss on flyway populations of migratory shorebirds in the pacific coastal areas (Iwamura et al., 2013 and 2014). I will also summarize pros and cons for other emerging approaches for conservation planning of migratory species, and propose a synthesizing framework for effective managements of migratory species.

SOCIAL-ECOLOGICAL MODELING FOR ENVIRONMENTAL SUSTAINABILITY AND CONSERVATION PLANNING

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Human influences shape ecological and geophysical processes – thus we live in "Anthropocene". Conservation biology traditionally deals human influences as ewthreats and considers its impacts on ecosystems and biodiversity. However, it is thus necessary to establish framework to fully incorporate interactions between human and ecological systems. Recently, Coupled Human-Nature Systems (CHANS) and Social-Ecological Systems (SEs) attract lots of attention to integrate human-social dynamisms with ecological system. These approaches, originally derived from geography and economics, often simplifies ecological functions. Here I present the research results based on our social-ecological model for indigenous lands in Amazon basin (Iwamura et al. 2014). This model take advantage of vast field dataset on animal observations, land cover changes, hunting data and social parameters. We applied this model to analyze the impacts of various policies on human population, animal population and diversity, and primary forest cover in the study area. I then generalize learning from



this modelling exercise and comparative policy analyses for broader perspective and propose other applications where feedbacks between human systems and ecological systems are critical, such as Mediterranean ecosystem.

124 FILLING THE GAP IN MITIGATION POLICY IMPLEMENTATION FOR COASTAL AND MARINE DEVELOPMENT PROJECTS

Celine Jacob

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Although coastal and marine ecosystems are among the most productive ecosystems on Earth and are highly vulnerable to human-induced impacts, there are few data on the influence of mitigation policy implementation on slowing or stopping marine and coastal biodiversity loss. Our reviews of marine and coastal Environmental Impact Assessments (EIAs) consistently show that assessments of impacts are particularly intricate. In most cases, the analyses lead to a finding of no significant residual impacts and do not propose offsetting measures. In a review of offshore windfarm EIAs of seven European countries, we found a lack of offsetting measures and questioned the very few measures proposed to offset residual impacts in terms of equivalency and appropriateness. Further, a similar study conducted on EIAs related to different types of marine works including dredging, port extension, oil drilling, wastewater discharge, and offshore windfarms, in France, led to the same conclusions. Thus, we consider that one of the main pitfalls of the mitigation implementation for coastal and marine projects appears to be the unsuitability of the methodologies used to assess ecological losses resulting from a development project and ecological gains generated by a compensatory measure. Here we present a qualitative multi-criteria method based on indicators resulting from different European environmental policies contexts and from Rapid Assessment Methods used in wetland mitigation banking in the United States. We assess ecological losses and gains in terms of biophysical indicators linked to biodiversity structures and ecosystems functions. In doing so, our aim is to prioritize compensatory measures while placing emphasis on impacted biodiversity components and scaling the compensation when ecological engineering is available. These considerations will help feed a broader discussion on the applicability of the mitigation hierarchy to marine and coastal development projects.

PEOPLE OR THE PLOW? UNDERSTANDING RANGE COLLAPSE IN LARGE AFRICAN CARNIVORES

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East Africa holds globally important, yet declining, populations of lions *Panthera leo*, cheetahs *Acinonyx jubatus* and African wild dogs *Lycaon pictus*. However, East Africa's human population is expected to balloon, with most country populations expected to double or triple by 2050. These species contribute to multi-billion dollar tourism operations, and as apex predators help regulate ecosystems, yet are responsible for significant human and livestock deaths. Despite their status as large carnivores, these species vary in their susceptibility and reaction to threats. Illegal killing and habitat loss via land conversion are two primary threats to these large carnivores. Using recently released human population estimates and newly created maps of anthropogenic land conversion, I investigate these carnivores' susceptibility to their primary threats. With nearly 100,000 presence points, I employ a variety of distribution modeling approaches to investigate the importance of environmental layers to explain current distribution. I use three spatial scales and advanced spatial filtering to improve model results. Additionally, I summarize differences between expert-derived resident and extirpated range. Preliminary findings suggest that lions are the most susceptible to human populations possibly due to their greater reliance on large prey and role in human-wildlife conflict. Research findings will aid in determining appropriate management and conservation strategies. Additionally, identifying how species respond to land conversion and human population increases will enable better zonation to designate area where large carnivores can thrive despite burgeoning human populations.

HOW CAN WE RESTORE POLLINATION WEBS IN WETLANDS ?

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Habitat fragmentation has severe effects on plant pollinator interactions by modifying the abundance, diversity and foraging behavior of insect visitors. Over several years, we monitored the pollination webs in wet heathlands and wetlands in Belgium. From the plant side, we investigated pollinator generalist (*Calluna vulgaris*) and specialist species (*Erica tetralix*, *Vaccinium myrtillus*, *V. uliginosum*). We focused the study of the pollinators on bumblebees. These social insects depend on both the quality and the quantity of pollen and nectar for colony development and population survival. Nectar represents the main source for sugars while pollen is mainly collected to provide amino acids, polypeptides and sterols. We quantified the quality of both pollen and nectar of the main floral resources visited by the observed pollinators.



Diversity and abundance of pollinators differed according to plant population size and landscape. Bumblebees visiting specialist ericaceous species switched their foraging behavior according to plant population size: while they collected both pollen and nectar in large populations, they largely neglected pollen collection in small remnant populations. Reproductive success of plant (i.e. seed set) was not affected by population size. Plant species greatly differed in their resource qualities, even within the Ericaceae species. Diversity of co-flowering plant species at both local and landscape levels seems of crucial importance for pollinator survival. Overall, pollinator communities seemed much more sensible than plant communities to fragmentation. Habitat fragmentation might not immediately threaten the reproductive success of the main plant species but has rapid negative effects on their pollinators. Future management plans for wetland restoration need to consider the maintenance of floral diversity but also a landscape mosaic offering resources of different quality.

GOVERNING NATURE BY NUMBERS - EU SUBSIDY REGULATIONS DO NOT CAPTURE THE UNIQUE VALUES OF WOODY PASTURES

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Stockholm University

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A vast majority of European farmers are dependent on EU subsidies, which make subsidy regulations through the Common Agricultural Policy (CAP) powerful tools in shaping agricultural landscapes. Unfortunately, recommendations that steer these regulations are sometimes arbitrary, like in the case of pasture management, where 50 trees per hectare constitute an upper limit to qualify for subsidies targeted to benefit biodiversity. Although pasture biodiversity is well studied and the core of many conservation programmes within CAP, it is seldom studied as direct effects of subsidy systems. In this paper, we examine how plant diversity is affected by the CAP tree density limit regulation in Swedish woody pastures along a gradient from 3 to 214 trees per hectare. We selected 64 sites where we recorded plant species richness and composition, soil properties and canopy cover. We found a general increase in total species richness (γ -diversity) and species spatial turnover (β -diversity) along the gradient, whereas plot scale richness (α -diversity) tended to drop at 100 trees/ha. The number of typical grassland species remained indifferent along the gradient. Additionally, tree density, together with organic content and C:N-ratio, were the strongest predictors of plant species composition. Hence, when CAP regulations encourage tree cutting for pastures to qualify for subsidies there is a risk of homogenisation of all EU grasslands, leading to decreased γ - and β -diversity. If a general target for the subsidies is to increase biodiversity of plants, there is a need to scrutinise these regulation details to preserve the high biodiversity values

of woody pastures. We argue that habitat variation, species diversity and low intensity management, rather than using a specific number of trees, should be the main incentives for financial support to preserve biodiversity.

TOWARDS MORE EFFECTIVE GOVERNANCE OF COMMUNITY-BASED WILDLIFE MANAGEMENT

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Community-based natural resource management (CBNRM) has been suggested as a means to accomplish both ecological and social objectives. However, effective governance of communal wildlife resources is critical for successful management. We present the first study to employ Elinor Ostrom's eight principles of commons governance to examine community-based wildlife management programs in Mexico. Wildlife Management Units (UMA) have become a widespread tool for managing wildlife and supporting local livelihoods throughout Mexico. The success of these programs has been mixed, but the impact of governance mechanisms remains unstudied. We examined the governance context of an UMA within an ejido in Campeche, Mexico. This UMA was created in 2011 as a means for diversifying income generation through sustainable extractive and non-extractive wildlife use. The focal point of our work consisted of using current literature on common-pool resource governance to assess the governance structure of the ejidatarios then, through a participatory process, devise practices to strengthen the governance and management of the UMA. Our participatory action research was carried out through a series of meetings and semi-structured interviews with diverse stakeholders linked to the UMA. We determined that the ejidatarios lacked clearly defined rules on how to improve the functioning of the UMA, distinct roles for each member and sufficient participation by all members, and linkages to internal and external entities that can provide assistance and resources. We then used participatory methods to jointly develop capacity-building workshops in order to address some of these shortcomings. Our research demonstrates the importance of governance for determining outcomes of community-based wildlife management, and emphasizes the power of participatory research methods to contribute to conservation.

INVESTIGATING A DINOSAUR: CONSERVATION GENETICS AND DEMOGRAPHIC ANALYSIS OF THE ENDANGERED CYCAD SPECIES CYCAS MEGACARPA AND IMPLICATIONS FOR A PROPOSED TRANSLOCATION.

Heather James

University of the Sunshine Coast



Robert LAMONT, *University of the Sunshine Coast*; Paul FORSTER, *Queensland Herbarium*; Alison SHAPCOTT, *University of the Sunshine Coast*

Cycads are iconic plant species that existed over 200 million years ago before dinosaurs roamed the earth. *Cycas megacarpa* is one of around 300 cycad species spread across the tropics and subtropics including in Australia. *Cycas megacarpa* is listed as endangered currently under threat from urban, rural and commercial infrastructure development. Cycad populations are often disjunct and scattered throughout the landscape and it has been thought that gene flow between populations is minimal or non-existent. This study investigates the effect habitat fragmentation has had on the genetic structure of *C. megacarpa* populations across its entire range as well as the implications of translocating large numbers of cycads from several populations to a single site due to the construction of a gas transmission pipeline. This study focused on three analysis levels; a landscape scale involving the whole species, a regional scale involving multiple populations in the same geographic region, and a within population scale focusing on four individual populations. 34 populations were sampled across the species' known range, 18 of these were in the translocation region; using 24 microsatellite loci developed using next generation sequencing. Habitat loss and fragmentation has had a significant impact on the amount of suitable habitat remaining. Examination of the translocation region revealed less genetic differentiation than was expected between two affected mountain ranges. Minimum pollen dispersal distance was found to average at 30m with a maximum distance of 339m. Effective population size (as a proportion of adult population) was found to be similar between demographic and genetic measures in focus four populations averaging at 0.75 and 0.79 respectively. Across the species' range genetic clustering occurs within 36km indicating regional historic gene flow in contrast to expectations highlighting the importance of maintaining population clusters for its conservation.

INVESTIGATING THE USE OF CONSPECIFIC-ATTRACTION IN THE CONSERVATION OF AN ENDANGERED AMPHIBIAN - MANIPULATING CHORUS AGGREGATION AND LANDSCAPE DISTRIBUTION

Melanie Sandra James

University of Newcastle

Michelle Pirrie STOCKWELL, University of Newcastle; Pizzatto LIGIA, University of Newcastle; Simon CLULOW, University of Newcastle; John CLULOW, University of Newcastle; Michael Joseph MAHONY, University of Newcastle

Conspecific attraction can prevent occupancy of restored or created habitats by limiting dispersal to unoccupied areas. This may cause problems for threatened taxa where habitat

restoration and creation programs are implemented as part of recovery plans. Studies on birds have found that introduction of artificial calling from speakers can increase occupancy of restored habitat. The endangered green and golden bell frog (*Litoria aurea*) has a loud conspicuous call and large chorusing aggregations. To date, attempts to repopulate restored and created habitat through natural immigration and active translocation has had limited success. We used *L. aurea* as a model species to determine if distribution could be manipulated via artificial communication cues to increase success of the recovery program in N.S.W., Australia. We undertook two studies 1. We placed speaker systems in uninhabited areas of five habited ponds across two locations and broadcast calls of *L. aurea* to see if we could manipulate distribution into previously unoccupied areas and 2. We placed speakers in five unoccupied ponds to see if we could increase occupancy. Surveys undertaken before and after speaker placement indicate for study 1 we successfully manipulated adult *L. aurea* distribution within ponds increasing occupancy and calling around speakers. For study 2 attempted manipulation to unoccupied ponds was successful in two ponds, one of which experienced a large chorus and at least one breeding event. We suggest that conspecific attraction is causing aggregatory behaviour in ponds and that manipulation of landscape distribution via conspecific attraction for conservation programs may be possible.

GEOGRAPHICAL ONTOGENETIC AND SEX BASED SEPARATION OF THE ENDANGERED GREEN AND GOLDEN BELL FROG (LITORIA AUREA)

Melanie Sandra James

University of Newcastle

Michelle Pirrie STOCKWELL, University of Newcastle; Carla Jean POLLARD, University of Newcastle; Evan John PICKETT, University of Newcastle; James Ian GARNHAM, University of Newcastle; Deborah Sheena BOWER, University of Newcastle; Ligia PIZZATTO, University of Newcastle; Simon CLULOW, University of Newcastle; John CLULOW, University of Newcastle; Michael Joseph MAHONY, University of Newcastle

Describing species distribution and habitat use can improve conservation programs by providing useful information to habitat rehabilitation and creation programs. For some taxa, the spatial distribution of juveniles, males and females can be segregated, resulting in patchy distributions within a landscape. This ontogenetic and sex based habitat disassociation may be due to intraspecific competition, cannibalism, differential predation, age or sex specific habitat requirements, sexual harassment or explosive dispersal and breeding. The endangered green and golden bell frog (*Litoria aurea*) is a focus of many conservation efforts in NSW Australia, however, a detailed analysis of age and sex based distribution



patterns has not been undertaken. In the current study, we undertook visual encounter surveys within ponds and in terrestrial areas in Sydney Olympic Park the breeding season (September - March) from 2008 to 2013. The distribution of males, females and juveniles were mapped using a Global Positioning System device. Spatial mapping indicates that distribution is primarily within ponds and within patches of emergent vegetation. Aggregations within vegetation patches were isolated using hierarchical clustering in JMP and a contingency analysis of males, females and juveniles was undertaken for all clusters. The contingency analysis indicated there is very little distributional overlap between males, females and juveniles. For species experiencing this behaviour, it is recommended that habitat rehabilitation and creation programs ensure a landscape contains multiple ponds and vegetation patches to facilitate ontogenetic and sex based segregation.

LANDSCAPE EFFECT ON THE DEMOGRAPHY OF THE LESSER HORSESHOE BAT (*RHINOLOPHUS HIPPOSIDEROS*) DETERMINED FROM A FIFTEEN YEARS MONITORING PROGRAM

Pierre-Loup Jan
INRA

Damien FOURCY, INRA ; Alice BAUDOUIN, CNRS ; Olivier FARCY, Bretagne Vivante ; Josselin BOIREAU, Groupe Mammologique Breton ; Eric PETIT, INRA

The lesser horseshoe bat (*Rhinolophus hipposideros*) has undergone a dramatic decline over the past decades, especially in northern and central Europe. In order to better understand which features impact the demography of this bat, we analyzed the outcome of a standardized demographic monitoring program of nursery roosts of the lesser horseshoe bat. This program was ongoing during the last fifteen years in Brittany, where numerous nursery roosts of this species can still be found. Bats were counted in about 90 nursery roosts twice a year, before and after birth, in order to estimate population size as well as fecundity. We found that population sizes of the lesser horseshoe bat globally increased during the program, but this evolution was extremely variable depending on roost. We tried to explain roost size and fecundity variability with roost and landscape characteristics, by means of GLMM and information criteria. Two main features influenced the lesser horseshoe bat demography, namely broadleaved woodland surface in close proximity of the roost and roost type. Unlike other European bat species, this demographic study did not find any appeal from water surfaces and coniferous woodland. However, our results were totally consistent with previous work on the lesser horseshoe bat made at the individual scale (radio-tracking), revealing the consequences of individual behaviors on population dynamics.

IS CLIMATE-SMART CONSERVATION PLANNING FEASIBLE IN EUROPE? SPATIAL RELATIONS OF NATURA 2000 SITES, SOIL CARBON, AND LAND VALUES

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The expectations on protected areas to deliver not only biodiversity conservation but also to provide an array of different ecosystem services rise. Climate regulation and more specifically the sequestration and storage of carbon are especially seen as promising services protected areas may provide. To estimate the potential for climate-smart conservation planning in Europe, we integrate spatially explicit data on terrestrial Natura 2000 sites, soil organic carbon, and agricultural land values for the European Union. The specific objectives of this study are to analyse spatial relations between soil carbon content, land value and protected areas on European Union's land area and to locate and quantify the proportion of land with high carbon and low economic value within and outside protected areas. We apply a unique interdisciplinary framework with methods ranging from analyses with geographical information systems, agricultural economics to statistics. Findings indicate that there is a significant overlap between Natura 2000 sites and regions with a high carbon content across Europe. Economic analyses shows that carbon-rich regions have significantly lower land values than other areas. Our results suggest that biodiversity protection and mitigation of climate change through conservation of soil carbon could be simultaneously achieved in Europe's protected areas and beyond. We conclude that there is a notable potential for climate-smart conservation in Europe that needs to be further explored.

SYMPOSIUM ID 134 - THE USE OF MARXAN TO ADDRESS INVASIVE SPECIES IN CONSERVATION MANAGEMENT

Stephanie Januchowski-Hartley

Texas A & M Corpus Christi

Vanessa ADAMS, University of Queensland ; Virgilio HERMOSO, Centre Tecnologic Forestal de Catalunya ; Piero VISCONTI, Microsoft Research

Management of invasive species is a global conservation priority given their prominent impact on ecological and socio-economic values across all realms. Because costs of mitigating impact or restoring systems from invasive species can be unaffordable there is a need for methods that can allocate limited resources efficiently to control or eradicate invasive species. Systematic conservation approaches, which include



the use of spatial prioritization tools such as Marxan, can offer cost-effective and efficient solutions to guide the allocation of resources for invasive species management. However, despite these methods being widely used in protected area planning, the application of such approaches to the invasive species management problem has been extremely limited. With this in mind, we review how invasive species management has been planned for to date across ecological realms, and identify the pros and cons of different approaches. We focus on two case studies, the only studies to our knowledge, to demonstrate how Marxan can be used as a conservation planning tool to guide the control of invasive species and discuss the benefits of using systematic approaches over other non-systematic approaches. Finally, we highlight current best practice and identify opportunities for expanding the use of Marxan and systematic approaches more broadly to improve invasive species management strategies.

A STANDING OVATION FOR CONSERVATION

Rebecca Jarvis

Institute for Applied Ecology New Zealand, AUT University
Barbara BOLLARD BREEN, Institute for Applied Ecology New Zealand, AUT University

Collective action is any action taken by a group of people to achieve a common goal. In conservation, it is important to understand how groups voluntarily organise to protect biodiversity and natural resources. There is often an underlying assumption that better information will change individual motives and lead to collective results. However, different groups with similar levels of support for an action can lead to very different outcomes for conservation. Micro-motives do not equal macro-behaviour and the emergent properties of the group can be very different when individual preferences interact and aggregate. In a standing ovation, each individual decides to stand or not depending on the quality of the information they receive and the actions of others around them. A simple model will be used to demonstrate how learning, diversity, networks and uncertainty affect the likelihood of a standing ovation. This talk will explore what a standing ovation has in common with successful conservation, and how collective action depends on more than communicating information to the public. Understanding collective action as greater than a sum of its parts provides important insights relevant to capacity development, governance, policy, and social and environmental change.

THE STRUCTURE OF AN ELECTRONIC DATABASE ON CARMINE SCALE INSECTS OF EASTERN KAZAKHSTAN AND WESTERN CHINA

Roman Jashenko

Almaty Management University

Sergey KOLOV, Institute of Zoology

In the course of studies to assess the natural resources of carmine scale insects of eastern Kazakhstan and western China has developed a specialized database structure. The structure of an electronic database consists of three main elements: I. Data entry system comprising a user-friendly interface. It includes: insect taxa; host plants; localization on forage plants; geographical coordinates by GPS or GLONAS; biocenosis in the hierarchical arrangement (forest, forest-steppe, steppe, semi-desert, desert, mountain vertical zoning, intrazonal); date of collection or observation; the development stage of the insect (egg, larva of a certain age, adults); gender of collected insect; number of collection according the field notebook; the number of manufacturing permanent microscopic preparations; biological features (observation in text format); ecological features (observation in text format); the number/density of population; photos; video files; name of collector/observer; published articles; links to online resources. II. The data processing system, integrated with GIS. A data processing system is carried out using the specialized software (ArcGIS, MapInfo). III. The output system of processed data is performed in different ways: on the screen, to the printer, saved in a file (or image data), or sent to a network resource. As a result, all known up to date findings of carmine scale insects were introduced into a spreadsheet (MS Excel) and integrated into a common database with geo-referenced. On the basis of this created a series of maps of populations localization of carmine scale insects. In the future, based on the developed electronic database will be created predictive model of the spatial distribution of populations of scale insects, which takes into account the vegetation, soil cover, terrain, water, etc., as well as the model of their biological resources.

COMMUNICATION STRATEGIES FOR WILDLIFE CONSERVATION

Asher Jay

National Geographic Emerging Explorer

The consumer demand for wildlife products, exotic meats and pets to produce snake oil cures for human ailments and assert status, and individuality for the elite have created profit markets that bank on extinctions in the Anthropocene. This has resulted in a global market place that illegally capitalizes on the exploitation of our planet's finite natural resources to cater the myopic vested interests of a few at the cost of many. More recently, this demand has trebled with a rise in the purchasing power of a burgeoning middle class, which has implied the inevitable demise of various species, unless public education seeds shifts in cultural consciousness. In the digital age, where public engagement in global concerns that affect collective welfare is incited by pithy sound-bites that are 140 characters or less, it is vital not only to condense and collate



data sets but translate them into a vernacular that is familiar to the masses. Unless academic research is made accessible to the layperson in simple, mainstream vocabulary, the long-term conservation of wildlife and wilderness areas will remain a marginalized interest of an exclusive community. The work I produce bridges the hiatus between science and storytelling, it utilizes advertising and marketing tactics to galvanize community involvement. Impact is then calibrated through backend data analytics like any other marketing effort run by the corporate world. "And as far-fetched as it may sound, scientists, professors, and leading wildlife groups are flocking to the 30-year-old artist because, after their fieldwork, research, and strategizing are done, Jay can do something they can't: translate the work into images that make people take notice." – National Geographic

FINE-SCALE URBANIZATION AFFECTS ODONATA SPECIES DIVERSITY IN PONDS OF A MEGACITY (PARIS, FRANCE)

Martin Jeanmougin

Muséum National d'Histoire Naturelle[INSTITUTE]Natureparif
Fabien LEPRIEUR, Université Montpellier 2 ; Grégoire LOÏS, Muséum National d'Histoire Naturelle[INSTITUTE]Natureparif ; Philippe CLERGEAU, Muséum National d'Histoire Naturelle

Although ponds are recognized as biodiversity hotspots, very few studies focus on pond ecosystems in urban ecology and urban developments. Using Odonata as an indicator group, we explored changes in species composition in ponds localized along an urban gradient of a megacity (Paris, France). We assessed the relative importance of local- and landscape-scale variables in shaping Odonata α -diversity patterns using a model-averaging approach. Analyses were performed for adult (A) and adult plus exuviae (AE) census data. At 26 ponds, we recorded 657 adults and 815 exuviae belonging to 17 Odonata species. The results concerning both A and AE showed that the species assemblage composition was not determined by pond localization along the urban gradient. Similarly, pond characteristics were found to be similar among urban, suburban and periurban ponds. The analyses of AE census data revealed that fine-scale urbanization (i.e. increased density of buildings surrounding ponds) negatively affects Odonata α -diversity. In contrast, pond localization along the urban gradient weakly explained the α -diversity patterns. Several local-scale variables, such as the coverage of submerged macrophytes, were found to be significant drivers of Odonata α -diversity. Together, these results show that the degree of urbanization around ponds must be considered instead of the localization of a pond along the urban gradient when assessing the potential impacts of urbanization on Odonata species diversity. This work also indicates the importance of exuviae sampling in understanding the response of Odonata to urbanization.

142 FROM BIODIVERSITY CONSERVATION IN AGRICULTURAL LANDSCAPES TO THE PROMOTION OF FUNCTIONAL BIODIVERSITY: SHIFTING A PARADIGM?

Philippe Jeanneret

Agroscope - INH

Thomas WALTER, Agroscope - INH ; Felix HERZOG, Agroscope - INH

In European agricultural landscapes, the last 20 years of research and implementation of measures targeting biodiversity have been essentially focused on species and habitat conservation and promotion. Agri-environment schemes have been partly successful in achieving these goals. At the same time, agriculture has used various means to ensure and increase production, mostly by intensifying management and continuously high pesticide and fertilizer inputs. However, systemic approaches have also been implemented such as integrated pest management (IPM) which aims at preserving and promoting natural control of pests by natural enemies, and limiting and synchronizing pesticide applications. Recently, "functional biodiversity" has been introduced as a concept which highlights the role of biodiversity in the regulation of ecosystem functioning including agro-ecosystems. Moreover, functional biodiversity can provide benefits to human society known as ecosystem services which encompass pest control and pollination. In Switzerland, the agri-environment scheme has stabilized measures for biodiversity conservation and is currently developing new measures to promote functions, such as the introduction of habitats targeting population increase of common pollinators. Such measures go in the right direction but should not replace specific measures for rare species conservation. As exemplified by the Swiss case and ongoing research projects, we discuss the possible conflict or complementarity between measures focusing on biodiversity in general and service-based specific measures in the context of land sharing and land sparing. We highlight important issues for future research and implementation of agri-environment schemes in the context of the Common Agricultural Policy. We propose measures to increase the functional benefit of green infrastructure. And we discuss possible synergies and conflicts between the policy goals of promoting functional biodiversity vs species conservation.

ENGAGING PUBLIC AUDIENCES ON NATURE RESERVES: WHAT MAKES A GOOD NATURE EXPERIENCE?

Rebecca Jefferson

RSPB Centre for Conservation Science



Richard BRADBURY, RSPB Centre for Conservation Science

Nature reserves are predominantly designated and managed for conservation priorities such as habitat creation for rare or vulnerable species. Their role in providing spaces for people to be close to nature is being increasingly valued, particularly as disconnection from nature impacts on support for conservation action. This research project investigates how well these two priorities align: is a nature experience with a species of high conservation concern more powerful to nature reserve visitors than an experience with a species of lower conservation concern? To what extent do factors such as proximity to a species influence the experience? These sorts of questions have been investigated through face to face interviews with nature reserve visitors ($n = 204$) and members of the Royal Society for the Protection of Birds ($n = 1000$). Results show the relative importance of conservation based variables (e.g. rarity, endemism) against 'selfish' variables (e.g. novelty, proximity to species) in nature experiences, and assess the influence of logistics (e.g. signage, information). The findings of this study inform practice on nature reserves for providing powerful ways to engage public audiences with nature conservation, whilst supporting the conservation priorities of the site.

SYMPOSIUM 191: AUDIENCE-LED ENGAGEMENT: HOW UNDERSTANDING PUBLIC PERCEPTIONS OF NATURE CAN DELIVER MORE EFFECTIVE CONSERVATION MARKETING

Rebecca Jefferson

RSPB Centre for Conservation Science

Richard BRADBURY, RSPB Centre for Conservation Science

To address the conservation challenges currently faced, society must be engaged to change their behaviour and reduce negative impacts on natural environments. However, 'society' is not a single audience. Perceptions of nature are heterogeneous within our society, and this means that different approaches are required to engage with different audiences. This presentation will review some of the variables which lead to this heterogeneity, including gender, social values and the role of conservation importance. By understanding the lenses through which an audience views the environment or conservation issue in question, it is possible to develop engagement mechanisms which resonate with the target audience. This is illustrated with examples from the practice of the Royal Society for the Protection of Birds to connect with its audiences, which has been informed by research into audience perceptions. The new pathway for conservation is the integration of conservation biology approaches e.g. identification of ecological priorities for ecosystem health, alongside public perceptions analysis to develop engagement

mechanisms which resonate most effectively with the target audience.

ANATOMY OF A FAILED CARIBOU (RANGIFER TARANDUS CARIBOU) TRANSLOCATION

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Mountain caribou, an endangered deep-snow ecotype of woodland caribou (*Rangifer tarandus caribou*) have been declining in British Columbia (BC), Canada over the last number of decades. A particularly imperilled population was experimentally augmented with 19 northern caribou, a geographically distinct shallow-snow ecotype, from northern BC. To assess ecologically meaningful seasonal variation in risk of predation by cougars we used a recently-developed clustering framework based on homogeneous space-use patterns of GPS-collared animals. We identified five resident caribou seasons, two donor caribou seasons, and two cougar seasons. Resident caribou remained at high elevations year-round and primarily selected habitats not used by cougars. In contrast translocated caribou tended to occupy habitats extensively used by cougars, resulting in predation of at least six, and possibly eight, of 19 caribou over 30 months. Additionally, translocated caribou had a significantly higher daily travel rate than resident thus rendering them to increased risk as a function of probability of encounter. We conclude that the translocated caribou ecotype either failed to have adequate innate behavioural plasticity or sufficient time to adapt to a novel landscape and a novel predator.

PROTECTED AREA ASSET MANAGEMENT

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Competing claims for land resources are undermining PAs as a policy and cultural ideal. The 'go/no-go' question in the extractive sector and the rise of PADD (downgrading, downsizing, & degazettement) suggests that protected areas may be at increasing risk from development interests. Our new protected area asset framework (Caldecott & Jepson 2014) responds to the need to i) demonstrate the forms of value generated by PAs in ways meaningful for citizens, politicians, and markets, ii) enhance risk management science and practice and iii) attract new investment into PAs from old and new funding sources. Framing protected areas as spatial assets that are invested in to generate long term value speaks to the language of economics and investment. Whilst many type of value cannot be monetised directly they generate forms of risk that are material in investment decisions. Our asset



framework is intended to inspire work on the development of a new generation of PA metrics afforded by 'big data' and new computational techniques. These metrics are intended to support improved decision making - protected area asset management - that effectively values, maintains, operates, and defends PA assets; attracts and properly deploys the right mix of private, public, and philanthropic capital into PA assets; and also identifies assets that are under-performing or poorly utilised.

TEMPORAL FEATURES OF TUNDRA ECOSYSTEMS INFLUENCING THE DENSITY OF BARREN-GROUND GRIZZLY BEARS IN THE CANADIAN SOUTHERN ARCTIC

Tyler Jessen

University of Calgary

Marco MUSIANI, University of Calgary ; Rianne DIEPSTRATEN, University of Calgary ; Greg MCDERMID, University of Calgary ; Paul GALPERN, University of Calgary ; Alessandro MASSOLO, University of Calgary ; Alistair BATH, Memorial University ; David PAETKAU, Wildlife Genetics International

Grizzly bears inhabiting the barren-grounds of the Canadian Southern Arctic are listed as a species of 'Special Concern' by the Committee on the Status of Endangered Wildlife in Canada because of their vulnerability to population declines and human disturbance. We report initial findings of a multi-year, DNA based hair snare program and phenology study in a 30,000km² study area encompassing all 4 recently constructed diamond mines in the Northwest Territories, Canada. We also include Traditional Ecological Knowledge from the Lutsel K'e Dené First Nation. Microsatellite analysis of 2,174 hair samples collected from 2012 to 2013 identified 127 individual bears (89 female, 48 male). Motion cameras (n = 20) and time lapse vegetation cameras (n = 59) collected 10,948 and 16,783 images respectively to assess the temporal availability of bear food sources throughout the active season for bears (June – September). Our results indicate that static landscape features are having little effect on grizzly bear distributions despite occasional human-bear interactions. However, the temporal variation of food resources, including plants and barren-ground caribou, may be a better indicator of bear density in the tundra since landscapes exhibit low spatial heterogeneity and pronounced seasonality. As northern ecosystems continue to undergo rapid changes in climate and human activity, understanding the relationship between the availability of food sources and the density of species of concern such as the grizzly bear will help form the basis on which sound management decisions are made.

ARE ECOSYSTEM SERVICES THE SOLUTION TO THE DWINDLING HABITAT FOR WETLAND BIRDS?

Allwin Jesudasan

Ashoka Trust for Research in Ecology and the Environment (ATREE)

Giridhar MALLA, Ashoka Trust for Research in Ecology and the Environment (ATREE) ; T GANESH, Ashoka Trust for Research in Ecology and the Environment (ATREE)

Despite the growing anthropogenic pressures on habitat for wetland birds, there are many examples from India where local villagers go out of their way to protect such habitation. Yet, there are also recent examples of local communities' indifference towards such habitat. Very little is known about why some communities actively conserve while still others are indifferent. The objective of our study is to understand the role of ecosystem services in motivating people to conserve. Surveys were carried to elicit peoples Willingness To Pay (WTP) in eight villages in Southern India. The villages were selected in groups of two such that the two villages were similar in all characteristics except that one had a tradition of protecting bird habitat while the other did not. A total 404 respondents were interviewed. Double bound dichotomous model was used to estimate the mean WTP in each village. The mean WTP in the villages protecting the bird habitat was significantly higher than the other group. Additionally, there was no impact of personal cost on WTP. Surprisingly, households which received payment from the forest department for conserving trees had a negative and significant impact on WTP. It appears that intangible ecosystem services played a crucial role in peoples motivation to conserve. However, the role of tangible ecosystem service such as payments made by a government agency is not positive. Because WTP is a reflection of peoples' ownership towards a good, it appears that people who received payments do not have the ownership over the 'good'. Our study assumes significance because Payment for Ecosystem Services has been projected as a conservation solution in such landscapes where poverty is seen as a hurdle for conservation. However, by paying people for things that they were already doing can take away their 'ownership' and perhaps also their motivation to conserve.

EVIDENCE FOR HETEROGENEOUS EFFECTIVE POPULATION SIZE AND ITS CONSEQUENCES IN CONSERVATION

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The drift-effective population size (N_e) is a central concept in conservation genetics. It is the size of an ideal population undergoing the same rate of genetic drift as the population under study. An accurate estimation of N_e is essential for conservation as N_e is used as a diagnosis tool for the conservation status of endangered species/breeds and the performance of the breeding programs. It is generally assumed that a single N_e can account for drift across the whole genome. However, recent studies in *Drosophila* spp. and other species suggest that different segments of the genome might undergo different rates of genetic drift, challenging this assumption. We currently lack any clear idea of how much heterogeneity in N_e is found across species, and what underlies/is causing such heterogeneity. Making use of the large genomic datasets available from cattle, we tested the hypothesis of heterogeneity of N_e using 50k SNP chip data from the Danish Holstein population. Using temporal samples, we estimated the standardized variance in allele frequency changes in different windows comprising 100 SNPs along the genome and estimated a realized N_e within each bin. We observed significant variation in N_e along the different chromosomal regions with ca. 500 chromosomal segments spanning 100 SNPs (corresponding to 4-7 Mb) exhibiting a realized N_e varying about 6-fold (N_e : 40-250). We also found significant variation in N_e between chromosomes. This variation is genuine and exceeds the mere sampling variance around our N_e estimates. We investigate whether differences in recombination rate and gene content – variables mediating effects of hitchhiking and background selection – co-vary with N_e across the genome. The implications of such N_e heterogeneity for conservation practices are substantial, as endangered populations can locally be accumulating homozygosity at a rate much faster than expected given an average N_e .

TESTING THE EFFICIENCY OF UNEVEN-AGED FORESTRY AS A CONSERVATION TOOL TO PROMOTE BIODIVERSITY AND ECOLOGICAL LEGACIES.

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Forestry in Sweden is dominated by even-aged management, e.g. clear-felling. Even-aged forestry simplifies forest structure, breaks forest continuity and negatively affects biodiversity. This has led to renewed interest in uneven-aged forestry, which maintains a layered forest structure, preserve forest continuity and have less impact on micro-climate than clear-

felling. Current knowledge indicates that uneven-aged forestry potentially preserve biodiversity better than even-aged forestry. However, we still need to quantify the differences and identify proximate reasons for this. By experimentally compare uneven-aged to even-aged forestry we will test the following hypotheses: 1) Uneven-aged forestry will retain pertinent ecological structures necessary to maintain abundance, species richness and composition of beetles at a) higher levels than observed in stands with even-aged structure and b) similar to levels in reference stands. 2) Uneven-aged forestry will favor species associated with old growth forest characteristics but disfavor species associated with early successional forests. We analysed the abundance, diversity and species composition of beetles in five different stand types; representing uneven aged forestry (selective felling), two phases in even aged forestry (clear-felling and thinning) and unmanaged forest (control stand and woodland key habitat) to evaluate the efficiency of uneven-aged forestry as a tool to promote biodiversity.

INTEGRATIVE TAXONOMY AND CONSERVATION OF THE FLY ORCHID GROUP

Nina Joffard

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The Orchidaceae family is famous for its great taxonomic and floral diversity and has attracted the attention of the scientific community since Darwin. This is particularly true for the *Ophrys* genus, which is known for its unusual pollination strategy called sexual deception and its insect-mimicking flowers. However, the *Ophrys* genus is currently subject to "taxonomic inflation" and its taxonomy is highly debated between orchidologists. This has negative consequences for its conservation not only because it makes species identification in the field difficult, but also because it is hard to conserve taxa whose taxonomic ranks are unstable. Thus, taxonomic studies are of primary importance for the conservation of the charismatic yet endangered *Ophrys* genus, endemic from the Mediterranean region. Integrative taxonomy, by taking into account several unrelated characters, seems to be a promising approach to delimit closely related orchid species. We investigated here the fly orchid group which comprises three taxa, *Ophrys insectifera* being widely distributed across Europe while *O. subinsectifera* and *O. aymoninii* are rare endemics. Recently, Triponez et al. (2013) have shown that they were genetically very close, but morphologically and ecologically differentiated. Our objective was to complete this work by analysing floral odour, which mimics sexual pheromones of female insects and is thus of primary importance in pollinators attraction and reproductive isolation. Using solid-phase-micro



extraction (SPME) and gas chromatography-mass spectrometry (GC-MS), we showed that floral odours of these three taxa are very different. We explain the incongruence between genetic, morphological, ecological and chemical characters in the light of the evolution of the fly orchid group and conclude that *O. insectifera*, *O. subinsectifera* and *O. aymoninii* are three different species and must be considered as such in conservation politics.

EXPERIENCES OF STAKEHOLDER ENGAGEMENT IN POLICY-DRIVEN RESEARCH: A SYSTEMATIC REVIEW PERSPECTIVE

Sif Johansson

MISTRA EviEM

Neal Haddaway, MISTRA EviEM; Claes BERNES, MISTRA EviEM; Magnus LAND, MISTRA EviEM; Oona LÖNNSTEDT, MISTRA EviEM; Matilda MILJAND, MISTRA EviEM; Mats SVENSSON, Swedish Agency for Marine and Water Management; Hanna ZETTERBERG, MISTRA EviEM

Conservation practitioners and policy-makers (decision-makers) increasingly turn to evidence reviews to aid decision making: more frequently systematic reviews (SRs). The reason is the rigorous, transparent, objective and repeatable way of reviewing academic and grey literature that aims to answer specific questions or assess the state of knowledge for particular subject. SRs are undertaken according to strict guidelines to ensure that they are as rigorous as possible when searching for, screening and critically appraising the studies, and synthesising the evidence. This is done by teams of expert reviewers to ensure high quality. This high level of rigour also appeals greatly to decision-makers needing to show that their choices are based on the best available evidence. Acceptance of SRs by stakeholders is vital, particularly where there is controversy. SRs must therefore involve stakeholders to ensure that the questions of highest priority are being asked in an appropriate way using the best available information and are presented in a usable and digestible format. SR stakeholders are diverse and different groups should be involved depending on the issue being reviewed. Key stakeholders are those needing the information as a basis for decisions; from government agencies to practitioners. Stakeholders also play a vital role in directing reviewers towards evidence, particularly grey literature. As end-users of the review findings, stakeholders can also help tailor research outputs to optimise impact. EviEM is a fixed-term project aiming to summarise existing evidence relating to human interactions with the environment using SRs. By undertaking several SRs on a variety of questions we have allocated considerable resources to developing a framework for stakeholder engagement (SE) in SRs. Here we discuss our experiences in SE and introduce a framework for participatory secondary research that aims to

provide decision-makers with widely accepted best available evidence.

HARVEST OF LOGGING RESIDUES FOR BIOENERGY - IMPLICATIONS FOR SAPROXYLIC INSECT DIVERSITY

Victor Johansson

Swedish University of Agricultural Sciences

With increasing demand for non-fossil energy sources, harvest of logging residues as a source of bioenergy is increasing. Twigs and tops as well as stumps are presently used. However, with this harvest, the amount of habitat for saproxylic species will decrease correspondingly. As many saproxylic species already are considered to be under threat due to present forest management, a further harvest of wood from the managed forests may increase the problems of maintaining biodiversity. To investigate if this is true and find ways to mitigate the problems I made several surveys of the species assemblage in bioenergy wood. There are big differences between different qualities of bioenergy wood, Spruce wood have less species, especially in logging residues. Spruce has moreover increased its distribution during the last decade. Spruce could therefore be harvested more intensively than deciduous tree species. In general, however, bioenergy wood was species rich, including also red-listed species. Another study made in a managed 25000 ha boreal forest landscape, showed that several species have the main part of the population in clear felling stumps: eight out of 39 beetle species had more than 50 % in clear felling stumps. In yet another study we found that beetle diversity per stump decrease in stumps on clear cuts where 25 % of the stumps were retained compared to a non-harvested clear cut. This suggest that even with the high retention levels presently recommended, species will be lost if most clear cuts in a region are stump harvested. But it is possible to select among qualities of bioenergy wood and harvest the types with lower value for biodiversity.

ENHANCING MOBILIZATION FOR CONSERVATION GOALS VIA COMPELLING STORIES AND MYTH

David Johns

Portland State University

Most conservationists know that the most effective vehicle for communicating conservation goals and their importance to audiences whose support is needed for success is story. But they do not always consider the essential elements what makes stories persuasive and compelling—what makes stories lead to action in support of conservation goals. Stories must appeal to an audiences needs, emotions and myths (what is sacred and just); they must be familiar; audiences must be able to find themselves in the story's characters; they must be memorable



and vivid; they must answer questions existing stories fail to answer; stories must be conveyed with evocative symbols and tellable in a variety of media and time frames from soundbites, songs and short films to full-length narrative films and books; and the messenger and channels must be right. There is no substitute for charismatic storytellers, but the elements of story can be mastered by others. Compelling stories must become a bigger part of conservation work if needed support is to be mobilized on behalf of the Earth's degraded landscapes imperiled species. This paper will explain these elements of story, why each is important, and how conservationists can improve their storytelling ability. The relation of story to other elements of mobilization will be briefly noted.

LESSONS FROM ORGANIZING LARGE LANDSCAPE CONSERVATION AND THE ROLE OF NETWORKS

David Johns

Portland State University

Charlie CHESTER, Brandeis University

As early as the 1930s, the Ecological Society of America called for protecting large areas representing each ecosystem type. By the early 1990s it was apparent to conservation activists and scientists that existing protected areas were losing species and function because they were often too small, in the wrong places and were becoming islands. The Mesoamerican Paseo Pantera (Path of the Panther) was a pioneering effort to link large habitat blocks. In 1991 the Wildlands Project (now Wildlands Network) launched an effort to create a North American-scale system of large connected protected areas focused on top carnivores, wide-ranging species and ecosystem function. In 1993 the Yellowstone to Yukon Conservation Initiative was founded to ensure connectivity and enhance protection in that part of the Rocky Mountains and adjacent areas. Similar large-scale conservation efforts emerged in the late 90s around the globe, including Australia, Russia, and southern Africa. These large-scale conservation initiatives have generated similar lessons, the most important being the need to add value to existing conservation work. They must bring a bold vision & inspiration, new funding, science to bear on goals, a geographically broad structure for advocacy, institution & community building, and information sharing. There are other lessons as well—the importance of good leaders, the right core of founders, the use of iconic species and places to gain support for the less dramatic, the ability to recognize the strengths and weakness of NGO networks across large geographies, and honesty in addressing conflicts of interest among participant NGOs.

AUGMENTING SURVEY DATA WITH COMMUNITY KNOWLEDGE TO INFORM A RECOVERY STRATEGY FOR AN ENDANGERED SPECIES IN CANADA: IDENTIFYING IMPORTANT AREAS OF HABITAT FOR PEARY CARIBOU ACROSS THE CANADIAN ARCTIC ARCHIPELAGO

Cheryl Johnson

Environment Canada

Sarah BANKS, Environment Canada

Peary caribou (*Rangifer tarandus pearyi*) is listed as an endangered species under the Canadian Species at Risk Act (SARA). The Minister of the Environment is legally required to prepare a Recovery Strategy for this species under SARA that includes an identification of its critical habitat where possible. Critical habitat is protected under Canadian federal law once it is identified in a species' recovery strategy. We describe how available survey and field data on Peary caribou were used in combination with community knowledge on the species' space use patterns to model patterns of habitat use for Peary caribou across the Canadian Arctic Archipelago. We used hierarchical approach to develop a series of models that examined the relative importance of climate, vegetation and other habitat attributes, as well as human development, in describing and predicting patterns of habitat use for Peary. We describe how the spatial predictions from the habitat models were used to help inform the identification of critical habitat in the federal recovery strategy for Peary caribou. Our methods highlight the usefulness of incorporating community knowledge to help fill information gaps on species habitat use. Our results indicate that climate is a major factor influencing Peary habitat use at broad scales. We assess the models ability to predict patterns of Peary habitat use to past climate conditions and use the results to inform model performance at forecasting future patterns of habitat use to changing climate conditions. The implications of potential future changes to the species' patterns of occupancy and habitat use to the species' recovery are discussed.

NEW THREAT FROM AN OLD ENEMY: THE ROLE OF THE FERAL CAT IN THE CURRENT DECLINE OF MAMMALS ACROSS NORTHERN AUSTRALIA

Chris Johnson

University of Tasmania

Many species of small marsupials and rodents are currently declining across vast areas of the tropical savannas of northern Australia. As a result, several are threatened with extinction. The traits of declining species point to predation as the cause, and circumstantial evidence implicates the feral cat. This is surprising, because cats have been in northern Australia for more than 100 years – why might they have emerged as a



threat only recently? We identify several factors that explain this. First, we show that cats prefer to hunt in areas recently burnt by hot fires, where their hunting success is optimised and, consequently, mortality rates of small mammals are extreme. Evidently, changes in fire regimes have amplified the predation pressure on small-mammal populations. Second, dingoes suppress the activity of cats, and force changes in their behaviour that could reduce hunting success. Recent declines of dingoes could therefore have released cat populations. Third, cats are highly adept at locating sparse populations of small mammals and concentrating their hunting on them, so that the pressure on small mammals is sustained even after they have been made rare. Our studies illustrate how changes in ecological conditions can cause increased impact of long-established invasive predators. They also show how ecological factors can be managed to reduce the impact of cats in the future.

SYMPOSIUM ID 65: CONSERVATION MANAGEMENT PRIORITIZATION WITH CITIZEN SCIENCE DATA AND SPECIES ABUNDANCE MODELS

Alison Johnston
Cornell University

Efficient use of conservation resources requires prioritization of the locations in which the largest number of target species will benefit from the management. Many migratory species also use landscapes dynamically and conservation action could also be targeted to the seasons that would benefit the greatest number of individuals or species. Dynamic conservation has the potential to be a very efficient tool, particularly for migratory species, but it requires detailed knowledge of the spatial and temporal distribution of species. Additionally, these management actions will often have the greatest impacts when targeted where populations are most abundant, rather than just species presence. We demonstrate how relative abundance can be modeled with eBird, a large citizen-science dataset. These estimates of abundance can be used to more accurately prioritize times and locations for implementing conservation measures and we describe the application of these models in current conservation programs of dynamic conservation. We compare fine-scale weekly estimates of relative abundance and occurrence for migratory waterbird species in California, U.S.A. We find estimates of abundance are not linearly related to occurrence and these patterns vary by species. Occurrence and abundance exhibit markedly different seasonal trends and locations prioritized for conservation by occurrence models have only 10-58% overlap with locations prioritized by abundance models. These results highlight the ability of citizen-science data to produce models of species abundance at a fine spatial and temporal resolution throughout an entire annual cycle. The results

also demonstrate that occurrence models will not typically identify the locations of highest abundance that are vital for conservation of populations.

CONSERVATION OF CRITICAL HABITATS FOR MONTANE BIRDS THROUGH COMMUNITY PARTICIPATION IN WESTERN HIMALAYAS

Virat Jolli
Biodiversity and Environmental Sustainability
Matthew J. GRAINGER, Newcastle University

The construction of hydro-electric projects in Sainj Valley has negatively affected critical habitat for montane bird communities. These habitats can be restored but only if local communities are willing to participate. However, there is lack of knowledge among local people regarding the rich biodiversity of this region, especially avian-fauna. Therefore to inform local people of the importance of biodiversity in this region we initiated a citizen science program to target local school children and educate them regarding the importance of conservation of avian habitats. Environmental awareness lectures were delivered in four different schools of Sainj Valley. From each school a group of five students were selected and given training in bird identification, and counting. With the help of these students a community-based bird survey was carried out in the Valley. They learned to identify and count the birds of Sainj Valley. It was the first time that local people from the valley participated in bird survey. The boys and girls students have shown good efficiency and during the project, girls were found to be good bird surveyors and we would like to employ them in future surveys, this could lead to social change in Sainj Valley. The study showed promising future for citizen science projects in Western Himalayas. However local people will only participate if they can see some economic benefit from conservation. Therefore for effective conservation planning we need to launch biological conservation projects with collaboration of local people. It will ensure long term benefits for the region.

A CENTURY-OLD GRASSLAND LEGACY ON PLANTS AND BUTTERFLIES IN SWEDISH PRODUCTION FORESTRY CLEAR-CUTS

Dennis Jonason
Linköping University
Torbjörn BLIXT, Linköping University; Mathias IBBE, Linköping University; Per MILBERG, Linköping University; Albert TUNÉR, Linköping University; Lars WESTERBERG, Linköping University; Karl-Olof BERGMAN, Linköping University

Traditionally managed semi-natural grasslands (i.e., unfertilised pastures and meadows) have due to massive land-use changes lost more than 90% of the area existing a century ago. However, effects of previous habitat size and configuration



on biodiversity may linger for long times. In this project, we investigated whether signs of historical grassland management can be found in clear-cuts after at least 80 years as coniferous production forest by comparing butterflies and plants between clear-cuts with a history as meadow and as forest in the 1870s in Sweden. Study sites were selected using old land-use maps and data on present-day clear-cuts. Clear-cuts with a history as meadow had on average 34% and 19% higher butterfly species richness and abundance, respectively, and 64% and 110% higher total plant species richness and of grassland indicator species, respectively, than did clear-cuts with a history as forest. Plants are known to respond more slowly to environmental changes compared to butterflies and being dependent on host plants and nectar sources, butterfly diversity may correlate with the land-use legacy of the local plant community. The study illustrates the importance of considering land-use legacies for understanding the distribution of species in fragmented landscapes, as well as in ecological research, conservation and management.

76- WHAT DOES IT TAKE TO SAVE SPECIES: A CASE STUDY FROM MAURITIUS

Carl Jones

Durrell Wildlife Conservation Trust

Several species of critically endangered Mauritian birds have been restored from small populations. Three of these: the Mauritius Kestrel *Falco punctatus*, Pink Pigeon *Nesoenas mayeri* and Echo Parakeet *Psittacula eques* have recovered from known populations of 12 or less, to several hundred. This has been achieved by improving survival and/or breeding success through addressing proximate limiting factors. Hence nest shortages are corrected by enhancing nesting-sites and the provision of artificial nest-boxes; high rates of predation corrected by predator control, and the other limiting factors corrected respectively by competitor control, disease control and supplemental feeding. The approach starts with addressing several possible causes of the species' rarity and then reducing management until only the main ones are being corrected. The populations have all responded quickly to this management and it needs to be maintained while the ultimate causes of rarity, such as habitat modification or exotic predators, are corrected.

HOW HAVE INVASIVE MAMMAL ERADICATION PROJECTS BENEFITTED NATIVE ISLAND FAUNA? A SYSTEMATIC REVIEW

Holly Jones

Northern Illinois University

Nick HOLMES, Island Conservation ; Peter KAPPES, Oregon State University ; Ilse CORKERY, University College Cork ;

Brad KEITT, Island Conservation ; Karl CAMPBELL, Island Conservation ; Bernie TERSHY, UC Santa Cruz ; Don CROLL, UC Santa Cruz ; Dena SPATZ, UC Santa Cruz ; Stuart BUTCHART, BirdLife International ; Doug ARMSTRONG, Massey University ; Phil SEDDON, University of Otago ; Stephen KRESS, Cornell University ; Colin MISKELLY, Te Papa Tongarewa ; Andrew BURBIDGE, Retired ; David TOWNS, Auckland University of Technology ; Alfonso AGUIRRE, Conservacion de Islas ; Araceli SAMANIEGO-HERRERA, University of Auckland ; Steve EBBERT, US Fish and Wildlife Service ; Mark RAUZON, Laney College ; Franck COURCHAMP, Laboratory of Ecology Systematics & Evolution of the University Paris-Sud ; Elsa BONNAUD, Laboratory of Ecology Systematics & Evolution of the University Paris-Sud ; Gerard ROCOMURA, Island Conservation Society ; Sally PONCET, FIQQ IZZ Stanley, South Georgia Surveys ; Steffen OPPEL, Royal Society for the Protection of Birds ; Richard CUTHBERT, Royal Society for the Protection of Birds

The number of invasive alien mammal eradications has grown substantially over the last few decades, with the primary goal of biodiversity protection including protecting threatened native species. The benefits of eradication to native island species have not yet been systematically collated at the global scale. We first aimed to collate data on potential beneficiaries of invasive mammal eradication globally by quantifying highly threatened mammals, birds, reptiles, and amphibians breeding on invasive mammal-eradicated islands in the past 10 years from an existing database. We found 270 populations of 117 globally threatened species potentially benefitted from invasive mammal eradication on 159 islands across the globe. This represents 17% of globally threatened island-breeding species, leaving conservation opportunities for more threatened species benefits with further invasive mammal eradication efforts. Next we did an in-depth systematic review of realized beneficiaries, in which we identified species that 1) increased in population size or reproductive success, 2) naturally recolonized an island after being extirpated, or colonized an island for the first time (unassisted colonization or recolonization) and/or 3) had a population translocated (conservation introduction or reintroduction) following invasive mammal eradication. We assessed realized species benefits for Australia, Ecuador, France, Mexico, New Zealand, the Seychelles, the United Kingdom, and United States of America, where >80% of eradications have taken place globally. We used established databases, a literature review, and expert interviews to procure the relevant information to compile this list. At least 448 populations of 199 species benefitted, including 60 populations of 26 globally threatened species, from 250 invasive species eradications across 133 islands. We find significant potential to focus on post-eradication reintroduction of seabirds.



DO REDD+ SOCIAL SAFEGUARDS REACH THE 'RIGHT' PEOPLE?

Julia Jones

Bangor University

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There is extensive debate about the potential impact of the climate mechanism REDD+ on the livelihoods and welfare of forest-dwelling people. To provide carbon credits, a forest carbon scheme must slow the rate of emissions. If this is achieved by slowing the expansion of agricultural land there is clearly a local cost. Madagascar has attracted significant investment in REDD+ and has a number of pilot projects with World Bank support. We focus on one such REDD+ pilot - the Ankeniheny Zahamena Corridor (CAZ). Some 2500 households around the corridor have been identified under World Bank safeguards as containing 'project affected people (PAPs)' and are receiving individual income generation projects as compensation. There has been controversy as to how such people are identified. We carried out intensive field work in one administrative unit, mapping the location of each household and selected a random sample stratified by location for detailed household interviews about livelihoods, food security, and assets. We compared the characteristics of households identified as eligible for compensation with those not identified as eligible. We found that people living closest to the forest, with livelihoods most dependent on the forest were less likely to be identified as PAPs while those living closest to the village centre and with powerful social positions were more likely (evidence perhaps of elite capture of the benefits being distributed). Given the extremely poor information available on local populations (even the location of quite significant villages is not available from maps), and the unwillingness of people's whose livelihood depends on illegal agricultural expansion to self-identify, it is unsurprising that the official process faced challenges. We question whether the approach of identifying and compensating particular households is practical in such settings and discuss alternatives.

CONTINENTAL-SCALE REWILDING OF AN INVADED ECOSYSTEM: AUSTRALIA

Menna Jones

University of Tasmania

Chris JOHNSON, University of Tasmania ; Mike LETNIC, University of New South Wales

Restoring ecosystem function by reintroducing highly interactive species, termed rewilding, is of high interest worldwide. Australia has the highest loss of mammal fauna in the world and is the largest island or continent on which there has been a general shift to an alternative stable state dominated by invasive species. Australia is an old and mostly arid continent with low ecosystem productivity, in which the relatively small human populations have had major impacts. There are plenty of rewildable landscapes, which are not intensively used for competing purposes but with lost or degraded ecological function. We will explore what has been lost through time in Australia's vertebrate fauna, from pre-aboriginal to aboriginal and recent European influences, and the extent to which it is possible to restore ecological function. Australia has some unique features that distinguish rewilding programs from those in Europe and North America. The Australian biota evolved in a higher degree of isolation for a longer period of evolutionary time than faunas on other continents, with the consequence that extinctions have resulted in the loss of entire taxons, such as diprotodons, genyornis and thylacoleonids. In contrast to northern continents, there are no close ecological analogues for some of the species and functional groups that have gone extinct in Australia. Another challenge is that population declines of once-abundant species have often preceded understanding of their ecological role in ecosystems. Consequently, important drivers of environmental change remain undiagnosed because we simply don't know how species which are now rare or extinct shaped ecosystems in the past. Invasive species dominate ecological communities across much of Australia. Reintroducing strongly interactive species may help to curb the interactions of these species. Some invasive species may, or may not, serve as functional analogues for extinct species.

SYMPOSIUM 175. STAKEHOLDERS PLAY A VITAL ROLE IN THE INTERGOVERNMENTAL PLATFORM ON BIODIVERSITY AND ECOSYSTEM SERVICES (IPBES)

Bengt Gunnar Jonsson

Mid Sweden University

In January this year the third plenary meeting of IPBES was held in Bonn Germany. In addition to outlining a set of assessments (thematic and regional), the member governments also adopted a strategy for engaging stakeholders in IPBES. In this respect stakeholders has a wide definition and includes, knowledge holders, rights holders and well as end-users of the IPBES products. The strategy establishes the possibility to create an open-ended network of organizations representing all these aspects and hence an exciting opportunity to link a



broad range of stakeholders with interests in biodiversity and ecosystem services. Stakeholders are considered essential for the four functions of IPBES (assessment, knowledge generation, policy support and capacity-building). The engagement strategy includes mobilizing stakeholders as contributors to the four functions, promote the use of the Platform's products, and to facilitate the participation of observers during IPBES Plenary sessions including reviewing documents that will be submitted to Plenary meetings. This highlights the role of scientific organizations, such as SCB, to be active in supporting the scientific quality of the work of the platform.

WILL FOREST CONSERVATION AREAS SAFEGUARD IMPORTANT FUNCTIONAL DIVERSITY OVER TIME?

Mari Jönsson

Swedish University of Agricultural Sciences
*Alejandro RUETE, Swedish University of Agricultural Sciences ;
Tord SNÄLL, Swedish University of Agricultural Sciences*

Biodiversity in conservation areas has rarely been linked to the range of functions the organisms perform in communities and ecosystems; i.e., their functional values. Incorporating functional values in biodiversity monitoring systems could add novel perspectives of the status of biodiversity in conservation areas over time. Based on regional monitoring data from 36 boreal forest old-growth conservation areas, we analyzed changes of several biodiversity components with multiple forest functional values over time. We detected significant reductions in the abundance of photoautotrophic indicator cyanolichens occurring on deciduous trees already after ten years, despite non-significant changes in their host substrates. Abundances of indicator pendulous lichens *Alectoria sarmentosa* and *Bryoria nadvornikiana* had also decreased, despite overall significant increases in the volume of large conifer host trees. In contrast to these lichens, the average abundances of saprotrophic fungi decaying coniferous deadwood and common parasitic fungi on deciduous trees (*Fomes fomentarius*) and coniferous trees (*Fomitopsis pinicola*) remained unchanged. The studied cyanolichens and fungi generally had similar area-based extinction rates over ten years, whilst only cyanolichens had substantially lower colonization rates. Reduced abundances of large foliose nitrogen-fixing cyanolichens may have negative effects on the nitrogen budget of the studied forests and represent a reduction in resources (e.g., food, material and shelter) for invertebrates, gastropods and birds. Reduced abundances of pendulous lichens represent a reduction in winter forage for reindeer and caribou. Unchanged abundances of deadwood and associated fungi represent an important supporting function for ecosystem services such as nutrient cycling, carbon storage and soil formation. Amid a severely fragmented landscape, conservation areas seem to struggle in preserving some of the basic old-growth forest functional values.

ACTIVELY LEARNING ABOUT CONSERVATION PRIORITIES

Lucas Joppa

Microsoft Research
Piero VISCONTI, Microsoft Research

Understanding where species occur (and why) is one of ecology's oldest questions - and of critical importance for biodiversity conservation. This is particularly true for invasive and endangered species, for which the distribution is often changing rapidly and is relatively unknown, and the collection of samples requires extensive resources. Active machine learning makes use of statistical models to estimate the expected information content of potential additional records, and identify the data points which would improve the accuracy of the models the most. This technique has been used for training image recognition models, web-content classifiers, among other uses, but has not yet been applied to ecological modelling. We test the applicability of active learning methods in generating the most accurate species distribution model with the fewest number of records. We use synthetic datasets of virtual species with known environmental responses and distribution, as well as real datasets of invasive plant species, and compare the performance of active and passive learning, stratified sampling and other methods commonly used to design field surveys. Performance is measured as the rate at which the model accuracy increases with number of data points collected and used for training species distribution models. We show that active learning methods are superior to all other sampling methods tested and provide recommendations on which active learning method to use depending on the distribution model structure and complexity.

97-TAKE BACK THE BLOCK: AN URBAN CITIZEN SCIENCE PROGRAM

Rebecca Jordan

Rutgers University
Amanda SORENSEN, Rutgers University

It is clear that citizen science programs result in a vast array of ecological and social outcomes. Positive outcomes recently reported in the literature include advancing conservation goals and increasing socio-ecological stewardship. Using data from the Mosquito Stoppers citizen science program, we will show that citizen science has the potential to increase socio-ecological resilience. This is supported by evidence that the act of participation in data gathering in socio-ecologically framed citizen science projects can: (1) Increase individual efficacy to drive community outcomes and that this increase in perceived efficacy need not be paired with actual efficacy; and (2) Help to build trust among members of similar or different communities that share goals. Mosquito Stoppers is the result of a collaboration between the University of Maryland Baltimore



County, The Cary Institute of Ecosystem Studies, and Rutgers University. This project is aimed at engaging local individuals of West Baltimore, MD, USA in mosquito control. This talk will first discuss how issue framing may affect the citizen scientists' perception of individual contributions and motivation for participation. Next we will discuss data about individuals' belief in personal efficacy in mosquito control, perception of mosquito effects on individuals' lives, and perception of municipal efficacy in meeting public needs. We found that individuals were less likely to report that mosquitoes kept them from enjoying the outdoors post Mosquito Stoppers participation. Additionally, individuals who reported being satisfied with their municipalities' handling of mosquitoes and pests dropped by half after participation. Finally, belief in personal efficacy in the process of mosquito remediation increased post participation. We will conclude that our findings demonstrate how appropriate coordination and framing can contribute to not only to local land stewardship but also the overall system resilience.

TWENTY TWO YEARS OF MONITORING HAWKSBILL TURTLE (*ERETMOCHELYS IMBRICATA*) NESTING AT REDANG ISLAND, TERENGGANU, MALAYSIA

Juanita Joseph

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A tagging and nesting study was conducted from 1993 to 2014 on the hawksbill turtles nesting at Redang Island, Terengganu, Malaysia. A total of 37 individuals were tagged over the 22-year period, and deposited a total of 206 egg clutches. During the early years (1993 – 2004), all nests for in-situ incubation had to be purchased from licensed egg collectors. Only 89% of nests were incubated during that period, while the remaining nests were sold by the licensed egg collectors at the market. Finally in 2005, the beach was gazetted as a turtle sanctuary and had stopped the collection of eggs. From 1993 to 2014, a total of 196 nests were protected and from these about 12,857 healthy hatchlings were released back to the sea. The nesting females tagged ranging from 0 to 6 individuals per year, with average curved carapace length and width of 82.85 ± 6.32 cm and 72.24 ± 2.71 cm, respectively. Females nest every 2 years on average, although remigration intervals of individual females do vary (range: 1 to 5 years). The average clutch frequency was 6 nests per female with average clutch size of 123 eggs, and average nesting interval of 15 days. The average incubation period was 58 days with an average hatching success of 62.18 %. Egg losses were attributed to red ants *Darylus* sp.(12.2%), crabs *Ocypodes* sp.(10.3%), maggots from *Megasaleria scalaris* larvae (14.6%), fungus *Fusarium* sp. and *Aspergillus* sp.(22.4%), plant roots (1.2%) and other unknown causes (39.3%). Apart from that, monitor lizards (15.5%), and nesting mothers (4.9%) also

destroyed some of the nests. Hawksbill turtle nesting density is very low in Redang Island, however it is hope that long-term protection of hawksbill turtles and their eggs will one day help increase the population at this area.

INDIGENOUS METHODS, KNOWLEDGE AND VOICE: A MI'KMAW FIRST NATION APPROACH TO LEARNING ABOUT FIRE'S RELATIONSHIPS TO THE LAND

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Dalhousie University

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This study addresses the need for both Mi'kmaq teachings about land fire history and ecology in Nova Scotia, Canada, and Mi'kmaq-appropriate research design and implementation. Fire is one of the four sacred elements for the Mi'kmaq and it represents a powerful force in nature to change and create habitat. Through history humans have been an ecological factor in reacting to, relating to, and learning from fires, however, very little is documented about the relationship between fire and the Mi'kmaq. There has been an accelerated bloom of academic investigations on Indigenous peoples and land fire relationship histories in North America. Many academic studies on North American Indigenous peoples-fire history use mainstream scientific methods such as paleoecology and European-based historical accounts but often lack First Nations community participatory approaches. As more biological research invites Indigenous knowledge, we also have yet to see purely Indigenous voices welcomed within mainstream ecological topics that are allowed to stand alone without the framework of mainstream science methodologies. Our research design follows principles of Indigenous methodologies with a blend of qualitative approaches, including Elder Advisory check-points, reflexive journaling, incorporation of Mi'kmaq language, and ceremony. With the engagement of Mi'kmaq researchers, the project went through various stages of visioning and redirecting to allow for a different worldview than mainstream science formats. The land fire topic was stretched out and reshaped into a way of looking at the land, and questioning the land and our people in a more culturally-appropriate and meaningful way, which often included methods coming from a purely Mi'kmaq culture, language and rigor. Both the methodology and stories about fire provide valuable lessons for future biological conservation work when incorporating Indigenous or Traditional Ecological Knowledge into the research design.

SYMPOSIUM ID 20 HOW TO MAKE THE MOST OF IT - NATIONWIDE CONSERVATION TRIAGE ACROSS A WEST AFRICAN BIODIVERSITY HOTSPOT

Jessica Junker



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Liberia includes almost half of the remaining Upper Guinean forests - a biodiversity hotspot and one of the most critically fragmented regions on the planet. Despite government plans to establish a network of conservation areas to cover at least 30% of Liberia's forests, only 2% of the country's land area is currently protected. We therefore systematically collected nationwide data on chimpanzee abundance, large mammal and tree diversity and human threats and related these to environmental and human impact variables. We developed spatial prediction models that served as base-layers for prioritization in MARXAN. We then identified and evaluated large mammal and biodiversity priority areas under different conservation scenarios. We improved upon standard software output to evaluate spatial properties of selected sites, determine site-specific target contributions, and estimate potential wildlife and biodiversity loss within logging and mining concessions. Last, we also assessed whether existing proposed protected areas (PPAs) achieved pre-determined conservation targets. The optimal conservation area network contained a candidate list of 92 areas that maximized biodiversity and chimpanzee abundance, minimized threats, and accomplished the preservation of 30% of Liberia's forests. It included more than half of West Africa's second largest chimpanzee population, which spatially coincided with that of some of the most species-diverse large mammal and tree communities. Logging and mining concessions largely overlapped with existing PPAs and conservation priority areas established in this study, and considerably increased their fragmentation. Existing PPAs, however, only partially covered our areas of prioritization and proved insufficient in meeting conservation targets. Our results demonstrate that in order to achieve a compromise between effective biodiversity protection and development in tropical Africa, evidence-based conservation planning is key.

SUCCESSION OF WOOD-DECAYING FUNGI IN EARLY-SERIAL FORESTS AFTER NATURAL DISTURBANCES

Kaisa Junninen
Metsähallitus

Fires and windstorms are among the most important natural disturbances in boreal forests, and the early-seral forests developing after these disturbances have been found to host diverse and distinct species assemblages. As dead wood

is abundant after stand-replacing disturbances, organisms dependent on dead wood, such as polypore fungi, are thriving during the early phases of forest succession. Results from two studies from eastern Finland are presented, one monitoring polypores in windblown areas and another one from burned areas. A 10-year monitoring of fallen trees and polypores in two windblown areas show that fallen pines can survive lying even for ten years, unlike fallen spruce trees. The number of species within the polypore community increases with time along with the change in the species composition, and ten years after disturbance some species of conservation concern, such as *Hapalopilus aurantiacus*, already inhabit fallen trunks. The polypore succession after fire has been monitored for 22 years in two forest stands that were burned for restoration purposes. On the study sites, burning has proved to be effective in facilitating the establishment of red-listed species. The post-fire succession of polypores on deciduous trees has almost come to its end within 22 years, whereas the number of species on conifers is still very high, including several species of conservation concern. The results highlight the importance of early-seral forests as habitat for organisms dependent on dead wood.

CAN YOU HAVE YOUR FISH AND EAT THEM TOO? EFFECTIVENESS OF PERIODICALLY HARVESTED CLOSURES FOR ACHIEVING MULTIPLE OBJECTIVES

Stacy Jupiter

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Historically, Pacific Island communities managed marine and coastal resources to achieve social, cultural and ecological objectives, which include: enhancing long-term fisheries sustainability; increasing short-term harvest efficiency; sustaining biodiversity and ecosystem functions; supporting local economy and livelihoods; and maintaining customs. Periodically harvested closures (PHCs) are commonly employed by Pacific communities to reach these objectives, in particular increase catch efficiency. However, increases in yields in PHCs, due to improved access to markets and technology, may be



compromising harvest efficiency and other objectives. We evaluate PHCs and address this potential problem through theoretical modelling, meta-analysis of empirical case studies and a literature review. Our theoretical model suggests that when fish behaviour is considered, PHCs can be a more efficient strategy for maximizing fish biomass and yield than permanent no-take areas or non-spatial management. Our meta-analysis indicates that PHCs can be effective at carrying more targeted fish biomass and abundance prior to a harvest than fished areas, and that they can be used as a fish reservoir for local communities during harvest events. The effectiveness of PHCs for providing a fisheries benefit to communities is greatest for large, old closures, where fishing pressure outside the PHC and harvest intensity inside is high. The literature review revealed that no data are yet available to evaluate more complex questions of recovery potential and whether PHCs can maintain absolute yields. Such questions are therefore being addressed using simulated fisheries models calibrated with empirical data from multiple PHC harvest events in Fiji. These models will provide guidance for local communities, describing sustainable PHC harvesting regimes and appropriate size of PHCs relative to the fishing grounds for best achieving socioeconomic and ecological objectives of this management system.

THE EFFECT OF FOREST MANAGEMENT, GRAZING AND AFFORESTATION ON WOOD-INHABITING FUNGI OCCUPYING DEAD WOOD OF DIFFERENT DIAMETER FRACTIONS

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Forest management has caused severe ecological degradation throughout the globe. One of its most prominent consequences is the drastic change in dead wood profile and, consequently, in the dead wood dependent biota. Wood-inhabiting fungi are, considering ecosystem functions, the most important species group utilizing dead wood, because they are responsible for majority of the decaying process. The earlier research focusing on the effects of forest management on wood-inhabiting fungi has strongly focused on large dead wood pieces (i.e. coarse woody debris, CWD), even though it has been shown that a major part of fungal diversity utilizes (also) small dead wood pieces (i.e. [very] fine woody debris, [V]FWD). We studied the effects of 1) earlier forest management, 2) grazing history and afforestation on the wood-inhabiting fungi occupying all dead wood diameter fractions including the smallest pieces. The study was conducted in boreal forests in Central Finland. We first surveyed corticioid and polyporoid fungi from 113 269 dead

wood pieces in 8 previously managed and 8 natural coniferous forests. In addition, we surveyed 66 929 dead wood pieces in 4 natural broadleaved herb rich forests, 4 afforested birch dominated fields and 4 birch dominated wood pastures. In both studies, we found differences among fungal communities occupying FWD in different forest types. Moreover, many rare species were detected only in one or two forest types. Spruce dominated natural forests and, surprisingly, afforested fields were especially rich in rare species. The main focus in forest conservation and restoration efforts may still be targeted on increasing CWD volume in managed landscapes, but simultaneously reasonable volume of FWD must be retained to ensure that specialist species utilizing it will not be driven to local extinctions. Combining this recommendation with increasing pressure for energy wood harvesting will remain as a challenge.

HUMAN LEOPARD CONFLICT - AN ALARMING INTIMIDATION FOR ITS CONSERVATION IN A HIMALAYAN ECOSYSTEM, PAKISTAN

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Livestock depredation by Leopards (*Panthera pardus*) is one of the global key conservation issues in landscapes with limited wild prey resources. Any attempts to mitigate Human Leopard conflict and conserve the species involved in conflict should be based on an unequivocal understanding of the conflict patterns. A household survey was conducted to quantify livestock losses resulting from depredation by Leopards in Machiara National Park, Pakistan. A total of 301 livestock were killed between June 2007 and August 2008. The extent of loss varied in different months, small-bodied livestock such as goat and sheep were more vulnerable. Domestic animals were killed more frequently after dark than during daylight hours. About 139 Leopards have been killed between 2000 and 2013, mostly in response to livestock depredation. Accurate information about the diet of Leopards is needed to properly design conservation strategies. The study examined Leopard diet composition by analyzing 141 scat samples collected in 2010. Leopards consumed 23 different prey species comprising 7 large mammals, 11 medium-sized and five small mammals. Livestock constituted a substantial part of Leopard diet (40.43%) followed by wild meso mammals (29.75%) and small mammals (18.97%). Consumption of livestock and wild prey species did not significantly differ in winter and summer diet composition. Results confirmed the claims of local people that Leopards kill livestock, and also documented the proportion of wild prey and domestic livestock, thus providing a scientific base to take effective conservation measures. Factors most closely associated with livestock depredation included decline



of natural prey, lacking herding and guarding practices. Local people repeatedly use pastures where Leopards are known to hunt. We suggest widespread local community education, proactive Human-Leopard conflict management, particularly through adopting carnivore-friendly livestock protection measures.

IMPACTS OF INSTITUTIONAL CHANGE ON RESOURCE SUSTAINABILITY: EDIBLE CATERPILLARS AND MIOMBO WOODLAND CONSERVATION IN NORTHERN ZAMBIA

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Availability of edible caterpillars is closely linked to healthy intact Miombo woodlands in Mpika District, northern Zambia. Without adequate trees and foliage, caterpillar populations plummet and local human communities lose a key source of protein and income. Field observations, structured interviews and focus groups were used to examine and understand institutions governing edible caterpillar use in three chiefdoms. Results showed that 82% of respondents harvested caterpillars; similarly, 77% were aware of rules and regulations for natural resource use, including traditional rules and taboos about harvesting passed down through successive generations. Of respondents aware of rules and norms, 88% had heard about them from traditional leaders. Lack of compliance with traditional governance systems was considered the driver of decline in edible caterpillar populations. However, only 19% of interview respondents reported incidents of community members being sanctioned for breaking harvesting rules, and sanctions were only mentioned twice during nine focus group discussions. Traditional leaders perceive that statutory frameworks have transferred their authority to government departments that fail to recognise traditional governance roles. While these departments are mandated to enforce statutory regulations for use of natural resources, they lack capacity due to insufficient resources. Both the traditional and government management systems have been rendered unenforceable, and thereby made caterpillar and other woodland products open-access resources. Commercialization has further eroded traditional conservation practices and incentives to overharvest are high; harvesters can earn ten times more for a five-litre bucket of caterpillars than for a similar quantity of maize, the predominant cash crop. There is an urgent need to mesh government policies with pre-existing traditional management institutions to enhance conservation and resource sustainability.

NOMADIC SPECIES AND HABITAT FRAGMENTATION - A LARGE SCALE CONSERVATION CHALLENGE FROM THE MONGOLIAN GOBI

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Asiatic wild ass (*Equus hemionus*) are among the most mobile of terrestrial mammals, ranging over thousands of square kilometers each year, a behavior that enables them to follow the unpredictable rainfall that characterizes the Gobi and to escape region-specific extreme weather events. Recent mining related infrastructure development, if not carefully managed, could fragment the range of this nomadic species in Mongolia. In summer 2013 we collared 20 Asiatic wild asses in the south-eastern Gobi. The goal of the project is to monitor space use and movement patterns, focusing on the impact of mining-related infrastructure and associated habitat fragmentation potentially caused by the Oyu Tolgoi (OT) copper and gold mine, the largest mining operations in the region. Collared wild asses are permanently "on the move" with straight line travel distances averaging 818 m/hour and 9.8 km between consecutive days. Over the 16 months monitoring period, individual wild asses have been roaming over areas of 9,942-63,641 km², covering a total area of 94,388 km². On average, 29% of wild ass locations have been in protected areas (accounting for 17% of the total range) and 22% within a 10 km restricted-entry strip along the international border with China (accounting for 6% of the total range). A dry summer followed by an unusual snowless winter in 2013/2014 highlighted the importance of specific water points. The international border fence with China is regularly approached by wild asses and walked along but never crossed. The unfenced 106 km-long OT mining road, with its currently low traffic volume of around 200 vehicles /day has been crossed a total of 100 times. Wild ass crossing times coincide with lowest traffic volumes, suggesting that if traffic volumes were to reach maximum projected traffic volumes of >1,600 vehicles/day, a significant barrier effect could be expected. We discuss the importance of our findings as a basis for achieving OT's Net Positive Impact goal.



ID38: APPLYING SITUATIONAL CRIME PREVENTION TECHNIQUES TO GLOBAL CONSERVATION CRIMES

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Michigan State University

Meredith GORE, Michigan State University

Conservation crime prevention techniques (e.g., patrolling) aiming to reduce poaching and illegal logging are in demand globally. Traditional conservation disciplines do not provide sufficient breadth or depth of training in crime prevention theories and methods. Conservation criminology is suited to provide alternative approaches and tools. One such approach is the 25 techniques of situational crime prevention (25 TSCP), which leverages 5 categories of 25 techniques to reduce crime: increase effort, increase risks, reduce rewards, reduce provocations, and remove excuses. The 25 TSCP is well known in reducing street crime: however, its suitability to conservation-based crimes is mostly unknown. The aim of this research is to adapt the 25 TSCP to conservation-based crimes. Our objectives were: apply 25 TSCP to conservation crime contexts and identify missing or unsuitable techniques within the context of conservation crime. We conducted focus groups with environmental professionals (n=80) centered on addressing illegal logging in two locations in Madagascar (Analamazaotra, Manompana) and a Delphi survey (n=20) with Global Tiger Initiative (GTI) professionals engaged in tiger (*Panthera tigris*) poaching-prevention activities. Participants identified conventional approaches (e.g., ranger patrols), discussed techniques unsuitable for species (e.g., removing targets), and added a novel category of techniques; strengthening traditional surveillance (e.g., Malagasy taboos for resource use). Results provide a foundation for developing a comprehensive TSCP tool that can be readily scaled and applied to different species and contexts (e.g., tiger poaching reduction in Sumatra, Indonesia). Interdisciplinary scholarship, such as a conservation criminology-based approach to TSCP, can provide novel tools and approaches to reduce conservation crimes.

HOW MUCH SHOULD WE COMPROMISE ON SETTING TARGETS IN CONSERVATION PRIORITIZATION PROBLEMS?

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Systematic conservation planning is an essential part of biodiversity preservation. In the context of conservation prioritization problems, the total cost of the entire reserve system is highly dependent on how big we set targets (e.g. 10% or 30%) for conservation features (e.g. species or habitats). Thus, it is of interest for conservation planners, how targets could be adjusted in a reasonable way in order to decrease

total cost. The aim is to give a feature ranking based on their influence on the latter. Focusing on the minimum set coverage problem – an integer linear optimization problem (ILP) – we developed a method to rank features according to their influence on total cost. Since the computation time is often too high to solve the ILP, we approximated its optimal solutions by the results of a linear optimization problem (LP). For the feature ranking we used the shadow prices of the LP comparing it to rankings created by methods which used an ILP solver and the software Marxan which is based on a simulated annealing algorithm. The results showed that for the minimum set coverage problem shadow prices can be used to create an approximate feature ranking of impact on total cost – this tells us which features are having the greatest impact on the total cost. Furthermore we realized that many planning units selected for conservation by Marxan and the LP solver were the same. These results can be useful to improve Marxan. Additionally an online app has been developed which allows the user to compare the solutions of the ILP/LP solver and Marxan for some selected real-world conservation prioritization problems.

SYMPOSIUM #20- TOWARDS THE AUTOMATED DETECTION OF PRIMATES USING PASSIVE ACOUSTIC MONITORING: PROGRESS AND CHALLENGES

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Advancements in remote sensing technology have opened up the field of biomonitoring to new methods. Here, we investigated the potential for passive acoustic monitoring (PAM) of terrestrial animals using autonomous recording units (ARUs). Our study focused on primates, hitherto understudied in the field of applied bioacoustics. Firstly, we developed a customized algorithm for the automated detection of sounds produced by three sympatric primate species living in Tai National Park, Côte d'Ivoire: chimpanzee buttress drumming and the loud calls of the King colobus and Diana monkey. Secondly, we used occupancy modelling to derive occupancy probabilities for all three species from data generated by the algorithm, as well as from human collected data from point transects in the same area. Due to the probabilistic nature of automated approaches, algorithms produce false positive and false negative detections, thereby requiring some cleaning before accurate inferences can be made. Therefore, we investigated to what degree these data needed to be manually verified by a human expert to provide reliable occupancy



probability estimates. We simulated various ARU datasets for each species, with varying degrees of cleaning for false positive and false negative detections. Our results show that occupancy estimates from automatically processed ARU data were robust to the degree of cleaning effort and approximated occupancy probabilities obtained using human point transect data. Also, we found some variation in detection probability of sounds according to environmental covariates such as temperature, rainfall and time of day. We suggest that occupancy probabilities derived from PAM could be used to longitudinally monitor vocalizing terrestrial species and even act as an early-warning system for detecting population shifts or disturbances. We provide concrete recommendations on how the current method could be improved to further its application as a conservation tool in the field.

BUMBLEBEE DIVERSITY AND DENSITIES IN MODERATELY INTENSIFIED NORTHERN FARMLANDS

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Recent pollinator declines have raised concerns about maintenance of biodiversity as well as stability of food production (Potts et al. 2010, Vanbergen et al. 2013). Despite bumblebees being important wild pollinators, landscape scale studies of bumblebees to date have mainly focused on highly modified landscapes (but see Diaz-Forrero 2013) while in moderately modified systems pollinators can show different responses to landscape use and features (Winfree 2013). We bridge this knowledge gap by studying factors influencing bumblebee diversity and abundance in a gradient of moderately intensified farming landscapes. We also investigate how spatial and temporal variability of food resources influence bumblebee diversity and density over the two-year study period. Using bumblebee and flower transects and ground-truthed land cover maps we calculated bumblebee diversity and density, flower resources and landscape characters for 25 Norwegian landscapes of 2km radius. We found that land-use diversity, measured as a Shannon diversity index, was positively correlated with both bumblebee diversity and density. Bumblebee diversity was also positively linked to flower diversity and abundance "flower poor" land, i.e. silage unfarmed land and grass crops. In contrast, bumble density was positively linked with forest cover, but negatively to "flower poor" land. These results suggest that while landscapes with abundant "flower poor" land-use types might not be able to sustain large

population sizes they can be important for populations of different species in providing other resources, such as variety of nesting places. This means that certain land-uses can have a trade-off between their influence on bumblebee diversities and densities. It is important for development of more pollinator friendly farming practices to understand how flower resources and land-use influence bumblebees in less intensively modified landscapes.

RESEARCH AND CONSERVATION OF LILYPAD WHITEFACE LEUCORRHINIA CAUDALIS (ODONATA: LIBELLULIDAE) IN LATVIA

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JSC "Latvian State Forests"

Lilypad Whiteface *Leucorrhinia caudalis* is one of the species of dragonflies occurring in Latvia, which is considered to be endangered and is included in the regulatory enactments of different levels of conservation of the species. The natural data management system contains only a few, including inaccurate entries on the fields of the species; therefore it is not possible to plan and carry out appropriate conservation of the fields of the species. When planning the measures of freshwater habitat management, the coastal habitat needs are not assessed in connection of the conservation of Lilypad Whiteface (and other specially protected species of dragonflies). The aim of the study was to summarize information on current research and conservation status of Lilypad Whiteface and give suggestions for conservation measures. The influencing factors of the population of Lilypad Whiteface are the following: their natural enemies and non-native species, collecting, extreme weather conditions, toxic substances in the environment and the minimum size of the population. However, all these factors hold an unknown or low to medium risk. The non-native species and the minimum size of the populations can be a high risk factor too. The loss of a habitat of the species is a medium risk factor, because it has been established only in some specific places. The fragmentation of habitats (isolation of fields), habitat management (cleaning of water bodies) and mismanagement of habitats of coastal zone (overgrowing) are assessed similarly. The protection plan of the species contains a description of the conservation measures of Lilypad Whiteface in the following areas: legislation and conservation planning, conservation of the species and habitats of it, research and monitoring, as well as information and education. A part of the described measures are attributable to the protection of invertebrates or even species and habitats as a whole.



CONSERVATION BIOLOGY OF CEPHALANTHERA CUCULLATA, A EUROPEAN PRIORITY ENDEMIC ORCHID OF CRETE (GREECE)

Apostolos Kaltsis

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Katerina KOUTSOVOULOU, National & Kapodistrian University of Athens ; Christini FOURNARAKI, Mediterranean Agronomic Institute of Chania ; Costas Thanos, National & Kapodistrian University of Athens

Cephalanthera cucullata is an endemic orchid of Crete, growing in forests on all four mountain massifs of the island. It is a species of European priority (Annex II, 92/43/EEC Directive) and is characterized as Endangered (EN) in the Red Data Book of Rare and Threatened Plants of Greece (2009); its total population size is estimated to less than 500 individuals. Starting in the 1980s, field observations by various researchers have indicated a decline in the overall population size, mainly due to overgrazing and habitat degradation. It was under the LIFE project CRETAPLANT (2004-2007) that the first systematic attempt of in situ conserving this plant was implemented and a Micro-Reserve (12.1 ha large) was established in Western Crete (Lefka Ori massif, 1200-1380 m asl) to safeguard the largest subpopulation of the species. Fencing of the Micro-Reserve offered protection from grazing but also made feasible the monitoring population dynamics of the species, throughout the period 2006-2015. Mapping and tagging each flowering individual (with the use of plastic labels placed on metal stakes) has revealed an interannually erratic, above-ground growth (due to vegetative dormancy) of *C. cucullata*, with a mean interval of emergence estimated at c. 2.75 yrs. A total of 235 individuals have been observed and labeled over these years, with the maximum number recorded in 2007 (146) and the minimum in 2011 (63). Meteorological data obtained from a micro-station (placed in the Micro-Reserve) are currently analyzed in an effort to correlate the microclimatic conditions to the population parameters (presence/absence, number of flowering stems etc.). In addition to long-term monitoring and in situ management of the species, an ex situ conservation initiative has been pursued. However, preliminary data on asexual, lab germination and propagation of this orchid confirm the general notion that seeds of *Cephalanthera* spp. are extremely difficult to sprout.

ECOLOGY AND CONSERVATION OF ENDANGERED DHOLES IN SOUTHEAST ASIA

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Dholes (*Cuon alpinus*), or Asiatic wild dogs, are the least studied and understood of the endangered large carnivores

in Asia. They have disappeared from >80% of their range during the past 50 years, and there are now < 2,500 adult dholes remaining in the wild. I reviewed the current status and distribution of dholes throughout Southeast Asia, and show that current populations are small and highly fragmented. In order to better understand their conservation needs, I carried out recent ecological research on dholes in Bhutan, Laos, and Cambodia. Results showed that in Bhutan, dholes have made a comeback in recent years, after being nearly extirpated from the country due to poisoning campaigns. However, current populations are limited by a low prey base. In Laos, dholes still occur in evergreen forests in the northern parts of the country, although packs were small and predation occurred on relatively few species, factors which likely limited their population size. My current research in the open deciduous forests of eastern Cambodia showed that predation by dholes focused almost exclusively on two common species, wild pig (*Sus scrofa*) and muntjac (*Muntiacus muntjak*). However, the population of dholes in the region is limited primarily by disease transmission from village dogs. Overall, dholes in Southeast Asia appear to be limited by different factors, including low prey base, human persecution, disease transmission from village dogs, and habitat loss. The future conservation of dholes in the region will be dependent on large protected area complexes, where high prey numbers are maintained and access by poachers and village dogs is limited.

IMPACTS OF COMMON FOREST RESOURCES MANAGEMENT IN BIODIVERSITY CONSERVATION IN THE MOUNTAINS OF NEPAL

Pratikshya Kandel

ICIMOD

Under community forestry (CF) program, the forest user groups take forest management and benefit distributions decisions. CF is envisioned as an appropriate mechanism for addressing local people's need for fodder, firewood and timber in the mountains of Nepal. By the end of the year 2014, it has been established as the largest social mobilization program involving one third of all households of Nepal. The program has been successful in restoring greenery of hills, forming local level institutions for resource management and improving the supply of forest products to farmers in the hills of Nepal. However, the biodiversity conservation outcome is less studied which is the focus of this study. The CF may have positively contributed to biodiversity conservation by restoration and rehabilitation of the landscapes. The increased incidences of human leopard conflicts causing 31 human deaths in last 4 years, may serve as a good example of the habitat restoration followed by habitat utilization by wild animals in hills of Nepal. Similarly, recent photographic evidence of trans-boarder movement of tigers and rhinos between Nepal and India through community-



restored forest landscape in western Nepal is another good example. The same landscape in addition to providing habitats for the flagship species; is conserving thousands of other less conspicuous species. It can also be urged that CF can fulfil the gaps in protected area network in mid-hills where expansion of protected area is limited. To facilitate this, it is urgently required to incline management objectives of CF towards biodiversity conservation. Biodiversity impact of CF includes prevention of local extinction of species and creation of corridors for wildlife. Biodiversity conservation needs clustering of CFs within landscape level. Modifications of management regimes is necessary to commensurate with that of biodiversity conservation.

MODELLING HUMAN PRESSURE IMPACT ON PROTECTED AREAS IN THE CZECH REPUBLIC

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Protected areas should serve as the reserves of biological diversity in human dominated landscape. This poster presents spatial analysis of human pressure on ecosystems in the Czech Republic and its impact on biodiversity loss. The aim of the work was to quantify the extent of main anthropogenic pressures on ecosystems, assess their spatial patterns and compare impacts in protected areas with other landscape. One of the main tools used in the study is Mean Species Abundance indicator (MSA) developed for model GLOBIO3 assessing human-induced changes in biodiversity based on simple cause-effect relationships between environmental drivers and biodiversity impacts. Drivers considered in this study are land-cover change, land-use intensity and fragmentation as they are assumed to be the main cause for biodiversity loss. MSA values indicate relative remaining mean species abundance of original species compared to primary vegetation scaled between zero and one (1 = all original species, 0 = no original species). To calculate MSA values based on land use and land cover data, the Consolidated Layer of Ecosystems of the Czech Republic was used as the most detailed currently available dataset of ecosystem distribution on the national-wide level. Results show significant impact of long-term human influence resulting in decrease of Mean Species Abundance in the Czech Republic to 31% of original biodiversity in intact ecosystems. The biggest impact was located in intensively used agricultural areas in the lowlands. Protected areas presented by forested mountain ranges in the border areas, as well as other forested interior parts of the country, achieved significantly higher values of MSA indicating they represent relatively best preserved ecosystems in comparison with others. However, the MSA in protected areas is still decreased on average by over 50 % which documents huge human pressure on protected ecosystems and threat for preserving their original diversity.

USING UNIVERSAL HUMAN NEEDS TO UNDERSTAND THE COSTS OF LIVING WITH DAMAGE CAUSING MAMMALIAN WILDLIFE

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Human Wildlife Conflict (HWC) is increasing globally and has been recognized as a major priority by conservation organizations as it can lead to a loss of support for conservation in general. Individuals vary in their tolerance towards living with damage causing wildlife but the drivers of tolerance are not well understood. We developed the Wildlife Tolerance Model (WTM) to predict drivers of tolerance across species and cultures and apply it in a case study of human-baboon conflict in Cape Town, South Africa. The WTM was developed from meta-analytic reviews as well as reviews of theories and concepts from a variety of disciplines. It aims to guide development of strategies and policies that can potentially be applied over landscapes. The WTM consists of two components; an outer model proposes that the net outcome of the extent to which a person is exposed to a species as well as the types of experiences (positive or negative) determine perceptions of the costs relative to benefits of living with a species. These in turn determine tolerance. A second component, the inner model, predicts eleven variables that impact on tolerance through costs and benefits. Baboons are one of the most common primate species involved in human-wildlife conflicts in Africa but few studies have examined the attitudes and tolerance of people towards them. We surveyed 403 residents living in five urban areas adjacent to the Table Mountain National Park. Using Structural Equation Modeling we tested and found support for the outer model. Overall 60% of tolerance was explained by perceptions of costs and benefits. We distinguished between tangible (monetary) and intangible (non monetary) costs and benefits and found that while intangible costs and benefits equally contributed to driving tolerance, tangible costs had no significant effect on tolerance. We use a "universal needs" approach to explain these findings.

MATRIX TYPE AND PROTECTED AREA CONSERVATION: THE ROLE OF BUFFER ZONES IN CHIMPANZEE CONSERVATION

Beth A. Kaplin

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Protected areas represent a cornerstone in biodiversity conservation. A key factor influencing protected area (PA) effectiveness is the surrounding matrix including land use type and intensity. Research has shown that matrix surrounding a PA mediates intensity and frequency of edge effects resulting in changes in biodiversity and ecosystem function. Buffer zones are a tool in PA management and can represent hard or soft matrix, yet few studies have evaluated efficacy in protecting biodiversity while contributing to local communities or reducing wildlife conflict. We studied the relationship between matrix type and an endangered species important for ecosystem services (seed dispersal) and tourism revenue, chimpanzees (*Pan troglodytes schweinfurthii*) in Nyungwe National Park (NNP), Rwanda. The park is partially surrounded by contrasting buffer zone types, tea (considered hard edge) and pine (considered soft edge) plantations. We compared chimpanzee and human sign along transects in forest adjacent to tea and pine and in interior forest, and in transects just outside the PA. Chimpanzees were more common in forest adjacent to pine buffer than tea (based on nest counts and sign). Human sign was more common in forest adjacent to pine and in interior forest. Transects sampled outside forest along PA edge showed more human sign in tea than pine buffer, and more chimpanzee sign outside forest adjacent to pine. These results suggest that matrix type affects quality of buffer zone benefits for the PA; hard matrix was better at reducing human disturbance within the forest, but human sign outside the forest was greater. Conversely, soft matrix effectively increased the area of the PA for chimpanzees, a key wildlife species, but also may increase probability of wildlife leaving the park. These findings highlight the importance of linkages between PAs and surrounding landscape, and the nuanced role of buffer zones in contributing to biodiversity conservation in PAs.

171 CITIZEN SCIENTISTS AS AGENTS FOR CONSERVATION

Krithi Karanth
WCS

Citizen scientists participation in conservation research – has become an important tool for monitoring and evaluating local and global conservation science and action. Citizen science projects enable large-scale data collection, increase scientific literacy, and monitor conservation management efforts. Few studies have examined the individual-level motivations and impacts of citizen science participation. I evaluate the experiences of citizen scientists volunteering with two conservation organizations based in Bangalore, India

that have engaged more than 4000 volunteers and trained them to contribute to conservation research projects over the past two decades. Citizen science can contribute to increased conservation awareness among the general public. Specifically, understanding processes whereby highly motivated individuals, seek out citizen science opportunities due to an interest in one or more environmental issues; gain expertise through citizen science participation; and diffuse acquired skills and knowledge to peers through social networks, education of other non-scientist Indian citizens, and/or changes in career or education trajectories. As a result, citizen scientists in India promote conservation principles through an active advocacy network.

195 UNDERSTANDING HUMAN-WILDLIFE INTERACTIONS IN INDIA: INSIGHTS FROM 10,000 SURVEYS

Krithi Karanth
WCS

Preventing and mitigating human–wildlife conflicts are a top conservation priority, particularly in India where wildlife and high densities of people co-occur. We surveyed more than 10,000 households in a 20,000-km² area in forest, scrub and grasslands areas in India from 2009-2014. We visited more than 3000 villages in 26 districts from Rajasthan, Madhya Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu and Karnataka, surveying households in protected and unprotected areas. Our observational study modeled self-reported crop and livestock loss, and compensation access by households. Many (>60%) households are agricultural and crop loss was higher around central and southern Indian forests compared to other ecosystems. Crop loss was associated with growing more crops and proximity to forest or grassland cover. Crop loss was attributed to 25 different species with wild pigs and elephant being most common. Overall, livestock loss was lower than crop loss across all sites, and highest in Central India. Livestock loss was associated with grazing animals inside reserves and collecting resources such as fuel wood from reserves. Livestock loss was attributed to 10 different species with leopard and tiger top ranked predators. Common mitigation measures for crop protection were night watching, fencing, guard animals and scare devices; and for livestock protection were closer watch on animals, guard animals, physical structures and fencing. Efficacy of these mitigation measures varied hugely by location, with many measures being completely ineffective. Compensation was universally low to non-existent and a serious evaluation of compensation practices in different states is needed.



MAPPING AND MODELLING LAND USE CONFLICT TO INFORM NATURAL RESOURCE PLANNING AND MANAGEMENT

Azadeh Karimi

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Greg BROWN, University of Queensland ; Marc HOCKINGS, University of Queensland

Land use conflict is endemic to natural resource management given the limited availability of resources and multiple stakeholders' interests in those resources. Recent research in public participation GIS (PPGIS) has sought to identify and measure the potential for land use conflict using a two dimensional model that combines spatially-explicit place values with land use preferences (Brown and Raymond, 2014). Based on this framework, potential land use conflict is determined by differences between perceived acceptable and unacceptable land uses in the same location that is weighted by level of place importance, as measured by the intensity of mapped landscape values in the same location. However, this perceptual model of conflict does not account for landscape heterogeneity that may (or may not) inform participants' perceptions. We seek to understand whether the perceptual model of land use conflict is associated with specific types of physical landscapes and locations to enhance land use conflict mapping and identification methods. Using empirical PPGIS data collected from a regional natural resource study in the Baffle Basin region, Queensland, Australia, we evaluate an expanded model of land use conflict that includes both perceptual and landscape attributes. We discuss the implications of our findings for natural resource planning and management that seek to use collaborative or participatory mapping methods.

INTEGRATING ECOSYSTEM THRESHOLDS INTO ADAPTIVE MANAGEMENT OF MARINE RESOURCES

Kendra Karr

Environmental Defense Fund

Rod FUJITA, Environmental Defense Fund

Ecosystem-based management of coral reef fisheries aims to sustainably deliver a diverse portfolio of ecosystem services. This goal can be undermined if the ecosystem shifts into a different state, with altered ecosystem functions and benefits to people. If levels of drivers that cause transitions between states are identified, management measures could be aimed at maintaining drivers below these levels to avoid ecosystem shifts. To find management targets for coral reef fisheries that could result in good sustainable yields while at the same time maintain the production of other ecosystem services at desirable levels, we examined empirical relationships between metrics associated with coral reef ecosystem structure and

function along a gradient of total fish biomass (proxy for fishing pressure). Several metrics (e.g., macroalgal cover, change in fish assemblage) show thresholds — abrupt non-linear changes — at high fish biomass levels supporting the concept that coral-dominated states are associated with high fish biomass. Other metrics show thresholds at lower fish biomass levels, suggesting that such levels may be associated with transitional states and finally macroalgae-dominated states. If the thresholds in this study are generalizable to scales relevant to management, it may be possible to produce sustainable yield while simultaneously maintaining coral-dominated reefs by restricting fishing mortality to levels that result in biomass ratios near 0.5. Fishing down to biomass ratios near 0.3 may increase the risk of overfishing (resulting in lower long-term yields) and transition to macroalgal-dominated reefs. Thresholds offer a simple and powerful way for managers to operationalize precautionary ecosystem-based fishery management by adaptively limiting fishing pressure in order to (i) maintain desirable coral reef conditions, (ii) establish a system-specific target for generating pretty good yield and (iii) maintain sustainable multi-species fishery yields.

HUMAN OR TIGER: WHO WINS? UNDERSTANDING KEY DETERMINANTS AND HUMAN DIMENSIONS OF HUMAN TIGER CONFLICT IN WEST SUMATRA INDONESIA

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Ministry of Forestry of Indonesia

Ignas HEITKONIG, Wageningen University

The human wildlife conflict (HWC) comprehends a large range of species, and contributes to declining wildlife populations. The impact of wild animals on humans and their activities can promote a negative attitude toward wildlife, including retaliatory killing. This is particularly the case when large carnivores like tigers are involved. Quantifying the direct impact of HWC only without taking into consideration the indirect impact of HWC may lead to a wrong conclusion about how big the impact of HWC is for entire communities. This paper is focusing on the magnitude and human dimensions of HWC. In this study, conflicts between humans and the Sumatran tiger (*Panthera tigris sumatrae*) as a model species (human tiger conflict, HTC) were analysed to understand the human dimension and factors associated with the HTC. A semi-structured interview was conducted in West Sumatra, Indonesia among 128 respondents. This study shows that calculating indirect impacts can explicitly explain the magnitude of the HTC in the community. In the case of human attacks, direct impacts seem to affect only 1.5% of the community members. Yet, by including indirect impacts too, over 98% of the community members were affected by HTC incidents. Furthermore, the analysis of the human dimension of HTC found that the emotions of people toward



tigers are inversely correlated with their conservation attitude and their level of tolerance toward tiger. Key determinants explaining human dimension factors are impact perceived as a result of HTC the intensity of environmental educations in the village, field location and ethnicity. Frequency of HTC, knowledge and gender each seem to have only a small impact on shaping human dimension factors. This study suggests that an integrated program combining environmental education, compensation for livestock and human losses, and community involvement to handle the HTC are recommended to improve local people's tolerance for tigers

ART MEETS CONSERVATION: STORYTELLING AND PARTICIPATORY VIDEO HELPS UNDERSTAND TIGER-HUMAN CONFLICTS

Erlinda Cahya Kartika

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To increase people awareness toward environment is challenges. Giving oral presentation or directly speak to people about conservation can be so boring and make them did not aware with what we are trying to deliver. Using art for delivering messages can be an alternative to gain people attention. Storytelling and participatory video are part of art which can be powerful educational tools to help school children and adults in Indonesia understand tiger-human conflicts (THC). The problem of THC in West Sumatra, has emerged due to a number of factors. One of these is believed to be a lack of knowledge about tigers and their importance in the ecosystem. Our environmental education project aims to rectify this situation. Conducted from January to September 2014 with support from the Rufford Foundation, the project was divided into two segments that focused on children and adults. For children, the environmental education was delivered through storytelling. For adults, it was delivered by a participatory audio-visual campaign. In West Sumatra, children usually go to regular school in the morning and Islamic school in the afternoon to learn the Qur'an. We went to a junior high school and an Islamic school to carry out storytelling activities. We found that students were very enthusiastic to hear the story of tigers and their ecosystem. To help the students understand, we used the local language, Minang instead of Bahasa Indonesia, the national language. Participatory videos are a great way of bringing people together to explore issues, voice concerns or simply to be creative and tell stories. This process can be very empowering, enabling a group or community to take action to solve their own problems and to communicate their needs and ideas to decision-makers and other groups within the community. As such, participatory videos can be highly effective to engage and mobilise marginalized people to implement their own sustainable development activities based on local needs.

HOW RELIGION CAN INFORM FOREST MANAGEMENT FOR BIRD CONSERVATION: THE CASE OF SACRED GROVES IN GREECE

Vassiliki Kati

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Eleftherios KAPSALIS, University of Patras ; Fotios XYSTRAKIS, University of Patras

Sacred groves are ancient natural sites, established and preserved since the 15th century through the Orthodox religion in Greece. They are small old-growth woodlands, locally managed and maintained by local communities. We selected 20 oak sacred groves in NW Greece (17 for passerines), and we employed a random selection algorithm to select an associated set of 20 (17) control oakwoods in the broader area, which are regularly managed by National Forest Service for wood harvesting. We sampled small terrestrial birds in 2012 using the point count method, and woodpeckers in 2011, using the playback method, while recording nests and tree holes from drumming (2782 trees examined). Sacred groves held a significantly more abundant forest bird community (22 species, 584 individuals) than control woods (18 species, 286 individuals) (U test: $z=8.037$, $p<0.0001$), attributed to the greater abundance of eight species associated with mature wood. Sacred groves had also greater species richness and abundance of woodpeckers (7 and 2 species, 55 and 7 individuals, respectively) (Friedman rank tests; $p<0.01$). They included significantly more trees with woodpecker nests and tree holes from drumming, whereas trees had significantly greater diameter (dbh) and height than trees in control woods. Our results provide a forest management guideline for bird conservation, towards the preservation of uncut mature forest stands in the managed oak zone, with a median tree diameter (dbh) of 45-85 cm and median tree height of 8-14 m. In conclusion, our results provide strong evidence towards the great conservation value of sacred groves for forest bird community and their value as a reference point for forest management.

197-PERSPECTIVES ON NATURA 2000: FROM DESIGN TO CONSERVATION

Vassiliki Kati

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The European Union (EU) has succeeded in establishing Natura 2000, a transnational network of protected areas to conserve species and habitats of conservation concern. The terrestrial component covers to date 17.9% of EU land territory, while the marine component is under development. A suite of legal, policy, and financial instruments are currently provided by the EU to facilitate Natura 2000 management (estimated cost of €5.8 billion/year). The successful implementation of Natura



2000 depends on seven key drivers: network design, use of external resources, legal frame, scientific input, procedural frame, social input, and national/local policy. The design of the network in terms of area and representativeness, and the relevant legal frame as provided by the Birds and Habitats Directives, are recognized as adequate. However, the two conservation directives are currently being audited and changes may weaken their strength, much more as only 17% of habitat and species of European concern merited a favourable conservation status (based on pre-2007 assessment). EU member states should invest great effort in the social and policy fields that appear the most problematic, as negative attitudes of local communities and a lack of political will towards conservation action at local and national levels are widely recognized. European conservation scientists emphasize the need for public awareness with special focus on local communities, the employment of high-quality conservation experts in all stages of Natura 2000 implementation, the improvement of studies that assess the impact of development projects within the network, and a permanent funding flow through a specific fund, in order to substantially increase Natura 2000 effectiveness.

MONITORING SELECTIVITY PATTERNS: A TOOL TO MANAGE UNGULATE-RELATED CONSERVATION PROBLEMS

Krisztián Katona

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Ungulate populations in Europe have increased during the last decades. This is a source of different conflicts to biodiversity conservation. However, hunting pressure could not compensate for this boom and could not provide a universal solution to those ungulate-related problems. Successful conflict management would require deeper understanding of ecological complexity of ungulate-habitat relationships. In Hungary, there are also serious conflicts linked to the "intolerable" impact of "overabundant" red deer and wild boar. The unbalanced definition of the role of ungulates in the ecosystems leads to causal oversimplification focusing only on their excessive negative effects. But red deer and wild boar are native ecosystem engineers, having regulatory functions in the near-natural ecosystems. Neglecting their positive effects and low consideration of the joint impact of different factors in the related conservation issues makes the implementation of adequate conservation measures difficult. We elaborated and apply an ungulate impact monitoring system in Hungary supporting conservation and management decisions. Standard and comparable evaluations based on ecological bioindicators, provide a tool to predict the relative

overabundance of ungulate species and the overutilization of vegetation. We have already collected data about the relationships between the patterns of vegetation (availability of saplings, shoots, and trunks) and selective utilisation of those natural resources by ungulates in about 20 different forested areas of different forest types and management regimes. Our results reveal that the important ecological role of selective ungulate feeding can be obvious especially in case of close to nature forest management. In those, more diverse areas the less "prioritized" woody species are mainly selected and the total ungulate impact is also at a moderate level. Selectivity patterns, therefore, can provide a useful set of bioindicators of forest naturalness.

INDIGENOUS KNOWLEDGE IN ECOLOGICAL CONSERVATION, A CASE STUDY FROM THARU COMMUNITY OF NEPAL

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In this paper, I summarize some of the contemporary practices in quantitative anthropological research of indigenous knowledge and economic systems which finally leads to the conservation of ecology. First, I concentrate on the different research methods prevailed in ethno-ecology by providing an overview of the quantitative studies of indigenous knowledge. Anthropologists use tools and techniques such as free lists, pile sorts, semi-structured interviews with major informants and objective tests to depict the indigenous knowledge regarding the ecological conservation. Demographic model of culture are drawn from the data to indicate distribution patterns of traditional knowledge in cultural groups. Variables like gender, age, social class and mode of subsistence are included in traditional environmental knowledge's patterns of distribution. Next, I reviewed the contemporary understandings of nature and environment in the reference of economic systems of Tharu community. Participation, access and approach ways of indigenous people are relatively studied to the distribution pattern in traditional environmental knowledge. Finally I urge some possible linkages between indigenous knowledge, economic market approach and ecology conservation.

106 UNDERSTANDING LOCAL STAKEHOLDER'S PREFERENCES FOR INTERVENTION DESIGN: THE CASE OF CONSERVANCIES IN KENYA'S MAASAI MARA

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Conservation interventions often set out to improve environmental and economic conditions by influencing



local people's livelihood choices. However, conflicts can arise when certain groups of stakeholders feel disadvantaged by the changes that ensue. To achieve success, conservationists should therefore aspire to understand the preferences of their target population and how they shape their responses to change. Here, we present the results of a case study of conservancy initiatives around the Maasai Mara National Reserve in southern Kenya, where there is a long history of conflicts over conservation. Conservancies are community-based organisations whose members lease their land for conservation and eco-tourism, foregoing rights to graze livestock on it in return for regular payments. Over the last decade, they have spread rapidly throughout Kenya but their effects remain poorly understood. Using discrete choice experiments (DCEs) and structured interviews, we quantified the preferences of local pastoralists for alternative livelihood options and conservancy designs. We show that despite rapid political and economic change in the region, Maasai retain a strong preference for diversified pastoral livelihoods, favouring scenarios in which they are able to maintain livestock herds with sufficient access to grazing land. However, we also demonstrate that there exists considerable variation in preferences between individuals, with important differences between men and women. Our findings show that conservancy managers must take particular care to ensure that they produce equitable outcomes within heterogeneous local communities, and suggest that the success of conservancies will depend on finding new and creative ways of integrating pastoralism, conservation and tourism.

HEDGEROWS INCREASE NATIVE CROP POLLINATOR OCCURRENCE BUT DO NOT INCREASE FUNCTIONAL REDUNDANCY OR RESPONSE DIVERSITY OF THESE COMMUNITIES

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Currently, pollinators are integral to the production of 75% of leading global food crops but managed pollinators, such as the European honeybee, are experiencing drastic declines. This makes native, crop-pollinating bee species even more important as they provide direct pollination services and can increase the effectiveness of pollination by managed honeybees even at low abundances. However, in intensively managed agricultural landscapes where demand is highest for pollination services, abundance of native pollinators is lowest. Restoration techniques, like hedgerows, can enhance native pollinator communities but it is unclear if they adequately

support resilient communities that can survive disturbance or adapt to climate change. Functional redundancy or the number of species that have similar roles in ecosystem processes has been used as a predicative measure of community resilience. Along the same lines, response diversity or the diversity of phenotypic traits within a group of functionally redundant species can be used to assess how environmental changes might impact a community. Using a comprehensive dataset of native pollinators collected on hedgerows and unrestored weedy strips in California's Central Valley, we found that hedgerows increased the occurrence of crop-pollinating native bee species. However, hedgerows did not increase functional redundancy or response diversity of crop-pollinating native bee communities. These results suggest that hedgerows can be an important part of pollination management in highly modified agricultural areas but more action may be necessary to increase community resilience.

DO LEAST-COST MODELS PREDICT ANIMAL MOVEMENT?

Annika Keeley

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Least-cost models are commonly used in conservation planning to identify areas that should be conserved as wildlife corridors. These models rely on estimates of landscape resistance which is a measure of how much landscape variables impede an animal of a focal species moving through the landscape. If these resistance values are wrong, then land-use planners, transportation agencies, and other decision-makers may be implementing poor corridor designs. For elk (*Cervus canadensis*) and desert bighorn sheep (*Ovis canadensis nelsoni*) we used three models to estimate resistance values: expert opinion, resource selection functions, and step selection functions. We calculated the costs of actual long distance movements based on each set of resistance estimates, and compared these costs to the costs of the least cost paths and 48 rotated and shifted versions of the long distance paths. The mean cost rank of the observed paths was a measure of aptness of the models. For elk (a habitat generalist), all three models performed better than chance, but not much better, with little difference among the 3 models. For desert bighorn sheep, aptness of all three models performed much better than chance, with little difference among models. Because the expert opinion model performed as well as the data-intensive models, practitioners can rely on the expert opinion model because it is cheap and easy to produce.



#165 HOW CAN EVALUATIVE THINKING HELP CONSERVATION BIOLOGY LEARN TO BE MORE EFFECTIVE?

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With the rise of evidence-based conservation, it is increasingly recognized that to improve the effectiveness of conservation outcomes we need to evaluate whether actions have been successful and use that information to learn and adapt management practices. In conservation, the approach to evaluation has generally focuses on a narrow set of quantitative methods that are focused on reducing uncertainty for simple management problems (e.g., which herbicide is most effective). However, most conservation problems are high complex, with social, political and economic aspects that are as influential as the biology. As predominantly natural scientists, conservation biologists are trained to think about the natural system, and often do not have the tools to understanding the broader socio-ecological system. However, the field of evaluation has a wide range of tool well suited to understanding these complex systems. In this presentation we will introduce the idea of evaluative thinking. Evaluative thinking has emerged from a co-learning process between systems thinkers, evaluators and conservation biologists. Based on a systems approach to evaluation, evaluative thinking is based around finding more effective conservation solutions by evaluating a conservation problem within the context of the broader system in which it functions. Evaluative thinking is underpinned by four key principles that we believe can help reframe the way we think about conservation problems: 1) Understand where a problem fits within the broader system; 2) Recognize that values are a fundamental part of making wise decisions; 3) Make learning a process of continual reflection; and 4) Accept that our understanding will always be incomplete. Building on the many things we already do well in conservation, enacting these four principles will provide a tool-kit to learn to do conservation more effectively.

PREDATION OF ATHERINA BOYERI UPON THE ENDANGERED FISH ECONOMIDICHTHYS TRICHONIS: THE ROLE OF THE PURSE SEINE FISHERY LIGHTS

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Atherina boyeri dominates the fish community in Lake Trichonis (Greece) and it is the target species in the professional purse seine fishery, conducted mainly during the night by the use of lamp rafts. Previous studies concerning the diet of this fish in the area showed that it is strictly zooplanktivorous, preying heavily on copepods and larvae of the bivalve *Dreissena blanci*, while it showed preference in its diet acting as visual predator. However, these studies were based on gut content analysis of specimens caught during the day. Thus, there is no information on its feeding preferences close to the artificial lights of the lamp rafts. Considering this, a five months study of the feeding of *A. boyeri* around light rafts revealed interesting results. Among the most striking differences of this study to the previous ones was the presence of large numbers of larvae of the native and endangered species *Economidichthys trichonis* in the diet. This prey showed higher frequency of occurrence in the gut contents of the larger stages of *A. boyeri*, while the smaller specimens fed on copepod nauplii and larvae of *D. blanci*. Greater predation on the larvae of *E. trichonis* was found during the summer months and coincided with the seasonal maximum of its pre-recruiting larval stage in the lake. A rough estimation of the *E. trichonis* larvae preyed per night around a single lamp raft by *A. boyeri* revealed an average number of nearly 50000 specimens between June and August. Although there are no estimates on the population size of *E. trichonis*, this decimation of its larvae by another fish species due to the use of fishery lights poses a great conservation issue. Considering the absence of similar studies, the present results may be a stimulus for analogous investigations in other marine and freshwater ecosystems worldwide.

ACCOUNTING FOR LAND-USE INTENSITY AND MAMMAL TRAITS IN SPECIES-AREA RELATIONSHIPS

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Land use change is a main driver of the on-going biodiversity crisis. Assessing the impact of land use on biodiversity is therefore crucial. Species-area relationships (SARs) provide an avenue to assess such impact. Classic SARs assume a hostile matrix, where no species survive in an agricultural landscape. Recent developments now classify between agricultural land (where some species can survive) and natural land, thus better representing the impact of agricultural expansion in species-area relationships. However, classifying an area as either



agricultural or natural land may also be an oversimplification considering the large variety in intensity of agricultural land-use and species mechanisms for coping with land-use change. We propose a species-area relationship that accounts for land-use intensity (LUI) by systematically testing a range of intensity indicators. We show how different species cope with varying intensities of land use by utilizing recently available mammal species traits datasets. We found that the base model was improved by the inclusion of land-use intensity metrics. Fertilizer input was the best predictor of species richness on a global scale, followed by rice harvested area. For species traits, we found that herbivores and species under 10kg exhibited the highest sensitivity to area. We found interesting interactions between species traits and LUI. For instance, omnivores exhibited highest species richness in areas of high irrigation, perhaps due to food availability in such areas, conversely, high species richness for carnivores were in areas of low irrigation. A deeper understanding of the different relationships between land-use and species richness are gained by the inclusion species traits and land-use intensity. Results allow us to better predict and understand species richness patterns on a global scale and may help in guiding conservation and management actions.

IMPACT OF INTRODUCED ANURANS ON NEWFOUNDLAND ECOSYSTEMS

Dion Kelly

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The successful establishment and dispersal of invasive anuran populations is influenced by competitive exclusion and/or niche differentiation with competing species. Invasive species often perpetuate an imbalance among native fauna and flora; effects of which are more pronounced for insular ecosystems. In Newfoundland, originally devoid of anurans, tadpoles may potentially be reshaping aquatic ecosystem structure by modifying biomass accumulation. I used a combination of anuran calling surveys and pond-edge transects to assess the relative regional distribution and ongoing dispersal for 2 of the 4 introduced anurans in western Newfoundland. The recently established Mink Frog, *Lithobates septentrionalis*, has dispersed ~50 km northeast and ~34 km southwest from the original (2001) discovery location; this population displays an unexpected spatial separation from long-established Green Frog populations, *Lithobates clamitans*, at landscape and local scales. To evaluate the effect of these introduced species on biomass accumulation in aquatic communities, I provided epilithon covered substrates for American Toad, *Anaxyrus americanus*, tadpoles taken from local sources and raised in Laboratory or Field enclosures at varying densities relative to that of local populations. Population densities significantly influenced weight rather than total length of tadpoles, while

lower population densities resulted in larger tadpoles that removed more organic material from substrates. The short term effect on organic resources appears to be influenced by the presence of anurans rather than existing population numbers. With greater dispersal of anurans in Newfoundland, greater reduction of pond epilithic layers may result in changes to ecosystem invertebrate abundance and community richness.

ISLAND BIOGEOGRAPHY OF BIRDS: TESTING CORE ASSUMPTIONS OF MACARTHUR AND WILSON 50 YEARS ON

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Island Biogeography Theory (IBT: MacArthur and Wilson 1963; 1967) has been highly influential in the development of ecology over the last 50 years. In their 1963 paper, 'An Equilibrium Theory of Island Biogeography' MacArthur and Wilson presented a classic case study which showed that the number of bird species increases with island area and decreases with distance from a single source area. The recent development of approaches that link species distribution modelling with functional traits provides an excellent opportunity to revisit MacArthur and Wilson's Pacific Island data. Here, we test two assumptions that underpin IBT: 1) that distance to a single source island is the most appropriate representation of island connectivity and 2) that patterns of bird distributions on islands are not related to the functional traits of individual species. First, we examined land bird data from 261 oceanic islands in Melanesia: the Bismarck Archipelago, Solomon Islands and Vanuatu. We used generalized linear regression models to explore three predictors of bird species richness: island area, distance to a single source area and distance to all possible source areas. Second, we used hierarchical regression models to examine how bird functional traits (body size, wing-length and diet) modulate species responses to island area and connectivity. We found that a measure of connectivity that accounted for multiple sources of colonisation was a better predictor of species richness than a measure based on a single source area. However, island area was the primary driver of bird species richness and had a much greater influence on model predictive ability. We also found strong evidence for interactions between island area and bird functional traits. For example, vertivores were more likely to experience a positive effect of island area than other dietary guilds. Our work shows that advances in quantitative ecology can improve IBT.



DYNAMIC APPROACHES TO CONSERVATION: DELIVERING COST-EFFECTIVE HABITAT FOR MIGRATORY BIRDS IN AGRICULTURAL LANDSCAPES

T. Rodd Kelsey

The Nature Conservancy

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Conservation on private agricultural lands has many challenges. We strive to create and incentivize the most effective management practices to conserve biodiversity in ways that work for farmers and that are durable. However, this objective is challenged by poor information about effectiveness, lack of tools for deploying conservation actions efficiently, and the cost of implementation at meaningful scales. In addition, agricultural landscapes are spatially and temporally dynamic, adding to the complexity of delivering valuable habitat reliably. We have been developing and testing new approaches and tools to address these challenges, as applied to creating migratory waterbird habitat at the right times and places in intensively cultivated agricultural landscapes of California. Working with farmers, agencies, and research partners, we have developed three approaches that have broad applicability to conservation in agricultural landscapes. First, we demonstrated application of scientifically robust adaptive management to implementation of a federal incentive program that assisted farmers to create habitat. Second, we have applied big data analytics and emerging precision science tools to enable more precise delivery of habitat investments on farmlands. Third, we have developed a novel habitat procurement market in which farmers are paid to modify their practices in order to create bird habitat. These approaches to delivering temporary habitat serve to meet the needs of migratory species and the practical reality of sourcing habitat from an intensive agricultural system. Through these approaches we have also demonstrated that temporary habitat can be more cost-effective than permanent protection when this is appropriate. These approaches and tools combined have resulted in over 90,000 hectares of habitat delivered. Through agency and industry collaborations we have partnered with over 200 farmers, demonstrating the large-scale applicability of these approaches.

UNDERSTANDING THE LINKS BETWEEN CARBON STOCK AND PLANT DIVERSITY IN SACRED GROVES IN SEMI-ARID AREAS OF CAMEROON

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Sacred groves worldwide are known for their great potential in conserving not only traditional cultural heritage but also biodiversity. Adequate management of such land use systems in semi-arid areas like the Far North region of Cameroon can also contribute in combating desertification and climate change. However, these ecosystems so far have undergone limited investigation from a biodiversity and carbon storage perspective. A floristic survey was conducted in 04 main sacred groves of the Diamare plain using nested circular plots of 1257 m², 616 m² and 50 m². A total of 24 plots were established. In each plot, all plant species were identified and measured. Above-ground carbon was estimated using generic allometric equation and species-specific wood density derived from wood density databases. Different types or purposes of sacred groves were identified: chieftom cemetery, initiation and other rites, forest of gods and Residence of village Totems. The highest tree density value were obtained in initiation and others rites sacred grove (4743.0 stems/ha) and the lowest value in Chieftom cemetery sacred grove (198.2 stems/ha). Mean aboveground carbon stock of 120.4 ± 71.7 tC/ha was obtain in the study area. *Khaya senegalensis* showed the greatest carbon stock (41.0 tC/ha) followed by *Anogeissus leiocarpus* (13.8 tC/ha), *Celtis integrifolia* (9.6 tC/ha), *Azadirachta indica* (4.7 tC/ha) and *Tamarindus indica* (3.8 tC/ha). This study demonstrates the key role of native species of sacred groves of semi-arid areas of Cameroon in storing carbon and therefore the significant contribution of indigenous protected areas in biodiversity conservation and climate change mitigation.

99. COMMUNITY-BASED CONSERVATION WITH AN URBAN PUBLIC

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Protectionist conservation excludes local people from land they have traditionally managed. In response to criticism of protectionism, conservation strategies in developing and rural areas have been adopted that include local people such as allowing economic production and maintaining traditional practices. In cities, different strategies are required to incorporate local people (the urban public). This project explored how the urban public is incorporated into



management of 79 high conservation value grasslands in the western suburbs of Melbourne, Australia. Semi-structured interviews were conducted with a representative sample of 44 grassland managers including professionals and community volunteers. Thematic analysis identified the underlying values shaping manager's attitudes. Some managers with strong intrinsic values saw the public as a threat that needed to be excluded from the reserves, while others believed that public involvement was required to ensure the ongoing future of the conservation reserves. Other managers had more human-centred values and saw the grasslands as important for improving people's wellbeing and connecting people to place. Two main conservation strategies involving the urban public were identified: 1) decentralised management involves the public in the planning and on-ground management of some reserves and 2) public use provides access for the public to the reserves for a variety of educational and recreational activities such as walking, using playground equipment and experiencing nature. Many risks were associated with these strategies, such as weed invasions, trampling or uninformed management. There was great uncertainty about the effects of public use of conservation reserves in cities, which often led to the blanket exclusion of the public by managers. A better understanding of the real impacts of different public uses is required to foster the emergence of norms and rules around the appropriate use of the reserves by the public.

DEMOGRAPHIC MONITORING TO DETECT CLIMATE CHANGE IMPACTS ON THREATENED POPULATIONS

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Climate change will have negative impacts on many species of conservation concern. At the population level, this will manifest as a change in long-term abundance trends, with populations shifting from stable to declining, or declining more rapidly over time. However, given the difficulty in accurately quantifying average abundance trends against a background of inter-annual variability, detecting changes in such trends will usually be impossible on time frames relevant to conservation decision-making. The changing trend in abundance is driven by a trend in mean demographic rates, which, as a simple trend, should be easier to detect than a change in a trend. We investigated the hypothesis that monitoring demographic rates would provide a more powerful indicator of climate change impacts on population dynamics than would monitoring abundance. Using age- and size-structured matrix models of real plant and animal populations, we simulated trends in various demographic parameters against a background of natural annual variability. We found that, using ten years of simulated data, the P values for tests of no trend in regressions of demographic rates on time were consistently smaller, and

usually much smaller, than the P values for tests of a nonzero quadratic term (identifying a change in trend) in a regression of abundance on time. The difference was greatest in long-lived species and for demographic rates to which population growth is not very sensitive; but was pronounced even for short-lived species and vital rates with elasticities close to one. Our results suggest that demographic monitoring will be much more powerful than abundance monitoring for detecting climate change impacts. However, differences in costs mean that future work must develop a framework that includes sampling uncertainty and costs to identify circumstances is the most cost-effective approach.

RANGE SIZE DOESN'T MATTERS, IT'S HOW YOU USE THE HABITAT

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Large range sizes are correlated with higher extinction risk, but specific patterns of habitat use within the range are often not considered. African vultures can travel substantial distances thanks to the low energetic costs of soaring flight. A single Ruppell's vulture can use an area of over 250,000 km² in one year, possibly the largest range of any non-migratory terrestrial vertebrate. However, Ruppell's vultures do not appear to be declining as rapidly as African white-backed vultures which have a significantly smaller range size. Using movement data from three species of vulture in East Africa, I evaluate how the interactions between range size, habitat selection, and behavior may mediate extinction risk in wide ranging species. Using information on altitude and speed of flight as well as distance between consecutive readings, I assess how differences in behavior in areas of high human habitation versus protected areas may lead to differences in extinction risk. Given that the primary risk to vultures in this region is poisoning of carcasses, which occurs mostly on pastoral lands, it is predicted that species that spend more time feeding in unprotected areas will suffer higher rates of decline and greater extinction risk even if they have smaller range sizes than other species.

ENHANCING THE PROFILE OF THREATENED PRIMATES: IMPACT OF 'TOP-25' LISTING ON THE CHOICE OF SPECIES FOR SCIENTIFIC STUDY

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A list of the World's 25 Most Endangered Primates is decided by consensus biennially since 2000 in order to draw attention and



action towards a few species that are considered as amongst the most endangered primates worldwide. We investigated, for the first time, whether the inclusion of a species in the Top-25 list had an influence on the number of peer reviewed articles published on that species in the following years. This is of vital importance because policy-makers and funding agencies rely mostly on scientific reports. Therefore, an increase in published literature about the most endangered primate species would promote action to save them. We performed text-mining of the metadata made available by several major publishers (namely PLoS, BMC, Elsevier, Springer, Nature and HighWire/Pubmed), analysing a total of about 40 million articles. We extracted articles where the name of a species present in any of the seven Top-25 lists published since 2000 appeared at least once (N= 69 species, found in 7,469 articles), and where the name of a primate control species (never included in the Top25 list) appeared at least once (N = 85 species, found in 13,656 articles). We calculated the trend per species during the years preceding the mention and we compared it with the trend during the years following the mention, over a time lag of 2, 3 and 5 years. According to our results, 2 years is a too short period to see any effect of a mention in the Top-25 list. However, within 3 or 5 years of a species being mentioned in the Top-25 list, there is an increase in the scientific output on these species, compared with the control species never mentioned in the list. In conclusion, the inclusion of a species in the Top-25 has a positive effect on the scientific output and may promote conservation actions on these endangered species.

POTENTIAL TOXICITY OF A NONSTEROIDAL ANTI-INFLAMMATORY (NSAID) FAMILY'S SALICYLATE ON AN ALTERNATIVE BIOLOGICAL MODEL: PARAMECIUM SP

Fella Kermiche Achaichia

University Badji Mokhtar

Houria DJEBAR, University Badji Mokhtar ; Mohamed-Reda DJEBAR, University Badji Mokhtar

Water is essential to life, however, the current globalization continues to deteriorate its properties instead of preserving and protecting it. With soil, surface water is the final recipient of countless persisting pollutants in the environment; they contaminate the food chain causing damage throughout. Agricultural and industrial sectors are primarily responsible for this situation, however a third contamination way is often underestimated which is the one via drugs. Indeed, human beings constantly consume various drugs that are often released naturally in their active form. This environmental contamination, due to the persistence of these pharmaceutical residues, can cause serious ecosystem disruptions and often irreversible damage to non-targeted organisms. This is the case of anti-inflammatory drugs which are considered moderately

toxic to humans, but their effects on other living organisms are yet to be studied and assessed. In this work, we investigated the potential toxicity of a well-known Non-Steroidal Anti Inflammatory (NSAID): Acetylsalicylic acid or Aspirin on an alternative biological model known to be very sensitive to minor changes to its external environment: *Paramecium* sp. It was exposed to various concentrations of xenobiotic (1 µg/l, 10 µg/l, 100 µg/l and 1 mg/l). The cell growth kinetics were appraised and changes in the respiratory metabolism were observed. The results obtained revealed a remarkable toxicity of acetylsalicylic acid.

BEAR PREDATION SIMPLIFIED: USING JUST FREQUENT LOCATION DOWNLOADS AND SPACE-TIME STATISTICS

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Accurate detection of kill sites and events remains an important objective of predator-prey studies. However, obtaining this information is often constrained by the cost and labor of fieldwork. To resolve this issue, researchers have used telemetry and targeted visits to identify kill sites. However, locations were often investigated well after the kill event due to limited data retrieval options, thus decreasing potential for remaining kill site evidence (carcass consumption by predators and scavengers). We adapt an existing clustering method (SaTScan) to detect kill sites of grizzly bears (*Ursus arctos*; n=18) fitted with Global Positioning System (GPS) satellite collars. This approach reduces delays between predation events and site visits. We visited 464 grizzly bear locations, 187 within clusters and 277 outside of clusters. The majority of kills (23 out of 27; $\chi^2 = 22.064$, $p = 0.0000026$) were found within clusters, with a location error of 15 metres (SD 12). We used logistic regression to assess the probability of kill occurrence using only time-space information contained in the collars. The top model's predictability was tested using k-fold cross validation and assessed using Pearson's correlation ($r = 0.334$, $p = 0.003542$). We, therefore, could predict predation events by grizzly bears without need for detailed habitat information. Using GPS-satellite technology and clustering analysis diminishes the need for fieldwork and still provides precise kill locations. Although this approach was tested specifically on grizzly bears predation, it can potentially be applied more generally to any terrestrial mammal that exhibits clustering movement patterns, provided the parameters are adjusted according to the species' biology. This approach also has the opportunity to predict behaviors beyond that of predation events, such as bedding



and grazing and could provide substantial insights into behavioural ecology and the resulting management decisions of other species.

EVOLUTION AND CONSERVATION OF THE COASTAL VEGETATION IN THE REGION OF TLEMCCEN

Rachida Kerzabi

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Evolution and conservation of the coastal vegetation in the region of Tlemcen Kerzabi Rachida, Merzouk Abdessamad Cherif Ismahane, Boubleneza Ibtissem, Bekkouche Assia didou_rach@yahoo.fr Laboratory of Ecology and Natural Ecosystems Management, University Abou Bekr Belkaid – TLEMCCEN
Abstract : The natural environment is a very complex system to master, because any irrational exploitation of biological resources, water and soil leads to an imbalance of increasingly important ecological and socio-economic plans. The circum-méditerranéenne region thus appears globally as a major center of differentiation of plant species for this reason, one of the first concerns of géobotanistes is to know the floristic diversity and distribution of species and higher units of purely biogeographic perspective. Mediterranean coastal ecosystems are characterized by strong climatic and soil constraints, salinity, wind, drought and shallow soils or mobile. Among the what The Algerian coast as a whole is subject to significant human pressure, more intense than in the rest of the country. This pressure is for decades on vegetation and is ongoing. The preservation of biological diversity is a priority in Algeria with regard to the variety of existing ecosystems, their sensitivity and speed of degradation. The Mediterranean coastal sand formations are invaded every year by a crowd of more and more numerous of summer. The coastal development rework the mid destroying parts being fixings natural vegetation and enriching the sand with organic matter, it follows that the various species are very mixed. Most invasive gaining ground and the procession of plants related to the presence of man made his intrusion with the inevitable piles of garbage that bloom in unsupervised areas. Key words: Algerian coast, biodiversity, inventory psammophile, ecological factors

UTILIZING CITIZEN SCIENCE AND NEW TECHNOLOGY TO IMPROVE THE PALAU NATIONAL BIRD MONITORING PROGRAM

Heather Ketebengang

Palau Conservation Society

Islands are known to have high biological diversity and high concentrations of endemic species, but also have high rates of species decline and extinction. Managing island resources to ensure that species decline and extinction is stemmed

requires a range of capacities that most small islands do not have. This is particularly true for small Pacific Island nations such as Palau. Limited scientific and technical capacity to engage in data collection needed to manage natural resources has been identified as a barrier to effective natural resource management in Palau. Fortunately, technological advancements and the citizen science movement are measures to narrow that capacity gap. The Palau National Bird Monitoring Program launched in 2010 provides a framework for engaging amateur naturalists and avid bird watchers to document their observations in a database for use by the natural resource management community in Palau. New and innovative technology has eased the data collection and management efforts. These innovative platforms for learning allow both residents and visitors to Palau to support and improve Palau's natural resource management regimes.

123 ECOSYSTEM SERVICES PROVIDED BY DRAINED PEATLANDS

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Drained peatlands are novel ecosystems with distinctly different soil conditions and vegetation communities than on upland forest sites or on pristine mires. Ditching has lowered their water table thus improving tree growth and accelerating the decomposition of surface peat. In Finland 4,76 million hectares of peatlands have been drained for timber production, mostly between 1960's and 1980's. This has increased the growth of forests by 14 million m³ per year. However, the harvesting potential of drained peatlands is underutilized due to high timber procurement costs. 830 000 hectares of drained peatlands are so low-productive sites, that further investments to forestry are unprofitable. How these sites should be managed in the future is unclear and therefore an important research question. Drained peatlands produce several ecosystem services, including production of timber, berries and game, control of water quality and carbon sequestration. So far they have been managed primarily for timber production. Better understanding of the ecosystem services they produce is necessary for better informed decision making and management. Currently drained peatlands act as carbon sinks because carbon sequestration of the rapidly increasing growing stock clearly exceeds the release of carbon dioxide from the peat soil. However in the long run the continuous release of carbon dioxide from the drained peat will exceed the sink effect of the growing stock on nutrient rich sites. On nutrient poor sites it will probably be possible to carry out carbon neutral forestry also in the long term. Ditch network maintenance is a significant source of suspended solids to watercourses. Uneven-aged management can provide one way to reduce the negative impacts of peatland forestry on water



quality. An important research question is how large growing stock is needed for maintaining the water table low enough by evapotranspiration.

POPULATION VIABILITY ANALYSIS OF RHINOS RHINOCEROS UNICORNIS IN NEPAL: ASSESSING IMPACTS OF ANTIPOACHING AND TRANSLOCATION STRATEGIES

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Small populations of the large-bodied species, such as rhinoceros (*Rhinoceros unicornis*), that are restricted to a limited geographical range are always prone to extinction. Identifying factors underpinning the fate of such species is critical to addressing their ultimate persistence. We used VORTEX population viability analyses to assess the viability of rhino population in Nepal. We simulated deterministic single-population models under different scenarios to assess the impacts of poaching and the potential for rhino translocation in achieving viable rhino populations in Chitwan and Bardia National Parks in Nepal. Population and demographic data were obtained from censuses and from the published literatures. Model output predicted that the Chitwan population is stable and capable of supplying at least 10 rhinos per 3 years for translocation, provided poaching is restricted to 2 animals per 3 year intervals. However, the Bardia population is more vulnerable and unable to persist without supplementation even at the lowest rate of poaching (2 animals/yr). Supplementation of at least 10 animals added every 3 years for 30 years is crucial for establishing a viable population of rhinos in Bardia. This level of supplementation can withstand poaching of 2 animals/yr per year. Our study demonstrates that poaching is the major factor determining the fate of rhino population viability in Nepal. The supplementation of animals to Bardia from Chitwan, and increased effort in reducing poaching, will enhance the viability of rhino populations in Nepal.

AVAILABILITY OF PREY AND NATURAL HABITATS ARE RELATED WITH TEMPORAL DYNAMICS IN RANGE AND HABITAT SUITABILITY FOR ASIATIC CHEETAH IN IRAN

Leili Khalatbari

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Understanding how species have been affected by recent human mediated landscape transformation is critical for designing effective conservation strategies. The Critically Endangered Asiatic cheetah (*Acinonyx jubatus venaticus*) has faced dramatic range decline and currently occurs in small populations restricted to the mountain deserts of Central Iran. Few data is available about these highly isolated and threatened populations. In this study, we quantified temporal changes in ecological requirements and availability of suitable areas for the Asiatic cheetah in Iran and adjacent areas. Ecological models for historical and contemporary time-periods, based on past and present species records and using a set of 11 ecogeographical variables including abiotic (climate, land cover) and biotic factors (prey availability), were built using maximum entropy modelling. Probability of cheetah presence was associated to prey availability (small distance to *Gazella bennettii*) and natural habitats (small distance to wildlands) in both time periods. There were differences in the response of cheetahs to distinct factors between time-periods that suggested shifts in the ecological preferences of the species. Availability of suitable areas was estimated to have declined by 37.1% during the last century. The apparent change in ecological requirements is probably related to the dramatic range regression experienced by cheetahs. Our results have direct implications for improving the ongoing conservation programs and management of this endangered cat in Iran, and provide as well directions for further research.

DOLPHINS AND FISHERIES: CAN THEY CO-EXIST?

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River dolphins are increasingly threatened by high resource extraction (e.g., overexploited fisheries) worldwide. We asked if the Ganges river dolphin, a freshwater dolphin endemic to the Indian-subcontinent can co-exist alongside with the current level of fisheries in the Ganges river system. We investigated the potential for resource competition between dolphins and fishers by assessing the extent of spatial overlap between dolphin's distribution and fishing activities. We also determined the factors that affect the distribution of river dolphins. We conducted sighting surveys using a motorized boat along a 65-km channel of the Karnali river of Nepal and



India. We recorded the presence/absence of dolphins and measured the habitat variables in each 1 km long sampling segments (n=65). Our results show that the probability of dolphin presence increases in downstream segments, which may be due to reduced stream velocity and high fish biomass in downstream segments. Downstream habitat in Karnali River offers favorable sites for ferry crossings and fishing activity. Almost two-third of the dolphin sighting locations overlapped considerably with the ferry crossings and high fishing areas, suggesting a high potential for resource competition mostly in downstream habitat. A high spatial overlap between dolphin distribution and fishing activity may indicate either resource competition or co-existence. At the current level of fishing activity, dolphins seem to co-exist with fisheries. But because fishers in this region have experienced serious decline in fish catch over years, use of more destructive fishing gear (e.g. large fishing nets) may become pervasive, which can jeopardize the fish population leading to high resource competition while also increasing the risk of dolphin entrapment in such fishing gears. Our results demonstrate the need for curbing destructive fishing practices to restore fish populations for sustainable fisheries and river dolphin conservation.

COMMUNITY BASED ASIATIC WILD DOG AND CHINESE PANGOLIN CONSERVATION IN EASTERN HIMALAYAS OF NEPAL

Ambika Prasad Khatiwada

National Trust for Nature Conservation

Carly WATERMAN, Zoology Society of London ; Kyran KUNKEL, University of Montana ; Monsoon POKHAREL KHATIWADA, Tribhuvan University

The eastern Himalayas of Nepal is a biodiversity hotspot and a crises eco-region. Agriculture is the traditional occupation and main source of livelihood of local people, including shifting cultivation, livestock husbandry for dairy and transport of goods. This paper presents case studies of community initiatives for two important species in eastern Nepal. Asiatic wild dog or dhole (*Cuon alpinus*) is the most imperiled pack hunting carnivore worldwide. Fewer than 2500 dholes remain and declining population trends continue. Human-dhole conflict is major conservation issue in Kangchenjunga Conservation Area. We initiated first ever conservation effort to save dholes in 2010 and implemented Community Managed Livestock Insurance Scheme (CMLIS) in 2013. Three self-sustaining CMLIS are established in priority areas and run by local people where 137 herders included their 801 livestock into the scheme. Herders started to get relief fund if livestock is killed by dholes. The CMLIS also supported invested in livelihoods. This approach is working toward long term conservation of a viable population of dholes and can be replicated elsewhere for large carnivore conservation. Chinese pangolin (*Manis pentadactyla*), the burrowing small

mammal-known as scaly ant eater, is a critically endangered species. More than a million pangolins were illegally traded in last ten years. We piloted a project in human dominated landscape covering 40 sq.km areas in 2012 where eighteen sub-committees and two pangolin conservation committees are established directly engaging 263 people and informed >1182 individuals for pangolin conservation. The committees started to raise awareness among villagers, stopped poaching and if any one captured pangolin, the committee members help to release back to its natural habitat. This approach supported conservation of Chinese pangolin controlling illegal trade locally. Communities now believe that Chinese pangolins are worth more alive than dead.

SPECIES RICHNESS PATTERNS IN SMALL MAMMALS ALONG AN ELEVATIONAL GRADIENT IN EASTERN HIMALAYA, INDIA

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Although only about 7,000 km² in area, because of its extreme elevation range (from 200 m to 8000 m) the Himalayan state of Sikkim in India has faunal components from three major biogeographic realms – the Indo-Malayan, Palaeartic and Ethiopian. This provides a unique situation to examine species richness patterns along an elevation gradient. In this study we examined the species richness patterns of small mammals (murid rodents, pikas, ground and tree shrews) along the elevation gradient from 230 m to 4200 m. We trapped small mammals using Sherman live traps, laid at 10 m interval along traplines in seven elevation zones, with one trapping session lasting for 5 consecutive nights. We sampled 38 trap lines in 7 elevation zones, with a total sampling effort of 9069 trap nights. We recorded 430 individuals belonging to 22 species, with 15 species of murids, 5 ground shrews, one species each of tree shrew and pika, the latter occurring only >3000 m. Species richness showed a bimodal elevation pattern with low species richness at mid elevation (1500 m) and high species richness at low and high elevations, the latter due to the presence of Palearctic species, such as *Ochotona tibetana*, *Microtus* sp., *Sorex* sp. and *Pitymus sikkimensis* which were limited >3000 m. There are also several species restricted to <1500 m, e.g. *Rattus sikkimensis*, *Mus musculus castaneus*, *Suncus murinus* and *Tupia belangeri*. In contrast, the mid elevation had relatively very few exclusive species (e.g. *Niviventer niviventer*, *Rattus rattus brunneusculus* and *Rattus rattus tistae*) and only very few species occurred in the mid elevation. Range profile shows the restriction of most of the species either in the higher or the lower elevation. The region undergoing rapid unsustainable developments, therefore we recommend immediate conservation attention.



THEY DON'T COME EASY; FEASIBILITY OF ASIATIC LION REINTRODUCTION TO IRAN

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Despite being extinct in Iran's wilderness, Asiatic lions (*Panthera leo ssp. persica*) are still alive in literature and fine arts. This charismatic species has been Iran's national emblem and known as a symbol of glory, grandeur and power since Mithraism era. The last report of Asiatic lion in Iran goes back to 60 years ago and therefore our understanding of the habitat characteristics is limited to historical observation records and travelogues. Asiatic lions had a wide historic distribution from Greece and Syria in the west through Azerbaijan, Iraq, Iran, Afghanistan, Pakistan, and up to India in the east, but is now restricted to a single isolated population in India's Gujarat State. In 1973, the Department of Environment of Iran conducted preliminary studies to reintroduce Asiatic lion to Iran. The reintroduction project was postponed and never executed on that time, though the tendency to put the project into effect remained with the decision makers. In this study we predicted the habitat suitability for Asiatic lion in Iran. We first trained ensemble of species distribution models using historical observations and physical variables. The outcome of the ensemble models were updated by the local expert knowledge using biological and anthropogenic variables. The final model was then used to predict the habitat suitability for Asiatic lion in all protected areas in Iran. Our study revealed that none of the protected areas at the current condition are ready to accommodate the Asiatic lion. According to the elicited knowledge, land cover, anthropogenic conflicts, and prey population are the most important factors, determining the habitat suitability for Asiatic lion. Any reintroduction plan for the Iran's national emblem requires a comprehensive carrying capacity study, intensive habitat restoration and preparation, as well as public awareness and participation.

PREDICTING THE POTENTIAL INVASIVE DISTRIBUTION OF RACCOON IN IRAN

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Raccoon (*Procyon lotor*) is a native species in the Western Hemisphere, ranging from central Canada to Panama. In early 1930s, it has been introduced to the Eastern Hemisphere in USSR for its fur. This introduced species has been extending its range and apparently has been changed to an invasive species

in western Asia and Northern Europe. In 1991, for the first time, raccoon was observed and reported in the Hyrcanian mixed forests ecoregion in Iran, near the border of Azerbaijan. Since then, scattered observation records of this non-native mammal implied that the distribution of raccoon not only confined to the forests and woodlands, but has been extended toward forest steppes and urban areas in the south and in the east of the ecoregion. Unfortunately, the rapid march of raccoon in Iran (~400 km in 10 years) has been ignored and its impacts on native species, and the potential invasive distribution remained poorly-studied. In this study we employed an ensemble of species distribution models to predict the potential invasive distribution of raccoon in Iran. To do so, we trained the models using species distribution data and environmental explanatory variables in north and center of America. We then extrapolated the models into space to obtain the habitat favorability map for the raccoon in Iran. Ultimately we evaluated the local favorability map using independent observation records. Our results revealed that the potential invasive distribution of raccoon in Iran is tremendous, covering more than one-fifth of the country. However long freezing period and severe drought might limit their survival. We hope that our finding rings the bell and persuade the national and international authorities for a comprehensive conservation plan. Though in the absence of a north American parasites, potential predator, and lack of local expertise that might be a challenge.

BIODIVERSITY CONSERVATION CORRIDORS CAMBODIA PROJECT

Bunnath Khun

Biodiversity Conservation Corridors Cambodia

The Project is promoting sustainable resource use, and restore and enhance these productive landscapes. It will do so through conservation and development activities. The design of the biodiversity corridors is embedded within a multipurpose, sustainable, biodiversity landscapes approach. The Project will cover 22 communes (12 in Monduliri and 10 in Koh Kong) located across 8 districts with a total population of approximately 68,048 (2008 census) in both provinces and households numbering just over 14,000. The Project in both Koh Kong and Monduliri provinces is predominantly in mountainous areas covered with protected forests, NPs, and wildlife sanctuaries. An estimated 17,500 households will benefit from the Project, of which about 25% are indigenous peoples of Monduliri largely from the Phnong group, and 50% are women. The Project is (i) providing forest tenurial security to local communities and indigenous groups for collective management of forest resources; (ii) restore habitat on degraded forest lands with tree planting of natives species and agroforestry models with improved sources of non-timber forest products; (iii) improve livelihoods and income enhancing



small scale infrastructure; and (iv) generate over 1 million cash-based labor days through project activities. Delineation and demarcation of these corridors will be in consultation with primary beneficiaries based on a participatory land use planning approach. The project is now reaching of it midterm review which is starting from year 2011 to 2018, and that is great opportunity to sharing and receiving project feedback and construction recommendations to make it more quality effectives and biodiversity sustainability as we do expected.

SYCAMORE PASTURES IN THE NORTHERN ALPS: A HOTSPOT OF BIODIVERSITY

Thomas Kiebacher

WSL

Matthias BÜRGI, WSL ; Christine KELLER, WSL ; Christoph SCHEIDEGGER, WSL ; Ariel BERGAMINI, WSL

Sycamore pastures are a traditional land management system in the montane region of the Northern Alps. Like many other old cultural landscapes they are threatened by on-going land use changes which may reduce the typical biodiversity associated with these landscapes. Old sycamore trees on these pastures are especially rich in epiphytic cryptogams with up to 100 bryophyte and lichen species co-occurring on one tree and can thus be considered as hotspots of biodiversity. Moreover they are the main habitat of the moss *Tayloria rudolphiana* (Splachnaceae), which is a priority species for nature conservation listed in the FFH - directive, and other rare and threatened species such as *Lobaria pulmonaria* and *L. amplissima*. There is thus a high responsibility for nature conservation authorities to protect this ecosystem. So far hardly anything is known about biodiversity patterns of bryophytes and lichens in this ecosystem. Here we conduct an in-depth analysis of species richness patterns of bryophytes and lichens and their dependencies on different environmental variables. Although bryophytes and lichens are similar with respect to a number of functional traits (e.g. they are poikilohydric organisms), species richness patterns of these two groups may not necessarily coincide. That means that richness hotspots or rarity hotspots between these two groups or even within the groups between different subgroups (e.g. functional or taxonomic groups like liverworts and mosses or macro- and microlichens) may show considerable variation. In the talk we will focus on patterns of species richness of bryophytes and lichens, their relation to environmental variables (e.g. tree parameters and connectivity) as well as to the occurrence of our target species *Tayloria rudolphiana*.

124-THE NEXT GENERATION OF MITIGATION: LANDSCAPE PLANNING IMPROVES OUTCOMES FOR PEOPLE AND NATURE

Joseph Kiesecker

The Nature Conservancy

Christina KENNEDY, The Nature Conservancy ; Daniela MITEVA, The Nature Conservancy ; James OAKLEAF, The Nature Conservancy ; Mike HEINER, The Nature Conservancy ; Kei SOCHI, The Nature Conservancy

Mitigation offers the opportunity to address the impacts of development through application of the mitigation hierarchy: avoid, minimize, restore, offset. But there are many problems with how mitigation is currently applied. Applying the mitigation hierarchy on a project-by-project basis, often at small spatial extents, underestimates the cumulative impacts of multiple current or future projects and undermines the hierarchy's purpose and utility. The development of mitigation policy is beginning to explore a move away from site-based, piecemeal mitigation - which often results in a patchwork of isolated and difficult-to-manage projects - to a scale that is able to account for impacts affecting an entire region. For example, new mitigation regulations in several countries now require the adoption of a landscape-scale approach to facilitate investment in key regional conservation priorities and to ensure early integration of mitigation considerations in development projects. Impact mitigation at broader scales is expected to provide more effective conservation outcomes, reduce regulatory hurdles, and potentially offer cost savings to developers. Here we will discuss a series of projects from the United States, Mongolia and Brazil that provide early support for the benefits that landscape level mitigation can deliver.

PERFORMANCE OF WILDLIFE CONSERVATION APPROACHES IN NORTHERN TANZANIA

Christian Kiffner

The School For Field Studies

In most ecosystems of sub-Saharan Africa, the extent of protected areas is not sufficient to conserve the functional connectivity that is required for large mammal conservation. Similar to other ecosystems, the Tarangire-Manyara ecosystem in Northern Tanzania contains a patchwork of conservation and land-use utilisation approaches. Unfortunately, we know little how different conservation approaches affect wildlife populations and which measurable wildlife parameters effectively mirror conservation performance. To address these questions we estimated illegal hunting pressure, and assessed behaviour, population densities and community structure of large mammals in different multiple-use areas and national parks. Evidence for anthropogenic drivers of wildlife declines (hunting and livestock) was highest in the game controlled area (CA), immediate in a pastoral area (PA) and lowest in national parks (NP). Large mammal species richness in PA and NPs were similar but the mammal community was considerably impoverished in CA. Most, but



not all large mammal species showed a gradual adjustment of responsiveness towards humans according to conservation status and were most responsive in CA and least responsive in NPs. However, behavioural budgets of common herbivores did not differ consistently between study areas. Matched comparisons of population densities revealed that CA and PA occasionally held higher species-specific densities than adjacent NPs. Most wildlife populations in the study areas have remained fairly stable in the past decade but current wildlife densities are below historic baselines. Results suggest that only species richness unambiguously reflected the level of human disturbance in a management unit. In this dynamic and fragmented ecosystem, potential early warning indicators of human exploitation were not reliable indicators of conservation performance, highlighting the need for ecosystem-wide monitoring and management of threats and wildlife populations.

DISTRIBUTION PATTERN OF WOODY ENDEMIC PLANT SPECIES IN GEORGIA (THE SOUTH CAUCASUS)

Mariam Kikvidze

Ilia State University

Marina MOSULISHVILI, Ilia State University ; Ketevan BATSATSASHVILI, Ilia State University

The book „Red List of the endemic plants of the Caucasus: Armenia, Azerbaijan, Georgia, Iran, Russia, and Turkey“ published recently by Missouri Botanical Garden Press provides a comprehensive list of more than 2,700 endemic vascular plant species of the Caucasus biodiversity hotspot, 1,300 of which occur in Georgia. 150 of these Caucasus endemics recorded in Georgia are woody plants. In the present article we analyse distribution pattern of the woody species of endemic plants along the elevational gradient in Georgia within West Caucasian or Colchic, East Caucasian and South-Caucasian (West Asian) vegetation zonation types given in the publication “Main types of vegetation zonation on the mountains of the Caucasus”, on the one hand, and the vegetation map on the Caucasus as in the „Karte der natürlichen Vegetation Europas“, on the other (the elevational patterns of woody endemic plant distribution at the family level, the elevational pattern of endemic distribution of the entire woody flora, the elevational pattern of different life forms such as trees, shrubs and semi-shrubs, the correlation of each variable with each other and the elevation as such). We also consider results of species richness and complementarity (reserve selection) analysis of rare woody endemic species distribution as well as GAP analysis to reveal the picture of their presence on protected areas and identify Important Plant Areas in order to focus on those, which are not under legal protection and thus require particular conservation attention.

IDENTIFYING AND MAPPING ECOSYSTEM SERVICES SUPPORTING TOURISM: THE ECO-PARCEL APPROACH

Halima Kilungu

Wageningen University

Rik LEEMANS, Wageningen University ; Pantaleo. Kirari. Thomas MUNISHI, Sokoine University of Agriculture ; Bas AMELUNG, Wageningen University

The wide variety of the world's ecosystem services that tourism depends on necessitates the use of specific approaches for their identification and mapping. In fact, not all ecosystems and their services serve as tourist attractions in any given landscape. Yet no approaches are available to date that cluster ecosystem services into patches or other ecological unit(s) that are meaningful to tourism stakeholders to enhance their decisions. Therefore, our study developed an approach 'Eco-parcel' that isolate and group uniquely attractive ecological units that holds more potential as tourist attractions and referred them as ecological parcels 'Eco-parcel'. The Eco-parcel approach integrates GIS techniques to identify, map, delineate and group tourist attractions according to their similarities and differences and questionnaire survey to determine which eco-parcels are more appealing. The approach shows even in small area a wide variety of eco-parcels arising from topographic gradients, watershed characteristics, and physical landscapes can be identified while Eco-parcels that contain multiple attractions tend to be more preferred. For instance, 72% tourists climb Mount. Kilimanjaro due to its height and snow atop while 98% tourists visit the Serengeti due to attractions within endless plains. This study suggests the eco-parcel as useful unit and tool for identifying tourism resources.

HUNTING FOR THE PROBLEM: INVESTIGATING BUSHMEAT USE AROUND NORTH LUANGWA NATIONAL PARK, ZAMBIA

Emily King

Imperial College London

Aidan KEANE, Edinburgh University ; Andrea WALLACE, Frankfurt Zoological Society ; Graham WALLACE, Frankfurt Zoological Society

Bushmeat is an important source of protein and income in the rural tropics. Growing human populations are making it unsustainable, threatening wildlife as well as rural livelihoods. Successful conservation projects rely on understanding the scale and drivers of bushmeat use; however, it is often illegal and a sensitive topic within rural communities, making it difficult to obtain accurate information. This research used a specialised method, the double-list Unmatched Count Technique (UCT), with a structured interview to indirectly survey households across Zambia's North Luangwa ecosystem



about the prevalence and drivers of bushmeat use, and attitudes towards it. This survey method reduces bias due to question sensitivity but to date has rarely been used in conservation research. Results were triangulated with focus group and key informant data to characterise bushmeat use in this little-studied wilderness area. Estimates of prevalence were low, with less than 1% of the population hunting or trading bushmeat and 13.5% consuming bushmeat. Primary drivers of bushmeat use were taste, low food and income security, and human-wildlife conflict. Bushmeat hunting and trading has traditionally commanded high levels of social respect within local communities; however, this is no longer the case and the shift has coincided with an increase in the perceived probability of being arrested, fined, and/or imprisoned. The research informs conservation interventions addressing the drivers of bushmeat use by providing alternative sources of food and income, such as establishing local butcheries or community banks. This may be facilitated by pooling resources and knowledge with development agencies to increase food and income security. However, hitherto unconventional approaches such as community-managed wildlife farming may be required to address bushmeat consumption driven by taste. The research also demonstrates the value of the double-list UCT when examining bushmeat issues.

CHANGING CONSERVATION POLICY AND MANAGEMENT - SOME EXPERIENCES FROM THE SWAMPS

Richard Kingsford

Centre for Ecosystem Science

As scientists, we are increasingly challenged and often frustrated by the inertia of conservation policy and management to change in response to scientific evidence. Many governments and their agencies are committed to base conservation policy and management changes on scientific evidence. But there are small and large barriers everywhere from the political to vocational. There are few professional incentives and some disincentives for scientists to change the way we do things. We are paid and rewarded for successful grants, mentoring postgraduate students and publishing in high impact journals. But are we failing to make a real impact in changing the world? The burgeoning extinction crisis continues to bear testament to our collective inability to change the business as usual model. I will present a series of case studies from wetland and river research in Australia which have improved conservation policy and management outcomes. These include the declaration of national parks, forging of conservation agreements for whole river systems, environmental flows and stopping the building of dams. There are also plenty of failures. Despite this, there are some clear lessons and generalities to be drawn. I aim to focus

on the critical aspects of engagement, trust, confrontation, communication, politics, media and advocacy, as well of course good science. As conservation biologists, we need to find effective ways of influencing conservation policy, given the ongoing extinction crisis. This means expanding our influence beyond the echo chambers of our scientific world.

24. CLOSING THE COLLABORATIVE GAP: ALIGNING SOCIAL AND ECOLOGICAL CONNECTIVITY FOR BETTER MANAGEMENT OF INTERCONNECTED WETLANDS

Stuart Kininmonth

Stockholm University

Arvid Bergsten, Stockholm University ; Örjan BODIN, Stockholm University

Understanding how governance structures align to ecological processes in a landscape is critical for effective management of ecological resources. Ecological resources are not independent from each other, instead they are interconnected, and their well-being is often critically dependent on upholding ecological connectivity, especially in times of change and disturbances. Coordination and collaboration among managing actors, each managing their own piece of the puzzle, is therefore essentially a requirement for effective management. We present a conceptual model that includes ecological resources, managing and coordinating actors, along with an explicit representation on how all these entities are connected to each other. We apply this model to 25 municipalities that manage 408 wetlands in central Sweden. The study shows a good social and ecological alignment, however with a high prevalence for coordination through third parties. We discuss this pattern emergence, its potential implications, and examine which municipalities adopt these coordinating functions.

HUMAN WILDLIFE CONFLICT IN KENYA

Jonathan Kirui

Kenya wildlife service

Human wildlife conflict in Kenya , has been on the increase in the recent past, occasioned by increase in human population and encroachment onto the wildlife dispersal areas. There are six major types of human wildlife conflict in Kenya , which are crop destruction, livestock depredation, property destruction, threat to humans security, human injury and human deaths. between 2008 and 2013' nine thousand eight hundred and ninety three cases of human threat reported in Kenya, nine hundred and four persons injured while three hundred and eighty four persons were killed by wildlife in the same period. seven thousand and ten cases of crops destruction were encountered over the same period. Mitigation measures were



carried out. This paper will endeavor to explain the challenges in mitigating this phenomenon.

ADDING UP THE EFFECTS OF CLIMATE CHANGE FOR MONTANE AMPHIBIANS: STAGE-SPECIFIC EFFECTS OF WARMING, DRYING, AND INCREASED CLIMATIC VARIABILITY

Amanda Kissel

Simon Fraser University

Wendy PALEN, Simon Fraser University ; Maureen RYAN, Simon Fraser University ; Michael ADAMS, U.S. Geological Survey

Anthropogenic climate change is expected to alter the access of wetland obligate species to crucial habitat, which may in turn disrupt important phenological processes. Specifically, changes in the timing and form of precipitation are likely to alter wetland hydroperiods such that ephemeral wetlands dry sooner, and permanent wetlands become ephemeral. This phenomenon is expected to be exacerbated at high elevations, where climatic processes such as precipitation and snowmelt influence wetland hydrology. Species that rely on consistent water sources for reproduction, such as amphibians, may experience a phenological mismatch between the periods in which offspring are dependent on water for growth and development, and the period of time in which wetlands physically hold water. Potential consequences of early drying are increased levels of embryonic or larval mortality if wetlands dry before eggs hatch or larvae metamorphose, and if mortality is high enough, could scale up to affect population stability. To address this, we collected baseline data on >60 Cascades frog (*Rana cascadae*) breeding sites within Olympic and Mt. Rainier National Parks in Washington state, USA, that span a range of hydroperiod types (short, intermediate, perennial, and permanent) and quantified the proportion of reproductive effort that was lost as a result of wetland drying. We found that mortality occurs in all wetland types (short to permanent), and can result in a loss of up to 37% of reproductive effort in a population. Combining these data with existing demographic data and site-specific predictions of future warming and drying rates allows us to explore how climate change will affect *R. cascadae* populations now and in the future. These results can then be used to inform conservation decisions, for example removing non-native, predatory fish in permanent wetlands that may act as refuges for amphibians in the future.

62. A DYNAMIC SYSTEMS APPROACH TO CULTURAL VALUES: IMPLICATIONS FOR HUMAN-ENVIRONMENT INTERFACE

Shinobu Kitayama

University of Michigan

The development of sustainable eco-cultural systems is an agenda of the utmost significance today. One central question pertains to the notion of cultural values, i.e., positively valenced goal states that are shared by a historically, regionally, and ethnically defined group of people. In the present talk, I will propose a dynamic systems view of cultural values. This view is based on three important considerations. First, cultural values are historically path-dependent. A variety of ecological, social, economic, and political factors are associated with the development of different values. For example, histories of frontier settlement foster independence and, thus, are associated with less appreciation of interdependencies between humans and the nature. Likewise, farming, particularly farming of crops like rice, tends to foster values of interdependence. Second, our approach is informed by recent work highlighting the power of cultural values in fostering neurobiological changes. Evidence is growing that culture's beliefs and practices can plastically change processing pathways of the brain. For example, interdependence requires close attunement to goals and interests of close others because these others are psychologically incorporated into the self. Those who value interdependence tend to have brain pathways set up such that they respond at least as strongly when others' goals are at stake as when their own goals are at stake. The third pillar of our approach, gene x culture interactions, is suggested by an observation that not everyone in a cultural group acquires norms of their culture. One hypothesis that is being currently investigated is that some people are genetically more sensitive to social and cultural norms than others. Overall, the current view, emphasizing dynamic systemic interdependencies among culture, brain, and the mind, offers some implications for human-environment interface.

15. BIODIVERSITY CONSERVATION FOR ECOSYSTEM SERVICE DELIVERY OR ECOSYSTEM SERVICES FOR BIODIVERSITY CONSERVATION

David Kleijn

Alterra

Biodiversity conservation is increasingly being justified because of the ecosystem services it delivers. The basic evidence for more diverse ecosystems delivering more benefits comes from experimental studies. Such studies do not consider the costs of maintaining or promoting biodiversity. When costs are taken into account, justifications based solely on ecosystem service delivery could result in optimization rather than maximization of biodiversity conservation. Using wild bee species as a concrete example of an important service providing group, we examine in real world landscapes what the economic



contribution of wild pollinators is to crop production, what proportion of the total species pool is making significant contributions to crop pollination, how this varies in space and time, how common these species are in the wider countryside and how easily they can be enhanced. We examined these issues using existing datasets of bee pollinators from five continents. Wild bee communities contribute on average over \$3000 per ha to the production of insect-pollinated crops. However, a limited subset of all known bee species provides the majority of pollination services because, across crops, years and biogeographical regions, crop-visiting bee communities are dominated by a small number of common species and rarely contain regionally threatened species. These species are dominant crop pollinators because they are able to exist in agricultural landscapes and many are enhanced relatively easily by simple conservation measures. Focusing conservation on the services delivered by pollinators may therefore lead to management strategies that predominantly benefit the limited set of species currently providing the majority of crop pollination. Consequently, conservation of the biological diversity of bees should be motivated not only by immediate benefits from ecosystem services, but by the full richness of arguments for conservation.

A NEW TOOL TO CALCULATE ROADLESS SPACE IN FOREST LANDSCAPES, APPLIED IN THE CONGO BASIN

Fritz Kleinschroth

CIRAD

Sylvie GOURLET-FLEURY, CIRAD ; Frédéric MORTIER, CIRAD ; John R. HEALEY, Bangor University ; Radu STOICA, Université Lille 1

New global strategies for road building require innovative tools to analyze linear patterns and their spatial distribution and to evaluate their environmental impacts. Roads not only present physical barriers to wildlife but also provide access for human and biological invasions. In tropical regions especially, forest degradation has been associated with roads built for selective logging into formerly intact forest landscapes. To quantify to what extent ecosystems are influenced by roads, it is important not only to know road length density but also their location in a landscape unit. The concept of roadless space is based on distance to the nearest road from any point. We present the computation of this distribution using the Empty-Space-Function, a general statistical mathematical tool based on stochastic geometry and random sets theory. We demonstrate the applicability of this well-defined probability function to calculate roadless space based on vector road data. In a Congo Basin case study we compared the temporal development of road networks inside different logging concessions over time. We hypothesized that roadless space decreases, even when the rate of wood volume harvest remains constant.

Based on LANDSAT time series covering the last 29 years, we assessed accessible roads in relation with the river network and calculated the roadless space at different points in time. As expected, roadless space decreased continuously throughout most concessions, despite a drop in total annual harvest volume after 2008 and independent of forest certification schemes. We recommend that measures to reduce impacts of selective logging should not only be based on the extraction of timber, but should also include the total area impacted by roads. The Empty-Space-Function provides a rigorous mathematical description and a straightforward way to assess intact forest landscapes and is therefore highly applicable to road impact evaluation in conservation science.

218 NATURA 2000 IN GERMANY

Frank Klingenstein

German Federal Ministry for the Environment

The EU habitats and birds directives are the basis for protecting biodiversity in the European Union by mainly three instruments: Establishing protected areas (= the Natura 2000 network) with obligations to protect and actively manage these sites perform impact assessments and compensate possible negative influence of plans and projects on these sites protect species in and outside these areas. For the selection and designation of the Natura 2000 sites only scientific criteria should have been used. Economic or social interest e.g. of land users should be integrated when the conservation measures are defined (e.g. management plans). In Germany, there are at about 5.300 Natura 2000 sites covering 15.4 % of the terrestrial surface and at about 45% of the sea. The designation of these sites in Germany has been a long and difficult process leading to the conviction of Germany by the European Court of Justice. In this process, scientific data gathered mainly by the civil society had a significant impact: The so called Important Bird Areas became a strong argument for site designation and lead to legal uncertainties and a lack of planning reliability endangering economic activities. After the establishment of the German Natura 2000 network the rules and procedures of the EU habitats and birds directives become more and more part of the everyday business of administrations and companies. The contribution will focus on the role of scientific data in the German Natura 2000 process and will try to explain why any changes in the directives may have serious impacts on the legal certainty and the achievements of the directives that have already been reached.



THE USE OF MICROSATELLITE, MAJOR HISTOCOMPATIBILITY COMPLEX, AND TOLL-LIKE RECEPTOR MARKERS TO EXAMINE BOTTLENECK EFFECTS IN THREE DIVERSE NEW ZEALAND SPECIES

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University of Otago

Catherine GRUEBER, University of Sydney, NSW ; Bruce ROBERTSON, University of Otago ; Ian JAMIESON, University of Otago

Studies exploring the genetic consequences of population bottlenecks are increasingly examining the loss of diversity at functional loci such as those associated with adaptive (major histocompatibility complex, MHC) and innate (toll-like receptors, TLRs) immunity while using neutral microsatellite markers as a control. Aspects that require further research include whether remnant genetically depauperate mainland and insular-originating source populations differ in immune-gene diversity, whether contemporary bottleneck circumstance (i.e. human-induced via translocation vs. natural via pathogen outbreak) differentially affects the genetic diversity of various molecular markers, and whether signals of selective responses to disease can be detected in threatened populations. I will discuss the findings of my PhD research, addressing these questions in three of New Zealand's endangered bird species. In kakapo (*Strigops habroptilus*), results reveal that MHC but not TLR markers generally support findings based on neutral markers; that mainland-originating kakapo contain unique alleles not found in insular-originating kakapo and indicate that the MHC is an important tool to rank individuals for breeding opportunity/artificial insemination procedures. Anthropogenic and natural contemporary population bottlenecks differentially affected patterns of diversity loss at microsatellite, MHC, and TLR loci in South Island saddlebacks (*Philesturnus carunculatus*). Finally, preliminary results indicate that a selective response to a viral outbreak may be responsible for TLR1LA genetic diversity loss in a population of red-crowned parakeet (*Cyanoramphus novaezelandiae*). Taken together, these studies show that genetic diversity patterns across loci reflect the species-specific narratives of population decline.

URBANIZATION CAUSES RELATIVELY HIGH LOCAL BIODIVERSITY BUT LARGE SCALE BIOTIC HOMOGENIZATION

Eva Knop

University of Bern

Tabea TURRINI, University of Bern

Cities are growing rapidly worldwide, yet the impact of urbanization on arthropod diversity remains ambiguous. Also, urbanization is regarded as one of the major causes for global

biotic homogenization. Evidence for the homogenization hypothesis is mostly derived from plants and birds, whereas arthropods have so far mostly been neglected. We thus asked whether a) species diversity and abundance of arboreal arthropods is higher in intensively managed farmland areas as compared to cities, and b) species communities between cities are more similar than between rural sites. We further were interested whether the presence of non-native species explains the pattern observed. To do so we used species community data of three indicator groups, namely true bugs, leafhoppers, beetles. The specimens were sampled on a total of 36 standardized birch trees in a total of 6 cities and 6 rural areas nearby. Species richness of bugs was significantly higher in cities than in rural sites, and for the other two indicator groups it did not differ between the two ecosystems. Species abundance of all indicator groups was significantly higher in cities than in rural sites. In contrast, species turnover of two indicator groups (bugs and leafhoppers) was significantly higher between rural sites than between urban sites, and did not differ for beetles between the two ecosystems. The exclusion of non-native species did not change the pattern found. Our study shows that cities might harbour similar or even higher species diversity than intensively managed rural sites nearby. However, on a very large scale, urbanization seems to homogenize species communities. Specific measures in cities targeted at species typical for the biogeographic region might help to counteract the on-going biotic homogenization due to urbanization.

15 QUANTIFYING THE SOCIO-ECONOMIC IMPLICATIONS OF MOBILIZING ECOSYSTEM SERVICES IN AGRICULTURE

Thomas Koellner

University of Bayreuth

Patrick POPPENBORG, University of Bayreuth ; Alison BAILEY, University of Reading ; Mark BRADY, Swedish University of Agricultural Sciences

Meeting growing demand for food and bio-fuels from agricultural landscapes is a challenge that is exacerbated by needing to account for biodiversity and associated provisioning of ecosystem services. Successful implementation of such a multi-criteria objective not only requires appropriate agricultural management systems, but crucially depends on farmers' willingness to implement them as well. One part of the Liberation FP7 project thus deals with the socio-economic implications of eco-functional intensification. We therefore integrated spatial production functions with economic optimization models to evaluate the impact of landscape structure on supporting ecosystem services, crop yields and farmers' incomes for a cross-section of European landscapes. Special focus was put on agricultural production risk, as higher biodiversity levels might reduce the relative variability



of yields and reliance on external inputs. Furthermore, we conducted interviews to identify farmers' acceptance of different landscape management options. We hope to make general conclusions about the potential benefits of cooperative solutions and what landscape characteristics are important for combining biodiversity conservation with agricultural production.

ID 68 / SUPPORTING BIODIVERSITY IN LANDSCAPES OF MANAGED FORESTS: INVERTEBRATES AS RESEARCH AND APPLICATION CHALLENGES

Matti Koivula

University of Eastern Finland

In Northern Europe, modernized forest legislation, certification systems and guidelines encourage forest owners to apply continuous-cover retention forestry, and the public acceptance of this regime increases with wider acknowledgement of forest values other than economics. This can be seen as a welcome trend for diversity, but in reality the paradigm shift is slow. The tardiness is due to several obstacles, such as financial losses and slow regeneration, but also because the biological outcome of a considerably more widespread application of retention and rehabilitation applications is uncertain. This shortcoming is pronounced concerning invertebrates, even though some field explorations suggest forestry-initiated changes in the geographic distribution of forest specialists. Invertebrates are often considered irrelevant for the landscape scale because of their small home ranges, or because representative sampling is thought to be too labor intensive and expensive. Moreover, continuous-cover forestry is still seldom applied by forest owners. Accordingly, a 2014 review showed that only two out of 45 North American and Fennoscandian continuous-cover experiments had an intended goal of comparing landscapes with different harvesting regimes. An understanding of landscape-level phenomena is, however, crucial for justifying continuous-cover forestry: does its large-scale application support recoveries of specialized forest species? I will demonstrate human impacts on invertebrates using two real-life landscape approaches. Lesson learned is that landscape is a relevant, achievable scale to study invertebrates. The biggest challenge in landscape experiments is to motivate forest owners to apply continuous-cover forestry, but it also requires careful a priori consideration of research questions and sample representativeness.

123 AFFORESTED FIELDS AS NOVEL ECOSYSTEMS: BIODIVERSITY AT DIFFERENT TROPHIC LEVELS

Atte Komonen

University of Jyväskylä

The agricultural legacy in afforested fields is manifested in the physical, chemical and biological features of the soil. Afforested fields can thereby harbor novel species assemblages and interactions. Based on an extensive field experiment, I present results on biodiversity patterns at afforested fields 25 years after afforestation. Many rare, calciphilous and herb-rich forest specialist fungi (Basidiomycete: agarics and boletales) were recorded. The carabid beetle (Coleoptera: Carabidae) and ant (Hymenoptera: Formicidae) assemblages were dominated by generalists. Different trophic levels responded differently to tree species identity. Fungal diversity was highest in spruce and pine plots, whereas both the carabid and ant assemblages were more diverse in birch plots. Similarities in species composition varied depending on the trophic level. Fungal community was the most dissimilar among birch plots, whereas carabid and ant communities were the most dissimilar among birch plots and among spruce plots. Overall, there was great variation in community composition among geographical locations. The results show that early successional afforested fields can be valuable compensatory habitats for calciphilous and herb-rich forest fungal species, and can also harbor species rich arthropod assemblages. Field afforestation is therefore a potential conservation tool that could be used to complement rare habitat types in the highly fragmented protected area networks. The diversity and species composition of fungal and arthropod assemblages are influenced by tree species identity. This is evident already at early successional stages and is likely to become more prominent as succession proceeds. Thus, the identity of the tree species used in afforestation is one important factor, if field afforestation has biodiversity objectives.

126 BIODIVERSITY CONSERVATION AS FACILITATOR OF DEVELOPMENT: THE CÔTE D'IVOIRE EXAMPLE

Souleymane Konaté

University of Nangui Abrogoua

Côte d'Ivoire is a West African country that is characterized by an outstandingly high biodiversity, which is heavily threatened due to its socio-economic development since independence. The importance of this biodiversity is indicated, on one hand, by the fact that most of the protected areas of the country belong to the global priority zone for the conservation of biodiversity in West Africa (the Upper Guinea biodiversity hot spot); and on the other hand, by the presence two important UNESCO Biosphere reserves and World Heritage Sites in the country (Taï NP with the last continuous primary moist rain forest in West Africa, and Comoé-NP as largest savannah NP in the region). However, from 1958 to the present, the country lost nearly 90% of its original forest cover (at a rate of 7.6% per year), as well as many species due to exploitative



land use practices and conversion of large proportions of natural habitats into cropland triggered by its unprecedented economic growth. Aware of the environmental and long-term socio-economic consequences of such a development, the country has recently committed itself to a sustainable development policy for an emerging economy by 2020. It involves all business actors including those of economy, environment, higher education and scientific research. To achieve these objectives, the country has launched a five years National Development Plan (NDP). What are the foundations of this new development policy? How can the particular biodiversity of the Côte d'Ivoire contribute to achieve this goal? What is the contribution of scientific research on biodiversity and climate change in order to enhance sustainable development and a green economy by 2020? These are the questions addressed in this presentation, which represents the vision of the Research Unit on Ecology and Biodiversity of the Research Pole in Environment and Sustainable Development of the University Nangui Abrogoua in Côte d'Ivoire.

URBAN CULTURAL LANDSCAPES AS MODELS OF URBAN BIODIVERSITY MANAGEMENT

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Cities cannot be sustainable without their hinterlands, but they are key to sustainability because the global network of cities appropriates most of the Earth's ecosystem services. Cities epitomize the conflicting priorities between development and sustainability. When cities face fundamental issues like resource scarcity, strong population growth and accelerated expansion of built areas, the existing green spaces are threatened because they are regarded as barriers against progress. The most visible losses are terms of physical disappearance of green areas, along with all its immediate benefits. But even more important is the loss of the daily interaction between humans and nature, which logically results in continuing and reinforcing the recent divergence between prosperity and nature inside (and beyond) the city itself. Solving this problem in cities - i.e. at human community levels - is fundamental to global nature conservation and sustainable development. In this paper, we review the issue of urban policy contradiction between development and sustainability, and we propose to address it by an integrative urban sustainability model which allows a holistic and coherent view upon urban green spaces. We apply the concept of Urban Sustainability Nexus (USN), a recently developed model, in which a landscape model is understood as a sub-model of a holistic eco-city model that comprises at its core the interdependencies between energy, water,

landscape and transport. In the model, we frame urban green areas as urban cultural landscapes, as applied to case studies in Versailles and Paris. We discuss the limits to ecosystem planning and the emergence of a city's genius loci from the interaction between nature and culture. Further, we use the model to generate a set of urban development and biodiversity conservation scenarios. Finally, we discuss the relevance of this approach for biodiversity conservation in different biogeographical and cultural areas of the world.

EFFECTS OF OIL AND GAS INFRASTRUCTURE AND OPERATING NOISE ON GRASSLAND SONGBIRDS IN ALBERTA, CANADA

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University of Manitoba

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New oil wells are continually being drilled across the Great Plains, but we have little understanding of their impacts on grassland songbirds. We evaluated effects of oil well pumpjacks and screwjacks on abundance, nesting success and behaviour of grassland songbirds in 47, 65-ha mixed-grass prairie sites in southern Alberta, Canada, from 2012-2014. We compared the impacts of two types of wells, powered by two different power sources, and compared impacts of active and inactive (silent) infrastructure, with control sites with no infrastructure. Most species responded positively or neutrally to infrastructure. Baird's sparrows and Sprague's pipits, both species showing significant population declines, had lower abundances in sites with oil infrastructure. This effect was greater in sites with noisy infrastructure for Baird's sparrows, whereas effects of noisy and silent infrastructure influenced Sprague's pipit abundances equally. Although vesper sparrows and Savannah sparrows had equal or higher abundances in sites with infrastructure, their nesting success was lower in these sites, suggesting that sites with infrastructure might be ecological traps. Clutch sizes were higher far from roads for several species. Behavioural experiments demonstrated that some observed effects may be caused by a breakdown in communication, as Savannah sparrows could not detect alarm calls in the noisiest sites. While most ecological effects were driven by the presence of infrastructure, not noise, Baird's sparrows might benefit from noise mitigation measures. The presence of anthropogenic infrastructure significantly influences the distribution and productivity of several species of grassland songbirds across the prairie landscape; efforts to minimize noise from infrastructure might mitigate some but not all negative effects.



EFFECT OF PEAT CHARACTERISTICS ON P, N, AND DOC MOBILIZATION FROM RE-WETTED PEAT SOILS - A LABORATORY COLUMN STUDY FOR THE IMPACTS OF RESTORATION ON FORESTRY-DRAINED PEATLANDS

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Peatlands are an integral part of the hydrological cycle in the boreal and temperate zones, providing ecosystem services such as water filtering. From the mid to late 1900's, over 15 ha of peatlands and wetlands were drained for forestry in the temperate and boreal zones, causing deterioration of biodiversity and loss of ecosystem services. They are now being restored in order to reverse this development. Restoration of peatlands has been found to cause leaching of DOC and nutrients after water level rise and expansion of reducing conditions in the peat. A molar ratio between redox-sensitive Fe and P in the peat of < 10 has been previously suggested as a limit value indicating risk of high P export. The ratio, however, does not predict the level of P release well when the value is < 10 . It has also been suggested that redox-sensitive Fe is involved in the export of DOC via consumption of protons during reduction reactions of Fe, which reduces the soil positive charge and makes the DOC molecules more electronegative, which makes them repel each other. An incubation experiment was conducted to study factors affecting P, N and DOC release from inundated peat from forestry-drained peatlands of several fertility classes. It was discovered that in addition to Fe, a high ratio of Al to P in the peat reduces P export under reducing conditions. High peat Fe content was also found to predict high DOC export, suggesting that minerotrophic sites are susceptible to post-restoration DOC leaching due to the Fe in their peat. Microbial biomass and mineralization potential of the peat were not found to be important for the export of DOC or P. High NO_3 content in the peat predicted high export of NH_4 under reducing conditions.

THE NATIVE TREE FLORA OF GREECE: AN OVERALL ASSESSMENT OF REPRODUCTIVE TRAITS, SEED GERMINATION AND EX SITU CONSERVATION

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The native tree flora of Greece comprises c. 2% of the general Greek flora. Data concerning flowering and fruiting season, masting, dispersal type, seed mass, seed germination, dormancy class, field seedling emergence and seed storage behaviour have been gathered for more than 100 taxa and are currently being analyzed. For the majority of the taxa, there exist either no scientific information on seed germination and seed storage behaviour for plant material collected in Greece or only a few, largely incomplete studies, which make ex situ conservation extremely difficult. In order to effectively protect and conserve the native tree taxa and their forest ecosystems, it is essential to investigate their reproductive biology. In the framework of a post-doc research, seed collections of 13 Greek tree taxa (including endemic and rare ones) have been carried out and experiments of seed germination and storage behaviour are currently being realized. Germination cases of the studied taxa will be presented (e.g. *Abies cephalonica*, *Alnus incana*, *A. glutinosa*, *Liquidambar orientalis*, *Platanus orientalis*). Part of this research is funded under the Project 'Research & Technology Development Innovation Projects'-AgroETAK, MIS 453350, in the framework of the Operational Program 'Human Resources Development'. It is co-funded by the European Social Fund through the National Strategic Reference Framework (Research Funding Program 2007-2013) coordinated by the Hellenic Agricultural Organization - DEMETER.

175-PARTICIPATION IN IPBES THROUGH UN REGIONS: OPPORTUNITIES AND BARRIERS FOR MEPS

Eszter Kovacs

The University of Cambridge

In this presentation, I will outline the expectations and experiences of Multidisciplinary Expert Panel (MEP) members from the first two years of the operationalisation of the Intergovernmental Panel for Biodiversity and Ecosystem Services (IPBES). MEPS are responsible for spearheading and directing work programme packages, fast track assessments,



the selection of experts in relevant areas, and the collation and writing up of scientific reports and assessments that will form the core of IPBES' outputs. However, the ability of MEPs to participate in the processes are uneven, constrained or enabled by their Regional networks, backgrounds, institutional affiliation and levels of financial support. These variations are also reflected in the geographical realisation of IPBES' work programme, and speak to a need to understand and to take into account the often politically inflected processes of "doing" science.

EVALUATION OF PARTICIPATORY MANAGEMENT PLANNING PROCESSES FOR NATURA 2000 SITES IN HUNGARY

Eszter Kovács

Institute of Nature Conservation and Landscape Management, Szent István University[INSTITUTE] Environmental Social Science Research Group (ESSRG) *Gabriella KISS, Budapest Business School, College of Finance and Accountancy; Veronika FABÓK, Institute of Nature Conservation and Landscape Management, Szent István University[INSTITUTE] Environmental Social Science Research Group (ESSRG); Ágnes KALÓCZKAI, Institute of Nature Conservation and Landscape Management, Szent István University[INSTITUTE] Environmental Social Science Research Group (ESSRG); Barbara MIHÓK, MTA ÖK Lendület Ecosystem Services Research Group, Centre for Ecological Research, Hungarian Academy of Sciences; György PATAKI, Department of Environmental Economics and Technology, Corvinus University of Budapest[INSTITUTE] Environmental Social Science Research Group (ESSRG); Bálint BALÁZS, Institute of Nature Conservation and Landscape Management, Szent István University[INSTITUTE] Environmental Social Science Research Group (ESSRG); Györgyi BELA, Institute of Nature Conservation and Landscape Management, Szent István University[INSTITUTE] Environmental Social Science Research Group (ESSRG); Boldizsár MEGYESI, Institute for Sociology, Centre for Social Sciences, Hungarian Academy of Sciences; Katalin MARGÓCZI, Department of Ecology, University of Szeged; Ágnes ROBOZ, Department of Environmental Economics and Technology, Corvinus University of Budapest*

The Natura 2000 network of the European Union consisting sites of community importance is considered as one of the largest networks of protected areas in the world. Preparation of management plans is recommended by one of the guiding directives, the Habitats Directive, as a means to maintain or restore the favourable conservation status of related habitats and species. Guidelines also emphasise the importance of stakeholder participation in the planning process in order to secure the support and involvement of locals in the management of designated areas. The present

research evaluates participatory processes of developing management plans for Natura 2000 sites in Hungary between 2007 and 2014. This evaluation aims to identify the main factors determining the quality of the participatory planning processes and their outcomes. Transcriptions and notes of semi-structured interviews and consultation forums, other documents and reports of the planning processes were analysed applying a qualitative content analysis method. A priori theoretically based codes were used to evaluate the process and the outcome along a set of criteria derived from the scientific literature on participation tailored to conservation related management planning. Our results demonstrate that regulation on management planning, early involvement of stakeholders, engagement of state officials with decision-making power, time and resources allocated to the process, available incentives for land users to comply with the measures are all important factors to make the planning process successful. Professional facilitation and involvement of social scientists are also crucial to ensure the quality of the process and assist in the resolution of conflicts that may arise.

SYMPOSIUM ID 175 - IPBES - THEMATIC ASSESSMENT OF POLLINATORS, POLLINATION AND FOOD PRODUCTION

Anikó Kovács-Hostyánszki

MTA Centre for Ecological Research
Simon G. POTTS, School of Agriculture, Policy and Development, Reading University; Vera Lucia IMPERATRIZ FONSECA, Instituto de Biociências, Universidade de S. Paulo; Anne LARIGAUDERIE, IPBES Secretariat

The thematic assessment of pollinators, pollination and food production is the first in a series of biodiversity assessments by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). More than 60 experts from around the world are working on the six chapters of assessment and will deliver the final report in early 2016. The assessment will review the diversity, status and trends of pollinators and pollination systems and their role in supporting food production, in human well-being and biodiversity maintenance. Direct and indirect drivers of change of pollination systems will be detailed, such as land-use, agricultural management, pesticide use, pests or changing climatic conditions. It will assess economic methodologies for determining the value of pollination for food production and the economic impacts of declines in pollinator populations. In addition, the assessment will include indigenous and local knowledge perspectives on pollinators and pollination systems and their benefits to those knowledge holders. Responses to risks associated with the degradation of pollination services and opportunities to restore and strengthen those services will be addressed. The assessment aims to understand the reasons of pollination declines and deficits and how this knowledge can help to



advance practices and policies, particularly for land-use management, horticulture and agriculture, including through innovative approaches such as ecologically intensified agriculture as well as those used by indigenous and local communities, to mitigate the further loss. The assessment represents an early deliverable IPBES that will identify policy-relevant findings for decision-making in government, the private sector and civil society. It will also help demonstrate how an essential ecosystem service contributes to the post-2015 development agenda and contribute to Aichi Biodiversity Target 14 on safeguarding and restoring ecosystems that provide essential services.

IDENTIFYING AFRICAN PROTECTED AREAS AT RISK FROM THE ILLEGAL WILDLIFE TRADE

Olena Kovalenko

University of Helsinki

Atte MOILANEN, University of Helsinki ; Enrico DI MININ, University of Helsinki

The illegal trade in biodiversity, which is estimated to be the world's second largest illegal market after narcotics, is undermining conservation efforts in many parts of the world. Africa hosts some of the most iconic species, which are in high demand in the illegal wildlife market. In this study, we identified the protected areas that will increasingly be targeted by criminals for the illegal harvesting of iconic African species listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the IUCN Red List. We did so by identifying the priority areas where these species are most abundant and, at the same time, more accessible to poachers according to continental and international illegal wildlife trade routes. We then identified which protected areas are most at risk by overlaying the priority areas for poachers with a layer including all African protected areas. Our results highlight where resources should be allocated immediately for improved protection of these species and have policy implications reaching beyond the conservation of iconic species.

SINANODONTA WOODIANA AS A GOOD SURROGATE SPECIES IN ENVIRONMENTAL ASSESSMENT

Nora Kováts

University of Pannonia

Eszter HORVÁTH, University of Pannonia ; Bettina ECK-VARANKA, University of Pannonia ; Gábor PAULOVITS, Balaton Limnological Institute, Centre for Ecological Research

Bivalves are sentinel and filter-feeding organisms, which make them ideal for toxicity testing as they are able to accumulate and bioconcentrate most pollutants. Due to their sensitivity, however, native Unionid populations have shown a serious

decline. As such, while native Unionid species are holding a specific nature conservation status, the alien and invasive Chinese pond mussel (*Sinanodonta woodiana* LEA) raises no ethical constraint to collect or to sacrifice. In order to use it as a good surrogate species, however, it should show comparable sensitivity with native Unionids. In our study, sensitivity of *Sinanodonta woodiana* was compared to that of *Unio pictorum* to evaluate the genotoxic potential of two well known pollutants with high relevance in fresh water pollution: CuSO₄ and benzo(a)pyrene (B[a]P). For genotoxicity assessment, the micronucleus (MN) test was applied where MN formation indicates mitotic chromosome breakage or chromosome mis-segregation. Results show that under laboratory conditions *S. woodiana* shows good sensitivity and therefore can replace native species. On the contrary, there is a serious constraint: being an alien species, it cannot be used in situ when transplanted mussels are required.

210 AN OUTLINE OF A POLICY FOR ROADLESS AREAS CONSERVATION ACROSS SCALES

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In the past few years, roadless areas have received increasing attention as effective conservation targets of great potential. This leaves the global society, particularly conservation biologists, advocates and policy-makers, with the task to explore an almost entirely new field of policy (laws, strategies, funding). Transparent definitions are needed to operationalise general strategic goals of roadless areas conservation. Existing concepts comprise assumptions regarding minimum size or maximum tolerable impact that varies with their regions of origin, but such basic conceptual work is still lacking for most regions. A policy analysis shows roadless areas so far are hardly taken into account in any relevant policy field, such as conservation, development cooperation, or traffic infrastructure planning. Few exceptions exist, of which roadless areas and wilderness legislation in the U.S. stands out. The current primary goals of most other policy fields are driven by interests in (economic) development and are thus at odds with roadless areas conservation. However, many other environmental policies promise to be synergistic. Examples



on the continental scale is the EU No Net Loss initiative, and, on national level, the German Federal Defragmentation Programme. Protected areas have proven to vary in their effectiveness as a barrier to road building. Similarly, a stakeholder analysis highlights wide gaps in all stakeholder groups needed for effective conservation of roadless areas. Among others, advocacy by NGOs as an interface between science and policy will be of key importance. A global roadless ecology framework is currently being developed. It lays the foundation for a global policy of roadless areas conservation that should be established in relevant sectors (e.g. CBD, World Bank programmes etc.). Clearly, an equivalent challenge is regionalisation of both basic scientific knowledge and policy implications, such as traffic infrastructure planning.

NATURA 2000 - SOLUTION FOR EASTERN EUROPE OR JUST A GOOD START? THE ŠUMAVA NATIONAL PARK AS A TEST CASE.

Zdenka Křenová

Global Change Research Centre, AS CR

Pavel KINDLMANN, Global Change Research Centre, AS CR

Natura 2000 is a unique EU-wide network of protected areas, which aims to maintain European biodiversity or at least prevent its worsening based on two Directives: Bird Directive 79/409/EEC and Habitats Directive 92/43/EEC. It is assumed that this will assure the long-term survival of Europe's most valuable and threatened species and habitats. The new member states implemented the Natura 2000 Directives in their own legislation as a part of the EU-integration process. Here we present the practical difficulties of implementing these directives in the Czech Republic as a warning of the problems likely to be encountered in post-communist countries. Our results are mainly based on a case study of the Šumava National Park. We analyze, why Natura 2000 may not work here and look for possible solutions, which would require changes in Natura 2000 policies and their implementation in national policies. We conclude that the problems encountered in implementing these directives in the Czech Republic are likely to affect their successful implementation in most other post-communist countries.

INFLUENCE OF EXURBAN RESIDENTS' ENVIRONMENTAL VALUES, MANAGEMENT OBJECTIVES AND REGIONAL LAND-USE CONTEXT ON PRIVATE LAND ACTIVITIES AND BEHAVIORS

Heidi Kretser

Wildlife Conservation Society

John VOGEL, Cornell Univeristy ; T. Bruce LAUBER, Cornell Univeristy ; Shorna BROUSSARD, Cornell Univeristy

Exurban or low-density residential development is an increasingly common form of sprawl that impacts rural areas of North America, with particularly deleterious impacts on native wildlife. We examined how environmental values and management objectives within the regional land-use context influence the type of activities exurban landowners engage in around their homes at two study sites: the Adirondack region of northern New York and the Greater Yellowstone Ecosystem in Montana. We administered a mail survey to over 200 exurban landowners and conducted in-depth interviews with landowners and decision-makers that govern land use, such as town and county planning departments and homeowner associations. This mixed methods research design builds on social-psychological frameworks to develop an understanding of hierarchical elements that impact how landowners manage their land. We found that exurban landowners' environmental values may be characterized into one of four types previously identified in the literature: mastery over nature, stewardship of nature, partnership with nature and participation in nature. Exurban residents identified with stewardship of and participation in nature most strongly. We investigated how these values relate to how landowners' management desires and the heterogeneity of activities found on private lands. Values tended not to be strongly associated with levels of activity and property management behaviors, however norms from family and neighbors were influential. An explicit understanding of how exurban landowners navigate external constraints and internal values indicates that management opportunities for engaging homeowner associations and individual or neighborhood incentives could potentially lead to improved habitat for wildlife in private lands of exurban landscapes. Incorporation of data from two distinct study areas allows for wider applicability of the findings to other regions experiencing exurban development.

IMPORTANCE OF BEAR MANAGEMENT FOR CONSERVATION OF EURASIAN LYNX

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Interspecific interactions are one of the key factors in the evolution and ecology of animal communities. However, managers, conservationists and decision-makers rarely consider potential side-effects of management of one species for the conservation of other species. For example, kleptoparasitism can have a wide range of consequences for numerous host species, but it is poorly understood how management of dominant scavengers affect their interactions with predators and other scavengers. As the largest terrestrial



scavengers with superb olfactory abilities, bears are one of the most important dominant scavengers and kleptoparasites in the Holarctic region. At the same time, bears are usually actively managed, e.g. through culling, supplemental feeding, and translocations. Here, we studied how management of the brown bear (*Ursus arctos*) affected its interactions with an apex predator, the Eurasian lynx (*Lynx lynx*), in Dinaric Mountains of Slovenia. Brown bears in this area are intensively managed through zone-specific hunting and supplemental feeding, which considerably alter bear distribution and local densities. We showed how bear management indirectly affected endangered Dinaric lynx population by altering interaction intensity. Locally, lynx were observed to be under strong pressure of kleptoparasitism by brown bears, resulting in substantial energetic loss for lynx and potentially affecting lynx reproductive success. Ability of lynx to compensate the losses by increasing their hunting frequency was limited after certain level of kleptoparasitism intensity. Based on our results, we call attention to the importance of considering interspecific interactions in wildlife management. In the concrete case, we suggest that existing bear-feeding regimes should be reconsidered, in order to reduce side-effects of this controversial management measure that can lead to locally high concentrations of bears.

THE WASHINGTON-BRITISH COLUMBIA TRANSBOUNDARY CLIMATE-CONNECTIVITY ASSESSMENT: ENGAGING SCIENCE-MANAGEMENT PARTNERSHIPS TO ADDRESS CLIMATE IMPACTS ON WILDLIFE CONNECTIVITY

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University of Washington

Maintaining and restoring ecological connectivity is a primary conservation need and the most frequently recommended climate adaptation strategy for biodiversity conservation. And yet, little guidance exists regarding where and how to connect fragmented habitats to facilitate climate-driven shifts in species ranges, or how to anticipate and address climate impacts to existing habitat corridors. We will describe an effort to address these needs in the transboundary region of Washington State, USA, and British Columbia, Canada, where we have engaged international science-management partnerships to inform the decision-making of land and wildlife managers tasked with maintaining connected, resilient ecosystems in the face of climate change. We will describe the history of the project, which was conceived as a direct response to feedback from regional managers; highlight the diverse management scales, objectives, and activities of participant agencies, tribes, First Nations, and NGOs; describe our project approach and results, which illustrate a range of possible solutions to the

technical and conceptual challenges associated with adapting connectivity conservation to climate change; and share insights gained from our efforts to bridge the significant technical, institutional, and political barriers that international borders pose to climate adaptation and landscape conservation.

LINKS BETWEEN ON FARM HABITAT, BIRD DIVERSITY, PEST CONTROL AND CROP DAMAGE IN CALIFORNIA'S CENTRAL VALLEY

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In many of the world's agricultural regions, farmland is virtually the only habitat available for wildlife. Agricultural lands are therefore a critical, but often overlooked, opportunity for conservation efforts. Conversely, intensification of agricultural practices has been identified as a major threat to many of the species that rely on farmland, and conservationists advocate wildlife-friendly farming practices, including preserving habitat remnants and establishing linear features such as hedgerows, to offset the negative impact of farming on biodiversity. However, farmers often view this as a tradeoff between conservation and their economic bottom lines. Birds, as one of the most well-studied and ubiquitous taxa persisting in farmland, offer a unique opportunity for measuring the benefits of wildlife-friendly farming practices for biodiversity, while simultaneously measuring the beneficial and detrimental impacts that these practices can have on farmers. The few studies that have examined pest control services by birds have shown that some species can be beneficial to agriculture, yet birds are often maligned by farmers and their efforts to drive birds from fields can compound the detrimental impact of agricultural intensification on wildlife. We will present a synthesis of multiple studies in California's Central Valley, one of the world's most productive agricultural landscapes, which have sought to understand these relationships. Our results show a positive relationship between avian diversity and both field- and landscape- level habitat features. We will also show that birds provide insect pest control for multiple crops including alfalfa, walnuts, sunflowers and tomatoes, and that the benefits of avian foraging on insect pests outweigh the damage that birds cause to economically-valuable sunflower seed crops.

A CONTINENTAL APPROACH TO ORCHID CONSERVATION AND RESTORATION

Gary Krupnick

Smithsonian Institution



Dennis WHIGHAM, Smithsonian Institution

Many species are at risk globally, and species in the Orchidaceae, one of the most species rich families of flowering plants on earth, are no exception. More than half of native orchid species in North America have been listed as threatened or endangered at local, state, regional, or national levels. To respond to the ever increasing threats to native orchids (e.g., habitat alteration, climate change, invasive species, illegal harvesting), organizations need to aggressively pursue approaches that reduce the risks to orchids while providing a mechanism for restoration and conservation. The North American Orchid Conservation Center (NAOCC) has a goal of conserving the genetic diversity of all native orchid species in the U.S. and Canada. NAOCC is developing a network of botanical gardens, researchers, and public and private organizations to focus on efforts to conserve orchid genetic diversity. This will be done through the implementation of seed and mycorrhizal fungal banks and the development of botanical garden protocols for the establishment of sustainable populations of all orchid species. NAOCC is also developing educational tools including an interactive online website (GoOrchids) that can be used to identify any native orchid species in the U.S. and Canada. This presentation will share the experiences during Phase 1 of NAOCC development.

PROMOTION OF BIODIVERSITY IN AGRICULTURAL LANDSCAPE VIA UMBRELLA BIRD SPECIES, AGRICULTURAL ENVIRONMENTAL SCHEME AND CITIZEN SCIENCE PROJECT: LESSONS FROM CENTRAL EUROPEAN COUNTRY

Vojtech Kubelka

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Biodiversity and ecosystem functioning are highly deteriorated in current agricultural landscape in many countries across the world. A huge conservation effort has been devoted to improve this issue, however so far with only limited evidence of success and ambiguous results. Agri-environmental schemes (AES) represent a promising tool how to encourage biodiversity of agricultural landscape on larger scale. However, the best localities for AES implementation on national level have to be chosen in advance and the efficacy of the prescription has to be monitored, i.e. two very time and money demanding operations are necessary parts of the AES. Here we report about our hopeful approach using suitable umbrella species, public volunteers and user-friendly on-line database. The Northern Lapwing (*Vanellus vanellus*) is a suitable species as it is well known and unmistakable shorebird for public, representing endangered wetland species inhabiting

agricultural landscapes; therefore via proper conservation management for lapwings we are able to effectively promote biodiversity of agricultural landscape in general. We obtained over 3000 detailed observations from more than 1000 lapwing breeding grounds with great help of more than 200 volunteers across the Czech Republic during breeding seasons 2012–2014. Subsequently, 350 best localities (particularly wet fields regularly concerning large breeding colonies) were chosen for AES. Five-year concept of this AES for Northern Lapwing on arable land consists of ploughed field left unmanaged from winter until 15th of June. Then the field is sown with two types of plant seeds mixtures and ploughed again in late autumn. Pivotal step in 2015 is to convince the farmers to get involved in this AES. There is great potential of the project, e.g. AES efficacy evaluation on the same plots before and after AES implementation. Pros and cons of the chosen approach with detailed results will be thoroughly discussed during the presentation.

SYMPOSIUM #20 THE PAN AFRICAN CHIMPANZEE PROGRAMME: REMOTE VIDEO, ORGANIC AND ECOLOGICAL SAMPLING AT 40 TEMPORARY RESEARCH SITES ACROSS AFRICA

Hjalmar Kuehl

Max Planck Institute for Evolutionary Anthropology
Mimi Arandjelovic, Max Planck Institute for Evolutionary Anthropology; Christophe BOESCH, Max Planck Institute for Evolutionary Anthropology

Effective conservation planning requires more than just knowledge of a species' distribution and population size but also an understanding of their ecological, behavioral and genetic diversity. We established the Pan African Chimpanzee Programme, a never-before attempted, large-scale research project covering all possible habitats of the different chimpanzee subspecies (*Pan troglodytes*) across their entire range. The project aims to understand the socioecological and demographic drivers of chimpanzee culture and to document the diversity of chimpanzee behaviors to draw attention to important areas for conservation action. Since 2010, we have been collecting directly comparable data from 40 temporary and collaborative research sites in 14 countries across Africa. Sites were selected systematically and established for a duration of 12 to 17 months. A detailed field protocol based on non-invasive methods was created and implemented, including traditional monitoring techniques to record habitat characteristics and innovative approaches such as camera traps for assessing biodiversity and chimpanzee group demography. Additionally, organic materials for analyses on pathogen loads, stable isotopes to estimate dietary intake, genetic samples to determine chimpanzee population history, and carrion flies containing eDNA to assess biodiversity levels are collected. Extensive recces were required to establish each site to confirm



ape absence or presence in areas which were previously data deficient. The analysis of these large data sets has required the implementation and assessment of various novel techniques. For example, we are evaluating whether a web-based citizen science platform is better suited than automated animal detection software for identifying species and behaviours from over 2500 hours of camera trap video. We highlight other promises and pitfalls of large-scale data collection and meta-analysis on an important flagship and umbrella species for conservation.

TOWARDS A MORE STRATEGIC APPROACH TO OFFSETTING BIODIVERSITY LOSSES: THE ROLE OF SPATIAL PRIORITIZATION CONCEPTS AND TOOLS

Heini Kujala

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Governments and industries increasingly use offsets to compensate for the unavoidable impacts of development on biodiversity. However, high uncertainty about the biodiversity outcomes has led to significant criticism of offsetting strategies in the academic and policy literature. At the same time the ad-hoc application of offsets has raised concerns that the current guidelines might favour some species and communities at the expense of others, potentially failing to achieve the underlying offsetting objective of 'no net loss'. We explored ways to improve offsetting outcomes through regional offset planning approaches, which are underpinned by concepts of complementarity and irreplaceability from the conservation planning literature. We assessed different offsetting strategies in the Hunter Valley, Australia, to offset biodiversity losses arising from minimal to extensive mining expansion, using data for 569 flora and fauna species. We compared the more traditional 'like-for-like' approach to a complementarity based offsetting approach, and prioritized areas for protection, restoration, or both, to offset the anticipated losses. We evaluated the performance of the different strategies by calculating the area needed for offsetting and the expected change in regional biodiversity value and species' protection. The complementarity approach was clearly more efficient than the 'like-for-like' approach, both in meeting the offset requirements and improving the level of biodiversity protection in the region. Our results highlight the potential inefficiency of 'like-for-like' offsets and the benefits of a more strategic offsetting approach using principles of complementarity and irreplaceability. We show that concepts and tools from spatial conservation planning provide many opportunities for offsetting, enhancing our understanding of regional-scale impacts and providing more efficient identification of offset sites and improved biodiversity outcomes.

THE POTENTIAL OF NATURA 2000 NETWORK HAS NOT BEEN FULLY REALIZED DUE TO LACK OF INTERNATIONAL COORDINATION

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The Natura 2000 network (N2K) is an ecological network of protected areas, covering two types of sites determined by the EU in two directives (Birds and Habitats Directives). The goal has been to protect biodiversity "irrespective of national or political boundaries". Here, we present the first EU-wide assessment of N2K with systematic conservation planning (SCP) methods using a large high-resolution multi-taxon species dataset. We address the two directives and EU policy in spatial prioritizations performed with Zonation conservation planning software. We evaluate how the outcomes of planning at the EU, member state, and bio-geographical level differ from each other. We show that average species ranges covered in N2K for directive species (Annex I Birds Directive, Annex II and IV in Habitats Directive) within our data is 34% while we could achieve 60 % coverage of species ranges with optimal areas. However, N2K protects better directive than non-directive species and does a better job than a random allocation of sites. N2K fails to cover some species while it succeeds to protect well some endangered species. Differences between taxa, both in existing N2K coverage and potential optimal coverage are substantial. While it would be possible to protect high fractions of the ranges of amphibians and reptiles, for mammals and birds the optimal solution reaches only moderate coverages. We show that planning in the bio-geographical level would have potential at least for Annex II (Habitats Directive) species. Besides N2K is regarded as a joint conservation effort, we show that current protection illustrates a process where decisions are done with interests of member states, and that better outcomes could be achieved with a community planning. To respect the original goal of protection irrespective of boundaries, collaboration between countries with application of systematic conservation planning is required when designing complementary conservation schemes for the EU.

EVALUATING WILDLIFE CONSERVATION STRATEGIES IN WEST AFRICAN RAINFORESTS

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The Gulf of Guinea Forests constitute the largest continuous forest block of the whole West African biodiversity hotspot. To conserve its exceptionally diverse species pool, including endangered wildlife such as Elliot's Chimpanzee and Central African Elephant, several strategies had been implemented. In Southwest Cameroon a good number of protected areas had been established along with barely protected Forest Management Units (FMUs). In addition, sustainable land use practices were promoted in largely intact forest landscapes around reserves, which are dominated by rural agroforestry systems. However, hunting remained a major threat to wildlife and key species for conservation were already predicted to face extinction in reserves in the nearer future. Also, little is known about the status of wildlife in agroforestry matrices, which would be mandatory, since they are facing a new agro-industrial wave entailing habitat conversion and fragmentation, particularly in the context of palm oil. To evaluate the performance of conservation strategies, we carried out a systematic transect survey in an agroforestry landscape (survey effort L=182km) and compared the results with wildlife data provided by conservation agencies from Korup (L=176km) and Mt Cameroon (L=63km) National Parks as well as two FMUs (L=96km, L=47km). Our results highlight the alarming situation of chimpanzees and elephants numbering few hundreds and being largely confined to reserves. However, they were still encountered in agricultural matrices. While in FMUs also other hunted wildlife seem to approach extinction, their densities were considerably high in agroforestry systems, stressing their importance for stabilizing wildlife populations. We discuss that existing regulations need to be urgently enforced to avoid massive extinction by focusing on improved patrol management in reserves and binding landscape management plans to sustain rural agroforestry systems in place of agro-industrial developments.

CAN FROGS THRIVE IN OIL PALM? A STUDY OF THE EFFECTS OF HABITAT MANAGEMENT ON FROG DIVERSITY

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CORLET, University of Cambridge ; William FOSTER, University of Cambridge

Every 25-30 years, oil palm plantations undergo a severe disturbance event in which large swaths of mature palm trees are clear-cut and re-planted with young palms. This process presumably leads to major ecological changes in the oil palm ecosystem, including changes to species assemblages that had developed over the previous three decades. We compared frog assemblages between mature (21-27 year old) and young, recently re-planted (1-2 year old) oil palm. After sampling 719 anurans from 14 species across 18 oil palm plots, we found that richness, abundance, and diversity of assemblages were all higher in mature oil palm. In addition, frog assemblage composition differed significantly between the two ages of oil palm. Some "forest-associated" frog species persisted and even thrived in mature oil palm but not young oil palm: we encountered five forest-associated frog species within mature oil palm plantations that were at least 50 km from any substantial tracts of forest. We therefore recommend that oil palm re-planting schemes preserve vegetative heterogeneity in the oil palm matrix so that important amphibian species are not lost from entire agricultural landscapes. We also studied the effect of understory vegetation removal on anuran assemblages in mature oil palm. We sampled anurans before and after six oil palm plots were treated with herbicide, and compared the change in assemblage structure to results from control plots. After recording 752 anurans from 13 species and 6 families, we found a significant difference in anuran assemblage composition by plot type over time. Our results indicate that the presence of understory vegetation may play a significant role in shaping the anuran assemblages that inhabit oil palm. Allowing understory vegetation to grow between palm trees and paths in plantations could be a simple management strategy that promotes more robust anuran assemblages within the oil palm landscape.

USING ELECTRICAL ENGINEERING TO AID MARINE CONSERVATION

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Marine conservation efforts are commonly more complex than their terrestrial counterparts because of the large areas involved and the need for remote sensing to detect subsurface phenomena. Partnerships between conservation biologists and engineers can help overcome these limitations. We report on a project led by Portland State University (PSU) acoustic engineers, originally developed in conjunction with The Nature Conservancy, that demonstrates the value of



such collaborations. This work relies on a suite of underwater monitoring tools, first designed to help the U.S. Navy detect submarines, consisting of acoustic gliders that can surface and communicate with satellites and onshore stations, autonomous hydrophones on buoys, and open-source software. The two components of this program to date are (1) monitoring of marine protected areas (MPA) and (2) censusing of marine mammal populations. MPAs need frequent patrolling to detect and exclude intrusions by unauthorized fishing vessels. However fuel and personnel costs of ship-borne monitoring can be prohibitively expensive. The alternative hydrophone and glider-based monitoring system developed by PSU can be trained to distinguish friendly from hostile ships by the diagnostic sounds of their engines. This approach was tested successfully in Hawaii's Ahihi-Kinohi'ou Natural Reserve Area. The second application measures marine mammal populations based on a combination of acoustic signatures and ecological distance sampling techniques. These methods use four autonomously collected variables—number of detected cues or calls, probability of detecting a cue as a function of distance, rate at which animals produce cues, and fraction of false positive detections—to estimate population densities. This approach was used to census sperm whales in the Sea of Sardinia in summer 2014. These applications point to the value of expanded interactions between conservation biologists and engineers of all types.

FRAMING THE PRIVATE LAND CONSERVATION CONVERSATION

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Conservation on private land is becoming an increasingly important and significant part of global conservation efforts. The degree to which conservation on private land is successful is intrinsically linked to the engagement of willing landholder participants (amongst other factors). Despite much research into understanding the factors that influence landholder participation, studies show that only a small proportion of landholders tend to participate in private land conservation schemes. Although there has been widespread implementation of private land conservation policy instruments, there has been mixed success in engaging rural landholders in conservation initiatives. To understand how the private land conservation sector could better engage landholders in the future, we undertook an analysis of how contemporary communications from the sector currently communicate participation benefits to landholders, and whether these are likely to engage a broad or narrow range of landholders. Using the Australian private

land conservation sector as a case study, we undertook a survey of the messages of the key schemes across Australia and categorised the way in which the benefits offered by each scheme were framed. We categorised these as either benefits to the landholder, to society, or to the environment. These categories correspond to the egoistic, altruistic and biospheric value orientations that have previously been shown to influence human behaviour. Our results suggest too heavy a reliance on environmentally-themed messages which likely fail to engage more egoistically oriented landholders. This is particularly the case with market-based schemes. The results from this study have implications for the future design and communication of private land conservation schemes that seek to achieve wider landholder engagement.

HOW HUNTING AND PREY DYNAMICS INFLUENCE THE LARGE CARNIVORE OCCURRENCE IN THE EDGE OF THE WESTERN CARPATHIANS?

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The conservation and management of wolves *Canis lupus* in the periphery of their distribution is challenging. Edges of wolf distribution are characterized by very few and intermittent occurrences of individuals, which are modulated by multiple factors affecting the overall population such as human-caused mortality, management regimes and food availability. As a consequence, understanding population dynamics in the edges of their distribution is not an easy task. However, this knowledge becomes crucial when hunting takes place nearby the edges, which may preclude population expansion. Here, using as example the occurrence of wolves in the Beskydy Mountains (Czech-Slovak border), which are the edge distribution of the wolf and Eurasian lynx (*Lynx lynx*) populations in West Carpathians, we explored how food availability and hunting in the Slovakian source affected the abundance of wolves in the edges of this population. While wolves are game species in Slovakia and protected species in Czech, lynx is strictly protected year-round in both countries. During 2003–2012, we monitored large carnivore occurrence by snow-tracking surveys and tested potential differences in the occurrence of these species in Beskydy Mountains and potential mechanisms behind detected patterns. We found significant differences in the occurrence of wolves and lynx in this area. The wolf was a very rare species and was recorded almost six times less often than the lynx. By using N-mixture models, we observed how the expected abundance of wolves



in the Beskydy Mountains were modulated by prey availability (inverse correlation and significant effect) and harvest the year before (positive correlation although non-significant) in the Slovakian wolf source. We discuss conservation and recommendations concerning large carnivore management.

ANOTHER AUSTRALIAN DESPOT. THE POTENTIAL FOR THE YELLOW-THROATED MINER TO ALTER THE AVIFAUNA ACROSS A VAST CONTINENTAL AREA

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In Australia despotic communal native birds of the genus *Manorina* are known to have a significant effect on birds smaller than themselves. These species are known as “strong interactors”. We explored whether one species (the yellow-throated miner *Manorina flavigula*) not previously considered having a significant effect on other birds, greatly affected the composition of avifaunas in > 500 000 km² in north-eastern Australian rangelands. Repeated avian surveys were conducted in 368 locations, for which in-site vegetation and landscape-contextual measurements were made. Hierarchical Bayesian and mixed effect models were used to determine whether avian assemblages were affected by variation in abundances of the yellow-throated miner. Variation in the abundances of the yellow-throated miner appeared to be governed largely by vegetation cover in surrounding landscapes. Sites with < 70% retained woodland cover contained a homogenised avifauna. Abundances and richness of birds less massive than the yellow-throated miner (< 53 g) were negatively associated with abundances of the yellow-throated miner. The species affected were largely small bodied, insectivorous and common participants in mixed feeding flocks. We suggest that increasing abundance of the yellow-throated miner might result in a cascading effect on ecosystem function. In addition the mooted agricultural expansion and proposed associated land clearing in northern Australia would almost certainly favour the spread of the yellow-throated miner, and may severely affect the small bird community across a vast continental area.

POPULATION GENETIC ANALYSIS OF AN ENDANGERED SPECIES, RHODODENDRON AUREUM, AND ITS CONGENERIC SPECIES, R. BRACHYCARPUM, ERICACEAE

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Rhododendron aureum Georgi, Ericaceae, is an evergreen bush, designated as endangered species by Ministry of Environment of Korea. *Rhododendron aureum* is being considered an alpine species and its populations and number of individuals increase to the north up to Kamchatka peninsula and Siberia. However, Korean *R. aureum* population is consisted of very small numbers of individuals only in the top of the Seorak Mountain, thought to be a relic population from glacial period. On the contrary, while *R. brachycarpum* D. Don ex G. Don distributes only in Japan and Korea, the *R. brachycarpum* populations can be found in several sites in Korea and distributes parapatrically with *R. aureum* in the several sites in Korea and Japan. This study was performed to compare the genetic diversity and structures of these two species using microsatellites. Firstly, nineteen transferable polymorphic microsatellite markers for *R. aureum* and *R. brachycarpum* were developed using next generation sequencing. The genotypes of 375 individuals from 15 populations from Korea, Japan, China, and Russia were obtained using 26 microsatellite markers including seven previously reported ones. In general, two species were well separated based on microsatellite data but several putative hybrids were found between *R. brachycarpum* and *R. aureum* in Japan. The populations of both species were highly structured according to the geographic distance. Genetic diversity of *R. aureum* is slightly higher than *R. brachycarpum*. However, the *R. aureum* population in the Seorak Mountain revealed the lowest genetic diversity. Thus, the strong action should be required to conserve *R. aureum* population in the Seorak Mountain as a southern boundary of *R. aureum* distribution.

EVALUATING UNIVERSITY STUDENTS’ UNDERSTANDING AND PERCEPTION OF SEA LEVEL RISE IN THE STATE OF TEXAS

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Anthropogenic climate change has important implications for all natural ecosystems and human societies, yet many populations are unprepared to deal with the consequences of droughts, stronger storms, forest fires, and sea level rise (SLR). One reason for this lack of preparation is a lack of understanding about direct connections between climate change and environmental consequences in portions of the U.S. workforce. To identify which professions are likely to have unprepared future employees to deal with climate change, we surveyed university students from six universities in Texas:



St. Edward's University, University of Texas Austin, University of North Texas Dallas, Embry-Riddle Aeronautical University Corpus Christi, University of Texas Medical Branch, and Texas A&M University Corpus Christi. We had three main objectives: 1) to examine the perception and knowledge of climate change and how it relates to SLR across all university students 2) to determine whether current and childhood geographic location (i.e., distance to coast) influences knowledge and perception of sea level rise, and 3) to compare differences in knowledge and perception based upon major and year in school. Our results have important implications for educators and policymakers, as they highlight fields and geographic regions that are currently ill prepared to deal with the imminent threats of climate change. Additional efforts to improve education in these areas will be necessary as all professions and geographic regions will be affected in some way by anthropogenic climate change.

CLIMATE CHANGE IMPACTS TO BIODIVERSITY IN THE BRASILIAN CERRADO AND IMPLICATIONS FOR LONG TERM CONSERVATION MANAGEMENT

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UC Davis

The Brazilian Cerrado is an exceptionally biodiverse subtropical grassland biome containing over 10,000 species of plants of which 45% are endemic. Although the Cerrado encompasses 23% of Brazil's total area, it is experiencing such rapid habitat destruction that more than 50%, or almost 1 million kilometers, has been lost in the past 35 years. Unfortunately, current records show that only 2.2% of the Cerrado is under legal protection with approximately 20% of threatened and endangered species not represented in protected reserves. Thus, the Cerrado is quickly becoming a target of concern for conservationists throughout the globe. Climate change now threatens to exacerbate negative effects from habitat destruction and fragmentation, increasing the need to integrate potential impacts of climate change in reserve selection and prioritization. This project combines modeled species distributions with the most recent reserve prioritization scheme developed by the Centro Nacional de Conservação da Flora and the Lab Biogeografia da Conservação to highlight priority areas in the Cerrado expected to maintain relatively high species richness in the future. To do this, I modeled future potential suitable habitat for over 2300 terrestrial plant species found in the Cerrado biome, applying different spatial and temporal scales of climatic data depending on plant traits. I used the programming platform R for modeling and Bayesian data analysis. Results are depicted as probability distributions rather than discrete range maps, illustrating potential changes in species richness across the Cerrado as a result of climate change. The spatial overlap between my results, current conservation areas, and areas identified as

priority areas will highlight areas where efforts might be most fruitful for long term biodiversity conservation. Furthermore, this project illustrates an improved methodological framework for modelling functionally diverse plant species on large geographic scales.

THE EFFECTS OF THE CHARACTERISTICS OF HEDGEROWS ON CHIROPTERA AND ORTHOPTERA COMMUNITIES: WHAT IS THE RELEVANT SPATIAL SCALE TO DETECT THEM?

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Biodiversity is threatened by the loss and fragmentation of habitats. One consequence is the removal of hedgerows networks. The role of hedgerows in maintaining biodiversity was well established, but the importance for biodiversity of the intrinsic characteristics of hedgerows and the quality of hedgerow networks along a spatial scale are poorly known for now. We chose to analyze three quality indices providing information at different territorial levels: density, structural diversity and wood production. We performed an acoustic survey in a grassland to estimate species abundance and community composition of bats and grasshoppers. Using an approach based on species and traits, we assessed how the hedgerow quality influenced the activity of these taxa at different spatial scales and focused on three types of traits: grasshopper mobility ability, bat foraging strategy and habitat specialization. Our results showed 1) the importance of studying the relevant spatial scale, 2) the importance of hedgerow quality for Chiroptera and Orthoptera. However the strength of the association between taxa and hedgerows varied substantially among the species and the spatial scales. Although it depends on the taxa, the production, density and structural diversity of hedgerows each had an overall positive effect. Our results suggested that effects were generally more important at large scales. The scale effect of the production index is the best predictor of activity for Chiroptera and Orthoptera taxa and traits. Our results showed the importance of studying the relevant spatial scale to detect the effects of the quality and quantity of hedgerows on the ecology of bat and grasshopper communities and could be used to improve conservation management. Finally, our results showed the effects of the types of hedgerows in order to suggest efficient and practical management actions for the conservation of hedgerows and Chiroptera and Orthoptera communities.



SYMPOSIUM 151 - HOST DIVERSITY AND DISEASE PREVALENCE: A CASE STUDY BASED ON BARLEY AND CEREAL YELLOW DWARF VIRUSES

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Community assembly processes may provide a predictive framework for understanding the mechanisms underlying disease dilution (reduced disease prevalence with increasing biodiversity). The effect of biodiversity on disease prevalence may depend both on a heterogeneity in host traits related to disease spread and on the order of species loss in community disassembly. If host communities decay to a predictable subset of hosts, disease prevalence may reflect the competence of the remaining hosts. To test this hypothesis, we measured local host species abundance and prevalence of four generalist aphid-vectored pathogens (barley and cereal yellow dwarf viruses, Luteoviridae) in a sentinel ubiquitous annual grass host (*Bromus hordeaceus*, Poaceae) at 10 sites spanning 2000 km along the North American West Coast. We measured in laboratory and field trials virus infection, as well as aphid vector fecundity and feeding preferences on several host species. Virus prevalence increased as local host richness declined. Grass community disassembly in this system was non-random: hosts from our ubiquitous sentinel species dominating species-poor assemblages were among the most competent for vector production and virus transmission. These results suggest that non-random biodiversity loss led to predictable increases in disease prevalence, providing a clear mechanism by which disease dilution can occur.

NEW ZEALAND MARINE RESERVES DO AFFORD PROTECTION FOR THE ECOLOGICALLY, ECONOMICALLY AND CULTURALLY IMPORTANT BLACK FOOT PAUA, HALIOTIS IRIS.

Alix Laferriere

Victoria University Wellington
Jonathan GARDNER, Victoria University Wellington

Haliotis iris, an abalone commonly referred to as paua, is a New Zealand endemic species that inhabits rocky reefs and is the focus of important customary, recreational and commercial fisheries. Paua are long lived species with limited larval dispersal and adult movement patterns, which are life history characteristics that predict a positive response to marine reserve implementation. Demography and growth rates of paua populations are highly variable and habitat and fishing pressure have been suggested to influence the demography

of the population. Marine reserves, where fishing pressure is excluded, are an ideal laboratory to examine habitat effects on distribution, density and growth of paua. In the Austral summer of 2013 and 2014, we conducted surveys of *Haliotis iris* and habitat types via SCUBA within and outside five marine reserves in central New Zealand. *H. iris* was significantly denser in four reserves and size was significantly greater within five reserves, showing that marine reserves do afford protection for this iconic species. Habitat associations were a strong and significant driver of paua size. This is the first time that paua has been shown to respond positively to marine reserve implementation in New Zealand and these findings have direct relevance to paua conservation and management.

BEACH POLLUTION AT BOTH ENDS OF THE SPECTRUM: INSIGHTS FROM SLOVENIA

Betty J.I. Laglbauer

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The amount of marine debris in the environment is increasing worldwide, which results in an array of negative effects to biota. This study provides the first account of macrodebris on the beach and microplastics in the sediment (shoreline and infralittoral) in relation to tourism activities in Slovenia. The study assessed the quality and quantity of macrodebris and the quality, size and quantity of microplastics at six beaches, contrasting those under the influences of tourism and those that were not. Beach cleanliness was estimated using the Clean Coast Index. Although tourism did not seem to have an effect on macrodebris or microplastic quantity at beaches at the moment of this study, over 64% of macrodebris was plastic, and microplastics were ubiquitous. This pollution poses potential ecosystem threats, which calls for further research into the dynamics of beach pollution in Slovenia and eventual classification of plastics as hazardous materials. Standard measures are needed for marine debris assessment, especially in the form of an all-encompassing debris index. Recommendations for future assessments are provided for the Adriatic region.

LEOPARDS IN CHINA: CURRENT STATUS AND DISTRIBUTION

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RIORDAN, *The University of Oxford* ; Kun SHI, *Beijing Forestry University*

Historically, leopards (*Panthera pardus*) were distributed throughout most of China, however recent studies indicated leopards have disappeared from large areas of the country, probably due to habitat loss, low prey base, and poaching. We reviewed recent literature and interviewed specialists to determine the current status and distribution of leopards in China, which may contain up to 4 subspecies. In addition, camera trapping was conducted between 2008 and 2014 in Shanxi Province to monitor highly fragmented populations of the north Chinese leopard (*P. p. japonensis*), a little-known subspecies endemic to China. Results showed that leopards have declined dramatically in China, and they were confirmed only from 44 sites in 11 provinces, despite extensive surveys in many areas. Current populations are small and fragmented, and occur mainly in isolated nature reserves. Based on the number and size of protected areas where leopards still occur, we estimate a total population of only 174-348 individuals for *P. p. japonensis*, and <30 individuals for each of the other subspecies. In Shanxi Province, species distribution modeling highlights that forest cover is the variable that most influences leopard occurrence and it is positively correlated with the probability of leopard presence. The highest probability of leopard presence was found inside nature reserves, but also in areas 70-170 km from reserves. In Lishan National Park, we estimated a density of 0.96 leopard/100km² based on camera-trap data, which is first reliable density estimate of *P. p. japonensis* from anywhere within its distribution. Based on our findings, we recommend that a separate IUCN assessment be made for *P. p. japonensis*, and that this subspecies be classified as Endangered. We provide the first reliable estimates of the distribution and status of leopards in China, and this information will be important to help guide conservation efforts of this species throughout the country.

ISSUES CURRENTLY AFFECTING GYPS VULTURE POPULATIONS IN ASSAM, INDIA

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The populations of three species of Gyps vultures have been declined disastrously in the Indian subcontinent in the last decade as a result of contamination of livestock carcasses with diclofenac and possibly to other NSAIDs (non-steroidal anti-inflammatory drug) with similar properties. To know the status and to initiate a long term conservation process for two critically endangered vultures (*G. tenuirostris* and *G. bengalensis*), a survey was initiated in 2003 and thereafter surveying and monitoring regularly to know about the factors which are currently affecting their survival. These include

destruction of nests and cutting and thinning of nesting trees; egg collection for medicinal purposes, hunting chicks and adult birds for meat; being killed accidentally by vehicles and trains while feeding on carcasses on roads and railway tracks and, the deliberate poisoning of carcasses with pesticides and insecticides to kill carnivores. Three-year running averages of the number of nestings of both species suggest a decline in the order of 50% over the eight year period, with a particularly sharp drop recorded in 2010 – 2012. In order to ensure the long-term conservation of vultures in wild in Assam, we propose: awareness campaigns among local communities to protect nests, nestlings and nesting trees; to use safer drugs in veterinary medicine instead of diclofenac and other NSAIDs with similar properties, and to avoid the poisoning of carcasses likely to be consumed by vultures.

IS MY SPECIES DISTRIBUTION MODEL FIT FOR PURPOSE? MATCHING DATA AND MODELS TO APPLICATIONS

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Many conservation decisions are spatially-explicit, from choosing a suitable reintroduction site to planning the location of new protected areas or forecasting the impacts of future climate change on biodiversity distribution. The knowledge of where one or more species occur (distribution) or where the conditions are suitable for them to persist (habitat suitability) is often vital information to support such decisions. Species distribution models (SDMs) can provide the required estimated distributions/suitabilities, and have become a very popular quantitative tool to inform a range of conservation applications. However, users often underestimate the strong links between data type, model output and suitability for end-use. In our study (Guillera-Arroita et al. 2015 *Global Ecology & Biogeography*) we synthesize current knowledge and provide a simple framework that summarizes how interactions between data type and the sampling process (i.e. imperfect detection and sampling bias) determine the quantity that is estimated by a SDM. We draw upon the published literature and simulations to illustrate and evaluate the information needs of common conservation applications of SDM outputs. Predictions of models fitted to the most commonly available observational data (presence records) suffice for some applications, others require estimates of occurrence probabilities, which are unattainable without reliable absence records. Our literature review and simulations reveal that, while converting



continuous SDM outputs into categories of assumed presence or absence using a threshold is common practice, it is seldom clearly justified by the application's objective and it usually degrades inference. Matching SDMs to the needs of particular conservation applications is critical to avoid poor ecological inference and management outcomes. Our study aims to help modellers and users assess whether their intended SDM outputs are indeed fit for purpose.

124 MEASUREMENT OF BIODIVERSITY, OFFSET RATIOS AND RISKS IN THE APPLICATION OF MARKET-BASED INSTRUMENTS FOR CONSERVATION

Jussi Laitila

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Atte MOILANEN, University of Helsinki ; Federico, M. POUZOLS, Science & Technology Facilities Council

There has been a trend towards increasing integration between biodiversity markets, private sector finance and biodiversity conservation. Many instruments, such as biodiversity offsetting and banking, tend to view biodiversity as a form of interchangeable currency. This is not straightforward, because biodiversity consists of the variety of living organisms in a complex, nonlinear and interlinked manner. Measuring biodiversity in space and time is inaccurate and uncertain, which leads to potential problems in the application of such instruments when the principle of no net loss should be maintained. We first discuss the characteristics of market-based biodiversity instruments and biodiversity finance. We review and identify risks and consequences to biodiversity of misuse and fraud in the application of such instruments. We next turn to biodiversity offsetting, whose effectiveness is often measured in terms of offset multipliers or ratios. One common problem of offsets is that they may exchange certain and almost immediate losses for uncertain future gains. We demonstrate, using a minimum offset multiplier method, that when accounting for time delay, no net loss multipliers can be quite large, in the order of dozens, contradicting some relatively low multipliers applied in practice.

TAMBU: A MELANESIAN MODEL FOR THE SUSTAINABILITY OF THE ADMIRALTY CUSCUS (SPILOCUSCUS KRAEMERI)?

John Lamarinis

Wildlife Conservation Society-Papua New Guinea Program
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Tambu areas are a well-respected concept in Melanesian societies where a no-go zone is imposed on a section of forest or coral reef to preserve plants, animals and fish stocks. Such tambu areas are used for customary obligations and restocking resources. They have also been suggested as the basis for

conservation and sustainability in Melanesia. The Admiralty cuscus (*Spilocuscus kraemeri*) is an aboreal possum-like animal endemic to the Admiralty Islands of Papua New Guinea where it is a major source of terrestrial protein for much of the human population. The home range and movement patterns of 10 cuscus (8 females and 2 males) were investigated using radio telemetry in a 26 ha tambu area on Manus Island. Home range sizes were estimated using a 95% minimum convex polygon method and possible contributing factors to home range size were assessed through model selection on 12 candidate linear models. Home range size was highly variable (mean = 2.2 ha, 95% CI = 0.8 – 5.9 ha) and was not associated with body mass, age, or sex. The minimum size of a tambu area required to allow a self-sustaining population was estimated through application of Laplace's extension to Buffon's needle problem using the vital rates of a closely related surrogate species, the Common Brushtail Possum, *Trichosurus vulpecula*. The results suggest that at a 26 ha tambu area will likely only have a ~50% chance of being self-sustaining. On this basis we hypothesise that tambu are likely to have some utility for sustaining populations but the areas need to be expanded and networked to provide a measure of security at local scales.

SHOULD I STAY OR SHOULD I GO? CONSERVATION IMPLICATIONS OF INDIVIDUAL VARIATION IN BROWN PELICAN MIGRATORY STRATEGIES

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Although Brown Pelicans (*Pelecanus occidentalis*) are resident throughout their range, some individuals regularly undertake postbreeding migrations of up to 3,000 km. Variation in migratory strategies could expose different subsets of the population to differing risk factors and play a substantial role in population dynamics of the species; however, little information exists on the prevalence or distribution of long-distance migrants. To address this information gap, we used GPS loggers to track postbreeding movements in 85 Brown Pelicans breeding across the northern Gulf of Mexico. For all individuals for which we obtained a complete migration cycle (n=66), we modeled migratory strategy (resident, medium-distance, or long-distance) as a function of sex, body condition, breeding location, and reproductive success during the most recent breeding season. We also used vulnerability mapping to assess the geographic distribution of known risk factors. We found that females were more likely to migrate long distances, while males were more likely to be resident. Body size was a significant predictor for males, with larger males more likely to remain resident, but was not significantly different between resident and migrant females. Likelihood of migration also increased with colony size. Neither body condition nor



breeding success influenced migratory strategy, and migration is highly consistent within individuals. Combining risk maps with migratory strategies, we predict that male pelicans will be more vulnerable to changing winter climate in the northern Gulf, while risks to females wintering in the southern Gulf remain largely unknown. Several migratory routes encompassed over-land portions, increasing vulnerability to terrestrial threats such as hunting and wind turbines. We conclude that differential migration patterns significantly influence the distribution of mortality risk in Brown Pelicans, particularly during the non-breeding season.

ENHANCING REFORESTATION IN DEGRADED TROPICAL PEATLANDS

Maija Lampela

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Tropical peatlands of Southeast Asia are great terrestrial carbon stores and major hot spots of biodiversity. Main tropical peat ecosystem is peat swamp forest (PSF), a rain forest on top of up to 20 m deep peat. Currently peat swamp forests are converted to plantations and agriculture with breath-taking pace. Aside from conservation, also active restoration is needed on destroyed areas. Our work searches practical and affordable techniques for reforestation of degraded peatlands. Our study site was clear-felled open, drained and several times burnt deep peat area in the so-called Ex-Mega Rice area in Central Kalimantan, Indonesia. We chose five native PSF tree species known to have potential for reforestation. Seed material acquired from local forests was grown in a field nursery. At the age of 6-11 months seedlings were planted in the field in three blocks characterized by differing wetness conditions. We used three treatments: weeding (3 intensities), mounding and fertilizing, and their combinations to study the best practices to enhance seedling success. Growth and mortality of the seedlings and environmental variables (water table, temperature, light) were monitored for two years. Effects of treatments and environmental variables on the growth and mortality rates were tested with mixed-effect models. We conclude that of the three treatments, fertilizing had most clear positive effect both on growth and mortality in all tested species whereas mounding decreased mortality but the effects on growth were not clear. Weeding gave mixed results between the species. Of the environmental variables water table position was the most influential but the sensitivity of the species to water table fluctuations varied substantially. When labor and material costs are taken into account, our results can derive species-specific best option for reforestation scheme for these five species on degraded tropical peatlands.

USING COMMUNITY-BASED MICROFINANCE FOR CONSERVATION: LESSONS FROM CASE STUDIES IN RURAL ZAMBIA AND TANZANIA

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Imperial College

Andrea P C WALLACE, Frankfurt Zoological Society ; Graham E. WALLACE, Frankfurt Zoological Society ; E J MILNER-GULLAND, Imperial College

Community-based microfinance programmes are increasingly being seen as a valuable component of conservation interventions. Such programmes aim to expand livelihood options, improve resilience, and reduce reliance on natural resources. Despite some promising reports, there is very limited empirical research examining their social and conservation outcomes. We evaluate socio-economic impacts of a microfinance initiative on participants and the wider community, effects on attitudes towards conservation and potential to foster behavioural change. We focus on savings and loans groups established by Frankfurt Zoological Society as Community Conservation Banks (COCOBAs) in North Luangwa ecosystem, Zambia and Serengeti ecosystem, Tanzania. Data were obtained from semi-structured interviews, focus groups and key informants. Overall, programme participants had greater wealth than non-participants and more positive conservation attitudes. There were also indications of pro-conservation behaviour changes. We were unable to conduct a Before-After-Control-Impact evaluation but evidence suggests that changes may be attributed to COCOBA participation. Although general wellbeing was equivalent between participants and others, specific economic wellbeing was higher for participants. Non-participants perceived wider community benefits from microfinance, whereas participants focused more on direct benefits to themselves and for conservation. Key success factors were identified across stages of COCOBA groups and included providing ongoing support and capacity building, mixed-sex groups with a positive culture, regular individual savings and offering large enough loans to support income-generating activities of a meaningful size. This is one of the first empirical evaluations of a conservation-focused microfinance initiative. Our findings suggest such approaches are a promising tool to promote socio-economic benefits, community-driven conservation and pro-conservation behavioural change.

SYMPOSIUM ID:122 - ACCOUNTING FOR ENVIRONMENTAL AND MARKET FEEDBACKS WHEN PRIORITISING LAND FOR CONSERVATION

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Cristina BANKS-LEITE, Imperial College London ; Luis Roman CARRASCO, National University of Singapore ; Leandro Reverberi TAMBOSI, Universidade de Sao Paulo ; E J MILNER-GULLAND, Imperial College London

Increasingly conservationists use systematic conservation planning to decide when, where and how to invest limited funds to maximize conservation benefits. Important assumptions underlie this approach, in particular that environmental and economic conditions remain static over time. These assumptions generally do not hold; in fact, conservation interventions may themselves change the conditions, thereby invalidating the predictions of the models that guided the intervention design. We explore this issue with a case study of a payment for landowners to set aside private land to enable natural forest regeneration in the Atlantic forest of Brazil, a key global biodiversity hotspot with exceptionally high biodiversity and extreme land cover disturbance. We modelled the effect of including market and ecological feedbacks into prioritisation of areas for ecological set-asides within an agricultural landscape. We perform a spatially explicit prioritisation at a series of time steps taking three criteria into consideration: an area's potential contribution to biodiversity, its potential contribution to forest connectivity, and the opportunity cost of diverting land from production. The prioritization outcome at each time step has an effect on the three criteria in the following time step, at different spatial scales. We model the ecological feedbacks from changes in forest configuration and market feedbacks from foregone agricultural production, and explore the consequences for conservation outcomes of ignoring these feedbacks. Finally, we assess the trade-offs between the costs and benefits of accounting for feedbacks in this system. This is the first time both ecological and market feedbacks have been considered within a spatial conservation prioritisation.

LANDSCAPE SIMPLIFICATION AND INSECTICIDE USE: INSIGHT FROM A REGRESSION ANALYSIS OF THE CONTINENTAL US OVER 25 YEARS

Ashley Larsen

UC Santa Barbara

Steven GAINES, UC Santa Barbara ; Olivier DESCHÊNES, UC Santa Barbara

Insecticides have numerous negative externalities for human health, ecosystem services and ecological communities, and thus their efficient use is an economic and ecological priority. Simplified landscapes are thought to enhance insecticide use by reducing natural enemies and increasing connectivity of crops, but empirical tests of this theory are inconclusive. We investigated the relationship between landscape simplification and insecticide use using longitudinal data from USDA Census of Agriculture spanning 25 years for nearly 3000 counties

in the continental United States. The effect of landscape simplification was highly variable spatially and temporally with landscape simplification consistently correlated with higher insecticide treatment in some regions, but not in others. This variation was robust to the inclusion of annual weather and non-linear effects of cropland. Our results indicate that the landscape simplification – insecticide use relationship is complex and region specific. Thus, national-scale land use policy would benefit from actions that adequately reflect the spatial differences in the importance of landscape complexity to insecticide use.

ID # 165 THE EUROPEAN KNOWLEDGEBASE FOR BIODIVERSITY TO ASSESS PROGRESS - A PERSPECTIVE FROM EU

Frank Wugt Larsen

European Environment Agency (EEA)

The European Environment Agency (EEA) is an agency of the European Union and a major information source for those involved in developing, adopting, implementing and evaluating environmental policy. The presentation will introduce examples of the comprehensive knowledge base in the area of biodiversity, which is a significant (re)source for anybody working in the area of environment policy evaluation in a European context. For example, the EEA five-year assessment "The European Environment – State and Outlook 2015" (SOER 2015) (due in March 2015), which is an indicator-based assessment, providing a baseline for the European Union's 7th Environment Action Programme ("Living well, within the limits of our planet"); the "State of nature in the EU" assessment (due mid 2015), which provide results reported for the EU legislation for species and habitats; and the ongoing work in relation to the mid-term review of the EU biodiversity strategy to evaluate progress (due late 2015).

EFFECTS OF RECREATION ON ANIMALS REVEALED AS WIDESPREAD THROUGH A GLOBAL SYSTEMATIC REVIEW

Courtney Larson

Colorado State University

Sarah REED, Wildlife Conservation Society ; Adina MERENLENDER, University of California - Berkeley ; Kevin CROOKS, Colorado State University

Globally, the mission of most protected areas includes both biodiversity conservation and improving human welfare through resource use or nature-based recreation. Recreation has numerous benefits for human communities; however, an increasing number of studies are demonstrating negative effects on animal species. Understanding potential trade-offs between biodiversity conservation and recreation is critical for protected area policy and management. We conducted



a global systematic review of 218 articles on the effects of all types of recreation activities on any animal species. We quantified trends in publication rates and outlets, identified knowledge gaps, and assessed evidence for negative and positive effects of recreation. Whereas publication rates are low, evidence of impact is clear with over 93% of reviewed articles documenting at least one effect of recreation. Although responses are often species- or context-specific, some taxonomic groups (e.g., passerine birds, shorebirds, ungulates, and corals) had greater evidence for an effect of recreation. Counter to public perception, non-motorized activities had more evidence for a recreation effect than motorized activities. Snow-based activities also had greater evidence for recreation impacts than other activities, though sample size was low. Birds (39% of articles) and mammals (37%) were the focus of the majority of recreation studies, while studies of amphibians, reptiles, and fish were rare. Locations in South America, Asia, and Africa and responses at the population and community levels had low representation in the literature. Further, less than 10% of studies examined threatened species. Protecting biodiversity from harmful effects of recreation is a major concern for protected area managers facing rapidly increasing park visitation rates around the world. The conservation science community should provide data-based information to help guide solutions to these management dilemmas.

147 ESSENTIAL BIODIVERSITY VARIABLES FOR INVASION MONITORING

Guillaume Latombe

Monash University

Melodie McGeoch, Monash University

Unlike the systematic evaluation and monitoring process in place for tracking the status of threatened species at multiple spatial scales, no such process is yet in place for invasive species. The variables and metrics for doing so in a standardised way (necessary to underpin a robust observation system) have also not been fully developed, widely agreed to, or adopted. Invasion biology has over the last several decades produced a wealth of conceptual and evidence-based generalisations upon which a standardised observation system for invasive species can be designed, as well as assessment criteria for monitoring. Essential Biodiversity Variable (EBV) provide a valuable vehicle for designing such an observation system. All species populations can be defined by their abundance and distribution. This is true of species undergoing population declines as well as those expanding their ranges. Unlike threatened species, invasive species are those introduced by human agency beyond their native ranges, that establish viable populations, grow and spread and that negatively impact biodiversity. The concept of invasion therefore encompasses both process and impact components. Invasive species impact is a function of population abundance

x distribution (occupancy) x per capita impact. Therefore the measurements essential for studying, reporting and managing the threat that invasive species pose to biodiversity encompass at least two, and up to four, EBV classes, two core EBVs and a range of additional possibilities. EBVs facilitate the harmonisation of existing monitoring schemes and guide the implementation of new ones, especially in regions where information on biodiversity change is still very sparse, providing an opportunity to significantly advance a robust global framework for this key driver of biodiversity change.

SYMPOSIUM 163 - MOVING FORWARD FROM EBA: TRANSFORMATIVE CLIMATE ADAPTATION

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CNRS

Matthew COLLOFF, CSIRO ; Michael DUNLOP, CSIRO ; Russell WISE, CSIRO

Adaptation to climate change must be acknowledged as a long-term driver of economic, social, political and cultural transformations. EBA strategies often ignore the slower transformational changes of biophysical and ecosystem processes expected under severe climate change, and risk to lead to maladaptation in the long-term. Alternative approaches are required to support strategic policy and actions. This presentation aims to introduce the Transformative Adaptation Research Alliance (TARA), which has developed an operational framework to study and support transformative adaptations. TARA links the three novel concepts of adaptation services, the values-rules-knowledge perspective on decision contexts, and adaptation pathways. Adaptation services are the benefits people derive from the capacity of ecosystems to moderate and adapt to the effects of climate change. Adaptation services progress from EBA by formally recognising the intrinsic ability of ecosystems to provide valuable services for societal adaptation by (i) buffering risks, (ii) providing options and (iii) transforming. However, for adaptation services to emerge and inform adaptation, a new perspective on decision contexts is required that reveals the need for transformation. Decision-making contexts are characterised by dynamic interactions between societal systems of values, rules and knowledge. Transformative adaptation will require shifts in norms, preferences and values to foster fundamental shifts in rules and innovative governance structures; and therefore new transdisciplinary knowledge to drive such social changes, and to achieve consensus on decisions and actions. The adaptation pathways approach provides a means of planning and implementation for such transformation by revealing critical elements for long-term climate adaptation? It informs timing within long decision timeframes and incorporates flexibility to enable social learning and co-creation, experimentation and iteration.



THE UTILITY OF CONCEPTUAL AND BAYESIAN NETWORK SOCIAL-ECOLOGICAL MODELS FOR PROTECTED AREA TIME AND RESOURCE ALLOCATION DECISION MAKING

Rebecca Laws

University of Queensland

Models are commonly developed to assist with conservation decision making but their utility to 'on the ground' resource allocation is rarely evaluated. We developed social-ecological staff time allocation models with staff at 10 National Parks in Australia. Conceptual models were developed through sharing mental models during one day workshops. Conceptual models were then parameterised to create Bayesian Network models through eliciting staff opinion of the importance of protected area values and threats, and the impact of management actions. Follow up workshops illustrated the application of the Bayesian Network models and further refined models. Structured interviews were used to evaluate the model building process and model utility immediately after workshops and several months later. Managers reported that the final models sufficiently reflected how their protected area actually functioned (average 8.5 on a scale of 1, poor fit, to 10, perfect fit, range 7 – 10, n=9). Sixty percent of managers said that they felt confident using the conceptual model as a decision support tool while an additional 30% said they could use the model with some reservations, while half said that they felt that they could also effectively use the Bayesian Network model. Forty percent of managers said that they would use the model for planning and decision support, 30% said they would probably use the model but only after some alterations and the remaining said that it was unlikely that they would use the model. Managers cited developing annual work plans as the most likely useful application of their model with revising the plan of management and management effectiveness reporting also possible uses. The biggest barriers to model use were identified as complexity of user interface, training requirements, the time required to use, update and refine, and difficulty predicting time spent on management activities. Models appeared to be effective tools under some circumstances.

161-ACHIEVING SUSTAINABILITY IN COASTAL MANAGEMENT: EMBRACING THE SOCIAL-ECOLOGICAL SYSTEMS APPROACH TO SMALL-SCALE FISHERIES

Elodie Le Cornu

Center for Ocean Solutions

Larry CROWDER, Center for Ocean Solutions

Over the past few decades, scientists and managers have adopted a variety of approaches to conserving biodiversity and ecosystem services in coastal ecosystems including marine protected areas and multiple-use ocean planning. But current approaches still struggle to fully integrate social data with ecological data to improve both ecological and social outcomes. As we transition toward ecosystem-based approaches that fully integrate the biophysical system, social system, and institutions, we need to embrace the complexity of human relationships with ecosystems, including their social, cultural, political, and economic dimensions, in order to develop and implement viable management strategies. Social-ecological system approaches can produce a more comprehensive understanding of these complex seascapes and aid in planning aimed at achieving sustainable social and ecological outcomes. Here we illustrate these concepts through the lens of rights-based management approaches to small-scale fisheries. We assess the critical enabling conditions underlying rights-based management and examine how – by making these conditions more visible – we can guide implementation to be more successful. While rights-based management approaches to small-scale fisheries are being actively implemented, the assumptions that underpin the theory of change have not been critically evaluated. This may preclude understanding what drives the relative success or failure of these initiatives. We developed a general theory of change for applying rights-based management approaches to small-scale fisheries and used it to structure a global review of case studies. For each case study, we assessed whether the assumptions were met, as well as the specific outcomes and the alternative outcomes (unintended outcomes) associated with specific strategies. Based on the results, we will present recommendations to guide efforts toward rights-based approaches to small-scale fisheries.

AN EXPERT-ASSISTED CITIZEN SCIENCE PROGRAM PROVIDES GENERAL PATTERNS ON BEE ASSEMBLAGES AT A NATIONAL SCALE

Violette Le Féon

INRA

Mickaël HENRY, INRA ; Eric DUFRÊNE, Observatoire des Abeilles ; Laurent GUILBAUD, INRA ; Emilie KOLODZIEJCZYK, Bergerie Nationale ; Fabrice REQUIER, INRA ; Bernard VAISSIÈRE, INRA

Data on species distribution constitute baseline information in biogeography and macroecology. Scientists in those topics require large datasets that cannot be gathered by individual research teams. In this context, the benefits of citizen science are extension of spatial and temporal sampling effort, cost reduction, as well as reconnection of people to nature. Bees represent a biological group that is highly diverse, difficult



to identify and with limited tools for identification at the species level, being therefore poorly suitable for classical citizen science. Here we report the first results of an ongoing citizen science program where a specific group of participants, teachers from agricultural high schools, were involved in standardized surveys of bees, which were then identified to species level by taxonomist experts. Bees were sampled by pan traps during three years in 20 schools spread over France. Overall the dataset includes 70 collections (year \times sampling site combinations) and 4574 specimens belonging to 195 species. All collections were dominated by a non-parasitic, soil-nesting species. In most cases this species was social and polylectic. A single species, *Lasioglossum malachurum*, dominated in 32 collections. Herein we confront this biological dataset to environmental data freely available at the national scale describing agricultural practices at the municipality level (High Nature Value index) and landscape context (Corine Land Cover). These analyses showed that (1) species richness increases with increasing proportion of herbaceous semi-natural elements in 100 m landscape sectors; (2) dominance (proportion of the most abundant species) decreases with increasing crop diversity; (3) the proportion of cavity nesting species and specimens increases when the intensity of fertilizer and pesticide use decreases. This expert-assisted citizen science program thus provides new insights on bee vulnerability to anthropogenic disturbances at a national scale.

DEMOGRAPHY AND SOCIALITY: ELASTICITY ANALYSIS IN A GORILLA POPULATION AFFECTED BY AN EBOLA OUTBREAK

Pascaline Le Gouar

University of Rennes 1

Sandra LE THIEC, University of Rennes 1 ; Amandine PIERRE, University of Rennes 1 ; Céline GENTON, University of Rennes 1 ; Jean-Sébastien PIERRE, University of Rennes 1 ; Michael SCHAUB, Swiss Ornithological Institute ; Nelly MÉNARD, CNRS

Identifying the life history traits that contribute the most to population growth rate is essential to assess persistence of endangered species, especially when catastrophic events perturb life history traits. In social species with complex links between demographic rates and social dynamics, it is challenging to analyze variation in growth rate when vital rates vary (i.e. elasticity analysis). In this purpose, we studied wild gorillas that experienced Ebola outbreak. Decreases in survival and reproduction, as well as perturbations in social transfers and immigration, were detected during Ebola outbreak. We aimed to understand how the outbreak modified vital rates' elasticity and how it impacted long term population viability. Using an age, sex and social structured population matrix model, we performed elasticity analysis and investigated effects of variations in social structure and immigration patterns on gorilla population growth rate. Demographic

parameters and social transfers were estimated for each epidemic period (before, during, after outbreak). Analysis of the asymptotic population growth rate showed that female matrix drove the population dynamics during non-epidemic periods, whereas it was the male matrix during the outbreak. Elasticity analysis indicated that variations in survival of adult females in breeding groups impacted the most the growth rate of population before and after outbreak. During outbreak, survival and social transfers of solitary silverbacks were the most critical parameters. Perturbation of initial social structure led to minor changes in population dynamics, while immigration was necessary to reach increasing population after outbreak. Simulations assuming that demographic parameters returned to pre-epidemic values immediately after outbreak suggested that the population will return to pre-epidemic size in 80 years. However, delayed immature males immigration, as detected with observational data, induced an additional 20 years delay.

177 - PARTICIPATORY AGENT-BASED SIMULATION TO FOSTER DIALOGUE AND BUILD TRUST BETWEEN LOCAL COMMUNITIES AND RESEARCHERS: A CASE STUDY ON BUSHMEAT HUNTING IN THE PERIPHERY OF KORUP NATIONAL PARK (SOUTH-WEST CAMEROON)

Christophe Le Page

CIRAD

Kadiri Serge BOBO, Dschang University ; Towa Olivier William KAMGAING, Dschang University ; Bobo Fernanda NGAHANE, Dschang University ; Matthias WALTERT, Georg-August University

To investigate the sustainability of bushmeat hunting activities in the region of the Korup National Park (South-West Cameroon), an agent-based model (ABM) representing snare trapping of blue duikers (*Cephalophus monticola*) was co-designed and used with local populations. Village meetings based on interactive computer simulations were structured in three successive steps. During the first step, an abstract representation of a village surrounded by a portion of forest was co-designed by directly manipulating the computer interface. Then, knowledge about the live-cycle traits and the behavior of blue duikers was shared through the demonstration of the individual-based population dynamics module of the ABM. The objective of the second step, introducing the hunting module of the ABM, was to elicit snare trapping practices through interactive simulation and to calibrate the hunting module by setting a value for the probability of a blue duiker to be caught by a snare trap. In a third step, a more realistic version of the ABM was introduced. The seven villages included in the process were located in the GIS-based spatial representation, and the number of 'Hunter'



agents for each village in the ABM was set according to the results of a survey. The demonstration of this realistic version triggered discussion about possible management scenarios based on reducing the number of hunters and/or the number of traps per hunter, but also on setting up temporal (rotating) reserves. A second round of village meetings was organized 8 months later to collectively explore with the finalized version of the ABM the pre-identified management options. The whole process resulted in enhancing the trust-building between the local communities and the research team. Some villagers established an association to promote activities related to environmental management, and the research team was given a plot of land to establish an accommodation belonging to Dschang University in the village.

151-DISEASE CONTROL IN WILDLIFE: EVALUATING A TEST AND CULL PROGRAMME FOR BOVINE TUBERCULOSIS IN AFRICAN BUFFALO

Nikki Le Roex

Stellenbosch University

Dave COOPER, Ezemvelo KwaZulu-Natal Wildlife ; Paul VAN HELDEN, Stellenbosch University ; Eileen HOAL, Stellenbosch University ; Anna JOLLES, Oregon State University

Providing an evidence base for wildlife population management is difficult due to limited opportunities for experimentation and study replication at the population level. We utilised an opportunity to assess the outcome of a test and cull programme aimed at limiting the spread of *Mycobacterium bovis* in African buffalo. Buffalo act as reservoirs of *M. bovis*, the causative agent of bovine tuberculosis (BTB), which can have major economic, ecological and public health impacts through the risk of infection to other wildlife species, livestock and surrounding communities. BTB prevalence data were collected in conjunction with disease control operations in Hluhluwe-iMfolozi Park, South Africa, from 1999-2006. 4733 buffalo (250-950 per year) were tested for BTB using the single comparative intradermal tuberculin (SCIT) test. BTB prevalence was spatially and temporally variable, from 2.3% to 54.7%. Geographic area was a strong predictor of BTB transmission in HiP, owing to relatively stable herds and home-ranges. Herds experiencing more intensive and frequent captures showed reduced per capita disease transmission risk and less increase in herd prevalence over time. Disease hotspots did not expand spatially over time, and BTB prevalence in all but the hotspot areas was maintained between 10-15% throughout the study period. Our data suggest that HiP's test and cull programme was effective at reducing BTB transmission, with capture effort and interval found to be the crucial components of the programme. The programme was thus successful with respect to the original goals; however, there are additional factors that should be considered in future cost/benefit analyses and decision making. These findings may be utilised and expanded

in future collaborative work between wildlife managers, veterinarians and scientists, in order to optimise wildlife disease control programmes and mitigate conflict at the interface of conservation, agricultural and urban areas.

ESTIMATING THE SUPPLY OF ECOSYSTEM SERVICES IN BOREAL FORESTS

Eric Le Tortorec

University of Jyväskylä

Adriano MAZZIOTTA, University of Jyväskylä ; Tähti POHJANMIES, University of Jyväskylä ; Maria TRIVIÑO DE LA CAL, University of Jyväskylä ; Mikko MÖNKKÖNEN, University of Jyväskylä

Human well-being is dependent on a number of critical processes that nature supplies, commonly referred to as ecosystem services. In particular, boreal forests provide several globally important services such as carbon storage and sequestration, as well as timber production. However, in order to maintain ecosystem services in landscapes we need methods to estimate the nature and magnitude of these services. Dynamic forest landscapes, with their long rotation periods, pose an interesting challenge when estimating the wide variety of ecosystem services that even single forest stands can provide. Measuring ecosystem services can be relatively straightforward for provisioning services such as the production of commodities (e.g. timber), but estimating maintenance and regulating services as well as cultural ones needs carefully thought out indicators. In order to accurately estimate the potential of a landscape to supply ecosystem services through time we need indicators that display both spatial and temporal sensitivity. A common way to estimate the ecosystem services supplied by landscapes has been through landcover classification, which is, however, a very coarse estimation method both spatially and temporally. In the case of managed forests we need indicators that can be quantified at the stand level or at even finer scales. Indicators also need to show temporal sensitivity since in the case of managed forests the composition of stands changes as the stand develops through time, and the supplied services can change through the rotation period of the stand. Here we present an overview of existing indicators that can be used to estimate the supply of provisioning, regulation and maintenance, and cultural services provided by boreal forests. In particular, we review spatially and temporally sensitive indicators that can be derived from reliable data based on commonly existing monitoring systems, and demonstrate their applicability in assessing ecosystem services.



SYMPOSIUM 171: UNDERSTANDING THE IMPACT OF CONSERVATION LEADERSHIP CAPACITY DEVELOPMENT: THE CASE OF THE CAMBRIDGE MASTERS IN CONSERVATION LEADERSHIP

Nigel Leader-Williams

University of Cambridge

Chris Sandbrook, UNEP World Conservation Monitoring Centre

Established in 2010, the Masters in Conservation Leadership at the University of Cambridge is a ground-breaking degree programme that aims to provide established conservation professionals with the skills they need to become successful conservation leaders. It does so by drawing on the academic and applied expertise offered by the organisations that comprise the Cambridge Conservation Initiative. The course has succeeded in attracting a diverse range of high-quality students from around the world. Now that it has been running for 5 years, it is possible to begin assessing the impact the course has had on alumni and ultimately for conservation. In this presentation we will provide an overview of the course and its students, and present early evidence on impact. We will also introduce the rest of the symposium on Building Conservation Leadership Capacity, and outline some ideas for future shared activities that might emerge from it.

ECOLOGICAL ENGINEERING TO INCREASE THE NURSERY POTENTIAL OF SHORELINE INFRASTRUCTURES

Gilles Lecaillon

Ecocean

Fabien DUBAS, Ecocean ; Philippe LENFANT, University of Perpignan ; Réda NEVEU, University of Perpignan ; Anaïs GUDEFIN, University of Perpignan

A key factor to the recovery and long-term sustainability of any fish stock is the protection of its young and juveniles so that these can reach maturity and spawn. Starvation and predation are two primary mechanisms affecting their mortality which is naturally important during settlement. However, with two-thirds of the human population concentrated around shorelines, modification of the natural coastlines is inevitable-crucial natural nurseries where young fishes usually find refuge from predation and nutrients to grow have strongly diminished and reduce significantly their chance of survival. A dedicated mitigation for the impacts caused by human coastal development occurring during these lifestyle stages is crucial to restore the connectivity, life cycles of fish and preserve ecosystem services. In 2013, a two years project called NAPPEX (Nurseries Artificielles Pour des Ports Exemplaires) has been implemented in six French Mediterranean marinas. The project's goals are the large scale deployment and the ecological benefits assessment of Biohut, a constructed fish

habitat designed for marinas to improve nursery habitats around urban waterfronts where restoration of the natural systems is no longer an option. This artificial habitat aims to restore ecosystem functions of nursery by protecting early life stage of fish from predation during their settlement period, thereby allowing them to mature to the point at which they will escape from predation and contribute to adult populations. The presentation will address the importance of protecting and restoring shoreline habitats and presents the results of the ecological benefits assessment of the Biohut performed in the six marinas by the scientists from the University of Perpignan.

PUTTING BIODIVERSITY ON THE MAP: CONSERVATION PRIORITIES IN GABON

Michelle Lee

University of Oxford

In data-poor tropical rainforest countries, "conserving biodiversity" can be an unclear and therefore elusive goal. We created a spatial information base to help the country of Gabon assess protection of its biodiversity resources and prioritize the species, habitats, sites and actions needed to meet conservation targets, across land managed by different sectors. We found that nine percent of terrestrial vertebrates met criteria for conservation attention, many of which are unprotected by law. Mapping priority species, ecological land units and formal sector land uses revealed a strong spatial structure – over one-third of species and habitats cover <1% of Gabon, and major extractive or conversion uses are limited to <5% of land. Despite an acclaimed national park network, we found species and habitat representation in existing protected areas to be relatively low, but could identify a number of near-optimal solutions that meet all targets, with minimal impact on land used for local livelihoods. We distill these solutions down to a handful of critical biodiversity sites, and examine the feasibility of protecting these sites where they overlap with permits in industrial sectors, making management actions explicit for the species and habitats they contain. The spatial structure of biodiversity and land uses dictates that for Gabon to achieve its conservation targets, biodiversity management on production lands must be stepped up – we are working with government agencies to improve species protection laws and integrate this information in management and land use plans.

ELEPHANTS IN HUMAN LANDSCAPES: BEHAVIOURAL AND SOCIAL RESPONSES TO RISK IN AMBOSELI, KENYA

Phyllis Lee

University of Stirling



Mark SOWERS, *Amboseli Trust for Elephants*; Keith LINDSAY, *Amboseli Trust for Elephants*; Vicki FISHLOCK, *Amboseli Trust for Elephants*; Harvey CROZE, *Amboseli Trust for Elephants*; Kadzo KANGWANA, *Amboseli Trust for Elephants*; Cynthia MOSS, *Amboseli Trust for Elephants*

We present a perspective of elephants as co-equal partner stakeholders in the Amboseli ecosystem of southern Kenya, along with the local land owners, the Maasai and their livestock. This well protected elephant population of some 1500 individuals ranges over 8000 km² of pastoralist rangeland, which has only in the last 4 years begun to become fragmented and fenced. Therefore understanding the dynamics of stakeholder interactions and use of space may contribute to ensuring the continued sharing of that space between species. Landscape usage patterns combined with threats (mortality, risk of injury) to stakeholders (elephants and people) are commonly used to indicate responses to risk. Here, we take an integrative and long-term approach that maps elephant responses to humans, using (a) historical dung locations from the 1990s; (b) recent elephant movements from tracking of collared female elephants in 2013; and (c) the location of human settlements and human, livestock or elephant injuries or deaths from 2006 to 2013. In addition to historical and recent usage mapping, we present a qualitative representation of elephant dispersal corridors based on 42 years of knowledge of their use of the landscape in relation to human settlements and vital water resources. We also examine elephant grouping patterns and densities over the very long term as behavioural responses to risks from humans.

ID 7. WILD GREAT APES AS SOURCES AND SENTINELS FOR EMERGING INFECTIOUS DISEASES

Fabian Leendertz
Robert Koch-Institute

Emerging zoonotic infectious diseases originating from wildlife pose a serious threat to human health. This is especially true in relation to microorganisms originating from great apes, whose close phylogenetic relationship with humans results in high potential for microorganism exchange. Intense contact between humans and great apes occurs during bushmeat hunting, which is widely practiced throughout most of the great ape's remaining habitats. I will present examples of how studies on the microorganisms of wild great apes can lead to the discovery of novel pathogens of potential importance for humans. I will also illustrate how these primates, living in their natural habitats, can serve as sentinels for diseases with high likelihoods of emergence into human populations. Greater efforts in broad geographic collection of non-invasive samples from live great apes, as well as systematic collection of samples from wildlife carcasses (either found dead or via

bushmeat studies), coupled with improvements in sample preservation and novel diagnostic capacities, will rapidly improve our understanding of the diversity and distribution of microorganisms in wild great apes. In addition, collaborations with projects focused on great apes habituated to human presence (for research and/or tourism) will allow for more in-depth studies. Linking non-invasive diagnostic data obtained from analyses of materials such as faeces and urine samples, with observational health data from wild great apes are a promising approach for the discovery of not only acute disease causing microorganisms, but also chronic infections, potentially very relevant for human health.

218 THE EU CONSERVATION DIRECTIVES - REFIT AND A PERSPECTIVE FROM THE EU COMMISSION

Stefan Leiner
EU Commission, Directorate B3 - Nature

The 1979 Birds Directive and the 1992 Habitats Directive provide a common EU framework that sets the standards for nature protection across the Member States. The aim of these directives is to contribute to ensuring biodiversity in the EU. A key component for this to be achieved is through conservation and sustainable use of an EU network of areas of high biodiversity value, called Natura 2000 which now consists of more than 27.000 sites covering over 18% of the EU terrestrial area and over 4% of the marine area. As part of its Smart Regulation policy the Commission has initiated a Regulatory Fitness and Performance Programme (REFIT). Under the first stages of this programme, the Commission has reviewed the entire stock of EU legislation and decided on follow-up actions, one of which is a 'Fitness Check' involving a comprehensive policy evaluation. The fitness Checks provide an evidence-based critical analysis of whether EU actions are proportionate to their objectives and delivering as expected. Evidence from the fitness check will be collected through a comprehensive and wide ranging consultation. The REFIT process is about making sure that EU legislation is 'fit for purpose'. There is no prefixed decision at this stage that the legislation will be changed and the objectives of the legislation are not being called into question. The results of the on-going Fitness Check of the Birds and Habitats Directives are expected to be ready by early 2016.

DISENTANGLING THE MULTIPLE EFFECTS OF LAND USE ON FISH ASSEMBLAGES IN AMAZON STREAMS

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DE PESQUISAS DA AMAZONIA ; Paulo Santos POMPEU, Universidade Federal de Lavras ; David MOUILLOT, Université de Montpellier[INSTITUTE]James Cook University ; Jos BARLOW, Lancaster University[INSTITUTE]Museu Paraense Emílio Goeldi ; Robert M HUGHES, Oregon State University ; Philip R KAUFMANN, US Environmental Protection Agency ; SÉbastien VILLÉGER, Université de Montpellier ; Daniele KASPER, INSTITUTO NACIONAL DE PESQUISAS DA AMAZONIA ; Joice FERREIRA, Embrapa Amazônia Oriental ; Felipe ROSSETTI, Universidade de São Paulo ; Silvio FERRAZ, Universidade de São Paulo ; Jim THOMSON, University of Canberra ; Ralph MAC NALLY, University of Canberra ; Toby GARDNER, Stockholm Environment Institute

Land use change (LUC) can have a major impact on small streams and is of major concern in the tropics where rates of deforestation and land-use intensification remain very high. Yet the processes by which LUC alters tropical streams remain very poorly understood. Here we present results of the most comprehensive multi-scale assessment of the biological condition of headwater streams in the human-modified eastern Amazon, examining taxonomic and functional responses of fish assemblages to both LUC and changes in physical stream habitat. We sampled fish in 99 streams encompassing five river basins and two large regions, and characterized instream habitat by several physical attributes and key LUC variables, including density of road crossings, deforestation, and agricultural intensification. All 141 species were characterized in terms of their function using ecomorphological traits describing feeding, locomotion, and habitat. Overall we found that multiple drivers operating at different spatial scales influence stream condition, including taxonomic and functional diversity. Our results highlight the highly heterogeneous nature of such systems, where species turnover between stream sites represent 70% of gamma diversity, and assemblages exhibit distinct responses to similar drivers in different basins or regions. That said, some general patterns emerged, including a threshold of 70 to 80% of catchment forest cover above which water temperature is consistently lower than in more deforested areas; and a trend of functional homogenization due to the effect of road crossings. Our results underscore the importance of some landscape changes often unrecognised, such as road crossings and agriculture intensification that can have a marked effect on streams. We draw on the relationships observed in our data to suggest priorities for the improved management of stream systems in the multiple-use landscapes that characterise so much of the human-modified tropics.

THE EFFECT OF ROCK TYPE AND LANDSCAPE PROPRIETIES IN THE POPULATION DEMOGRAPHY, GENETIC STRUCTURE, PHENOTYPIC DIVERGENCE AND REPRODUCTIVE INVESTMENT IN A NEOTROPICAL MONTANE ORCHID

Bruno Leles

São Paulo State University

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Knowledge of the role of Neotropical montane landscapes in shaping genetic connectivity and local adaptation is essential for understanding the evolutionary processes that have shaped the extraordinary species diversity in these regions. In the present study, we examined the landscape genetics, estimated genetic diversity, and explored the effect of rock outcrop type in demographic structure, morphological variability and reproductive strategies in seven natural populations of *Cattleya liliputana* (Orchidaceae). Nuclear microsatellite markers were used for genetic analyses. Spatial Bayesian clustering and population-based analyses revealed significant genetic structuring and high genetic diversity ($H_e = 0.733 \pm 0.03$). Strong differentiation was found between populations over short spatial scales ($F_{ST} = 0.138$, $p < 0.001$), reflecting the landscape discontinuity and isolation. Monmonier's maximum difference algorithm, Bayesian analysis on STRUCTURE and principal component analysis identified one major genetic discontinuity reflecting the variation in types of rock outcrops. Divergent genetic groups showed phenotypic divergence in flower traits and reproductive strategies. Approximate Bayesian Computation (ABC) modelling suggested low gene flow between populations at different rock outcrop and signs of population bottleneck. Demographic structure and increased sexual reproductive effort was associated with rock outcrop type and may be a response to adverse conditions for growth and vegetative reproduction. Here we show that divergent habitat (rock type) and restricted gene flow are drivers of population differentiation in Neotropical montane rock outcrops. These genetic divergence and rock type should be considered for an efficient conservation planning.

191 THE POWER OF BEHAVIOUR CHANGE. HOW TO APPLY SOCIAL MARKETING PRINCIPLES TO CONSERVATION ISSUES

Christiane Lellig

European Social Marketing Association / Stratageme Consulting Limited

Most of the current challenges the world faces today are manmade and therefore behaviour driven. These behaviours



follow the logics and norms of our societal systems. In order to drive positive change we need to address the system as much as the individual or group behaviour. There are three approaches to do so: legislation (enforcement), incentives (fiscal policies, subventions, etc.) and voluntary behaviour change, e.g. through the application of marketing techniques (Social Marketing). Social Marketing is defined as an approach that "seeks to develop and integrate marketing concepts with other approaches to influence behaviours that benefit individuals and communities for the greater social good." (ISMA, ESMA, AASM 2013). Ethical principles, audience insight and best practice as much as theory base are guiding the application of Social Marketing. Engagement with our audiences, preferably through participatory processes, is key when we aim at changing people's behaviours on a voluntary basis. Looking at conservation issues, studies in the UK and Switzerland suggest that it is people's love for nature, an innate fascination with the beauty of wildlife, that makes them willing to protect biodiversity. However, the same studies show that there is no awareness of the problem, i.e. the significant decline in biodiversity. Findings also show that approaches to enhance problem awareness through threatening images of landscapes in decay rather lead to problem denial and resignation than willingness to act. While framing of key messages is an important part of behaviour change programmes, creating the insight based foundations is the single most important and most neglected part to ensure success. A variety of projects in collaboration with NGO, retailers and government provide for some hands-on ideas how conference participants could enhance their project results by applying Social Marketing principles to conservation issues.

INTEGRATED ASSESSMENT OF TAXONOMIC, PHYLOGENETIC, AND FUNCTIONAL DIVERSITY REVEALS OPPORTUNITIES FOR CONSERVATION IN THE BRAZILIAN ATLANTIC FOREST

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Spatial conservation prioritization should embrace different aspects of biodiversity, so as to protect nature in a well-balanced manner. Phylogenetic and functional diversity are powerful measures of their underlying evolutionary history and ecological processes. However, it is still unclear how to include these diversity measures into spatial planning and how to evaluate conservation outcomes with respect to said

measures. Here, we compared common spatial prioritization (based on species distribution) with analyses that incorporate functional traits and evolutionary information. We also verified the hypothesis that spatial prioritization based on different diversity measures (taxonomic, functional and phylogenetic) delivers different solutions. Therefore, we integrated these solutions into a more inclusive and meaningful strategy for spatial conservation prioritization, one which is more relevant for on-the-ground conservation efforts in Brazil, and identified high-priority areas for anuran conservation in each biogeographical region of the Brazilian Atlantic Forest. Our results demonstrated a relatively high congruence between spatial conservation plans based on different diversity measures and identified high-priority conservation areas for each of the ecoregions of the Brazilian Atlantic Forest. The conservation priority outputs by biogeographical region also illustrated a high congruence between prioritization scenarios (although exceptions were found, e.g. Alto Paraná Atlantic Forest). Finally, all previously existing protected areas were identified as high-priority areas. Overall, our results reveal high spatial congruence of conservation opportunities that can minimize the loss of both evolutionary potential and species distributions simultaneously. Given the level of urgency and the need for action in Brazil, the present conservation prioritization can be used to better inform decision makers about high priority areas for anuran conservation.

CONTEXT-DEPENDENT EFFECT OF INVASIVE ALIEN SPECIES ON NATIVE PLANT COMMUNITIES

Magdalena Lenda

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Invasive alien species are regarded as one of the greatest threats to global biodiversity. Nowadays, many invasive species co-occur in one habitat patch but most of studies focus of simple effects of only one invasive species on native communities ignoring interactions between invasive species. In this study we address question how two invasive alien plant – Goldenrods *Solidago* sp and Walnut *Juglans regia* species affect native flora when they occur alone and together in one habitat patch. We choose several abandoned fields in southern Poland where these species occurred separately, together as well as control fields without these invasive species and where native Birches *Betula pendula* grew with Goldenrods together. When alone, Goldenrods decreased number of native plants species comparing to control plots. In similar scenario Walnuts also decreased number of species and their diversity, but to lower degree than Goldenrods. However, when growing together, under Walnuts there emerged patches free of Goldenrods and this facilitated higher number native plants species and



their diversity than in the Goldenrod-only stands. Birches also reduced number of native plants but to a lesser degree than both invasive species and we did not find native Birches to facilitate native herbs when growing in stands invaded by Goldenrods.

CASCADING EFFECTS OF POLITICAL-RELATED CHANGES IN AGRICULTURE ON INVASION OF THE PERSIAN WALNUT IN FORESTS

Magdalena Lenda

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In recent decades alien Persian Walnut *Juglans regia* has become invasive in agricultural landscapes of Central Europe due to land abandonment and increase of native dispersers, the Rooks. In this study, we tested if presence of abandoned fields with alien Walnuts bearing seeds, landscape structure and management may facilitate further invasion of this tree into forest habitats by involvement of another native seed dispersers – Jays *Garrulus glandarius*, and Squirrels *Sciurus vulgaris* and passive dispersal by gravity during variable weather conditions. We selected 102 forests in southern Poland where we estimated Walnut presence and its density together with density of Jays as dominant Walnut seed disperser in forests. We also estimated seed harvesting rate by Jays on Walnuts growing in abandoned fields and in human settlements. Forest occupancy by Walnuts and their densities were positively correlated with covers of abandoned fields and human settlements with Walnuts bearing seeds. Forests that were located in the depression under surrounding landscape had higher probability of Walnut occupancy. Density of Walnuts in forests was positively correlated with density of Jays. Jays often harvested seeds from Walnuts in abandoned fields independently on their distance from a forest. This bird also frequently visited Walnuts planted in human settlements but only if they were in the proximity of forests. We also demonstrated that Walnut seeds that were hidden in arable fields by Rooks may passively reach forest edges especially on sloping fields that adds to propagule pressure in forest ecosystems and underlines the importance of local terrain configuration on invasion processes. Our study indicates that invasion of alien Walnuts into agricultural landscapes has vast spatio-temporal cascading effects that have led to further colonization of forest ecosystems by alien Walnut trees.

LINK THE UTILIZATION OF TRANSLOCATED WILDLIFE SPECIES TO THE BENEFITS AND PERCEPTIONS OF CONSERVANCY MEMBERS

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The Community-based Natural Resources Management (CBNRM) programme in Namibia aims at providing opportunities for rural communities to improve their livelihoods by utilizing wildlife for tourism and other wildlife related activities through establishment of conservancies. Conservancies, which are run by local farmers in communal areas, aim at fulfilling the objectives of both biodiversity conservation and socio-economic development through sustainable harvesting. In order to achieve these objectives, it was essential to restock or build up wildlife populations in conservancies through translocation. Translocation is defined as a deliberate, human-induced movement of living organisms from one area to another. This study aims at linking the utilization of translocated species to the community benefits in the Nyae Nyae conservancy. This conservancy is predominantly inhabited by the Ju/'hoansi (San) people who are nomadic hunter-gatherers. A total of number of 2200 ungulate individuals from 8 species was translocated into the area. According to the results, although the majority of Nyae Nyae conservancy members receive benefits from the conservancy in the form of cash, meat, and community projects, training as well as cultural importance of wildlife. These benefits were related to the performance of wildlife populations and factors that affecting these populations. In addition, the annual quotas for wildlife species issued by the Ministry of Environment and Tourism were underutilized. Underutilization of allocated wildlife quotas has implications on the expectations and perceptions on benefits and wildlife management as a whole. The conservancy programme is the key driver for community development this area, dominated by the most marginalized community of Namibia.

82 - ACCOUNTING FOR HOW LANDOWNER CHARACTERISTICS AND BEHAVIOUR INFLUENCE CONSERVATION OPPORTUNITIES IN THE EASTERN AMAZON

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Identifying locations that offer the greatest opportunities for conservation investment requires an understanding of spatially heterogeneous social-ecological systems. Conservation researchers have often identified areas of greatest conservation opportunity as those with high conservation value and low cost when conserved using a single investment mechanism, such as fee-simple purchases or easements. Such approaches fail to contend with variation



in landowners' ability and willingness to engage with the various conservation options available to them, which may be independent of cost constraints but have a profound effect in limiting the success of any policies. Drawing on extensive ecological and socioeconomic survey data from 36 watersheds in the Eastern Amazon assembled as part of the Sustainable Amazon Network, together with state-wide remote sensing and agricultural census data for the state Brazilian state of Pará, we investigated how and where to target alternative land management options - such as improved fire and forest management, reforestation, and avoidance of further degradation or clearing of remaining forests - after accounting for the relative importance of spatial variability in conservation values, economic costs and the propensity of landowners to engage in conservation work. We achieved this by developing a stochastic global search optimization framework that allows for multiple conservation policy mechanisms to be used simultaneously and in a spatially constrained manner. In accounting for differences in actor behaviour as a central part of the analysis, the practical outcomes of this research, and the policy recommendations that follow from it, represent a marked advance on existing conservation planning work in the Amazon region. More generally, these results can help draw broader conclusions as to how landowner behaviour and attitudes towards conservation may have a major effect in modulating the success of conservation interventions.

SPATIAL PRIORITISATION FOR MULTI-ACTION CONNECTIVITY CONSERVATION SPENDING

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Brendan WINTLE, The University of Melbourne

It is now well-recognised that habitat quality, area, and connectivity all need to be maintained and enhanced to ensure the ongoing persistence of declining fauna, and that much of this will have to take place on private land. As a result, increasing funds are being invested in connectivity conservation initiatives, but managers of these projects often face the difficult task of weighing up competing objectives to determine where this money is spent, and on what specific actions. We present a spatially-explicit approach which allows natural resource managers to transparently allocate funding from connectivity initiatives, using the freely available linkage mapper software graphab and the recently-released corridor penalty functionality in the spatial prioritisation software Zonation. This takes into account all key considerations but is still accessible to those with a basic understanding of statistics and spatial analysis. We demonstrate our approach using a case study from the Connecting Country initiative in northern Victoria, Australia, which seeks to enhance habitat connectivity for a range of declining woodland birds through investing \$6M in restoration works and environmental stewardship on

private land. We considered four potential actions that could benefit woodland birds: revegetation, grazing management, weeding and fencing. For the prioritisation process we draw on both species distribution and connectivity modelling for the target species, as well as information about the cost and likely conservation outcomes of each of the potential management actions. At the end of the process, managers are able to produce a priority map showing what actions should be carried out on which properties for both broad and fine-scale connectivity considerations. Our approach allows for the allocation of funds from connectivity schemes in a manner which is transparent and supported by solid quantitative ecological evidence.

A GLOBAL ANALYSIS OF FERAL AND FREE-RANGING CAT DIET

Christopher Lepczyk

Auburn University

Daniel HOUSE, University of Hawaii at Manoa ; Jocelyn

LINDNER, University of Otago ; Elsa BONNAUD, Université Paris

Sud ; Tim DOHERTY, Edith Cowan University

Free-roaming and feral cats are considered amongst the 100 worst invasive species in the world. Given their widespread introduction our goal was to conduct a global assessment of species depredated by cats and found cat diet. Specifically, we quantified diets of domestic cats throughout the world, described the diet taxonomically, by conservation status, and location. Globally, cat diet contained 1,072 unique species, of which 430 (41%) were insular. Birds and mammals constituted the majority (82%) of the diet, with feral cats depredating nearly 18 times more species than domestic cats on islands. Several human commensal species, such as house mouse and European rat, were found most often across studies and a large portion of studies were from Pacific Islands. Nearly 17% (69) of the island species depredated were listed as species of concern level or greater on the IUCN Red List. Our results approximately double previous estimates of species found in cat diets and species accumulation curves suggest that the current estimate may be conservative. Our findings are particularly relevant for conservation by further refining the degree to which cats act as invasive generalist predators.

161-SYNTHESIS FOR INTEGRATED SOCIAL-ECOLOGICAL FRAMEWORK TO SUPPORT MARINE SPATIAL PLANNING

Christopher Lepczyk

Auburn University

Simon PITTMAN, NOAA ; Lisa WEDDING, Stanford University

Marine spatial planning has made great strides in protecting and conserving a variety of marine systems around the world. Increasing the utility of marine spatial planning is viewing



it through the lens of social-ecological systems frameworks. In this concluding talk, we synthesize the use and value of social data in planning, how they can be used to broaden our definition of seascapes, and ultimately how we can move towards a more integrated approach of marine spatial planning. Additionally we identify not only the progress, but the challenges and key questions awaiting an integrated approach.

SEEING THE OCEAN THROUGH THE EYES OF SEABIRDS: A NEW PATH FOR MARINE CONSERVATION?

Amelie Lescroel

Centre d'Ecologie Fonctionnelle et Evolutive
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To cope with the social-ecological crisis that is affecting our oceans and coastal areas, conservation and management policies shifted from a paradigm of separated ecological and human systems governed by top-down policies, to one of more horizontally-governed social-ecological systems. However, 1) the extreme complexity of social-ecological systems, 2) the incapacity of marine protected areas alone to counter environmental degradation, and 3) the lack of consideration of asymmetries between participants in public participation processes, have prevented this shift to yield the expected results. To overcome these obstacles, we propose to use seabirds both as indicators of marine ecosystem health and as ambassadors of less visible, and often less charismatic, marine species to make progresses on marine policies and global conservation issues. Seeing the ocean through the eyes of seabirds therefore implies: 1) identifying, characterizing and quantifying the interactions between seabirds and human activities, 2) identifying ecological solidarities and vulnerability transfers among the different habitats used by seabirds, and 3) studying and developing the use of visual data collected on and by seabirds as a springboard for stakeholder cooperation. Here, we develop these three research avenues and give concrete examples of implementation in the English Channel. Using GPS loggers and video cameras deployed on Northern gannets (*Morus bassanus*), we were able to 1) identify, characterize and quantify the interactions between gannets and fisheries, 2) identify ecological solidarities between their breeding (the English Channel) and wintering (especially the coastal waters of West Africa) grounds, and 3) successfully use maps of GPS tracks and videos of gannet-trawlers interactions to address global marine conservation issues with fishermen, shellfish farmers, NGO representatives, environmental

managers and scientists. While there is no single, idealized solution to the marine social-ecological crisis, we believe that our interdisciplinary approach can help meeting the challenges of managing common-pool marine resources by enhancing ecosystem stewardship both in protected and unprotected areas.

SESSION # 197 A BOLD STRATEGY FOR BIODIVERSITY CONSERVATION

Elaine Leslie

Leslie

Ray SAUVAJOT, Leslie [INSTITUTE] National Park Service

As we edge closer to the National Park Service Centennial, we have much to celebrate. Science and stewardship have a prominent role in park, more than any time in our history, and yet there is reason for concern. The diversity of native species, and the genetic material they contain and the processes to which they are critically linked, is declining at an unprecedented rate. We are losing our nation's wealth, species richness, role/function, and a biodiverse landscape. This leads to destabilization of ecological processes and reduction in vital ecosystem services. We must acknowledge that biodiversity also has cultural and historical connections that we can't afford to lose. We must act. Parks are critical preserves of biodiversity in the face of increasing global changes yet they tend to be managed largely as isolated islands. Scientific consensus cautions that managers plan for connected ecosystems across broad spaces and that ensure the restoration of ecosystems and their keystone species. The NPS is committed to playing a leadership role in a strategy that will benefit biodiversity conservation across the landscape. Laws, policies, and programs implicitly or explicitly support the conservation of biological diversity. Although these protection efforts represent a significant investment in conservation, they have been insufficient to stem the tide of biodiversity loss and degradation. Now needed is a cohesive and comprehensive approach for designing this cornerstone strategy. We examine a national biodiversity conservation strategy in which the NPS plays a significant role. It is only with a national strategy that we can manage toward clear outcomes and evaluate the success of our progress toward the conservation of biodiversity. In taking a national approach, the NPS hopes to cultivate a support network, a community of practice among a myriad of global partners, with one common goal of biodiversity conservation and stewardship in the 21st century.

HIGH INTENSIFICATION DECREASES PHYLOGENETIC DIVERSITY OF PLANT COMMUNITIES IN MONTANE AND SUBALPINE AGO-ECOSYSTEMS

Malie Lessard-Therrien

University of Bern



Jean-Yves Humbert, University of Bern ; Raphaël Arlettaz, University of Bern

Below the tree line in the Alps, grasslands are maintained by human farming activity since centuries. A long history of extensive exploitation and different cultural and natural contexts has resulted in a rich assemblage of species in these habitats. However, in the recent decades, pressure to increase agricultural productivity has led to an intensification of the farming practices which have negative impacts on biodiversity. Our definition of biodiversity ranges from genetics to the ecosystem level. The aim of this ongoing research project is to find an optimal management where farmers obtain good hay yields while maintaining semi-natural grassland ecological integrity. Since 2010, different management treatments were applied in montane and subalpine meadows across the Swiss Central Alps. Surveys were conducted on the vegetation during the summer 2014. We found that phylogenetic diversity, along with the overall species richness decreased in the most intensive management treatment. Plants coverage responded differently according to their functional groups. The grasses coverage remained stable across control and management treatments. Any kind of management involving fertilization increased the forbs coverage. The legumes coverage was enhanced by both irrigation and/or fertilization. Further surveys are being conducted on insects and belowground organisms during summer 2015. Our results will be broadcasted to farmers and stakeholders and will serve to draw new guidelines for the future development of montane and subalpine agricultural systems.

IMPACTS OF A ROAD CONSTRUCTION ON WATERBIRD POPULATIONS AT ASUNCIÓN BAY, PARAGUAY

Arne Lesterhuis

Guyra Paraguay

A. Alberto Yanosky, Guyra Paraguay ; Marianela VELILLA, Guyra Paraguay

The Asunción Bay is a relatively small bay (c.600 ha in total) located along the northern outskirts of Asunción, the capital of Paraguay. Despite the relative small size of the area, over 290 species of birds have been recorded here, including 89 species of waterbird of which 22 are Nearctic migratory shorebirds. The waterbird community at the Asunción Bay responds to waterlevel fluctuations with numbers increasing when waterlevel is low (austral spring and summer) and decreasing when waterlevel is high (austral autumn and winter). Regular monitoring of waterbirds by Guyra Paraguay since 2000, has shown the site to be of great significance for waterbirds, and especially as a stopover site for Nearctic shorebirds during their southbound migration. High counts of the Near threatened Buff-breasted Sandpiper *Calidris subruficollis* triggered the

sites designation as an IBA and Western Hemisphere Shorebird Reserve Network site, and due to its importance to birds in general, it was declared an Ecological Reserve in 2005. The recent development of a coastal road has presented important opportunities for the urban population of Asunción to reconnect with its natural heritage, but unfortunately dredging to create the embankment for this road in 2010 destroyed close to 70% of the habitat in the bay used by waterbirds. The disappearance of muddy beaches on the bay caused the drastic reduction of the total number of Nearctic shorebirds that regularly visited the Bay, but also caused changes in abundance and diversity of resident waterbird populations. The Municipality of Asunción and the Ministry of Public Works have agreed to work with Guyra Paraguay to implement a series of habitat recuperation and management measure to improve remnants habitats for both waterbirds in general and shorebirds in particular.

RESTRICTING ACCESS TO INVASION HUBS ENABLES SUSTAINED CONTROL OF AN INVASIVE VERTEBRATE

Mike Letnic

University of New South Wales

Jonathan WEBB, University of Technology Sydney ; Tim JESSOP, La Trobe University ; Tim DEMPSTER, University of Melbourne

Biological invasions often occur through expansion of satellite populations that become established at 'invasion hubs'. Theoretical studies suggest that targeted control at invasion hubs can effectively suppress the populations and impacts of invaders, but there is little empirical evidence that such control activities can suppress both populations of invaders and their impacts. In Australia's arid rangelands, small dams that are used as reservoirs at artificial livestock watering points (AWP), function as invasion hubs by providing an invasive vertebrate, the cane toad (*Rhinella marina*), with refuge from extreme aridity during the annual dry season. Cane toads are toxic to many Australian predators, consequently some predator species have declined following toad invasion. Here, we ask whether sustained control of cane toads and alleviation of their impacts on native species can be achieved by restricting their access to water. First, we constructed fences to exclude toads from dams and maintained these fences for one year. Toad populations at fenced dams were suppressed by 1-2 orders of magnitude compared to unfenced controls and procedural controls. Second, we compared toad numbers and their impacts on monitor lizards at AWP fitted with two types of reservoir, dams and steel tanks. Toads have little access to water at tanks. In comparison to dams, toad numbers were low at steel tanks, and monitors were more abundant in the vicinity of tanks than dams. Conversely, small lizards, the prey of monitor lizards were more abundant near dams than tanks. Our study demonstrates that sustained control of invader populations and their impacts can be achieved by restricting their access



to invasion hubs. Elimination of invasion hubs could be conducted reactively, to control established populations of invaders, or conducted strategically, by rendering invasion hubs unsuitable for colonization ahead of the invasion front to prevent further population spread.

141 TROPHIC AND DIVERSITY CASCADES FOR RESILIENCE AND POLICY REFORM IN AGROECOSYSTEMS

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University of California

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Density-based trophic and diversity cascades are dynamic processes in agroecosystems, whereby community characteristics like relative abundance, species richness or evenness in one trophic level indirectly affects changes in a non-adjacent trophic level. On-farm research from the Central Coast of California shows how density and diversity cascades dampen potential shocks in commercial organic food production and marketing. Specifically, vegetational resource diversity at the landscape scale has indirect effects on the richness or evenness of arthropods and pathogens on the third trophic level. We show how these dynamics can increase biological control of key pests and reduce the likelihood of food contamination. However, food safety mandates and emerging policy threaten these biological processes, thus disrupting critical resiliency mechanisms and ecosystem services.

73. LINK BETWEEN SELF-RECRUITMENT, LOCAL RETENTION AND PERSISTENCE IN MARINE METAPOPULATIONS

Christophe Lett

IRD

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Accurately estimating connectivity, the exchange of individuals among distant subpopulations, is of central importance to understanding marine metapopulations dynamics and to effectively managing marine resources, for example via the creation of marine protected areas. Two main indices are used to assess the tendency for self-maintenance of local marine populations: self-recruitment (SR), defined as the ratio of locally produced settlement to settlement of all origins at a site; and local retention (LR), the ratio of locally produced settlement to local egg production. LR has a clear relationship to self-persistence of individual sites, however SR is easier to measure experimentally. We use theoretical, simulation and empirical approaches to bridge the gap between these two indices, and

demonstrate that there is a proportional relationship between SR and LR for metapopulations close to a stable state and with lifetime egg production (LEP) approximately uniform over space. Therefore, SR provides information on relative rates of LR for systems satisfying these conditions. Furthermore, the ratio between LR and SR can be used to evaluate global persistence of metapopulations, and therefore provides valuable information not necessarily available if only LR is considered.

FLUKEBOOK: CONNECTING STAKEHOLDERS IN CETACEAN CONSERVATION SCIENCE THROUGH POWERFUL WEB-BASED TOOLS AND SOCIAL MEDIA

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U.S. Department of Interior

Shane GERO, Dominica Sperm Whale Project

As a result of their large spatial and temporal ranges, conservation of cetaceans requires collaboration between diverse stakeholders. Current collaborative attempts either limit citizen science involvement by lacking an intuitive design, or limit integration between research institutions by having isolated databases. Flukebook is the first web platform that engages both the research and citizens science aspects of conservation. It provides researchers with the detailed scientific tools needed for analysis and transboundary collaboration without sacrificing interactivity or approachability for citizen scientists wanting to engage in the project. Researchers have access to data management tools; photo-matching algorithms and a global catalog of individuals; and connectivity to common analytical tools for mark-recapture; genetic, and socio-ecological studies. At the research level, data sharing is accomplished on a peer-approval basis which leads to growing inclusiveness. For citizens scientists, Flukebook enables participants to receive automatic profile updates on individuals they have sighted, encouraging repeat participation and engagement in conservation initiatives in those regions. During beta testing, whale watch operators, citizens, and researchers have connected to share data from 700+ individuals among thousands of sightings. Flukebook acts as a singular tool, filling gaps in species distribution, individual movements, social associations and genetic structure.

THE ECOLOGICAL IMPACTS OF CLIMATE CHANGE CAN BE GREATER IN THE TROPICS THAN THE ARCTIC

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Tropical temperatures are rising more slowly than arctic temperatures, and the ecological impacts of tropical climate change have often been assumed to be smaller. Some exceptions have recently been found, notably ectothermic species, which are unable to regulate their body temperatures



physiologically and which may be especially vulnerable to rising temperatures in the hot tropics. If they are already living at or above their optimal temperatures in hot regions then further warming could have much more negative effects than in cooler regions. Endotherms are often thought to be buffered from thermal stress, but here we look at whether this is actually the case. Even if tropical endotherms can thermoregulate physiologically, they remain vulnerable to the indirect effects of rising temperatures on the systems, habitats, and ectothermic species upon which they depend. By studying the Grey Plover *Pluvialis squatarola* which migrates between arctic and tropical regions, we demonstrate for the first time that the population growth rates of an endotherm can actually respond positively to higher temperatures in the cold arctic, but negatively to higher temperatures in the hot tropics. We propose that rising tropical temperatures may be important not just for ectotherms, but more generally for endotherms as well.

A BOLD PLAN FOR MAKING CONSERVATION MORE COMPELLING AND EFFECTIVE

William Lidicker

University of California

In spite of widespread, long-standing, and heroic efforts by numerous of conservationists and organizations, conservation accomplishments on a global scale have only been marginally successful. Certainly, progress in stemming the tide of human exploitation of resources, biodiversity declines, social unrest, energy requirements, climate change, warfare, terrorism, food scarcity, uneven distribution of wealth, and economic and political refugees, to name some of the dilemmas facing the human enterprise, has not come close to keeping up with needs. Although there remain grounds for optimism, we clearly need some bold new initiatives to significantly enhance the effectiveness of the conservation message. To do this we need to start with some basic principles of population dynamics. Six of the most basic and relevant principles are outlined. These scientific basics can then serve to anchor a cohort of strategic policies that address the objectives of human welfare and survival. Seven examples of such strategies are: 1) Devise ways to slow and then stop human population growth as urgently and humanely as possible; 2) Eliminate the confrontational approach that now dominates the human enterprise. We will not succeed without cooperation within the human family that focuses on our common goals, not our differences; 3) Develop procedures for dealing with non-cooperating individuals, interest groups, political parties, and nations. The common welfare must prevail over those who prefer selfish objectives or genocide; 4) Maintain an optimistic attitude to encourage cooperation, but without abandoning reality; 5) High levels of education must be sustained in order to have rational discussions of shared goals; 6) Income disparities must not

exceed modest levels that are commensurate with geography, relative contributions to human welfare, and variations in possession of special skills valued by communities; and 7) Provide adequate support for basic research in conservation.

BALANCING ECONOMIC COSTS AND THE ABILITY TO DETECT CHANGE IN SURVIVAL FOR OPTIMISING CAPTURE-RECAPTURE SURVEY DESIGN OF LONG-LIVED BIRDS

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Capture-recapture surveys (CR) have become popular tools in a context of evidence-based conservation and a growing number of practitioners include the marking of individuals when implementing population monitoring. Estimating environmentally-induced variability in survival is indeed of paramount importance for assessing population viability, especially for long-lived animals where survival is often the key driver of population dynamics. CR surveys have proved their efficiency in quantifying change in survival rates in relation to e.g. environmental conditions or the set-up of rescue actions, and are thus highly valuable for guiding conservation plans. Many such surveys however, although being particularly costly, are implemented without an appropriate assessment of what could be an optimal design, and this may impair management success. Based on a general life history and a monitoring strategy inspired from long-lived raptors, we propose here an integrative simulation experiment that combines the main components of a CR survey together with precise economic costs derived from existing monitoring programs. In particular, we explore the outcomes of the trade-off between the ability to detect a given change in survival rates and the effort dedicated to CR surveys (in terms of number of birds ringed/year, juvenile-to-adult ratio in ringed birds, resighting strategy and survey duration). Our ultimate aim is to propose to both practitioners and researchers a comprehensive set of guidelines ensuring an optimal resource allocation for designing new CR surveys or improving existing ones.

CHARACTERIZATION OF MHC CLASS II SUPERTYPES IN THE NEW ZEALAND ENDEMIC HOCHSTETTER'S FROG

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The New Zealand native frogs, family Leiopelmatidae, are among the most archaic in the world. All four species are among the top 100 evolutionarily distinct and globally endangered (EDGE) amphibians. *Leiopelma hochstetteri* (Hochstetter's frog) is a small, semi-aquatic frog with numerous, fragmented populations scattered across New Zealand's North Island. The MHC is a large gene family with a vital role in the vertebrate immune response and is useful an indicator of adaptive genetic variation to evaluate immunogenetic health. We characterized the major histocompatibility complex (MHC) class IIB gene (DAB) in *L. hochstetteri* from a spleen transcriptome, and then compared its diversity to neutral microsatellite markers to assess the adaptive genetic diversity of five populations. Positive selection and extreme population differentiation have contributed to very high diversity. In total, 74 DAB alleles were characterized and only two alleles were shared by more than one population. We identified four supertypes based on clustering analysis on the DAB alleles. All supertypes were represented in four of five populations, albeit at different frequencies. The Ottawa population was an exception to these observations, with only two DAB alleles present, representing two supertypes. This low immunogenetic diversity in Ottawa may predispose this population to a greater risk of extinction from emergent disease.

THE INFLUENCE OF REGULATORY FRAMEWORKS ON CORPORATE SUSTAINABILITY POLICIES AND PRACTICES IN THE PALM OIL INDUSTRY IN BRAZIL AND INDONESIA

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Concerns surrounding the palm oil industry have resounded around land use change from deforestation and the negative social impacts on rural smallholders. Sustainable palm oil development can occur but must be managed with a landscape approach that strives to balance large-scale agriculture with positive outcomes for conservation and communities. Indonesia's palm oil sector is well developed but has a notorious reputation for the destruction of primary rainforest. Brazil's palm oil sector is expanding, with a strong rhetoric of rural development and expansion on degraded lands. There are intentions that its trajectory will be unlike that of Southeast Asia. This exploratory research examines government regulations, programs and support structures in Indonesia and Brazil and asks how they may have driven current corporate policies of oil palm companies. It focuses

on two social and environmental sustainability outcomes: 1) inclusion and benefits for smallholders and 2) avoiding and reducing deforestation, maintenance of conservation areas, and development on degraded lands. I looked at case studies of companies in Indonesia (East Kalimantan) and Brazil (Pará) that are domestic and mid-sized to explore their sustainability practices and motivations. My methods included an extensive literature and document review, including smallholder surveys, government documents, seminar reports and presentations. I also conducted interviews with key informants in Indonesia and Brazil, including field researchers, smallholders and sustainability managers of the case study companies. Government intervention in the industry in each country occurs to a different degree, and has both enabled and disabled sustainability outcomes. The land permitting and zoning process as well as market incentives heavily affect sustainability policies. For a company to engage in sustainability, the public sector has to play a significant role in providing the support structures needed.

THE POPULATION GENETIC ANALYSIS OF AN ENDANGERED KOREA FIR (*ABIES KOREANA*) AND CONSERVATION IMPLICATION

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The *Abies koreana* E. H. Wilson, known as one of the charismas trees, is an endemic and rare species from Korea, whose distribution is limited to the high elevation of mountains in the Jejudo Island and the southern region of Korean peninsula. This species is considered to be endangered by IUCN because of repeated population reduction. Its congeneric species, *A. nephrolepis* (Trautv. ex Maxim.) Maxim. is distributed to the central and northern parts of Korea, Manchuria, and Siberia. We tried to investigate genetic status of *A. koreana*, comparing with *A. nephrolepis*. In order to understand genetic characteristics of two *Abies* species, the population genetic studies including extensive sampling will be desired. Thus, we conducted firstly developing microsatellite markers. Using one individual of *A. koreana*, 160Mbp (325,776 reads) of genome sequence was obtained by conducting the Roche 454 GS-FLX Titanium sequencing. Among them, we extracted the sequences including the repeat motifs of di- and tri-nucleotide repeats using a bioinformatic analysis. Two hundred eighty eight pairs of PCR primers were tested in order to amplify the fragments with repeat motifs and a total of 71 primer pairs were successfully amplified in both species. Among 71 primer pairs, 10 pairs showed the polymorphism in *A. koreana* and *A. nephrolepis*. Population genetic analysis of 433 individuals from 18 populations, reflecting their geographic distributions



is being performed with 13 microsatellite including previously reported ones. The genetic structure and basic statistics of genetic analysis will be presented. We believe that these analyses will contribute to understand current *A. koreana* distribution and the relationships between populations and to prepare conservation strategies.

BOTH CURRENT AND HISTORICAL LANDSCAPE CONFIGURATION AFFECT PLANTS AND BUTTERFLIES IN FRAGMENTED FARMLANDS

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There is an increasing awareness that not only area and isolation, but also the landscape surrounding habitat patches influence population persistence and species diversity in fragmented landscapes. In addition, populations can exhibit transient dynamics in response to historical land use, where slow extinctions and immigration delay the arrival to a new equilibrium. Here we assess under which current and historical land use circumstances an extinction debt occurs for plants and butterflies by examining the effects of grassland fragmentation in different landscape matrix. The organisms were studied in replicated semi-natural grassland patches of different sizes and isolation, embedded in landscapes dominated either by forest, arable land or a mix of these. Habitat loss was estimated in each landscape by comparing modern maps to ~45 year old digitized aerial photographs. We found positive effects of current patch area on species richness of butterflies but not of plants. Richness of both plants and butterflies was lowest in patches in landscapes dominated by arable land and highest in forest-dominated landscapes. Differences in matrix response among organism groups probably impinge on differing mechanisms. A forest matrix is likely to provide additional resources for butterflies whereas plant diversity in grassland can be explained by habitat generalists more easily invading these patches. Richness of specialist plants was best explained by historical habitat connectivity, whereas richness of butterfly specialists responded to both historical habitat area and connectivity. This suggest that also short-lived herbivorous insects could experience extinction debt if linked to the slow extinctions of persistent and long-lived plants. Our study shows the importance of considering both current and historical land use as well as landscape matrix characteristics when aiming at conserving multiple organism groups in fragmented landscapes.

101 LARGE, OLD TREES: RETAINING AND GROWING SMALL-SCALE CRITICAL STRUCTURES

David Lindenmayer

Australia National University

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Large old trees are key elements of vegetation structure in many natural and human-modified ecosystems globally. These range from forests and woodlands (including mangrove systems), to agricultural and urban environments. An array of empirical studies in these contrasting ecosystems indicates that large old trees are disproportionately important for ecological processes and many elements of biodiversity. These processes including storing carbon, producing flowers and seeds, providing habitat for wildlife (including threatened vertebrate and invertebrate taxa), and facilitating animal movement across landscapes. Populations of large old trees are declining in many ecosystems worldwide as a result of a suite of threatening processes that manifest in different, often ecosystem specific ways – logging, fire, over-grazing, weed invasion, and deliberate removal for human safety. These processes can accelerate the rate of loss of existing trees, impair the recruitment of new cohorts of large old trees, or both. The outcome will be a “functional extinction” of large old trees as a critical age cohort of trees in many ecosystems. The critical ecological roles played by large old trees coupled with the long lag times between their loss and recruitment has significant implications for conservation policy. First, it means that planting new trees as an offset for the loss of large old trees is a flawed approach to offsetting ecological impacts of tree removal. Second, very long-term policies are essential to conserve populations of large old trees – far beyond the typical time horizons of resource management agencies and government. Third, the array of long-term negative impacts of large old tree removal must be far better recognized in resource management policies and on-ground management practices.

PHOENIX FLAGSHIPS: CONSERVATION VALUES AND GUANACO REINTRODUCTION IN AN ANTHROPOGENIC LANDSCAPE

Adrien Lindon

CH2M HILL

Meredith Root-Bernstein, Aarhus University

Multiple forms of valuation contribute to public acceptance of conservation projects. Here we consider how aesthetic, intrinsic and utilitarian values contribute to public attitudes towards a proposed reintroduction of guanaco (*Lama guanicoe*) in a silvopastoral system of central Chile. The nexus among landscape perceptions and valuations, support for



reintroductions, and management of anthropogenic habitats is of increasing interest due to the proliferation of conservation approaches combining some or all of these elements, including rewilding and reconciliation ecology, for example. We assessed attitudes and values through an online questionnaire for residents of Santiago, Chile, using multiple methods including photo-montages and Likert scale assessments of value-based statements. We also combined the questionnaire approach with key informant interviews. We find strong support for the reintroduction of guanacos into the Chilean silvopastoral system ("espinal") in terms of aesthetic and intrinsic values, but less in terms of utilitarian values. Respondents preferred a scenario of espinal with guanacos and expressed interest in visiting it, as well as support for the reintroduction project on the basis that guanacos are native to central Chile. We suggest that reintroduced guanacos could serve as a "phoenix flagship species" for espinal conservation, that is, a flagship species that has gone regionally extinct and is known but not associated with the region in the cultural memory. We consider how the lack of local cultural identity can both help and weaken phoenix flagships, which we expect to become more common.

88-A COMPARISON OF SOFT AND HARD REINTRODUCTIONS OF THE CRITICALLY ENDANGERED WYOMING TOAD (ANAXYRUS BAXTERI)

Luke Linhoff

Florida International University

Maureen DONNELLY, Florida International University

The Wyoming toad (*Anaxyrus baxteri*) is a critically endangered species found only in Albany County, Wyoming, USA. In 1993, the Wyoming toad was listed as extinct in the wild, but it survived in captivity. Many wildlife translocation studies have shown how different release protocols can impact the successful establishment of reintroduced animals. Previous reintroductions of the Wyoming toad have typically utilized a hard release strategy for both translocation of larvae and adults. In contrast, allowing an animal to acclimate to the release site, known as a soft release, has been shown to decrease animal stress while increasing initial survivability in some taxa. After multiple reintroduction attempts of the Wyoming toad between 1992 and 2012 had limited success, efforts to study the causes of failure and explore new methods were undertaken by the Wyoming toad recovery team. In the summer of 2014, we performed a paired release of two groups of captive bred toads at Mortenson Lake, Wyoming, USA. Twelve individuals were hard released and twelve individuals were soft released after acclimating in an outdoor enclosure for 14 days. All released toads were fitted with a custom harness allowing for the external attachment of a novel harmonic tracking device. We tracked all toads for up to eight weeks to compare activity patterns, site fidelity, survival and home range

size in both groups. Finally, we examined the acquisition rates of the pathogenic fungus *Batrachochytrium dendrobatidis* (Bd) by collecting skin swabs from the reintroduced toads each week following their release. Results will be presented.

A GLOBAL DATABASE OF RIVER AND CATCHMENT ATTRIBUTES TO FACILITATE AQUATIC ECOSYSTEM MODELLING AND CONSERVATION PLANNING

Simon Linke

Griffith University

Bernhard LEHNER, McGill University

As river conservation planning is entering its second decade, the science behind planning for investment to protect freshwater bodies is steadily advancing. However, uptake of these methods is still hindered by technical aspects in many cases. Two key obstacles are a) defining the network topology that describes the connected nature of a river system and b) the patchy data sources that often hamper conservation planning and add bias to data rich areas. To facilitate broader application of modern species modelling and conservation planning methods, we designed a global database of river and catchment attributes, linked to the HydroSHEDS data framework which provides global river network and watershed delineations based on a digital elevation model (DEM) at 15 arc-second resolution. As part of this data framework, the HydroBASINS layer offers a hierarchical, nested breakdown of subcatchments. At the highest level of subdivision, Australia, for example, is split into 60 000 subcatchments. For each of these subcatchments, we calculated a suite of local (within subcatchment), as well as upstream (entire watershed area) attributes for a variety of both natural and human influenced descriptors. These include hydrological variables (including runoff and discharge estimates), climate, terrain, soils, vegetation, topology, and network geometry. To characterise human disturbance, we summarised land use measures, including new data on agricultural production, as well as location and storage volume of dams, population and urbanisation. In addition, we introduce a free application tool that will convert the network topology of HydroBASINS to files easily useable in conservation planning packages such as Marxan and Zonation. We will demonstrate a continental application of the data and the network tool based on data from South America. After beta-testing, we anticipate that both the attribute layers and the tool will be freely available in early 2016.

ID: 193 REWILDING LARGE CARNIVORES: NEW WILDERNESS OR WILD NOVEL ECOSYSTEM?

John Linnell

Norwegian Institute for Nature Research



Luigi BOITANI, University of Rome "La Sapienza"

With a few important exceptions, Europe's large carnivore populations have made a remarkable recovery during the last 30 years. There are 17,000 bears, 12,000 wolves, 9,000 lynx and around 1,250 wolverines in Europe today. One third of the continent's surface is home to at least one species of large carnivore. Conservation is now moving from a phase of "saving from extinction" to "living with success". This recovery has the potential to be viewed as one of the most ambitious rewilding efforts being undertaken anywhere on the globe. However, now that extinction is no longer an immediate threat a considerable debate is emerging concerning the appropriate recovery targets and management regimes. Questions like "how many carnivores are enough?" and "how should they be managed?" are hotly contested. On one hand, there is a movement to integrate them into existing wildlife management structures that focus on hands-on approaches like sustainable harvest, balancing competing land-use interests, and conflict containment. These views conceptually fall within the emerging "novel ecosystem" discourse. On the other hand, there are voices calling for hands-off approaches like continual protection from killing by humans and the restoration of natural ecosystem processes. These views fall into the emerging European "wilderness" discourse. Underlying these different views are widely different value systems and beliefs concerning the appropriate place of humans in nature. We explore the ecological and societal dimensions underlying the possibilities and practicalities of the range of potential strategies that lie between these two extremely different points of view. There is an urgent need to resolve various scientific issues associated with recovery goals because the ongoing debates are threatening to split the conservation movement, fracture potential pro-conservation alliances, and provide space for an increasingly organized anti-carnivore movement.

STRESSED IN THE CITY; WHY COMMON SPECIES ARE IMPORTANT

Paul Lintott

University of Stirling

N BUNNEFELD, University of Stirling ; K PARK, University of Stirling

Urbanisation is one of the most dramatic forms of land use change which relatively few species can adapt to. The fragmentation and loss of semi-natural habitats has reduced species richness resulting in biotic homogenisation. Declines in biodiversity have also led to the estrangement of people from nature with the consequence that urban green space is undervalued. In urban areas, the widespread distribution and high abundance of relatively common species also has the potential to reengage the public with nature and garner support for wider conservation action. However, common

species are often perceived to require little attention, as uninteresting, and their significance is frequently overlooked despite their importance to ecosystem functioning. Over the past four years we have studied bat activity using acoustic surveys within fragmented urban woodlands, along urban waterways, and within urban gardens at both local and landscape scales across the U.K. Pipistrelle bats (*Pipistrellus pygmaeus* & *P. pipistrellus*) were the most frequently recorded and widespread of all British bat species. We found that even those bat species considered to be relatively well adapted to city living were negatively affected by high concentrations of built environment. In this talk, using bats as an example, we discuss why common species merit our attention and conservation effort within cities and recommend management strategies at multiple spatial scales to protect and improve urban habitats for their benefit.

CONSERVING SIBERIAN CRANES IN CHINA THROUGH SUSTAINABLE WATER MANAGEMENT

Chunyue Liu

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Hongxing JIANG, Research Institute of Forest Ecology, Environment and Protection, Key Laboratory of Forest Protection of State Forestry Administration, Chinese Academy of Forestry

Siberian Crane is the world's third rarest crane, and listed in the IUCN Red List as a critically endangered species. The total population is estimated at 3,500 birds, of which approximately 98% belongs to the East Asian population. The Momoge National Nature Reserve, listed in Ramsar international important wetlands in 2013, is the most important stopovers along the eastern flyway. The Momoge NNR is the alluvial area in the lower reaches of Nenjiang River, which is in the semi-arid area of western Songnen Plain in Jilin Province, Northeast China. Since 2007, over 80% world population of Siberian Cranes used the Etoupao area for about 1.5 months during each migration season, which is the study area covering less than 5000 hectares in the middle of Momoge. With lack of effective water management, the crane distribution and populations are instable and changeable in this region. Predictions indicate that this region is sensitive to climate change, with conditions expected to become hotter and drier. To increase the resilience of wetland biodiversity, especially Critically Endangered Siberian cranes and other threatened waterbirds at Momoge NNR through sustainable and participatory water management practices that respond to increased water variability under the influences of human pressures and climate change. The presentation will show the achievement about strengthen conservation at Momoge by developing climate change adaptation plans, supported by a range of other activities including applied research at



these and nearby sites. The presentation will also demonstrate climate change adaptation to secure key conservation values and livelihoods for local communities, alleviating conflicts that impact wildlife and people, and helping local people to identify economic options less vulnerable to climate variability, thus better able to sustain local resources.

COMMUNITY-BASED HUMAN-WILDLIFE CONFLICT MITIGATION: A SUCCESSFUL CASE FROM WOLONG NATURE RESERVE, CHINA

Wei Liu

Human and Environment Linkage Programme
Beilu DUAN, Human and Environment Linkage Programme ; Meng MING, Human and Environment Linkage Programme

Human-wildlife conflict is a major threat to global biodiversity conservation. As a “public bad”, human-wildlife conflict cannot be effectively and sustainably mitigated without active participation of the affected communities. Here we report a successful case of community-based human-wildlife conflict mitigation from Wolong Nature Reserve, China, located in the SW-China Mountains global biodiversity hotspot. Wolong is most famous for hosting the largest wild panda population in China and is also home to ~5,000 local farmers. Crop raiding by wildlife was pervasive and remained unsettled by the government due to financial and policy limitations. Local people took various measures to protect croplands and/or scare crop raiders away. Almost all measures turned to be ineffective and caused additional problems, with some dangerous for people and livestock and others illegal and threatening wildlife and forests. To tackle this issue, wired fences were introduced to the reserve to mitigate human-wildlife conflict. We compared crop raiding impacts in three local communities - ZJL, ZMS and CBY, where fences were installed in ZJL by the government (in 2012) and in ZMS by us (in 2013) with intensive involvement of community members. We conducted baseline and follow-up surveys on household losses and attitudes. In 2013 Crop damages in ZMS (~5%) was much lower than ZJL (~24%) and CBY (~35%). We also found a range of indirect benefits and an improvement in community members’ attitude toward conservation. Through field surveys and habitat assessment we determined that the potential impacts of the fences on wildlife at landscape scale was not significant. Local government has recently provided fund to scale up the ZMS experience to the whole reserve. Applying Ostrom’s design principles in common pool resources management, we further discuss the importance of community participation and cross-sector partnership in mitigating human-wildlife conflicts.

SEASONAL ACTIVITY PATTERNS OF UNGULATES IN QINLING MOUNTAINS BASED ON CAMERA-TRAP DATA

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Between August 2009 and April 2013, in Guanyingshan Nature Reserve, Shaanxi, China, we collected photo data on six ungulates (*Budorcas taxicolor*, *Naemorhedus griseus*, *Elaphodus cephalophus*, *Capricornis milneedwardsii*, *Muntiacus reevesi* and *Moschus berezovskii*) with 18 infrared cameras. Using the relative abundance index (RAI), we analyzed their activity patterns and seasonal differences. The results show that: (1) the total RAI reaches 58.71%, the RAIs were 28.02% for *B. taxicolor*, 13.24% for *N. griseus*, 10.08% for *E. cephalophus*, 4.21% for *C. milneedwardsii*, 2.26% for *M. reevesi*, and 0.90% for *M. berezovskii*. (2) The monthly RAIs (MRAI) of six ungulates reflected seasonal activity patterns. *B. taxicolor*, *N. griseus*, *E. cephalophus*, *C. milneedwardsii*, *M. reevesi* show similar patterns, which were most active in summer, inactive in autumn and winter, and then active again in spring. In reverse, *M. berezovskii* was most active in winter and least active in summer. (3) The time-period relative abundance indices (TRAIs) of six ungulates reflect their daily activity patterns. *B. taxicolor* and *N. griseus* have similar daily patterns with a peak at 06:00-20:00, while *E. cephalophus*, *M. reevesi* and *M. berezovskii* show obvious crepuscular habits. *C. milneedwardsii* has two peaks at 02:00-06:00 and 20:00-22:00 implying nocturnal activities. (4) Comparison of daily activity patterns among four seasons show that *B. taxicolor* display a different pattern in spring with a peak at 16:00-20:00. Compared with other seasons, *N. griseus*, *E. cephalophus* and *C. milneedwardsii* have different patterns in winter with either a delayed or advanced activity peak. For *M. reevesi*, spring daily activity patterns showed two peaks at 00:00-10:00 and 18:00-20:00. Camera trapping data analysis help us to understand the activity patterns of these ungulates in Qinling and to provide a theoretical basis and data support for the nature reserves to protect these ungulates efficiently.

76: EVALUATING THE IMPACT OF SPECIES-BASED INTERVENTION: THE CONTRIBUTION OF REINTRODUCTIONS TO SPECIES RECOVERY.

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Humans have been moving species around the planet for millennia. Reintroductions, as a species conservation tool, have been constantly increasing in frequency within the last few decades and the science around translocations is constantly improving. As such, species reintroductions are now a ubiquitous tool within the discipline of conservation. The global use of reintroductions is reflected not only in terms of the scientific literature but also in terms of the number of applied conservation translocation programs. As this species-specific, intensive management technique is implemented in more and more places around the world, the taxonomic diversity benefiting is also ever-increasing. However, conservationists repeatedly state that reintroductions often fail, citing papers from over a decade ago. We challenge this view as being outdated, and pose the question how successful are reintroductions as a conservation strategy? Intriguingly, recent studies are revealing positive outcomes from reintroductions both on a local and global scale. We suggest that reintroductions are frequently successful and have made a real impact for species recovery and often for the restoration of ecological function. Given the improving science and impact of reintroductions, we attempt to delineate the potential role that conservation translocations can play in addressing new or accelerating threats to biodiversity.

ID163 THE IMPORTANCE OF FOREST AND TREES FOR ECOSYSTEM-BASED ADAPTATION IN RURAL LANDSCAPES

Bruno Locatelli
CIRAD-CIFOR

Ecosystems provide important services that can help people adapt to climate variability and change. Scientific literature provides evidence that EBA with forests and trees can reduce social vulnerability to climate hazards; however, uncertainties and knowledge gaps remain. Pilot projects under implementation also provide information on EBA and can serve as learning sites. Based on different sources of information from scientific literature and experiences on the ground, we discuss the potential of forests and trees for EBA in several cases: forests and trees providing goods to local communities facing climatic threats; trees in agricultural fields regulating water, soil, and microclimate for more resilient production; forested watersheds regulating water and protecting soils for reduced climate impacts; forests protecting coastal areas from climate-related threats; and forests regulating rainfall at the regional or continental level. We discuss uncertainties, knowledge gaps

and controversies regarding EBA. We show that uncertainties are important for adaptation based on the regulating services of forests and trees for protecting watersheds and coastal areas and regulating regional rainfall. The multiple benefits of EBA for biodiversity conservation and climate change are also well recognized but trade-offs exist between ecosystem services or between their beneficiaries. Better understanding is needed of the efficiency, costs, and benefits, and trade-offs of EBA with forests and trees.

THE IMPORTANCE OF BIODIVERSITY FOR MULTIPLE ECOSYSTEM FUNCTIONS IN A HUMAN-MODIFIED TROPICAL LANDSCAPE

Madelon Lohbeck

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Lourens POORTER, Wageningen University ; Miguel MARTINEZ-RAMOS, Centro de Investigaciones en Ecosistemas ; Frans BONGERS, Wageningen University

Biodiversity loss is expected to have large negative consequences for ecosystem functioning. Biodiversity is thought to be especially important for the multifunctionality of ecosystems, as different species contribute to different functions, but support for this idea comes mainly from experimental studies. We evaluated the importance of biodiversity for multiple ecosystem functions in a human-modified tropical forest landscape in Chiapas, Mexico. We quantified five key ecosystem functions (standing above-ground biomass, biomass productivity, litter production, wood decomposition and litter decomposition) at the landscape level, and evaluated to what extent individual species contribute to these functions. The species that contributed most to the different ecosystem functions were largely the same small set of dominant species, indicating a limited role of biodiversity for ecosystem multifunctionality. The use of simulations enabled teasing apart the relative importance of species richness, species dominance and species functional traits, and demonstrated that only when minimizing dominance do different species (with different functional traits) contribute to different ecosystem functions. The present study, like most studies on biodiversity-ecosystem functioning, focuses on a narrow range of (biogeochemical) functions. Future studies should address the consequences of biodiversity loss on ecosystem multifunctionality in natural ecosystems, including a wide range of ecosystem functions.

NATURETRADE: CREATING A MARKETPLACE FOR ECOSYSTEM SERVICES

Peter Long

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Marc MACIAS FAURIA, *University of Oxford*; Alistair YEOMANS, *Sylva Foundation*; Richard PIGGOTT, *Sylva Foundation*; Gabriel HEMERY, *Sylva Foundation*; Kathy WILLIS, *University of Oxford*

In spite of their importance in sustaining human well-being, ecosystem services have not commonly been an object of private-market transactions owing to intrinsic market failures such as lack of information and high transaction costs. Naturetrade is a tool to, where possible, overcome these market failures - allowing private markets for ecosystem services to develop, while simultaneously supporting improved ecosystem service provision. Naturetrade is a free, easy-to-use, web-based, ecosystem service mapping tool and trading platform that will enable European landowners to measure the ecosystem services provided by their lands, and facilitate beneficiaries of ecosystem services to contract with landowners for the continued and enhanced provision of these services. The tool is based upon assimilation of high resolution satellite data and environmental modelling to allow the state of the environment to be characterised at 30m resolution every 3 months. The ecosystem services include; water flow regulation, crop pollination, soil erosion protection, carbon in above-ground biomass, and recreational amenity. www.naturetrade.net

SYMPOSIUM # 20: INTEGRATED NON-INVASIVE HEALTH-MONITORING FOR DISEASE RISK ANALYSIS IN WILD APES

Elizabeth Lonsdorf

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Disease and other health hazards pose serious threats to the persistence of wild ape populations. The total chimpanzee population at Gombe National Park, Tanzania has declined from perhaps 120-150 in the 1960's to around 100 by the end of 2013, with death associated with observable signs of disease as the leading cause of mortality. Moreover, this park contains the only habituated population of chimpanzees in which individuals are positive for Simian Immunodeficiency Virus (SIVcpz), which has a substantial negative impact on the health, reproduction and survival of wild chimpanzees. In 2004, we began a non-invasive health-monitoring program in the two habituated communities in the park to 1) determine the population prevalence of clinical signs of ill health, 2) institute non-invasive diagnostics for pathogen identification, and 3) determine potential routes of transmission and methods of disease risk mitigation. Observational health data

is collected in a standardized format on known individuals during focal follows conducted by Tanzanian field staff. Non-invasive diagnostic sampling includes parasitology, virology, bacteriology, endocrinology and histopathology, making the Gombe chimpanzee population one of the best-studied in terms of both behavior and disease. Our work highlights the need for a large, collaborative team and long-term data to fully understand and mitigate the impacts of disease for wild ape populations.

TOWARDS IMPLEMENTATION OF A GLOBAL PLAN OF ACTION FOR CONSERVATION, SUSTAINABLE USE AND DEVELOPMENT OF FOREST GENETIC RESOURCES

Judy Loo

Bioersivity international

For the first time a Global Plan of Action (GPA) prioritizing conservation of forest tree genetic diversity has been developed (FAO 2013) and widely endorsed by most of the world's countries. Among the 27 Strategic Priorities for Action (SPs) listed in the GPA, 12 of them, such as "Strengthen the contribution of primary forests and protected areas to in situ conservation of FGR", have a specific focus on conservation. Notwithstanding the value of regional and international support, if the SPs are to be achieved, most of them must be implemented at the national or sub-national levels. Historically, little attention has been paid to genetic diversity in the design of forest conservation strategies or guidelines; even when developing conservation plans for tree species at risk, genetics has not generally been considered. How can these SPs that concern the conservation of tree genetic diversity be achieved without adding unrealistic cost and complexity to conservation plans and actions? To address this implementation challenge, we suggest that demystification is needed and conservation practitioners must understand basic principles of population genetics. Furthermore we recommend that measurable proxies for genetic diversity be integrated into protected area monitoring and inventory schemes.

LIVING WITH PREDATORS: ANTHROPOLOGICAL APPROACHES TO IBERIAN LYNX REINTRODUCTION

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Clara ESPIRITO SANTO, *CRIA-FCSH*; Amélia FRAZÃO-MOREIRA, *CRIA-FCSH*

Reintroductions of species are opportunities to apply a multidisciplinary approach to conservation, including anthropology. We are studying the return of the most threatened felid in the world to Portuguese natural areas, concerning attitudes of local people towards the process of



reintroduction and perceptions about lynx and carnivores. Results of ethnographic work and 95 semi-structured interviews reveal claims for economic compensation and guarantee of wild rabbit abundance, the main prey of the lynx. However, advantages of the reintroduction were indicated by informants, including the chance of saving the species, ecological equilibrium and a distinctive value for the territory. There is an association between restriction of human activities and species conservation, being a reaction to one idea of "natural parks" and "restored natural ecosystems" where wild animals are released and there might be no place for humans. This case study reveals a European rural context where human-environment interactions are changing rapidly: stakeholders have low scientific knowledge about lynx but local ecological knowledge subsists in 'specialists'. Local discourse is dominated by the idea of nature as a commodity, and conservation projects are viewed ambivalently. The lynx is admired and associated with exotic wild felids but living with predators is still a nuisance as they are competitors for game species. Stakeholders request more information from the administration on this theme but more involvement and participation is recommended. Qualitative analysis can be explored for the design of communication material and the identification of key issues indicated by stakeholders towards conservation processes for example we used data on lynx local memory in a public exhibition about the species. Anthropological approaches provide insights into the complex social representations which are built around species and nature conservation.

GENETIC RESTORATION FOR THE RECOVERY OF THE IBERIAN LYNX (LYNX PARDINUS) POPULATION IN DOÑANA, SW SPAIN

Guillermo López

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The steep decline suffered by the Iberian lynx in the second half of the 20th century left two isolated populations in Doñana and Eastern Sierra Morena, with 42 and 60 total individuals (nine and 18 territorial females), respectively, in 2002. Previous studies revealed a pattern of low diversity - both for microsatellite markers and MHC genes -, high inbreeding and strong differentiation. Signs of genetic erosion were especially evident in the Doñana population, and genetic and survival and reproduction parameters became concomitantly deteriorated there. These circumstances prompted the implementation of a genetic management program aimed

at mitigating the effects of genetic erosion in the Doñana population. A total of six lynxes from the Eastern Sierra Morena population were released in Doñana in the period 2007-2012. Successful reproduction of two of the six translocated lynxes and their descendants has resulted in higher microsatellite diversity and lower differentiation between populations. The introduction of novel alleles has also alleviated the lack of MHC variation that might have been limiting immune response. The restoration of genetic diversity has been accompanied by an improved reproductive output, and no outbreaks of infectious diseases have been detected since 2007. The productivity of admixed males was significantly higher than that displayed by pure males, while survival was unaffected by the genetic ancestry of the individuals. The genetic reinforcement of the Doñana lynx population provides an example of successful integration of conservation genetics into conservation practice.

ARE CHEF'S UP TO THE TASK? BRINGING SUSTAINABLE SEAFOOD TO THE TABLE

Rocio Lopez De La Lama

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Gastronomy is the main expression of our relationship with nature, which determines our wellbeing. Nowadays, Lima (Peru) is being recognized as the culinary capital of Latin America, thanks to its diversity of ingredients and variety of local cooking practices, mainly seafood. For thousands of years seafood has been the main resource for coastal development, and the reason behind the maritime foundation of Andean civilization. The recent culinary boom has created a constant and high demand of resources that has itself triggered a growing socio-economic force. This new market situation benefits many poor people, especially fishermen and farmers, for whom gastronomy is the perfect opportunity to increase their incomes and raise out of poverty. However, seafood is the last wild resource we take advantage off and special regulations must be implemented in order to assure sustainability. Involving key stakeholders related to gastronomy and seafood is crucial for effective coastal and marine stewardship and to secure the sustainability of marine resources' use. In order to reach a sustainable use of seafood, it is crucial to determine the knowledge and comprehend the attitudes and practices of the related stakeholders. Therefore, this study delivers the first baseline of knowledge, attitudes and practices of chefs towards marine ecosystems and seafood choices in Peru. This baseline enable us to identify information gaps, attitudes and misconceptions in daily practices of chefs and their relationship with seafood, information that can then be linked to ongoing campaigns or use to develop strategies seeking to increase the knowledge of, or change behaviors directed to; marine ecosystems and their resources in Peru. The long lasting idea is to forge a community of citizens that care



for their environment, empowered to start participating in the appropriate management of the marine ecosystem.

MANGROVE-HUMAN INTERACTIONS: HISTORICAL INSIGHTS, CURRENT STATUS AND PERSPECTIVES IN THE TROPICAL EASTERN PACIFIC

Juliana Lopez-Angarita

University of York

Alex TILLEY, Fundacion Talking Oceans ; Richard COOKE, Smithsonian Tropical Research Institute ; Callum ROBERTS, University of York

From the subsistence economies of early native pre-Columbians to the globalized world, mangroves have played an important role for the development of human society. More than 90% of the world's mangroves are located in developing countries, where rates of destruction are growing rapidly at large scales. In order to design effective conservation strategies for mangrove management, it is critical to understand the natural and anthropogenic dynamics of these coastal wetland habitats. In this work we use retrospective techniques to reconstruct mangrove forest history in the Tropical Eastern Pacific, exploring the change in attitudes towards mangroves and uses through time. We examine available historical estimates of mangrove area and evaluate the representation of mangroves in the protected area systems of Costa Rica, Panama, Colombia and Ecuador, examining existing policies regarding mangroves. Archaeozoological evidence shows that mangroves were exploited for many thousands of years by pre-Columbian societies. Unsustainable, post-conquest deforestation prevailed during the next 400 years. Since 1990, despite increasingly positive attitudes towards mangroves and their inclusion in protected areas systems and conservation policies, mangrove cover has continued to decline. Historical ecology provides an insight into the evolving uses and attitudes towards mangroves in relation to their decline in the region, generating important lessons that should be taken into account in decision making. This study represents an important step towards promoting regional strategies for mangrove management as it generates a better understanding of the underlying drivers of mangrove decline in the Tropical Eastern Pacific. Given the myriad negative consequences of mangrove loss recorded worldwide, countries of this region need to strengthen their protection systems, taking into account the importance of mangroves for local livelihoods.

EXPLORING THE RELATIONSHIP BETWEEN LAND-BASED ACTIVITIES, MANGROVE HEALTH AND FISHERIES STATUS IN A RAMSAR WETLAND

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Despite improvements in mangrove protection in recent decades, mangrove area keeps declining globally. Mitigating the loss of these ecosystems and maintaining their ecological functionality is imperative for many communities that depend on the multiple ecosystem services provided by mangroves. In developing countries, where rates of mangrove deforestation are high, poor coastal communities present a high dependence on mangrove products and services for their livelihoods. In the Pacific coast of Panama, where mangrove forests are abundant in estuaries, communities rely on artisanal fishing as their primary economic activity. However, land based economic activities such as agriculture; impose a threat to mangroves health. We examined the effect of land based impacts (agriculture, aquaculture and towns) on mangrove forests in the Gulf of Montijo, an important protected area and RAMSAR wetland located on the Pacific coast of Panama, with the purpose of identifying the state of this ecosystem and its relationship with the productivity of artisanal fisheries of the area. Using satellite images, interviews with locals and fisheries landings information, we constructed a spatial model of cumulative impacts. Results showed that in spite of the protection status of the Gulf of Montijo, mangrove forests are being affected by the agricultural activities taking place around them, compromising the health of these ecosystems. The most productive fishing grounds were located further away from towns and close to mangrove islands where impact from the mainland is low. This work shows the relevance and utility of incorporating publicly available satellite images into impact assessments to aid in marine spatial planning and protection of key coastal habitats.

TOWARDS COLLABORATIVE WORK BETWEEN SCIENTISTS, MANAGERS AND STAKEHOLDERS FOR CONSERVATION OF HUASCARÁN NATIONAL PARK (PERÚ)

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Perú is one of the 17 megadiverse countries in the world. To preserve its ecosystems and the services they provided, 17% of Peruvian territory has been declared as protected area. The protected territory is organized as a National Network that includes the most representative ecosystem of the country. This Network includes 77 protected areas with different level of legal protection. In the last decades, they are under increasing human pressure, and therefore its conservation could be at risk. In this context, effective management actions based on the best knowledge and adaptive governance are highly demanded. Science-Policy Interfaces (SPIs) represent an excellent tool to face this challenge. SPIs are social processes used to open frontiers between scientists, stakeholders and managers for addressing environmental issues collectively, but their use in the context of conservation biodiversity it is still scarce. With the aim to enhance the decision-making process in protected areas of Perú, we developed a SPI process in Huascarán National Park. This is one of the best samples of tropical glaciers ecosystems in the world, and climate change is affecting the development and welfare of human populations that directly depend on National Park ecosystems. To develop the SPI experience, we founded a community of practice integrated by scientists, stakeholders and managers, and launched co-learning and knowledge co-production processes between them. A knowledge brokering approach and the use of a graphical tool help us to clarify the roles involved in the collective actions, to facilitate mutual understanding, and to promote a culture of shared responsibility between social actors involved. 18 collaborative actions to address sustainability in the National Park were achieved by community of practice. In addition, the goal to continue with the collaborative work in the long-term was considered essential for dealing with environmental problems related to park conservation.

DISPERSAL RATES OF BIRD SPECIES AFFECT UNEQUALLY THEIR RESPONSES FACE THE GLOBAL CHANGES

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Biodiversity is threatened by numerous environmental changes among which land-use and climate changes. The consequences of global changes on birds community dynamics include polewards range shifts and declines of abundances, particularly for specialist species compared to generalist species. The viability of birds meta-populations depends largely on their ability to disperse. The present study investigates how dispersal

ability influences species viability in the context of global changes. We propose a multi-species and meta-population model where dynamics depend on both climate and land-use drivers. We used data from a large scale Breeding Bird Survey over Metropolitan France monitoring 37 species (farmland specialist species and generalist species). At the national scale and for each species, this model makes it possible to estimate values of dispersal rate. These dispersal rate are important parameters to explain variations of population abundances, i.e. including dispersal ability and abundances of neighbouring populations significantly improved the fit of the model when compared to a model including only climatic and land-use variables. We found a significant unimodal relation between habitat specialization of species and their dispersal rate (dispersal rate has a maximum for an intermediate specialization) interpreted as a trade off between the risk to fail to find a suitable habitat and the necessity to disperse to these habitats. In terms of meta-populations trends, this results in dispersal rate having no influence on specialists populations trends while there is a positive correlation for generalists. Using large scale empirical data, this is the first study showing the extent to which dispersal promotes species viability and how specialization to habitats restricts this capacity. Levels of dispersal can thus have a strong influence on the reshuffling of species communities, and should be taken into account in models predictions such as niche modeling.

IMPACTS OF WATER USE AND GLOBAL CLIMATE CHANGE ON AQUATIC VERTEBRATE BIODIVERSITY IN THE DRAA BASIN, SOUTHEASTERN MOROCCO

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The Drâa valley in southeastern Morocco is one of the 10 most arid watersheds on earth. The valley is also an area of rich cultural diversity and home to an estimated 750,000 people who earn a living from this fragile desert oasis. Yet, it is under threat from human encroachment and global climate change. In this area, dry periods frequently eliminate superficial flow, alternating with violent flash floods. In addition, a major dam was constructed upstream in 1972 and river flows are now severely constrained as water is held back for human use. The trend of increasing aridity and anthropogenically mediated salinisation strongly aggravates the already severe human impact on the aquatic biodiversity. Using ecologically relevant bioindicators allows highly sensitive insight into this rapidly changing ecosystem. In this study, we investigated the distribution, abundance and tolerance capacities of some



aquatic vertebrates and their relationship with and salinisation in the main river basins draining arid areas of the Draa basin, based on field sampling and experimental tests. We inventoried 13 species including 7 native fish (2 relict cichlids: *Coptodon zillii* and *Oreochromis aureus*; 4 cyprinids: *Luciobarbus* spp. and 1 salmonid: *Salmo trutta*), 4 anuran amphibians (*Pelophylax saharicus*, *Barbarophryne brongersmai*, *Bufo* *boulengeri* and *Amietophrynus mauritanicus*), a water snake (*Natrix maura*), and the Blue-eyed Pond turtle (*Mauremys leprosa saharica*), with a variable salinity tolerance affecting their presence and abundance in the water bodies. During dry periods, most populations are fragmented into widely separated pools of water in an intermittent and increasingly brackish to saline waters. Long periods of high salinity revealed to be likely to adversely affect some taxa, such as turtles, exposed to severe dehydration and/or osmotic stress. Consequently, populations of some species are on the verge of extinction and require that they should be given full protection.

MODELING THE RECOLONIZATION OF A LARGE CARNIVORE USING OPPORTUNISTIC DATA.

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Most large carnivores are facing high extinction risks due to harvest or deterioration of their habitat. Because predators and men exploit the same resources, their management is a great challenge involving opposite conservation vs economic objectives. In this context, assessing large carnivores' range dynamics is needed for decision makers to delineate zoning areas where a species is protected or predict areas with high risks of conflicts due to attacks on cheptel. However, monitoring the distribution of large carnivores is notoriously difficult due to their elusive behavior and their tendency to occupy large areas at low density. Across Europe, several countries have set up networks of observers to cope with these difficulties by collecting signs of presence of large carnivores. However, when mapping species distribution, the analysis of opportunistic data raises several issues due to the absence of standardized protocols. In particular, a greater observation effort can lead to more signs of presence independently from the actual species distribution. Therefore, ignoring uneven observation effort can lead to biased inference about the ecological state variable of interest. We assessed the spatial dynamics of wolf (*Canis lupus*) in France that has been recolonizing the country since the early 90's. We used 20-year non-invasive survey of geo-referenced signs of presence. We quantified the variability in the observation effort by i) estimating the spatial density of observers over time and ii)

accounting for heterogeneous recording effort by stratifying the observer prospection range according to professional activities. We then used dynamic occupancy models to assess the range dynamics of the species while accounting for imperfect species detection. Our results emphasize the importance of carefully characterizing the observation effort when mapping species distribution. Our approach has the potential to serve as a tool to predict human-wildlife conflicts.

90. CAN THE GROWING OF TRANSGENIC MAIZE THREATEN PROTECTED LEPIDOPTERA IN EUROPE?

Gabor L. Lövei

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Niels HOLST, Aarhus University ; Andreas LANG, Buero Lang

The large-scale growing of transgenic GM maize in North America seems to have created serious problems for the migratory lepidopteran, the monarch butterfly (*Danaus plexippus*), a unique species and conservation icon. In Europe, transgenic GM maize is one of the few crops authorised for commercial cultivation, although the acreage devoted to GM maize is not extensive. We used our earlier modelling results concerning the threat to the peacock butterfly (*Inachis io*) which indicated that in several areas of Europe, this species could be under threat by GM maize growing. We checked the larval phenology to identify other protected European butterflies that can be under threat due to phenological overlap. Additionally, we analysed the spatial distribution of maize growing and the distribution of protected areas in Europe, based on the Natura 2000 protected area network. The landscape analysis indicates that insect-resistant GM maize does pose a threat to several protected European lepidopteran species via maize pollen deposition on their food plants. The possible future spread of herbicide-tolerant maize poses an equal or even larger threat, which can be mitigated by careful landscape management. Special attention needs to be devoted to Eastern and South-eastern Europe, as they contain a large share of the European biodiversity of agricultural landscapes.

THE INFLUENCE OF MICROCREDIT-FUNDED BUSINESSES ON HUMAN WELFARE AND BUSHMEAT CONSUMPTION AMONG COMMUNITIES IN SERENGETI, TANZANIA

Asanterabi Lowassa

TAWIRI

Abuu MVUNGI, University of Dar es Salaam ; Loiruck NAIMAN, Frankfurt Zoological Society ; Andrea WALLACE, Frankfurt Zoological Society ; Anke FISCHER, Frankfurt Zoological Society

Bushmeat is harvested illegally in western Serengeti, Tanzania to provide cash and protein. Recently, microcredit-funded business have been initiated in Serengeti as an intervention that integrates conservation aims and human development



needs, to curb illegal bushmeat hunting and improve human livelihoods. The credit scheme aims to facilitate income generation to make local residents less dependent on bushmeat hunting. Our study investigated the impact of microcredit-funded business on the number of bushmeat meals consumed and perceived wellbeing of a household by using a quasi-experiment, comparing households from the same villages who had ($n=63$) and those that had not ($n=58$) participated in the microcredit scheme. The comparison focused on (a) the sources and amounts of protein consumed, as reported in a dietary recall exercise and (b) self-reported wellbeing and uses of the loans. Data was collected on a monthly basis over a 10 months-period. Results suggested that on average, households participating in the microcredit scheme consumed significantly less bushmeat than those not participating. Credit-takers tended to consume more non-bushmeat protein meals (such as beef, fish or chicken) than non-credit takers. Loans were found to improve household welfare by covering costs of, for example medical care, schooling and modernised housing. Approximately fifty percent of credit-takers established a small business, but most of these businesses were not able to sustain themselves due, not least, to the limited credit-size and a short period until repayment was due. We conclude that longer runtimes for credits and the provision of accessible advice for credit-takers could increase the sustainability of these businesses. In addition, facilitation of marketing the products would raise the impact of the microcredit scheme, thereby improving both livelihoods and wildlife conservation.

THE ROLE OF LOCAL KNOWLEDGE IN YANCHENG NATIONAL NATURE RESERVE MANAGEMENT

Yuan Lu
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Nature reserve is considered to be a good way to preserve biodiversity and natural ecosystems. However nature reserve is constantly facing economic development pressure from surrounding communities. Co-management is sometimes considered as a solution for both conservation and community development. According to literature, local knowledge (LK) can play an important role in co-management of nature reserve, but there are very few such studies in China. In order to fill the gap, the researcher chose Yancheng National Nature Reserve (YNNR) to carry out the research because it is the first and largest tidal flat nature reserve in China to protect rare migratory birds and their habitats. It is also an international biosphere reserve and a wetland of International Importance. The aim of the research is to find out if there are any LK useful for the management of the reserve and what are the challenges of and opportunities for the integration of LK into co-management of YNNR? Through more than a

month's on-site observation, semi-structured interviews with local people, nature reserve staff and scientists, the research found out that although the locals have detailed knowledge about fishery, farming, salt production and reed production, they have very limited knowledge concerning birds and their habitats. Such lack of knowledge undermined their ability to cooperate with the nature reserve for conservation. Additionally, most interviewees considered development is contradictory to conservation, because most developments are at the cost of environmental degradation. In order to achieve conservation goals, the higher level government must change their perception of development, and shift the GDP oriented economy to eco-oriented economy.

URBANIZATION INCREASES HONEYBEE SURVIVAL AND HONEY PRODUCTION

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In a context of global enthusiasm for urban beekeeping, cities are seen by many as a new haven of peace for honeybees, where floral resources are abundant, diversified and mostly pesticide-free. Initiated by beekeepers and fuelled by media, the idea that honeybees do better in urban areas than in the surrounding countryside has largely spread, but was never scientifically addressed. Based on data from 428 apiaries located in and around Paris metropolis, we studied the effect of urbanization on winter mortality and honey production. We found that urbanization decreases mortality and increases honey production, an increase that appears to be unrelated to urban floral resources.

CARNIVORE MANAGEMENT IN WESTERN-CANADA: PERCEPTIONS OF A LETHAL MANAGEMENT PARADIGM

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Attitudes towards large carnivores across much of the world have historically been fear-based, with elimination of these species from the landscape desirable. Research in the last century has underscored the vital role large predators play in ecosystem diversity and stability. With this understanding and the rise of the environmental movement, there has been a shift towards accepting, protecting, and re-introducing these species. Contemporary studies in Europe highlight context-specific management strategies that prioritize traditional and nonlethal tools, which foster coexistence between humans and large carnivores, even in human-dominated



landscapes. In Western Canada, management practices remain predominantly lethal (e.g. culls, poison, trapping) and prioritize human interests (e.g. livestock protection, large game populations) over other species. These anthropocentric views are increasingly rejected by citizens and scientists. The reason for this disconnect between science and practice is unclear and the focus of the present research. Wildlife managers from Alberta, British Columbia, and Northern Canada were interviewed to determine their personal perspectives and professional experiences with carnivore (i.e. wolf, cougar, and coyote) management. Transcribed interviews were coded in NVivo 10. Initial results showed that participants had scientific training and valued implementation of scientific knowledge. Perspectives on the role of hunting varied, but a general focus on population numbers over individuals or packs, and avoidance of ethical discussions was common. Also expressed was a sense of 'making the best' of a difficult political climate, where managers have little power to limit recreation and industrial activities. Implications of the political climate and perspectives of managers on the health of our ecosystems will be discussed, as well as a comparison of the North American versus European approach to carnivore management.

EFFECT OF THE CATTLE PRESENCE ON TEHUANTEPEC JACKRABBIT (*LEPUS FLAVIGULARIS*) MICROHABITAT SELECTION IN EFFECT OF THE CATTLE PRESENCE ON TEHUANTEPEC JACKRABBIT (*LEPUS FLAVIGULARIS*) MICROHABITAT SELECTION IN SOUTHERN OAXACA, MÉXICO.

Alma Luna

Universidad Autónoma de Nuevo León
Tamara Rioja, Universidad de Ciencias y Artes de Chiapas ; Laura SCOTT, Universidad Autónoma de Nuevo León ; Arturo CARRILLO-REYES, OIKOS: Conservación y Desarrollo Sustentable, A.C.

For the first time we determined whether the presence of cattle has any effect on microhabitat use (feeding and resting sites) of the Tehuantepec Jackrabbit (*Lepus flavigularis*), an endangered endemic species from Oaxaca, Mexico. Currently, the major risk to this lagomorph is due to the intense habitat fragmentation (livestock, agriculture, urban development) and poaching. Between November 2013 and December 2014, 21 adult radio-collared jackrabbits were monitored in pastures with and without cattle at Santa Maria del Mar, Oaxaca, México. We located every radio-collared jackrabbit in 8 day tracking periods, recording 12-18 positions per jackrabbit. Locations were registered every 15 minutes. We registered that the Tehuantepec jackrabbit prefers to set its feeding sites ($\lambda=0.8010$, $p=0.0020$) and its resting sites ($\lambda=0.6605$, $p=0.016$) in pastures with cattle presence. Probably the Tehuantepec jackrabbit is favored by the presence of cattle because this

is conditioning the existence of certain plant species that could serve as food source for the jackrabbit, through the establishment of seedlings from excreta cattle. Also, pastures with cattle have the appropriate conditions for the resting sites establishment due to the open and short grass areas, which allows *L. flavigularis* to detect the presence of predators (feral dogs, snakes, eagles) as already reported. Understanding the relationship between livestock and the Tehuantepec jackrabbit population dynamic is critical for conservation efforts for this endangered leporid.

TWO SPECIES OF POISON FROGS AND SUSTAINABLE AGRICULTURAL PRACTICES, AN ALTERNATIVE FOR THE CONSERVATION OF THREATENED AMPHIBIANS IN COLOMBIA.

Victor F. Luna-Mora

Natural Heritage Foundation [INSTITUTE] University of Tolima
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Tolima's poisonous frog (*Andinobates tolimensis*) and dotted frog (*A. dorisswansonae*), are two endemic species, sympatric and in endangered extinction; due mainly to the impact of agricultural activities unsustainable like extensive animal breeding, exotic tree crops and the influence of coffee dominant crop in the región which since 90's has cause an accelerated destruction of original ecosystems. In consequence, the rural landscape is dominated by coffee crops, pastures and subandean forest patches highly fragmented and isolated. Before restricted potential habitats distribution and farmers precarious social-economic conditions, as a result of deep agricultural crisis in Colombia, which increases ecosystems threats and pressures, species and their ecological process, Coffee Friend of Tolima's poisonous frogs appears like an initiative that has been constructed with an active participation of local communities, in search of viable economic options, defense of territory, food sovereignty and protection of natural resources. Additionally, this initiative has three major components: participative research, education and training, which have led to progress in this long process is just beginning, learning and unlearning through mistakes committed, with the firm conviction that "working together can go further". An initiative gaining strenght among communities who have learned about the process, it's the generation of a environmental friendly label with frogs, that currently conducts Fundacion Herencia Natural, for provides standards of protection and responsible use of wáter sources, riparian forests and associated biodiversity crops. This will allows a farmer's life quality improvement and will generate conservation agreemets to protect and renovate andean forest remnants; thus, a flagship product of colombian economy like coffee is, carries a message from Andean mountains to



the world regarding biological protection and a sustainable development of a small coffee area.

DIFFERENT FLAGSHIP STRATEGIES - SHOULD WE USE FLAGSHIP SPECIES OR FLAGSHIP FLEETS IN BIODIVERSITY CONSERVATION?

Piia Lundberg

University of Helsinki

Annukka VAINIO, Natural Resources Institute Finland (Luke);

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Flagship species are species that manage to capture the attention of the public, and are mostly used by non-governmental organizations to raise funds and conservation awareness. They are usually charismatic species, mainly large vertebrates, where the tiger and the giant panda are unquestionably the most well-known and iconic flagship species. Although charismatic high-profile species may manage to attract more funds, they may not be the ones of highest priority from a broader biodiversity conservation perspective because of inadequate ecological surrogacy power. Still funds may be earmarked to protect solely those species, which highlights the need to evaluate the cost-effectiveness of flagship species. The aim of this study is to improve the use of flagship species in biodiversity conservation. We evaluated with a willingness-to-pay (WTP) study the effectiveness of different types of conservation flagships in fundraising. We focused on birds and mammals, and covered strategies from use of single flagship species to flagship fleets (a set of charismatic species), compared with using habitat types or generic "biodiversity conservation" in fundraising. We also evaluated whether the information given on the intended use of the donation influenced WTP, for example, using the funds to protect the species' habitat, as opposed to using the flagship for purely marketing purposes. Our results point out to what sort of campaigns people are willing to donate as well as the role of charisma in allocating money for conservation of different species. Our recommendations can help NGOs to raise funds more effectively. In a further study, the results will be used in combination with data on surrogate power to assess overall cost-effectiveness of different surrogate strategies.

ASSESSING BENTHIC RESPONSES TO FISHING DISTURBANCE OVER BROAD SPATIAL SCALES THAT INCORPORATE HIGH ENVIRONMENTAL VARIATION

Carolyn Lundquist

NIWA

Judi HEWITT, NIWA

Marine benthic habitats are modified by a number of human-related disturbances. When these disturbances occur over areas of high environmental variability, it is difficult to assess impacts using either species richness or individual species distributions

due to species-specific responses to environmental drivers (e.g., exposure, sediment, temperature). Impact assessment can be more difficult when broad spatial scales are involved, as different regional species pools may be sampled. Even when effects on individual species can be detected, it is difficult to upscale from individual species to ecosystem scale effects. Here, we use a functional group approach to assess broad scale patterns in ecological processes with respect to fishing and environmental drivers. We use data from field surveys of benthic communities from two large, widely separated areas in New Zealand's EEZ (the Chatham Rise and the Challenger Plateau), and assigned 828 taxonomic units (usually to species) into eight functional groups related to important ecosystem processes and likely sensitivity to and recovery from disturbance to the seafloor. These included: opportunistic early colonists with limited substrate disturbance; opportunistic early colonists with considerable substrate disturbance; substrates stabilizers (e.g. tube map formers); substrate destabilizers; shell-hash creating species; emergent epifauna; burrowers; and predators and scavengers. We were able to observe, even at this broad scale, effects of fishing disturbance on benthic functional composition. Functional response varied between functional groups, with some being tolerant of fishing impacts, whereas others showed rapid declines with minimal fishing effort. The use of a functional group approach allows assessment of impacts across regions and species, allowing better generalizations of impacts to inform management and decision making.

175 SCENARIO ANALYSIS AND MODELLING OF BIODIVERSITY AND ECOSYSTEM SERVICES

Carolyn Lundquist

NIWA

One of the first IPBES assessments is Deliverable 3c, which provides the foundation for the use of scenario analysis and modelling of biodiversity and ecosystem services in regional, global and thematic assessments. The assessment will provide guidance for "evaluating alternative policy options using scenarios and models; including multiple drivers in assessments of future impacts; identifying criteria by which the quality of scenarios and models can be evaluated; ensuring comparability of regional and global policies; including input from stakeholders at various levels; implementing capacity-building mechanisms to promote the development, use and interpretation of scenarios and models by a wide range of policymakers and stakeholders; and communicating outcomes of scenario and model analyses to policymakers and other stakeholders" (IPBES/2/16/Add.4). Models and scenario analysis include the effects of changes in indirect drivers (e.g. socio-political, economic, technological and cultural factors) on direct drivers of change in, and therefore pressures on, biodiversity



and ecosystems (e.g. habitat conversion, exploitation, climate change, pollution, species introductions); the impacts of change in direct drivers - both negative, and positive (e.g. through policy or management intervention) - on nature; and the consequences of changes in biodiversity and ecosystems for the benefits that people derive from nature, and that therefore contribute to human well-being. In addition to outlining the objectives of this IPBES deliverable, I will also discuss the expert nomination and selection procedures and contact points for those interested in future involvement with IPBES assessments; the role of experts (including authors and reviewers) in assessments; and the internal and external review processes that have been put in place to safeguard the integrity and scientific robustness of the assessments.

CONSERVATION AND ECOTOURISM FOR DEVELOPMENT : WHO IS SACRIFICED? THE LOWER KINABATANGAN IN SABAH

Clotilde Luquiau

Centre Asie du Sud-Est

Conservation areas are often economically valorized through tourism in order to ensure development and to enhance the acceptability of the local population. Ecotourism is a sub sector of tourism that explicitly refers to the wellbeing of the local populations and as well as the protection of the environment. Protected areas are territories where ad hoc institutions are built in order to preserve the weak balance between the conservation of nature, the need of the inhabitants and the economic activities. In the wildlife sanctuary of the lower Kinabatangan, located in the north of Borneo in the Malaysian state of Sabah, the vulnerability of people and nature has been the cradle of original alliances between the inhabitants, the institutions, the activists, the scientists as well as the tour operators. Is the protection of nature enforced against the prosperity of the human societies? Based on the fieldwork conducted during my PhD, I argue that this binary question does not enable to grasp what is at stake in protected areas. I apply the terminology of geography such as space, landscape and territory to provide a grid which is more adapted to analyze the local geopolitics in place.

CONSERVATION ETHICS AND RISK PERCEPTIONS ASSOCIATED WITH HUMAN-WILDLIFE CONFLICT: IMPLICATIONS FOR ENCOURAGING STEWARDSHIP

Michelle L. Lute

Indiana University

Meredith L. GORE, Michigan State University

Carnivores like gray wolves present a significant management challenge because they can pose risks to humans. Although wolf populations are established in several regions of

North America and Europe, wolves still face threats from human intolerance and related behaviors, ranging from lawsuits and ballot initiatives to retaliatory killing. Wildlife managers know values and emotions can affect behaviors, but the extent to which affective (i.e., general feelings) risk perceptions, conservation ethics and emotional dispositions (e.g., reactions to wolf depredation, hunting wolves) interact to influence support for wolf conservation is unknown. Our objectives were to (a) create a novel theoretical framework for measuring conservation ethics and its impacts on risk perceptions and (b) test the framework's ability to predict the relationship between conservation ethics, risk perceptions, and stewardship behavior. We conducted a web-based survey of wolf stakeholders (n=1239) in Michigan in October-November 2013 and used path analysis to determine influences on the ethics-behavior relationship. Approximately three-quarters of respondents valued wolves and engaged in activities to support wolves in part because of their connection to a larger ecosystem. Intrinsic value for wolves predicted behaviors aimed at benefiting wolves. Affective risk perceptions and emotional dispositions influenced the relationship between ethics and behaviors. Results have implications for engaging stakeholders in managing human-wildlife conflict and encouraging stewardship of expanding carnivore populations. The role of emotion in human judgments related to conservation may be an important predictor of behavior and policy support; addressing emotion in decision processes may lead to more positive outcomes. Conservation ethics may provide comparable if not more useful information than traditional selection models for predicting public attitudes about carnivores and human-wildlife conflict management.

FISH CARBON: VALUATION OF MARINE VERTEBRATE CARBON SERVICES AS A MEANS TO PRIORITISE MARINE BIODIVERSITY CONSERVATION

Steven Lutz

GRID-Arendal

Angela Martin, Blue Climate Solutions

Can the value of 'Fish Carbon', the carbon cycling service provided by marine vertebrates, including fish, mammals and turtles, assist policy makers to prioritise biodiversity conservation in addressing the climate change challenge? Marine vertebrates are not included in most models of carbon cycling and their role in global climate change and carbon sequestration is largely invisible. However, recent scientific research has identified seven biological mechanisms provided by marine vertebrates that result in carbon sequestration, and one mechanism which may provide a buffer against ocean acidification. These mechanisms may have disproportionately large impacts on carbon uptake, storage and release, and all may contribute to the mitigation of climate change. The ecosystem-based Fish Carbon services provide a framework for



future scientific endeavour, but also permit innovative policy and management action based on the best available scientific information and the precautionary principle; an approach called for by the FAO and United Nations in the management of marine resources and in climate change policy. While reducing emissions remains at the forefront of national and international climate change initiatives, the vital role of ocean ecosystems as carbon sinks, including the contribution of marine vertebrates, may aid by mitigating against the severest effects. Fish Carbon provides a direct channel through which governments and the private sector can meet national, regional and global commitments on climate change and sustainability. The recognition and valuation of marine vertebrate carbon services may provide incentive for improved marine management, including biodiversity conservation, habitat protection and sustainable resource extraction, as a positive action toward mitigating climate change.

CAN PLANTS BE USED AS INDICATORS OF THE IMPACTS OF LIVESTOCK GRAZING ON CARABID BEETLES IN UPLAND CALCAREOUS GRASSLANDS?

Ashley Lyons

Edge Hill University

Paul ASHTON, Edge Hill University ; Ian POWELL, Edge Hill University ; Anne OXBROUGH, Edge Hill University

Calcareous grasslands are some of the most diverse habitats in Europe. However, agricultural intensification since the 1950s has led to a dramatic decline in habitat cover and increased fragmentation. In Britain, the majority of calcareous grasslands are situated in upland areas which have been overgrazed, particularly with sheep. Recognition of this has prompted a change in grazing practices, from high intensity sheep grazing to low intensity cattle grazing over the last fifteen years in an attempt to maintain and enhance areas of calcareous grassland. However, the preference of grazing at a low intensity with cattle is solely based on a perceived benefit to the plant community which is often derived from anecdotal evidence. This paper firstly examines the effects of long term low intensity grazing with sheep, cattle and no grazing on plant and carabid beetle diversity. Secondly, it explores whether plant species richness or composition can be used as a proxy for estimating carabid beetle assemblages under different grazing regimes. Carabid beetles are important in grassland ecosystem function, fulfilling roles as predators, herbivores and detritivores, and acting as a food source for other organisms. As with many invertebrate groups Carabid sampling is time consuming and requires specialist knowledge; this paper will determine if more readily identifiable components of the plant community can be used as a proxy. Across three upland limestone areas in Britain carabid beetles were sampled with pitfall traps and plant species richness and cover were recorded during summer 2013. Carabid beetle and plant diversity were linked

to grazing type and carabid beetle and plant diversity were related to each other. Implementation of appropriate grazing treatments can aid conservation of plants and carabid beetles. Management recommendations are made to inform best practice for supporting biodiversity.

BIODIVERSITY CONSERVATION IN AQUATIC AGRICULTURAL SYSTEMS: A STUDY OF INDIGENOUS FRESHWATER FISHES IN KHULNA, BANGLADESH

Heidi Ma

Zoological Society of London

Saima Sharif NILLA, CGIAR Research Program on Aquatic Agricultural Systems ; Zohura MEERA, CGIAR Research Program on Aquatic Agricultural Systems ; Kevin T. KAMP, CGIAR Research Program on Aquatic Agricultural Systems ; Robert J. WHITTAKER, University of Oxford School of Geography and the Environment

Freshwater fish biodiversity is fascinating, highly valued, and under threat. Their diversity is underpinned by the heterogeneous habitats they occupy. As the keystones of aquaculture production and a vital component of food security in many developing countries, freshwater fishes have been increasingly overharvested from open waters and intensively cultured in modified environments. In Bangladesh, smallholder agriculture densely occupies fertile floodplains and wetlands and relies heavily on ecosystem goods and services such as indigenous fish. This study investigates the community structure, pond habitats, and human use and perceptions of indigenous freshwater fish in Khulna, south-western Bangladesh. Fish were sampled using drift-nets in study ponds and floodplains surrounding the homesteads. The presences or absences of living and non-living plants and other physical habitat structures were recorded. Interviews were conducted with farmers about the abundance of indigenous species and reasons of their decline. Participatory action research, particularly involving women, was implemented through each stage of this study. We identified common and rare species. *Channa punctatus*, *Amblypharyngodon mola*, *Anabas testudineus*, *Salmostoma bacalia* and *Aplocheilichthys panchaxarethe* the most frequently occurring and most abundant species. Little overlap between species and habitat associations indicate that homestead ponds and unmanaged water bodies support considerably different indigenous species communities across villages. This study contributes to filling the data gaps of biodiversity science in fish and investigates the potential for habitat restoration in smallholder aquaculture ponds. Primary data collected in the field complement theoretical frameworks discussed in the literature and advocates land-sharing between wildlife and agriculture in densely-populated yet biodiverse regions.



REPRODUCTIVE AND EARLY LIFE HISTORY ASPECTS OF AN ENDEMIC ENDANGERED FRESHWATER FISH OF THE CHILEAN HIGHLANDS.

Consuelo Macaya Solís

Universidad de Chile

Irma VILA PINTO, Universidad de Chile

Reproduction and early life history stages of the genus *Orestias* (Teleostei: Cyprinodontidae), endemic of Andean high plains (Altiplano) aquatic ecosystems, have been barely studied. *Orestias ascotanensis* Parenti, endemic to the springs that feed the Ascotán Salt Bed in Chile is critically endangered due to reduction and fragmentation of its habitat, mainly caused by the negative water balance of the altiplanic systems and water extraction for mining activities. Between April and May 2014, 50 individuals were captured and kept in the laboratory under controlled conditions. After an acclimation period, mature females were induced to spawn through hormone therapy with Ovaprim® by artificial fertilization. Males showed color changes and courtship behavior and females slightly bulging belly. We obtained eggs of 1.5 to 1.8 mm size which developed tens of filaments giving them high adhesion and protection. The embryonic development at 20° C (± 1) lasted between 14-18 days and it was divided into 5 periods and 21 stages. Eggs showed a discoidal meroblastic cleavage and early pigmentation at 70 hours. The hatched larvae are on flexion state, equipped with pectoral and caudal fins and a functional mouth and eyes, allowing them to move and hunt from the second day. After 5-7 days from hatching, the larvae absorbed the yolk sac, and starting from day 24 they began developing the anal and dorsal fins and showed changes on coloration pattern. Low number of eggs per spawning, large eggs in proportion to adults and high survival of embryos (46.7%) agreed with partial spawners. Intense pigmentation and highly prepared hatching larvae for the free life could be an adaptation for extreme conditions. Finally, these results are relevant for the design of future actions for the protection of this species as hydrological restoration, artificial reproduction to restore subpopulations most affected and cryopreservation of gametes as a protection to genetic diversity.

MONITORING THE EFFECTIVENESS OF SILVER FIR FOREST RESTORATION: EFFECTS OF SCALE AND TYPE OF RESPONSE VARIABLE

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Monitoring restoration effectiveness implies that restoration actions should be evaluated using multi-scale approach and modelling. This allow to address the limitation caused by patters and ecological variation in sites. Identifying resources to monitor is also a fundamental step. We evaluated the effect of grain (e. g. the dimension of the sampling unit) for testing the response of species composition (for both presence/absence and abundance data) and species richness in in 3 Sites of Community Importance (SCI) in Tuscany (central Italy) subject to restoration management. Results demonstrated that grain size and type of response variable determine the ability of discriminating among control/reference and impact sites. Outcomes corroborate the hypothesis that monitoring multiple species at multiple spatial scales could improve the monitoring efficiency in restoration ecology. This study was funded by the European Commission, LIFE-Nature Project: RESILFOR (REstoring SILver-fir FOrest) LIFE08 NAT /IT/000371.

TRADE-OFFS BETWEEN AGRICULTURAL PRODUCTION AND BIODIVERSITY CONSERVATION IN COMPLEX LANDSCAPES OF THE ARGENTINEAN DRY CHACO. MOVING FORWARD THE SPARING/SHARING ANALYSIS

Leandro Macchi

Alexander von Humboldt

Hector Ricardo GRAU, Instituto Ecologia Regional, CONICET ; Ben PHALAN, Zoology Department, Cambridge ; Tobias KUEMMERLE, Alexander von Humboldt

Studies focus on the relationship between agricultural production and biodiversity conservation usually focus on one gradient ranging from a natural reference land cover type (typically forest) to an intensive productive land use. However, many semi-arid ecoregions such as the dry Chaco are characterized by a mosaic of different land covers, including natural grasslands and woody vegetation with different degrees of transformation, frequently aimed at meat production. Here we analyzed the associations between avian biodiversity and meat productivity of forest, natural grasslands, three types of livestock production systems, and soybean crops in northern Argentina dry Chaco; an area of c. 19 million ha characterized by high conservation value and rapid land use change. We estimated current regional production and future possible productions constrained by the regional governmental zonation. Using yield/density fitting models we explored which conservation strategies maximizes bird's populations for the current and future production levels. We compared the strategies of land sparing (high yield production and protected areas), land sharing (low intensity production systems in a wildlife friendly matrix) or an intermediate



strategy. We explored baselines landscapes with different forest:grasslands proportions. For the current production we found a similar number of birds species favored by a sparing and sharing strategies. Land sparing was the best strategy to satisfy future production levels minimizing bird's populations. Finally, we discuss future lines of studies to relate more clearly the conservation strategies with optimization and spatial analysis.

RISK OF TICK EXPOSURE IN CALIFORNIA OAK WOODLANDS

Andrew Macdonald

University of California, Santa Barbara

Conservation of biodiversity and protection of human health are central challenges for humanity in the face of anthropogenic change, and are increasingly recognized as fundamentally intertwined. Emergence of many zoonotic diseases, including Lyme disease (LD) in North America, is linked to land use and climate change through effects on reservoir hosts and/or vectors. While incidence of LD is increasing throughout North America, little is known about vector tick abundance or seasonal activity in southern (S) California. A recent study suggests that in highly endemic northwestern (NW) California, potentially infectious ticks are active year round resulting in higher risk of human exposure. Here we were interested in determining whether activity patterns, and thus risk of tick exposure, in S California mirror those in the north or are truncated leading to reduced risk of exposure. We used standardized drag sampling in oak woodland, as well as a range of other common habitats in S California, to determine seasonal abundance of the primary vector (*Ixodes pacificus*) of the pathogen, and compared patterns in S California to those observed in NW California. We found that seasonal activity of *I. pacificus* in S California is significantly shorter, and relative abundance significantly lower, than in NW California. We also found significantly higher abundance of *I. pacificus* in oak woodland habitats than in other habitats. These results suggest that risk of tick exposure is lower in S California than in NW California, and that oak woodland habitats pose the greatest risk. *I. pacificus* ticks are highly susceptible to environmental conditions, and under projected climate change endemic areas of NW California are expected to become hotter and drier, more closely approximating current climatic conditions in S California, which may lead to a reduction in risk of tick exposure and tick-borne disease in western North America.

116. CONSERVATION FOR PEOPLE AND NATURE

Georgina Mace

University College London

How can conservation goals be accommodated on a crowded planet? In the past it was common to regard nature conservation as an end in itself, and to envision large areas of intact wilderness where the patterns and processes of wild nature played out unperturbed by people. I will argue that this is neither tenable nor desirable as a vision for the 21st century. People are ultimately dependent on nature in many ways, and our future wellbeing depends on a sustainable but dynamic relationship with the rest of life on earth. This requires a more deliberative assessment of the ways in which people and nature are interdependent, considering the pathways whereby people depend on nature, and nature reacts to people's use and management. There is a wide variety of these relationships. Some of the rarest or most fragile species can only be conserved in wilderness areas, and they therefore define a need to make space for nature. But many other species are intricately associated with people, and will thrive in anthropogenic landscapes and seascapes. Over longer timescales, and over larger spatial scales, people and nature both depend on diverse, evolving and heterogeneous ecosystems. These longer term needs add another layer to planning, and to designing resilient nature networks for the 21st century.

151- CONSERVATION AT THE SCIENCE-POLICY INTERFACE: LEVERAGING HEALTH CONNECTIONS FOR A NEW PATH

Catherine Machalaba

EcoHealth Alliance and Future Earth ecoHEALTH

Peter DASZAK, EcoHealth Alliance ; Anne-Helene PRIEUR-RICHARD, DIVERSITAS ; William B. KARESH, EcoHealth Alliance

Conservation provides an understanding of the natural world that can be critical for public and animal health priorities. For example, analyses of the ecology of bats, primates and patterns of hunting or disease-driven declines have provided better ways to forecast and prevent Ebola virus, SARS and other zoonoses. However, conservation and health decision making typically occurs through separate channels. Leveraging conservation's value to health can engage a wider group of stakeholders in conservation efforts, generating health motivation for policy change that addresses drivers of both disease and biodiversity loss. There are evolving opportunities for the conservation community to inform health-relevant policy, including through collaboration with national authorities from the public health, agriculture and environment sectors, as well as in intergovernmental policy such as through the UN's Convention on Biological Diversity-World Health Organization Joint Work Programme, the World Organisation for Animal Health, and the IUCN Species Survival Commission Wildlife Health Specialist Group. Additionally, the science-policy interface is typically viewed as one-directional,



but we argue that it can be optimized through design of scientific studies that fluidly address policy questions to make information directly actionable to the health community. This is especially relevant to conservation where there are currently limited mechanisms employed for proactive assessments of benefits and consequences for biodiversity and health, such ecosystem service considerations of proposed land use decisions. Key areas of shared conservation-health policy opportunities and policy processes will be highlighted to encourage a new path for science-policy engagement that can help the conservation community broaden its impacts.

ADMIXTURE IN REINFORCED PLANT POPULATIONS

Nathalie Machon

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In the framework of reinforcement of declining plant populations, it is sometimes necessary to admix individuals from different origins to increase genetic diversity and fitness of the populations through heterosis. However, the risk associated with this practice is a possible co-occurrence of maladaptation and outbreeding depression. The outcome of such programs is therefore often uncertain. The process of admixture (interbreeding between individuals from different origins) has been poorly studied in plants, despite its importance in conservation genetics. Our presentation is based on a study that aimed to restore the population of the Sandwort *Arenaria grandiflora* L. in the Fontainebleau forest, France. This study began in 1999 when three identical populations were created in the Fontainebleau forest, each population established from 2/3 of local plants, and 1/3 of non-local plants. After 8 and 12 years of no human intervention in the maintenance of the populations, genetic diversity of the founders and reintroduced populations was assessed using 10 species-specific microsatellite markers. Our results revealed progressed admixture among individuals of the reintroduced populations. In addition, we evaluated the relationship between individual flowering (as a measure of fitness) and admixture levels. We found that this relationship is likely driven by conflicting effects of heterosis, inbreeding and outbreeding depression and local adaptation. A better understanding of the admixture process can directly contribute to the improvement of conservation programs.

INSTITUTIONS AND TRUST IN A CENTRAL INDIAN TIGER RESERVE

Biljana Macura

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Researchers agree that local people trust, social acceptability and positive attitudes towards agencies that govern protected areas are some of the major ingredients for the successful conservation. In context of top-down exclusive conservation in human-dominated forested landscapes of India, people-park conflicts are frequent because of limited space and resources, incompatible interests, unequal power and benefit flows. In such context, local community trust towards park management authority can be an important source of legitimacy and compliance with the park rules. This study uses household data from 16 villages located in the buffer zone of Pench Tiger Reserve, Madhya Pradesh, India: 1) to measure the level trust towards the management authority, and 2) to determine predictors of the trust (or lack of it). Study results are expected to highlight the importance of economic (benefit flow from the park, compensation for the crop or cattle loss) as well as institutional (level of social inclusiveness, local acceptance of resource access rules) context for the trust building.

THE LOST GENERATION HYPOTHESIS: COULD CLIMATE CHANGE DRIVE ECTOTHERMS INTO A DEVELOPMENTAL TRAP?

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Climate warming affects the rate and timing of the development in ectothermic organisms. Short-living, ectothermic organisms such as insects showing thermal plasticity in life-cycle regulation could, for example, increase the number of generations per year under warmer conditions. However, changed phenology may challenge the way organisms in temperate climates deal with the available thermal time window at the end of summer. Although adaptive plasticity is widely assumed in multivoltine organisms, rapid environmental change could blur the relationship between environmental cues that organisms use to make developmental decisions. Developmental traps are scenarios in which rapid environmental change triggers organisms to pursue maladaptive developmental pathways. This occurs because organisms must rely upon current environmental cues to predict future environmental conditions and corresponds to a novel case of ecological or evolutionary traps. Based on preliminary experiments, we argue that the dramatic declines of the Wall Brown (*Lasiommata megera*) in NW Europe may be an example of a developmental trap. This formerly widespread, bivoltine (or even multivoltine) butterfly has become a conundrum to conservationist biologists. A split-brood field experiment with *L. megera* indeed suggests issues with life-cycle regulation decisions at the end of summer. In



areas where the species went extinct recently, 100% of the individuals developed directly into a third generation without larval diapause, whereas only 43% did so in the areas where the species still occurs. Under unfavourable autumn conditions, the attempted third generation will result in high mortality and eventually a lost or 'suicidal' third generation in this insect with non-overlapping, discrete generations. We discuss the idea of a developmental trap within an integrated framework for assessing the vulnerability of species to climate change and its consequences for species conservation.

GRASSROOTS APPROACH TOWARDS SUSTAINABLE NATURAL RESOURCE MANAGEMENT AND DEVELOPMENT

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Lake Victoria in Africa, the second largest freshwater surface area in the world, together with its basin, comprise an ecosystem with extraordinary biodiversity and ecosystem service values, supporting the livelihoods of over 500,000 people. However the lake basin is threatened by unsustainable consumption and production patterns, including hunting, over-exploitation of natural resources, large-scale agriculture and pollution, exacerbated by weak coordination and governance, invasive species and climate change. This negatively affects particularly local communities who rely most directly on natural resources for their livelihood. However at the same time, local communities are the chief stewards of the world's ecosystems, and the vast majority of daily environmental management decisions depends on their local knowledge and how they use land and other natural resources. This creates great opportunities by empowering local communities to play a key role in the management of those vital natural resources. To this end, BirdLife International is implementing the Local Champions Project at six Important Bird and Biodiversity Areas across four countries: Burundi, Kenya, Rwanda, and Uganda. The project aims to strengthen the capacity of community-based Local Community Groups to conserve biodiversity and sustain ecosystem benefits for human well-being. This is being achieved through institutional capacity building of Local Community Groups in governance, natural resource management, advocacy, fundraising, networking, and building strategic partnerships with local government and the private sector. Subsequently the local communities themselves have developed Community Plans which lay out a clear road map and plan of action for the community to effectively address the identified challenges, and to sustainably manage their natural resources. The project demonstrates that local communities, as key stakeholders, can and should be empowered to sustainably manage their natural resources.

WHAT EVIDENCE IS THERE TO SUPPORT THE CREATION OF A PREDATOR FREE 'MAINLAND ISLAND' IN MAURITIUS TO PREVENT THE EXTINCTION OF A CRITICALLY ENDANGERED PASSERINE?

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Invasive species are a major threat for island biodiversity, causing species decline and extinction globally. Of all invasive mammals rats are one of the most detrimental and have been the target of numerous eradication programmes; a successful conservation tool for many taxa. However, for endangered species situated on large populated islands, where eradication is prevented, rat control remains a challenge. The local extirpation of rats through the establishment of large-scale, rat-free areas known as 'Mainland Islands' has been developed successfully in New Zealand using various rat management techniques and is one possible solution. However, large-scale rat management is a long-term investment with huge financial implications; therefore, robust evidence is required to support such an investment. For endangered species obtaining this information is often problematic due to small population sizes hindering experiments. Research conducted on a declining population of Mauritius olive white-eye (*Zosterops chloronothos*), a critically endangered endemic passerine, has explored this issue by combining small-scale field experiments with demographic models. We investigated the impact of rat management on nesting success by establishing rat poison and trapping grids within breeding territories. Results show that rat management significantly decreased rat abundance and increased nesting success, leading to a potential 5-6 fold increase in annual productivity, which in turn could be sufficient to stabilise the current population decline. In the absence of rat management, this analysis suggests the olive white-eye population will continue to decline by about 14% per annum. This research provides compelling evidence that rat-free areas are a viable management option for this declining population and supports further investigation into the development of a mainland island on Mauritius; identifying the most cost-effective technique.

HUMAN-WILDLIFE INTERACTION IN SERENGETI AND NGORONGORO DISTRICTS OF TANZANIA: A CASE STUDY ON SMALL MAMMALS

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In the Serengeti and Ngorongoro Districts, small mammals are said to provide protein and income to the local people. However, they are simultaneously reported to conflict with farming activities. These conflicting aspects have not been investigated there. The present article considers human-small mammal interactions in six villages adjacent to the protected areas. Data were obtained through questionnaire administration to the local people in the districts. Small mammals were hunted in the two districts for food purposes and some villagers declared that they were earning income from selling small mammals products. Seventy percent of the respondents in Serengeti District claimed that among the hunted small mammals, the rabbits were the most preferred animals whereas <5% of the respondents in Ngorongoro Districts declared to prefer rabbits. In terms of gender, there was no significant difference between males and females in the preference of rabbits in both districts. However, the frequency of hunting was higher in Serengeti District than in Ngorongoro District and dogs were significantly more used for hunting than were other means of hunting. Some small mammals, such as rodents, were a nuisance in raiding crop fields and food stores. In attempting to protect their crops and other properties against small mammal destruction, villagers used various strategies including trapping and poisoning although these methods were often ineffective. Some villagers suggested extermination of the small mammals as a control measure. Despite the fact that small mammals were destructive, about 26% (n = 150) of respondents disagreed with the proposal of animal extermination, instead they suggested establishment of conservancies or seeking for the government intervention. Domestication of small animals for reptile farms, ecologically focused small mammal management techniques and improved storage structures might reduce the conflict.

49-SPECIES INTERACTIONS SHOW VARIED RESPONSES TO THE DIFFERENT COMPONENTS OF FOREST FRAGMENTATION.

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Forest fragmentation dramatically alters species persistence and distribution and affects many ecological interactions among species. Recent studies suggest that mutualisms, such as pollination and seed dispersal, are more sensitive to the negative effects of forest fragmentation than antagonisms, such as predation or herbivory. We applied meta-analytical techniques to evaluate this hypothesis and quantified the relative contributions of different components of the fragmentation process (decreases in fragment size, edge

effects, increased isolation, and habitat degradation) to the overall effect. The effects of fragmentation on mutualisms were primarily driven by habitat degradation, edge effects, and fragment isolation, and, as predicted, they were consistently more negative on mutualisms than on antagonisms. For the most studied interaction type, seed dispersal, only certain components of fragmentation had significant (edge effects) or marginally significant (fragment size) effects. Seed size modulated the effect of fragmentation: species with large seeds showed stronger negative impacts of fragmentation via reduced dispersal rates. Our results reveal that different components of the habitat fragmentation process have varying impacts on key mutualisms. We also conclude that antagonistic interactions have been understudied in fragmented landscapes, most of the research has concentrated on particular types of mutualistic interactions such as seed dispersal, and that available studies of interspecific interactions have a strong geographical bias (arising mostly from studies carried out in Brazil, Chile, and the United States).

A 5-YEARS INTEGRATED PROJECT FOR THE CONSERVATION OF LIMODORUM TRABUTIANUM BATT. (ORCHIDACEAE): THE EXAMPLE OF THE MARTURANUM PARK (LATIUM, ITALY)

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Limodorum trabutianum is a steno-Mediterranean orchid with a highly fragmented distribution area that includes Morocco, Algeria, Portugal, Spain, France, and Italy where it is threatened with extinction. In 2010, a population within the Marturanum Park (Barbarano Romano, Viterbo - Italy), unique to Latium, experienced a strong demographic decline (about 80%), highlighting the urgent need to take serious preservation measures. Therefore, an integrated conservation strategy was performed and the Marturanum Park was chosen as testing-area where in situ/ex situ actions could be experienced before spreading them to the whole distribution area. The following in situ measures were carried out: 1) present and potential threats assessment; 2) fencing the population area, only during the anthesis/fruited phases, in order to prevent damages caused by trampling, grazing, and by massive wild boars presence; 3) tourism limitation in the area; 4) population census and monitoring; 5) Red List assessment IUCN. Furthermore, the following ex situ actions are thought to be necessary for an effective conservation strategy: 6) seed banking to preserve its genetic diversity over time; 7) evaluation of the reproductive success (germination, growth, and development capability) to



highlight potential intrinsic risk factors; 8) in vitro reproduction for conservation and possible reintroduction. Several educational activities were carried out to raise awareness about orchid conservation. After the first in situ actions, a clear improvement in conservation conditions was observed, with an extremely significant increase both in population size (from 2 to 27 plants, with a maximum of 36 in 2013) and in the percentage of mature individuals that have reached the fruiting phase. Results of the first 5 years of this project can provide useful indications for the management and conservation of *L. trabutianum* and other threatened orchids.

CUMULATIVE IMPACTS OF HUMAN ACTIVITIES ON CORAL REEFS IN BRAZIL

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Effective management of marine ecosystems requires strategies that reduce the cumulative impact of multiple human activities and stressors. Our goal was to inform conservation planning in Brazil by assessing the cumulative impact to coral reefs from multiple human activities. We collated publicly-available satellite data on the following stressors: fishing intensity (based on a decay-factor function that combines information on vessel transits and fisher behaviour); thermal stress (derived from an indicator of coral-bleaching events); coastal development (formulated based on the proximity to night-time light); sedimentation input (based on an indicator of water clarity); and marine mining (obtained from a government database). Our spatial domain was a gridded map of 2,276 cells (spatial resolution of 1 km²) containing all known coral reefs in Brazil. We calculated a cumulative exposure score for each cell using two approaches: (i) the vulnerability of coral reefs to stressors was equally weighted; and (ii) impact weights were used to reflect vulnerability of coral reefs to each human stressor. We found that 2% and 12% of coral reefs were heavily impacted (score > than 0.75), with or without information on vulnerability respectively, and 6.5% of reefs were relatively unaffected in both approaches. We developed hypothetical future scenarios to assess the sensitivity of our cumulative impact scores to changes in the footprint and intensity of stressors. This work is the first comprehensive spatial dataset of cumulative impact to coral reefs in Brazil and we demonstrate how it can be used to explore strategies for planning and management at multiple spatial and temporal scales.

BEHAVIORAL SOLUTIONS TO MISMATCHED HUMAN/ECOLOGICAL TIMESCALES THAT HURT CONSERVATION

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Ecological systems often operate on timescales significantly longer, or shorter, than the timescales typical of human learning, decision-making, and action, which can cause substantial difficulty for conservation. Invasive species, such as the white-nose syndrome affecting some North American bats, may move faster than humans can diagnose problems and initiate solutions. Large-scale climate and hydrologic systems may exhibit both long-term inertia and short-term fluctuations that obscure learning about the efficacy of restoration. For instance, efforts to restrict nitrogen to restore an estuary plagued by algal blooms were hampered by both short-term variation in water quality in response to rain events and by long-term release of nutrients from river sediments. We have developed a management decision framework that distinguishes institutional from individual actors, calls attention to the ways that individual actors and ecological systems respond to management actions, and notes institutional learning that accrues from observing these responses. We use this framework to classify timescale mismatches that arise both within and between the human and the ecological components of coupled natural-human systems. Because the timescales of ecological systems typically cannot be altered, solutions to these problems must come from modifying human behavior at the individual and institutional levels. Drawing on the behavioral economics and psychology literature, we propose behavioral interventions to help solve timescale issues that cause conservation failures. Such interventions include framing conservation decisions to enhance the salience of long-term consequences and using structured decision processes that make timescales of actions and consequences explicit. We demonstrate these tools for diagnosing and resolving threats caused by timescale mismatches using restoration of western Lake Erie, a great lake imperiled by agricultural run-off, as a case study.

RECOVERY TIME AFTER REFORESTATION DEPENDS ON THE MOBILITY AND FEEDING HABITS: CASE STUDY FOR GROUND-DWELLING ARTHROPODS

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We explored the recovery of ground-dwelling arthropods after reforestation with native trees. We studied ground beetles (Coleoptera: Carabidae) and millipedes (Myriapoda: Diplopoda) from mature (130-year-old) oak forest, and recently established (5-year-old), young (15-year-old), and middle-aged (45-year-old) reforestation with native English oak to assess the recovery dynamics of their diversity and composition. The overall number of the ground beetle individuals and species were significantly the highest in the 5-year-old reforestation, while the overall number of millipede individuals and species were significantly the lowest in the recently established reforestation. The elevated overall number of ground beetle individuals and species in the 5-year-old reforestation were due to the colonization of good disperser open-habitat species. The number of forest-associated ground beetle individuals and species were significantly the lowest in the 5-year-old reforestation. From 15 years after the reforestation, there was no significant difference in the number of forest-associated ground beetle species. The number of forest-associated millipede individuals and species were significantly the lowest in the 5-year-old reforestation; however, they were significantly the highest in the natural mature oak forest. The diversity and composition of ground beetles with high dispersal ability and less specific feeding habit recovers quickly after the closure of the canopy, while there is no similar quick recovery of millipedes with low dispersal ability and specific feeding habit. This research was supported by the TÁMOP-4.2.2.B-15/1/KONV-2015-0001 project.

THE ETHNO BOTANICAL REVIEW OF SOME PLANT USES BY VHAVENDA, VHEMBE DISTRICT, LIMPOPO PROVINCE, SOUTH AFRICA

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The Vhavenda people had a rich social culture intrinsically embedded to the natural environment, with their livelihood dependent on its sustainable utilization. The Vhavenda plant uses had been well documented through several studies that had reported on different categorical uses ranging from medicinal, vegetables, fruits, beverages, firewood, art and craft, and building construction. Some of the plants species had been recorded to be utilized in more than one category. To access the information on Vhavenda plant uses several

literatures were consulted followed by an ethno botanical rapid appraisal survey within the Vhembe District Municipality. Data collected was used to analyse the family and category trends of plant species usage. The overwhelming majority of plants are used as medicine for humans and animals healthcare, more than 40 plant species are used as vegetables, with hard wood plants mainly used for construction as well as art and craft. Six categorical uses were recorded for families; Anacardiaceae and Euphorbiaceae with Capparaceae, Celastraceae, Rhamnaceae, Papilionoideae as well as Rubiaceae used in five categories. The ethnobotanical rapid appraisal survey revealed an informative data trend on plant uses from earlier times to present. It also gave indication on plant use dynamics through time. Keywords: Vhavenda, sustainable utilization, and ethnobotanical rapid appraisal.

LARGE-SCALE TEMPERATURE VARIABILITY PREDISPOSES CORAL COMMUNITIES' TO VARIED RESPONSES TO EXTREME TEMPERATURES

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Corals species ranges are expected to contract to climate refugia with the intensified global warming, consequently there is a considerable interest in identifying locations where taxa has survived periods of regionally adverse climate, and the environmental attributes that confer this status. This interest is motivated by reports of selective impacts and mixed responses to extreme SST anomalies and of contrasting recovery trends towards pre-disturbance live coral states. So far, however, in spite of suggestions of projected widespread future thermal stress and possible coral extinction, there is considerable uncertainty on how large-scale climate variability has structured coral communities' physiological responses to extreme events and the scope for adaptation to change. We present results from the first global exploration of the association between severe coral bleaching occurrence records over the last ~3 decades and the components of large-scale historical temperature variability: predictability or orderliness of SST time series, frequency, periodicity, intensity, and duration of significant anomalous events. We show that, severe coral bleaching predominantly occurred in regions with a history of prolonged high intensity anomalous events, and are less likely to occur in regions that have experienced highly predictable and frequent anomalous events. Our findings provide a rare empirical support to theoretical deduction that temperature variability of the past has organized coral communities with varied responses to extreme events, leaping forward the current efforts to identify climate refugia.



PREDICTING IMPACTS OF FOREST MANAGEMENT AND CLIMATE CHANGE ON DEAD-WOOD DEPENDENT FUNGI DISTRIBUTIONS USING CITIZEN SCIENCE DATA AND A RANGE OF MODELING APPROACHES

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Understanding how species' distributions will be affected by forest management and climate change is an important conservation goal, which can be achieved through the application of species' distribution models (SDMs). SDMs require spatially extensive species observation datasets, and as such, citizen science recording schemes provide an excellent resource. However, such datasets are accompanied by problems of geographical and environmental bias introduced through recorder behaviour. A range of modeling approaches have therefore been developed to deal with such biased data, and I will present the results of applying several such models to dead-wood dependent fungi species in Sweden. The fungi studied are important indicator species of the quality and naturalness of forest stands. They are wood-decaying fungi which rely on an availability of dead wood and perform an important role in nutrient cycling in forest ecosystems. I will present the predicted impacts of forest management and climate change scenarios on these species distributions, showing how predictions made using different SDMs (and therefore different assumptions about the data) agree and differ amongst species. Such an approach allows a consensus to be drawn (and uncertainties to be identified) on the most appropriate forest management strategies for species conservation in the face of climate change.

HOW TO ADAPT PROTECTED AREA MANAGEMENT TO CHALLENGES OF CLIMATE CHANGE?

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Nature protected areas are seriously affected by climate change, and a main challenge for agriculture, conservation and water management is adaptation planning. We planned the process of implementing adaptation through a stakeholder dialogue in a SE-Hungarian area, to integrate interests into management plans. Major impacts of climate change that affect the agricultural use of wetlands and grasslands were explored. Ecological aspects should be combined with social

and economic factors during the stakeholder dialogue. Mowing techniques, frequency and exact date should be observed as well as grazing species and their breed, due to different grazing, group forming and trampling habits. The integration of landscape history and historical land development into the planning process (especially in case of water management works in the past) is also useful. Identification and engagement of key stakeholders should be followed by an informative meeting, providing information about climatic impacts, on natural and human systems, discussion of objectives, community based assessment of impacts, then elaboration of adapted strategies and measures. There is strong need to differentiate between stakeholders, and customize communication strategies for different groups. The benefits of intense stakeholder involvement are enhanced awareness, willingness to taking action, inclusion of local knowledge, strengthened habitat resilience through guidance of autonomous adaptation and reduction of land use pressures, information exchange among affected parties that might help finding common solutions, and building trust in authorities.

A SOCIO-ECOLOGICAL EXPLORATION OF HUMAN-WILDLIFE CONFLICT IN THE CONTEXT OF OIL PALM PLANTATION DEVELOPMENT IN CAMEROON

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Large-scale industrial agricultural expansion is a significant driver of biodiversity loss, increased carbon emissions, and substantial livelihood disruption for communities in tropical ecosystems. Although less documented, the influence of this expansion on encounters between wildlife and human communities is intimately related to these conservation issues. Local communities and wildlife are simultaneously shifted or fully displaced from intact protected areas and human-modified agro-forests, altering traditional modes of interaction. This study employs a socio-ecological systems approach to examine human-wildlife encounters that have escalated into conflict in the Ndian Division of southwest Cameroon, home to a number of protected areas alongside extensive smallholder and industrial oil palm plantations (both extant and planned concessions). The state of human-wildlife conflict, particularly in the form of crop raiding, and the broader socio-ecological system context is examined in three villages with 108 household interviews and fine-scale spatial surveys of village farms across a land use gradient from protected areas to oil palm plantations. To predict how conflict might change once planned oil palm concessions are realized, underlying causes of reported crop-raiding patterns and responses to raids are explored alongside village perceptions of land use change and oil palm development. Results indicate that farm attributes, such as crop diversity and farm age, are significant predictors



of presence for reported crop-raiding species across villages. However, demographic variables such as gender and socio-economic status provide a more nuanced understanding of both raiding patterns and farmer responses to raids. Ultimately, this study provides insight into how conservation practitioners might use a more inter-disciplinary approach towards achieving multi-functional agro-forest mosaic landscapes in Cameroon and similar tropical landscapes.

91: A FRAMEWORK TO USE CONSERVATION EVIDENCE IN A NATIONAL MANAGEMENT ORGANISATION: EXPERIENCES FROM THE NEW ZEALAND DEPARTMENT OF CONSERVATION

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Department of Conservation

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Like most conservation agencies, the New Zealand Department of Conservation strives to use the best available practice for undertaking conservation management actions, and in deciding which future conservation projects deserve attention. Its aim has been to provide information and advice on species, ecosystems, environmental issues and conservation threats, and to base this advice on best practice methodologies. Despite more than 100 years of conservation action, and nearly 30 years as a unified national conservation agency, a recent review indicated that we have failed to adequately provide best practice advice for much of our biodiversity work. To rectify this, we developed an improved best practice framework that: included links to policy and standard operating procedures; determined processes such as who builds, updates, maintains and disseminates best practice information; and ensured that best practice information was based on best available and correctly interpreted evidence, including data, published evidence and expert opinion. We describe our experiences in incorporating and implementing a conservation evidence pathway into a best practice framework for the flora and fauna-related biodiversity work the New Zealand Department of Conservation undertakes.

EFFECT OF HABITAT AND RESOURCE AVAILABILITY ON AVIAN NEST SURVIVAL IN YARDS AND ADJACENT FOREST PARKS

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Although residential areas comprise a large component of the urban landscape, avian conservation in urban areas usually emphasizes managing habitat remnants with limited human

development, such as forest parks. Part of this emphasis reflects a common assumption that residential yards act as reproductive sinks due to high levels of nest predation. We tested this assumption by comparing nest survival in adjacent forest and yard habitats. We also investigated how yard management practices influence nest survival. During 2011-2014, we monitored American Robin (*Turdus migratorius*) and Northern Cardinal (*Cardinalis cardinalis*) nests at 7 paired suburban neighborhoods and forest parks in Columbus, Ohio, USA, and recorded availability of bird feeders in neighborhoods. Daily nest survival (DSR) of robins was significantly higher in yards (0.970 ± 0.004) versus forest parks (0.946 ± 0.005) and robin nests in yards were twice as likely to fledge young compared to robin nests in forest parks. However, availability of bird feeders mediated survival of robin nests in yards: DSR decreased $0.004 (\pm 0.001)$ for each feeder present in the neighborhood and $<10\%$ of robin nests were expected to fledge in neighborhoods with 5 or more feeders. In contrast, cardinal DSR was similar between paired yard (0.960 ± 0.003) and forest (0.947 ± 0.005) habitats and there was no relationship between cardinal DSR and bird feeders. Our results show that assumptions about the relative value of natural versus developed landscapes and the effects of supplemental food may not be easily generalized across species. Additional research about the mechanisms responsible for these patterns is warranted to better inform conservation efforts for urban birds.

PHYSIOLOGICAL STRESS IN REINTRODUCED TIGER POPULATIONS: HOW DOES IT AFFECT CONSERVATION OUTCOMES?

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It is difficult to determine the causal factors for success of a reintroduction program. Each site and animal is unique and would respond to the reintroduction efforts in different manner. When local extinction of tiger (*Panthera tigris*) occurred in Sariska and Panna Tiger Reserves in India, it led to reintroduction of wild tigers there. Subsequently, Panna registered breeding of the founder population, with all but one female yielding multiple litters. In contrast, the Sariska founder population registered its first successful breeding after four years of reintroduction and of the five females only two have successfully littered. This study was undertaken to explain the potential reasons for differential breeding success between the two reserves. Many studies on wild animals have established a link between high physiological stress and low reproductive



potential. It was thus hypothesized that stress caused by anthropogenic pressures and other physiological factors, was a plausible cause for the differential breeding status of tigers. Tiger scat samples were collected and faecal hormone metabolite extraction and analyses were done to understand their stress and reproductive status. Data on stressors viz. prey and anthropogenic disturbance were collected using line transect method, circular plots and camera traps. Hormone analyses results suggested that tigers in Sariska were fertile although far more stressed than that in Panna. To explain which, we examined the status of stressors and found that prey density was high in Sariska, ruling out nutritional stress. However, anthropogenic disturbance was higher in Sariska than Panna, suggesting human induced stress. Moreover, stress levels in different tigers were found to be correlated to different types of anthropogenic disturbances within their home ranges.

LINKING CURRENT STATE OF FISH POPULATIONS AND THEIR DIVERSITY TO CHANGES IN ENVIRONMENTAL CONDITIONS OCCURRING IN THE MIDDLE FLOW OF SYRDARYA RIVER (CENTRAL ASIA)

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Ecological disaster in the main part of the Syrdarya River basin in the last decades of XXth century applied some governmental measures after that, in order to stabilise hydrological regimes of the Syrdarya River. In 2002-2014 we have conducted a series of field studies evaluating the state of habitats and diversity of fish populations in the part of the Syrdarya River situated within borders of the Republic of Kazakhstan. There were observed strong interannual variations in water salinity, concentration of biogenic elements (C, N, P, S) and metals (Cu, Fe, Pb) in water samples. Ionic composition of sediments in Syrdarya River was also differed substantially from the inflows and rivers in basin of the Balkhash Lake. Diversity of fishes was much lower than it was expected according to the known lists. There were not detected fringebarbel sturgeon, Syrdarya sturgeon, Aral salmon, pike asp and sharpray. The main species in commercial fishery are roach, sabrefish, carp, asp, pike perch,

snakehead and wels. Histological studies on fish detoxication systems such as liver, gills and kidneys have revealed different levels of damages suggesting significant level of environmental heterogeneity. Indigenous for the Syrdarya River species such as bearded stone loaches, aral spined loach, and ruff were not able to adopt to changed habitats, and thus were substituted in the river with some alien species. Water resources in most of the inflows are used completely by rural populations and cities and do not reach the main stream of Syrdarya River. It explains substantial differences in composition of ichthyofauna between Syrdarya River and its inflows. The main background species inhabiting inflows of the river are sattu snowtrout, Turkestan gudgeon, Tashkent riffle bleak, terskyi stone loach, Kuschakewitsch loach, Aral spined loach. Current level of the use of water resources in the region threatens sustainability of many indigenous fish species and their conservation.

SICILY AS THEORETICAL MODEL TO STUDY THE POTENTIAL IMPACT OF GENETICALLY MODIFIED PLANTS IN A HOTSPOTS OF BIODIVERSITY

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In Europe, especially in Italy, different considerations are necessary when potential GMPs are to be grown. In particular high biodiversity areas such as Sicily should have a more detail plans of potential benefits and risks assuring the conservation of biodiversity and endemic species. Sicily is one of the most relevant biodiversity hotspots in the Mediterranean area, with a vascular flora of 3252 species and 321 endemic taxa. Considering the latest IUCN categories and criteria, 401 taxa (12.4% of Sicilian flora) are under threat (categories "CR", "EN", "VU"), and 220 more taxa (6.8%) are "Near Threatened". Sicily is also known to have a rich butterfly and coleopteran fauna including endemic and rare species. Agricultural systems, 66% of the area, mainly cereal crops (40%) olive groves (7%), vineyard (6%), citrus groves (5%) and orchards (2%). 25% of these are within the Natura 2000 Network sites. Semi-natural systems account for about 21% of the area. The genus Brassica, Cichorium, Dianthus, Medicago, Prunus e Trifolium have a higher number of rare, endemic species, some of which have a high risk of extinction. Moreover, cultivated trees, as Prunus, have rich heritage of some hundreds ethno-varieties, results of centuries of selection practices of farmers. Sicilian territory will likely continue to have among its characteristics an entirely agricultural vocation, with a greater extension of organic agriculture, even in the presence of forms of integration with other sectors such as tourism and protection. For the above reasons Sicily was chosen as a pilot area to study the potential impact of PGMs on biodiversity. Model is based on the potential GMPs, their, traits, areas grown, potential gene flows,



distance from natural areas. Moreover an ecological approach for selection of non-target Lepidoptera species for ecological risk assessment of PGMs in Sicily, using data collected over a 3-year period, is reported.

RELIABILITY AND REFINEMENT OF THE HIGHER TAXA APPROACH FOR BEE RICHNESS AND COMPOSITION ASSESSMENTS

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Limited resources and taxonomic expertise in biodiversity surveys often lead to the application of the Higher Taxa Approach (HTA), i.e. the identification of specimens to genus or higher taxonomic levels rather than to species. The reliability of the HTA varies significantly among studies, yet the factors underlying this variability have rarely been investigated. Bees are an ideal model taxon for testing the HTA because they are highly diverse, challenging to identify and there is widespread interest in their role as native pollinators, driving demand for efficient diversity assessment tools. Using extensive bee data sets collected across three biomes and various habitats, we assessed the performance of the HTA in reflecting bee species richness and composition patterns at local scales, factors affecting this performance, and ways to improve it. The performance of the HTA varies considerably among biomes, taxonomic levels (genus and sub-families) and diversity measures (species richness and composition). The number of species per higher taxon was a main factor influencing this performance, while to co-occurrence of taxonomically related species had no significant influence on the performance of the HTA. Further subdividing genera by body size contributed to the performance of the HTA. The considerable variability found in the performance of the HTA in representing local-scale richness and composition patterns of bee species dictates caution in implementing this tool in bee surveys. When possible, an a priori evaluation of the expected performance of the HTA should be done, focusing on species distributions within higher taxonomic levels and the species/higher taxa ratio. Integrating morphological characteristics (such as body size) that consistently sub-divide genera will improve HTA's performance. Our results are likely applicable to other small-bodied and species-rich groups and contribute to the cost-effectiveness of biodiversity surveys.

RESPONSE OF TREE COMMUNITIES AND ABOVEGROUND CARBON STORAGE TO RAINFOREST FRAGMENTATION

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Fragmentation is among the most pervasive forms of human disturbance to forests across the tropics. While fragmentation is known to drive marked shifts in the composition of biological communities, there is limited understanding of resultant effects on ecosystem functioning and services. Here, we examine the effects of fragmentation on rainforest tree communities and aboveground carbon storage in a landscape comprising fragmented and contiguous rainforests in the Western Ghats of peninsular India. Using analyses of plant functional traits, we identify potential mechanisms by which fragmentation affects carbon storage, and assess the relative importance of these different mechanisms in governing aboveground carbon storage in forest fragments. Our results reveal that fragments store ~40% less carbon per unit area than contiguous rainforests, with reduced forest stature emerging as an important factor contributing to carbon losses. First, there were shifts in tree allometry, with trees in fragments not growing as tall for given basal diameter as conspecifics in contiguous forests. Additionally, fragmentation favoured tree communities dominated by small-seeded species, presumably due to shifts in the assemblage of seed dispersers. Because small-seeded species tend to be shorter than larger-seeded species – a pattern we observed not just in the tree community in this study but also more generally across other tropical forest tree species – such compositional shifts may generally be expected to reduce forest stature and carbon storage. These results imply that the ability of tropical forests to store carbon may be influenced by processes such as seed dispersal, and reduce when large vertebrate seed dispersers decline in forests which are fragmented or otherwise disturbed. Thus, conservation efforts to prevent defaunation and improve connectivity at broader landscape scales are also likely to enhance aboveground carbon storage in fragmented tropical forests.

133-ENGAGEMENT OF MUSLIM LEADERS FOR CONSERVATION AND SUSTAINABILITY ACTIONS IN INDONESIA

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Universitas Nasional

Muslim activists have been leading biological conservation efforts in Indonesia and urging influential Islamic scholars and clerics to collaborate with them. The Indonesian Clerics Council (Majelis Ulama Indonesia [MUI]) was established a special unit called the Institute of Honoring Environmental and Natural Resources (PLH-SDA) MUI in 2011. Since that time, the PLH-SDA MUI have been working together with government and environmental conservation NGOs to raise environmental awareness and promote conservation activities through edicts and aid. MUI has released four edicts related



to the environment: (1) the fatwa for environmentally friendly mining; (2) edict on the misuse of formalin and harm material in the production of fish; (3) edict on protection of wildlife for the balance of ecosystem; and (4) edict about wastes. Lessons learned from this “soft power movement” of interacting religious MUI and government, conservation NGOs and academia will be shared and hopes for future success toward ecological sustainability will be expressed.

EXTRAPOLATING CETACEAN DENSITIES IN THE OFFSHORE NORTH ATLANTIC: TOWARDS A BASIN-WIDE MANAGEMENT APPROACH

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Duke University

Jason ROBERTS, Duke University; Patrick HALPIN, Duke University

Extrapolating beyond the range of environmental variables is very risky; however, geographical extrapolation is acceptable when parsimonious habitat models are built from meaningful environmental predictors and survey datasets. We were contracted by the U.S. Navy to estimate the densities of 29 cetacean species in the Atlantic fleet testing and training (AFTT) area, extending from the shoreline of North America to 45°W and from 21 to 65°N. Most of this area has only been surveyed with line transect protocols within 200 miles from shore. Our objective was to provide reliable extrapolations of cetacean densities in the AFTT area based on available cetacean line transect surveys and environmental predictors. We built generalized additive models from over 1.2 million km of line transect surveys in the U.S. waters and a variety of environmental predictors, favoring those for which a broad range of values was covered in the surveyed area. Since the U.S. surveys mostly covered nearshore waters, we incorporated European surveys which extended farther offshore but in the other side of the North Atlantic basin. The results illustrate the difficulty of providing robust density estimates in offshore waters from surveys mainly conducted in nearshore waters. In addition, our study suggests that, for some species, different environmental variables may drive cetacean distributions on each side of the North Atlantic. For example, when we added European surveys to our fin whale model, different predictors were selected and the abundance estimate for the AFTT area doubled. In contrast, for harbor porpoise, the same predictors were selected and the estimated abundance decreased by a more modest 30%. In both cases, much of the change in abundance occurred beyond the shelf. In conclusion, our study stresses the urgent need of conducting line transect surveys in the offshore North Atlantic in order to provide the most accurate estimations of cetacean densities.

MAPPING ECOSYSTEM SERVICES AT THE SITE LEVEL: A PROXY-BASED APPROACH FOR RIZOELIA NATIONAL PARK, CYPRUS.

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Marios ANDREOU, Frederick University; Charalambos CHRISTODOULOU, Department of Forests, MANRE; Iro KOUZALI, Frederick University; Konstantinos PAPASAVVAS, Department of Forests, MANRE; Louise SUTHERLAND, Open University of Cyprus; Vassilis TRIGKAS, Open University of Cyprus; Ioannis N. VOGIATZAKIS, Open University of Cyprus

Conservation and management of Natura 2000 sites should go beyond simply conserving the biodiversity they support towards managing the multitude of services they provide. This shift in management necessitates the identification and mapping of these services. The National Park of Rizoelia in Cyprus is a Natura 2000 site supporting two priority habitats at the European level, Ziziphus arborescent mattoral (*5220) and gypsum steppes (*1520), which have been well documented and mapped. However, this is not the case for other services supported by the Park. The current study aims to identify, quantify and map the range of ecosystem services (ES) in the park. We develop a framework based on widely used methodologies using tables for regulating, provisioning and cultural ecosystem service linked to related indicators for their quantification. Furthermore, spatial concepts of service providing units, benefitting areas, spatial relations, rivalry, spatial and temporal scales are elaborated. Finally, matrices linking habitat types to ecosystem service potentials, flows, demands and budget estimates are provided. The resulting maps show the spatial distribution of ES in the park, which constitute a practical and easy tool for managers to integrate the concept of ES in decision-making. Nonetheless, integrating more data and validating this approach in the future is still necessary if it is to be adopted and applied as a standard method at regional or national scale.

SYMPOSIA NUMBER 188; NOT ALL SMALL DAMS ARE BENIGN: A STUDY ON THEIR CUMULATIVE IMPACTS IN SOUTH AFRICA

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Small dams are generally ignored in impact assessments due to the perception of their benign nature relative to large dams. This may be an oversight in catchments with a high density of small dams. In two South African regions, reduced low flows, deteriorated water quality, and impoverished macroinvertebrate communities (with dominance of opportunistic taxa and reduced abundance for specialist



groups) was previously established in catchments with high density of farm dams that support vineyards, stock farming and exotic timber plantations. An index of cumulative small dams with a threshold of five small dams per square root kilometer of catchment area was identified above which the density of small dams significantly compromises river functionality and impacts on environmental flows. Index values have been calculated at quaternary level (a basic water management unit in South Africa) and it was found that forty-three percent of the 1,946 quaternaries exceed the threshold for high density of small dams above which river deterioration is expected. This estimate of potentially impacted quaternaries is considered to be conservative since the GIS coverage for small dams used in the analysis does not include northern countries with which South Africa shares borders, and thus the index values for quaternaries with transboundary rivers to the north of South Africa might be biased. Secondly, the coverage of small dams dates back to the year 1999 and it is expected that the numbers have changed, possibly increased, since then. Current research is investigating incorporating this small-dams index into a river continuity index, which integrates both lateral and longitudinal discontinuities, for assessing the vulnerability of aquatic biota to climate change effects and for use as a conservation-related decision-making tool for South Africa.

CLIMATE CHANGE MEDIATES RISK OF GLOBAL BIODIVERSITY LOSS DUE TO LAND-COVER CHANGE

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Climate change and land-cover change will have major impacts on biodiversity persistence worldwide. While these two pressures are likely to interact, how climate change will mediate the effects of land-cover change remains poorly understood. Here we use an empirically-derived model of the interaction between habitat loss and climate to predict the implications of this for biodiversity loss and conservation priorities at the global scale. Risk analysis was used to estimate the risk of biodiversity loss due to alternative future land-cover change scenarios and to quantify how climate change mediates this risk. We demonstrate that the interaction of climate with land-cover change could increase the impact of land-cover change on birds and mammals by up to 43% and 24% respectively and alter the spatial distribution of threats. Additionally, we show that the ranking of global biodiversity hotspots by threat depends critically on the interaction between climate change and habitat loss. Our study suggests that the global priority hotspots will likely change once the interaction between climate change and land-cover change is

taken into account. We argue that global conservation efforts must take this into account if we are to develop cost-effective conservation policies and strategies under global change.

DEMOGRAPHY AND POPULATION GROWTH OF WORKING ELEPHANTS IN MYANMAR

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Although the Union of Myanmar is home to the world's largest captive population of Asian elephants (*Elephas maximus*), its demography has never studied in detail. Life history data analyzed in this study are taken from the records and reports archived and maintained by Myanma Timber Enterprise, which is under the charge of the Ministry of Forestry, the Government of the Union of Myanmar. The study population contains 5292 individually identified captive timber elephants, which were born or captured between 1952 and 2000. Overall population structure is in favour of females. A gradual increase in the population size is observable until 1991 followed by a decline until the end of study period in 2000. Projected trends in population size and age- and sex-specific structures are largely affected by the annual rate of capture, births, and deaths. The generation time (T), net reproduction rate (R_0) and the intrinsic rate of increase (r) of captive born and wild caught populations are calculated as 29.49 yr, 1.02, -0.001 and 31.60 yr, 0.47, -0.026, respectively, indicating that the captive born portion of the timber elephant population is self-sustaining while wild caught elephant population, on the other hand, is not self-sustaining, and their population is declining by about 53% each generation.

HUMAN-WILDLIFE CONFLICTS ON PRIVATE LANDS IN BRAZIL: A FAST GROWING ISSUE

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Human-wildlife conflicts have grown in Brazil over the past 10 years. There has been a dramatic increase in the number, diversity of species involved, geographic range, and severity of outcomes. This growth is concentrated on farming areas and at the urban-rural interface, and is attributed to several factors: expanding human settlement, changes in agricultural practices (e.g. recently banning of cane burning), growth of outdoor recreation, and increase in the number of species that have adapted to living in human-dominated landscapes. Managing these species is complicated by the growing diversity of wildlife values among different publics. We describe conflicts involving jaguars, pumas, capybaras (associated with agricultural damage, vehicle collisions and transmission of



zoonotic disease) and wild boars (a spreading exotic species involving issues of hunting/anti-hunting). Three critical needs are identified. 1) Move from a conservation to a management paradigm, where there may be need to reduce populations at some places, rather than the conventional situation where the population was always expected to increase, 2) Emphasize coexistence rather than conflict, addressing factors that can be precisely specified, objectively measured, and positively communicated to the different publics (e.g. tolerance or acceptance instead of conflict), and 3) Apply interdisciplinary approaches to research, management, planning and policy - with particular attention to bringing in the social sciences - by integrating natural, social and behavioural data from multiple species, multiple stakeholders and multiple spatial scale analysis.

SHAKEN, NOT STIRRED": STAKEHOLDER MAPPING AND SOCIAL NETWORK ANALYSIS OF A PROTECTED AREA BUFFER ZONE IN THE TEMPERATE RAINFOREST OF SOUTHERN CHILE

Gonzalo Mardones
University of Otago

One of the main challenges for a buffer zone of protected area is to achieve a successful integration of biodiversity conservation and development needs of local people. In this zone converges a wide range of social, political and economic actors, whose interests need to be integrated. This research presents a stakeholder mapping and a social network analysis of relevant actors in the buffer zone of a protected area in the temperate rainforest of southern Chile. The study identify nearly 200 institutions and organizations with interest and/or influence on conservation and/or development, from local communities organizations, public agencies, local governments, private companies, educational institutions and NGOs. The stakeholders are classified according to type of organization, geographical level of intervention, socio-ecosystem and degree of interest and/or influence, reflecting the multidimensional character should have a good governance of protected areas and their buffer zone. The social networks analysis suggests: a) weak linkage between conservation agency and local communities; b) limited links between conservation agency with other public agencies; c) the social network as a whole has little cohesion and there are a significant number of subgroups; d) the cross-scale links (regional-local) area based on subsectors (agriculture, forestry, fishery, education, health, etc.) without an overall vision; e) the connections at regional level between public agencies and private sector are almost absent; f) the ties between stakeholders are primarily for communicational purposes. All these situations have important consequences for the protected area governance, such as difficulties of sharing

information and knowledge, lower social and political support for conservation, little chance to amplify good experiences and lower resilience to uncertainties.

LIVING KNOWLEDGE ABOUT TRADITIONAL AGRICULTURE IN KALOTASZEG, CENTRAL-EASTERN EUROPE

Katalin Margóczy

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Krisztina MOLNÁR, University of Pannonia ; Krisztina GELLÉNY, University of Szeged, Department of Ecology ; Marianna BIRÓ, Institute of Ecology and Botany, MTA Centre for Ecological Research, Hungarian Academy of Sciences

Knowledge about traditional farming system could be crucial in planning conservation management, especially ecosystem management. The book of the Hungarian ethnographer K. Kós: "Traditional agriculture in Kalotaszeg" (in Hungarian) contains detailed description of the local traditional farming system and land use in the middle of the 20th century, and earlier. Kalotaszeg is a traditional farming landscape in Transylvania (in Romania), with a significant Hungarian population, and ethnographical importance. Kós described the three-field rotation of arable land, the importance of livestock in agriculture as power and maintenance of soil fertility, and the essential local integration of different types of land uses, as arable land, fallow, pasture, hayfield, orchard and garden. In 2013 we conducted 24 semi-structured deep interviews with the people living now here in two villages: Sztána and Zsobok. We asked the people about the past and present land use methods. They told us, that the collectivization (1949-1962) did not change considerably the agricultural system but after the collapse of socialism (1989) most of the arable land were abandoned, the number of livestock decreased considerably. Extensive sheep grazing is the main land use form nowadays, but seminatural vegetation occurs thorough the esthetically attractive landscape. Most of the asked people had detailed knowledge about the former land use system, described by Kós in his book in the middle of the 20th century. They think that present situation is only transitional, and the only right and appropriate method of land use in this area is the traditional method. We discuss the ecological and socio-economical sustainability of the past and present land use system in the presentation.

CONSERVATION OF A KEY STONE SPECIES: BLACK TAILED PRAIRIE DOG RECOVERY IN NORTHWESTERN MEXICO

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Instituto de Ecología UNAM



Rodrigo SIERRA-CORONA, Instituto de Ecología UNAM ; Sara ARIAS, Instituto de Ecología UNAM ; Gerardo CEBALLOS, Instituto de Ecología UNAM

In 1989 in the Northwest of Mexico a complex of 55000 ha of prairie dogs colonies was rediscovered, this complex was the largest in the country and the beginning of a conservation project in the Mexican grasslands. Since then, research studies in the area accompanied with biodiversity monitoring have shown the role of prairie dogs on grassland ecosystem, supporting associated biodiversity, aerating the soil, promoting the water infiltration and other ecosystem services. Paired with the research studies, a mistakenly conception of prairie dogs as a plague, which led to eradication campaigns and a recent land conversion to agriculture threat the populations and the grassland ecosystem. In 2005 in order to assess the status of prairie dogs populations, the complex was monitored revealing a reduction of 73 percent of the area covered by colonies in 1989 and an estimated population of 100 thousand individuals. In 2013 we conducted the third monitoring of the prairie dog complex and we found an accentuated reduction with only 2284 ha with prairie dogs active colonies and an estimate population of 13660 individuals, representing that only a 5.4 percent of the area remains from the original distribution mapped in 1989. We also found an increase in the fragmentation of the colonies in the complex, passing from 43 colonies units in 1989, 56 colonies in 2005 and 76 colonies on 2013, and this fragmentation associated with an increase of croplands and a decrease of active prairie dogs burrows, which serves to many others species in the grassland ecosystem. With the actualized distribution and population trends we recategorize the black tailed prairie dog as an endangered species in the Mexican law, as a first step of a long term strategy for this key species and as a mechanism to preserve the last grassland in northwest Mexico.

ADAPTIVE CONSERVATION OF ETHIOPIAN WOLF POPULATIONS: LONG-TERM EFFECTS OF SOCIALITY, CLIMATIC VARIATION AND DISEASE

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Successful strategies for the conservation of endangered carnivores rely on a good understanding of the factors and processes that drive their population dynamics. This knowledge, however, is typically constrained by the lack of detailed demographic data over long periods of time, so that the effects of climatic variation and of infrequent events such as sporadic disease epizootics can be captured. In social species with cooperative behaviours, an additional challenge is to

account for the impacts that behavioural decisions may have on population-level phenomena. Close monitoring of Ethiopian wolf (*Canis simensis*) populations over 30 years provides a valuable opportunity to assess these multiple influences, including that of recurrent rabies and canine distemper virus epizootics and reactive vaccination interventions. Demographic analyses and modelling revealed how these factors intermingle to control wolf numbers and their capacity to recover, with implications for their conservation and future population management interventions.

21. TOWARDS JUSTICE AS RECOGNITION: ASSESSING THE POLITICS OF REPRESENTATION IN CONSERVATION GOVERNANCE

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Over the past 30 years, scholars, practitioners, and policy makers have sought to transform global conservation efforts from being the source of injustice for forest-dependent communities towards being, at a minimum, initiatives that “do no harm.” As part of this quest, global conservation governance has adopted a set of justice practices aimed at facilitating justice at the community level, primarily focusing on enhancing procedural and distributional justice. In this paper I argue that the pursuit of these two dimensions of justice is insufficient for promoting just conservation. Instead, more attention to justice as recognition is required. Using data collected through two collaborative event ethnographies, coupled with institutional analysis of forest conservation projects in Laos and Southeast Asia, I show how understanding the politics of representation in global conservation governance across multiple scales of governance can open up new pathways towards justice as recognition. In particular, I direct attention to indigenous and local community representation at the Tenth Conference of Parties to the Convention on Biological Diversity, the World Parks Congress 2014, and their related forest conservation projects to highlight the barriers to and opportunities for facilitating justice as recognition.

SYMPOSIUM 116 - NATURE AND WILDERNESS IN THE ANTHROPOCENE

Virginie Maris

CEFE/CNRS

It is often said that we are witnessing the death of nature. Empirically, almost no place on the Earth remains uninfluenced by human activities. Conceptually, the old Nature/Culture dichotomy has been strongly criticized during the past thirty years. In the field of biodiversity conservation, there is less and less reference to the idea of nature, which is diluted in



the technical and economical spheres. From a technical point of view, the intensification of intrusive and technological-dependent means to conserve or restore biodiversity makes it less and less easy to distinguish what is natural from what is artificial, including in those areas traditionally dedicated to nature. From an economical point of view, the trend is made visible in the changing vocabulary of conservation, which increasingly borrows jargon and metaphors from economics, nature protection now having to do with the management of natural capital and the optimization of ecosystem services. The Anthropocene narrative reinforces this process of dissolution. By describing the present time as the one in which the Earth enter the era of humans, it looks like if there is no longer any room left for wild nature. However, a reference to nature is still salutary in order to face the environmental crisis. More precisely, the exteriority, the otherness and the agency of nature and natural entities are key features that offer the necessary background on which to project a peaceful and flourishing way to interact with other living beings. These features are well captured by the idea of wilderness. I will show that this concept, often criticized as an old-school phantasm, can still offer a precious guide for action in conservation, as long as it is re-conceptualized in terms of process rather than in terms of areas.

ARTISANAL AND RECREATIONAL FISHING FOOTPRINT ON CORALLIGENOUS VULNERABLE HABITATS

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Coralligenous habitats are extremely prone to mechanical disturbance and human activities such as fishing. Even though commercial fishing - and particularly bottom trawling - is considered by far the most destructive activity, recent studies show that small scale and recreational fishing should not be overlooked, as they extract a considerable amount of marine resources and exert significant pressure on benthic key habitats and species. Assessing fishing activity in the Mediterranean requires complicated approaches due to the increased heterogeneity and combination of gears, the variation of target species and the poor availability of data. Even though in most cases these activities are regulated a specific management plan should be developed, particularly in Marine Protected Areas (MPAs), due to the high biodiversity they host and the considerable numbers of fishermen involved in order to ensure their conservation targets. The present

study reveals areas vulnerable to the footprint of small scale and recreational fishing activities in Portofino MPA (Italy), aiming to support monitoring strategy in Mediterranean MPAs and support decision making for conservation objectives. Spatial analysis tools were used to integrate various sources of information from common MPA monitoring frameworks, in order to describe the impact and identify the spatial patterns of destructive fishing gears, such as fixed nets and longlines, on coralligenous habitats. The pressure assessment was based on the features of the gears and the fishing techniques in relation to the sea bottom characteristics. Results reveal an increased fishing footprint in areas where coralligenous habitats occur in 30-50m depth overlapping with elevated diving activity, increasing the risk of impact on this vulnerable habitat. The present study may provide baseline information on ecological, ecosystemic and conservation modelling related to fishing activity and vulnerable habitats in Mediterranean MPAs.

124-AVERTED LOSS OFFSETTING: COUNTERFACTUALS AND WHAT THEY MEAN FOR NNL GOALS

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The University of Queensland

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The extent and condition of native vegetation and habitat continues to decline in most parts of the world. Despite national and supranational commitments to stabilise biodiversity loss, the end point of these trajectories of decline remain unclear. In recent years, the growing popularity of biodiversity offsetting has helped popularise the concept of 'no net loss' of biodiversity. This outcome could be achieved through directly linking losses and gains (e.g. offsets) or more broadly ensuring we restore at least as much as we destroy. However, even this seemingly-clear goal can be interpreted in multiple ways, and depending on which interpretation prevails, achieving 'no net loss' can counter-intuitively mean that biodiversity continues to decline. We review goals and targets outlined in Australian native vegetation policy. We focus on offset policy, which in Australia is used extensively as a response to development that requires deforestation. Despite referring to 'no net loss' or a requirement to 'improve or maintain' biodiversity, all Australian applications of offsetting were based (implicitly or explicitly) on a declining baseline for biodiversity. In some States, these baselines were steep – up to 4.2% loss (of vegetation extent and/or condition) per annum. Policies that aim to achieve no net loss relative to a declining baseline essentially entrench it across impact-offset trades. Thus, the more that this type of 'averted loss' offsetting is relied upon to negate losses, the more broadly the declining baseline becomes entrenched. We suggest ways in which such perverse



outcomes can be minimised through linking baselines to biodiversity conservation goals.

BIODIVERSITY IN INPUT-OUTPUT ANALYSIS: THE INDIRECT DRIVERS OF BIODIVERSITY LOSS

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IDiv

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In 2010, the European Union established its growth strategy for the ten years ahead, the EU 2020 Strategy. The Resource-Efficient Europe is one of its flagship initiatives, framed under the principle of sustainable growth. One of its key proposals is the EU Biodiversity Strategy to 2020 to halt biodiversity loss and ecosystems degradation. This strategy highlights the importance of reducing the impacts of EU consumption patterns, particularly for resources that have significant negative impacts on biodiversity. Environmentally-extended input-output (IO) analysis has been increasingly used to identify the economic drivers of environmental impacts. Namely, the embodied impacts associated with a consumption activity and the impacts embodied in international trade. In this work, we developed a biodiversity extension to EXIOBASE, a global multi-regional environmentally extended input-output database. We used the countryside species area relationship to measure the number of species lost due to the activity of the land use sectors and analyze how consumption indirectly drives biodiversity loss. This work provides important insights into the linkages between economic activity and biodiversity loss. In an increasingly globalized world there is a spatial disconnection between production activities and the final consumer. Understanding how consumption drives biodiversity loss due to land use change can provide new pathways for biodiversity conservation.

EVALUATION OF A PARTNERSHIP WITH THE WINE INDUSTRY FOR SUSTAINABLE AGRICULTURE AND BIODIVERSITY CONSERVATION IN CHILE'S MEDITERRANEAN ECOSYSTEMS

Marcela Marquez-Garcia

University of Florida

Susan JACOBSON, University of Florida ; Olga BARBOSA, Universidad Austral de Chile

Only 1% of Chile's Mediterranean ecosystems are protected, yet this is a global conservation priority due to high levels of endemism and threats. Private land conservation efforts are needed, especially in partnership with the agricultural industry, which is a major economic driver in the region. The expanding wine industry is a primary target since producers and consumers increasingly value environmental stewardship. Using an organizational application of the theory of planned behavior, we compared the individual and institutional

factors of adopting conservation practices among Chilean winegrowers participating in a multi-year sustainability program with a control group. Semi-structured interviews were conducted with 25 vineyard managers. The program treatment group reported more conservation practices than the control. Ecosystem services, such as erosion control, pest and disease management, and aesthetic and spiritual benefits were the most important advantages of adopting conservation practices for both groups. Other motivations to engage in conservation were a sense of moral obligation and responsibility for future generations, which emerged more frequently in the treatment group. Regarding social pressures, the customers and the company's owner were important drivers of conservation behavior, but the treatment group reported a broader spectrum of internal stakeholder influence. Also, the treatment group seemed to be strongly influenced by conservation leaders within the company and from the sustainability program. The lack of information about the direct benefits of biodiversity conservation on the winegrape production and wine quality constituted an important barrier. This study enhanced our understanding of corporate environmental management, and identified factors beyond winegrowers' financial returns that explain sustainable agriculture and biodiversity conservation behaviors in endangered Chilean Mediterranean ecosystems.

MODELLING FINE SCALE HABITAT ASSOCIATIONS OF MEDIUM-TO-LARGE FOREST MAMMALS IN THE UZUNGWA MOUNTAINS OF TANZANIA USING CAMERA TRAPPING

Emanuel Martin

Sokoine University of Agriculture

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We used camera trap data from the Tropical Ecology, Assessment and Monitoring (TEAM) network, collected in 2013 from 60 camera trap locations, to determine medium-to -large forest mammals' habitat associations at a fine scale level in the Udzungwa Mountains of Tanzania. This is an outstanding area for biodiversity and endemism in Africa, particularly for forest mammals. Our sampling lasted one month and yielded 12,911 images of 26 species of mammals. We used generalized linear modeling to determine relationship between trapping events and vegetation and other habitat variables, and obtained satisfactory model fit for nine out of the 11 most recorded species, with explained deviance ranging from 5.79 to 63.7 %. For rare species such as Abbott's duiker (*Cephalophus spadix*) results showed their trapping events to be positively correlated with the distance to the National Park



border while for Lowe's genet (*Genetta servalina lowei*) it was found to be positively correlated with big trees diversity but negatively correlated with a visibility index and herbaceous-seedlings forest floor cover. Our study validates the usefulness of camera trapping to assess communities of forest mammals and in particular determining their habitat associations, thus providing data which are relevant to their conservation management.

15 - LINKING LANDSCAPE STRUCTURE AND ON-FARM MANAGEMENT TO BIODIVERSITY IN AGRICULTURAL LANDSCAPES

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Landscape structure and on-farm management are important factors for the richness and abundance of species in agricultural landscapes. Previous studies have shown beneficial effects of the proportion of non-crop habitat, the configurational complexity of landscapes and organic farming on biodiversity in agricultural landscapes. Various organisms including arthropods and birds exhibit higher species richness and abundance in landscapes with high amounts of natural or seminatural habitats that provide additional foraging and nesting resources. In addition to landscape composition, the spatial arrangement of land use types in a landscape can increase the interconnectedness of patches and thereby the richness and abundance of species. Finally, local management has a direct impact on organisms by pesticide application and different availability of food resources. However, the relative importance of landscape composition, landscape configuration and local management for different functional animal groups is still unclear. Due to data limitation, available syntheses lack functional resolution and have included only coarse local and landscape effects. Here, we use a quantitative meta-analytic approach based on the data of previous studies to analyse the interactive effects of local management intensity, landscape composition and configuration on functional groups of pollinators, pests and natural enemies in agricultural landscapes. We hypothesize that (1) Pollinator groups, which mainly depend on the amount of flowering resources, are most affected by landscape composition, whereas natural enemies are most affected by landscape configuration and the proportion of ecotones between habitat types, (2) Effects of local management intensity interact with landscape factors such that management effects are strongest in landscapes with both low amounts and a simple configuration of habitats. We will present and discuss results from the analysis of a large European-wide data set.

DIE-OFF OF LARGE TREES DRIVES FOREST COLLAPSE TO NON-FOREST STATE

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There is great concern different drivers may cause forests to rapidly transition to non-forest states. Such changes may be driven by human use (e.g. logging, grazing of animals), climatic stress (e.g. drought) or interactions between the two. While there have been many case studies indicative of such rapid transitions they tend to be hindered by short sampling periods. Our work uses a 50 year time series from a woodland in Southern England that appears to be switching to a non-forest state. This work shows that die off of large trees has resulted in massive change in forest structure in some areas. Plots that experienced more severe collapse had greater alteration of ecological communities and understories tended to be dominated by grasses. Mortality in the woodland may have been elevated by a combination of storms, drought and fungal pathogens. Regeneration in the woodland is almost nil probably as a result of overgrazing of livestock and deer. Together these different drivers are responsible for shifting the woodland to a largely treeless state in which it is likely to remain without any remedial action.

NATIVE FOREST COVER INFLUENCES SPECIES DISTRIBUTION AND NETWORK STRUCTURE OF ARTHROPOD-PLANT ASSEMBLAGES IN TRADITIONAL CORNFIELDS

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Understanding processes shaping communities in agroecosystems is essential for the design of strategies promoting long-term sustainability of ecosystem services, such as pest control. We studied the organization of arthropod-plant assemblages in twelve traditional cornfields from the Colombian Andes. We first investigated the association between patterns in species distribution and gradients in native forest cover, altitude, field size, and organic matter in soil. Then, we described the architecture of local species interaction networks. The assemblages of plants associated to corn crops were significantly nested, i. e., species composition of species-poor cornfields represent subsets of species-rich cornfields. Altitude and content of organic carbon in soil accounted for nestedness of the plant meta-community,



whereas forest cover and weed richness accounted for nestedness of the arthropod meta-community. Only the plant meta-community exhibited significant, albeit low, modularity. Local species interaction networks were modular, with plants acting as module hubs with arthropods, particularly herbivores, being peripheral species. The modular structure of arthropod-plant interaction networks suggests herbivores tend to be specialized with regards to their host plants. Forest cover and weed species richness within cornfields were positively related with both the number of arthropod species in networks and average interaction numbers per species, but negatively affected modularity. Thus, clearing native forest in this agroecosystems may induce the loss of predator species and also may lead to the lack of cohesion of overall weed-arthropod interaction networks with negative consequences for pest control. This network approach can be useful to identify environmental factors and species with potential, to play key roles in pest management. Increasing forest cover surrounding crops augments the local diversity of predators, decreasing demands for agrotoxicals.

LAND USE CHANGE SCENARIOS AND ECOSYSTEM SERVICES PROVISION IN CENTRAL CHILE

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Scenarios of land use and land cover change provide a platform to predict the possible outcomes of land use decisions on the provision of ecosystem services. This information can then be used to inform the development of policy and minimize unintended consequences. Despite the wide use of scenarios in ecosystem service assessments, there is a lack of clarity on how qualitative expert-derived information on the drivers of land use change can be transparently combined with quantitative analyses on the provision of ecosystem services. In this study we integrate qualitative scenario storylines derived through expert-elicitation with spatially explicit models of land use and land cover change. We quantify the impact of future land use and environmental change on a selection of ecosystem services in Central Chile: carbon storage, wine production, and scenic beauty. Experts identified urbanization sprawl and climate change as the critical drivers affecting the study area. The drivers were compiled into a set of four storylines depicting contrasting assumptions and translated into spatial rules of land use change according to their impacts on the selected services. The resultant scenario maps representing higher greenhouse gas concentration levels and higher levels of urbanization show a potential future decline in the provision of ecosystem services for the year 2050. The information derived from our scenario analysis is useful to inform and guide the development of future land use policy in Central Chile.

CHALLENGES & STRATEGIES WHEN DOCUMENTING INUIT KNOWLEDGE, A VALUABLE TRADITIONAL ECOLOGICAL KNOWLEDGE DATABASE FOR ARCTIC WILDLIFE MANAGEMENT AND CONSERVATION

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Combining Traditional Ecological Knowledge (TEK) with science has increased in ecology, particularly when working in remote locations such as the Arctic, where harvesters have a close relationship with wildlife. However, there are often limitations and biases in the methods used to gather, analyze and report TEK that not only jeopardize the validity of the data, but can potentially result in negative impacts for wildlife. Here, we discuss the limitations and biases faced during our documentation of TEK on walrus in the Canadian Arctic, and offer strategies to address these issues. Semi-directive interviews with a mapping process were used to collect Inuit Knowledge from 33 walrus experts. The audio-recorded interviews and digitized maps were analysed using NVivo and ArcGIS. Our data interpretation was verified during workshops held with participants. We found that by recording and adding to maps the geographic limits of participants' primary area of knowledge, we were able to distinguish areas that hunters typically visited and did not see walrus from areas that hunters never visited. Furthermore, using a top-down strategy, our statistical models showed that the variability in the quantity of mapped data was explained by the community of residence and the average number of hunting trips per individual but not their age. These results highlight the importance of considering and including key attributes as criteria to select participants. On the contrary, age explained the variability in the quantity of diverse mapped data, suggesting that while Elders do not provide a greater quantity of map information, they provide greater diversity. We hope this careful examination of methods will help to increase rigour in the methods used to gather TEK, and increase confidence in TEK datasets as a valuable source of knowledge for wildlife management and decision making.

MATRIX AND EDGE EFFECTS ON THE MAINTENANCE OF ECOLOGICAL FUNCTION IN AN AFROMONTANE PROTECTED AREA

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Land use type in the human dominated matrix surrounding tropical forest can influence edge effects on forest ecological processes. Seed dispersal is a key ecological process in tropical forest regeneration dynamics. Our hypothesis was that soft or low contrast matrix types will better support ecological processes than a hard or high contrast matrix. We examined how matrix type, tea plantations (hard) vs. pine plantations (soft), affects seed dispersal effectiveness and vegetation structure and composition in adjacent edges of montane tropical forest. Research was conducted in Nyungwe National Park, Rwanda, located in the Albertine Rift biodiversity hotspot. We conducted focal tree observations and sampled vegetation over a 10 month period. We found significant differences in frugivore assemblages and forest structure adjacent to hard vs. soft matrix types. Large birds made more visits to focal trees and removed more fruit (49%) in forest edge adjacent to soft, low contrast pine plantation, while primates made significantly more visits to focal trees and removed more fruit (90%) in forest edge adjacent to hard, high contrast tea plantations. Forest edges adjacent to tea plantations showed a deeper penetration of edge effects resulting in a greater proportion of small seeded, shade intolerant tree species than in edges adjacent to pine plantations. These findings demonstrate how land use around tropical forests affects forest composition, structure and function, and can contribute to ecological integrity in systems facing pressure from human land use in the surrounding matrix.

CONSERVATION EFFORTS ON HIGH NATURE VALUE FARMLANDS IN CYPRUS

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The growing recognition that the conservation of biodiversity in Europe depends on the continuation of low-intensity farming systems resulted in the concept of High Nature Value farming (HNVF). In the Mediterranean in particular, HNVF includes some of the most traditional agricultural crops such as cork oaks, olives, carobs and vineyards. In Cyprus carob groves and vineyards are among the crops which are inextricably linked with the economic and cultural character of the island. At the same time these crop systems when farmed

at low-intensity, support species of fauna and flora which are important at the National or European level, while providing a number of other ecosystem services. Despite their importance, these HNHF types on the island are now threatened by intensification, abandonment or lack of awareness about their role. This demonstration project puts into practice, tests, evaluates and disseminates actions/ methodologies that are unfamiliar to the Cyprus geographical, ecological and socio-economical context. The objectives of the project are to: a) Conserve biodiversity in vineyards and carob groves, with a strong focus on species listed in the Birds and Habitats Directives, b) Support and promote sustainable agricultural practices that increase ecosystem services, c) Identify strengths and weaknesses of bioindicators for evaluation of HNHF in small scale agriculture and d) Encourage stakeholder involvement and increase public awareness regarding HNHF issues through active participatory learning. Although this work is still under progress we anticipate that the knowledge generated from it would provide important guidelines for the sustainable management of vine and carob HNHF in Cyprus.

USING COUNTRYSIDE SPECIES-AREA RELATIONSHIP TO QUANTIFY THE IMPACTS OF LAND USE ON BIODIVERSITY

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Land use is one of the main drivers of biodiversity loss. The response of species richness to habitat area loss is often assessed using species area relationships (SAR) models. The classic SAR or power model assumes that the number of species is mainly determined by habitat area, projecting that all species go extinct after all native habitat is lost. However, the conversion of natural habitats to human-dominated habitats, for example the conversion of forests to agricultural areas, may lead to the increase in some species and decline in others. Alternative forms of the SAR, such as the countryside SAR, have been developed in order to address this problem. The countryside SAR model accounts for land use information and for species affinity to the different types of habitat. In this work we perform a global spatially explicit analysis to determine the impact of 14 land use activities on species extinctions of birds, mammals and amphibians. Using the habitat preferences and geographic range data from the IUCN we assessed the affinity of each species to a certain land use type. Our global analysis calculates, for each WWF ecoregion and biome, the species loss associated to each individual land use activity. Then this loss is allocated to each country taking into consideration the area



occupied by each land use sector in each country as well as the affinity of the species to that land use activity. At the national level our results provide important insights for sector driven policies to halt biodiversity loss.

THE SOCIAL IMPACTS OF PROTECTED AREAS: INSIGHTS FROM 100 VILLAGES IN INDONESIA

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Protected areas are an integral component of local, national, and international strategies for biodiversity conservation, but their contributions to sustainable development goals (SDGs) remain contested. To inform this debate, we examined the impacts of marine protected areas (MPAs) on household well-being in >100 villages across the Bird's Head Seascape (BHS) of Indonesia. Using a quasi-experimental design and drawing upon nearly 5,000 interviews, we examine social well-being across five social domains: economic well-being, health, political empowerment, education, and culture. Preliminary impact data from eight MPAs and matched control sites provide insights into the short-term impacts of protected area establishment on household well-being. We find that MPA social impacts vary widely, with the magnitude and direction of impacts differing within and among social groups, across social domains, and between sites, resulting in complex arrays of impacts. In addition to providing insights for site-level adaptive management, the heterogeneous social impacts of MPA establishment in the BHS highlights the need for a more nuanced approach to evaluating the social impacts of conservation interventions as the foundation for analyzing protected area–poverty linkages and advancing sustainable development goals. This manuscript is part of a set of contributed papers organized by L. Glew, M. Mascia, and D. Miller. If accepted, please include this presentation in the program immediately following the presentation by Dan Miller and immediately prior to the presentation by Lauren Persha. If you have any questions, please contact me directly. Thanks.

THE GEOGRAPHICAL RANGE OF BRITISH BIRDS EXPANDS DURING 15 YEARS OF WARMING

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British Trust for Ornithology

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Climate change is affecting the distributions and populations of many species and it is projected to lead to range contractions and extinctions. Previous assessments of distribution change have relied on presence-absence or presence-only data, and therefore only assess species entering new areas or leaving old areas. Furthermore, expansions

are easier to detect with presence data than contractions, so there may be biases in the data. Changes in abundance within an existing range are a more powerful way of assessing distributional change and they may be an early-warning of changes to range extent. We examine change in abundance within species ranges and assess whether range limits and range optimums are moving in response to climate change. We use 15 years of bird data from Great Britain, where there has been substantial northward movement of climate. Species northerly distribution margins moved northward for a wide range of species, but the southerly edges of the species distributions were largely static. This suggests the mechanisms defining the northerly and southerly distributional limits may differ. The northerly movement of the northerly edge of the distributions, without the concurrent contraction in the south has led to many species expanding their distribution. The magnitude of northerly distribution shifts lagged behind the equivalent shifts in temperature, suggesting that species may be accumulating a climatic debt and may find it increasingly difficult to track the moving climate. Contrary to the generally expected long-term consequences of climate change of range contraction and population decline, we show that the short-term response of birds to recent warming in Great Britain has been range expansion.

177-WETLAND SOCIAL-ECOLOGICAL DYNAMICS, BIODIVERSITY CONSERVATION AND DIALOGUE PROCESS: LESSONS-LEARNED FROM THE BUTORSTAR COMPUTER-BASED ROLE-PLAYING GAME

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With computer simulations and/or role-playing games, agent-based models (ABM) can support participatory modelling approaches in which stakeholders involved in biodiversity management projects collectively construct and/or reflect together on land use and land planning scenarios. Ten years ago we created ButorStar, a role-playing game based on an ABM that allows the simulation of the impacts of multiple uses of a wetland on habitat and fauna dynamics and their feedback on land cover changes and social-economic dynamics. This tool serves in training students in negotiation and participatory-management of both protected and unprotected natural areas. The analysis of gaming sessions with postgraduate students in social science, conservation science and environmental management shows that (i) students learned more about social dimensions of biodiversity conservation planning than about ecological interdependencies; (ii) students from social science were more able to find social-ecological trade-offs; (iii) students from conservation sciences were likely to create more



dikes to manage threatened species, increasing the man-made influence on the landscape. Also used with local stakeholders in several wetlands, and with managers of NGOs and protected areas, the results demonstrate that this approach contributes to increasing stakeholders' ability to adopt methods of interaction that promote adaptive management of natural areas. Overall our results show three key social effects within the context of integrated conservation and development projects: (1) the creation of social-ecological knowledge that may feed integrated conservation policy ; (2) the use of social learning to resolve practical problems ; (3) the rising awareness of social-ecological interdependencies during the game session increase the capacity of players to collaborate and to participate in the social change that any integrated conservation project may need.

IMMEDIATE BIRD RESPONSES TO WINDSTORM DISTURBANCE: A CASE STUDY FROM BUSSACO NATIONAL FOREST, CENTRAL PORTUGAL

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On 19 January 2013, a windstorm named Gong, which observed wind gusts of 140 km/h, hit the Portuguese coast and was responsible for the downfall of thousands of trees in some Portuguese forests and cities. Bussaco National Forest (BNF), an old-growth heritage forest, was affected in about 40% of its area, with over 2500 fallen trees. Acoustic and visual bird censuses were conducted from June to December, before and after the storm, in 35 sampling points distributed by the three main landscape units amongst BNF: Pinhal do Marquês Pinus pinaster pinewood, relict forest and the arboretum. The pinewood and the arboretum were highly damaged, whereas the relict forest, a climax woodland composed exclusively by native species, was the less affected landscape unit. Overall and in all landscape units, birds' species richness diminished, but birds' abundance increased. Diversity and evenness indices presented significant differences in the pinewood and in the arboretum, but no differences in the relict forest. The assemblage composition of the most abundant species was altered only in the pinewood, for instance with *Corvus corone*, that was not registered there before the storm, becoming the most abundant species afterwards. In all landscape units rare species recorded before the storm virtually disappeared afterwards. We discuss that windstorm disturbance may cause short-term immediate bird responses that only favour more common and resilient species and hypothesize that treefall gaps may however contribute to the structural heterogeneity of the forest and benefit the composition and richness of the bird community in the long run. Sound forest management

preventing ecological invasions and favouring native species is crucial for accelerating the restoration of the ecosystem. Some conservation perspectives are also discussed.

FORECASTING FUTURE DIVERSITY AND DISTRIBUTIONS OF BUTTERFLY SPECIES UNDER CLIMATE CHANGE IN JAPAN

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Future climate change is a major threat to biodiversity through habitat degradation or species geographic range shifts. The alteration of habitats under climate change could cause the current nature reserves less valuable to conserve species in the future. Butterflies are flagship species for conservation, and more than 25% of them are listed in Red Data Book in Japan. Forecasting their future distributions would enable us to identify priority species and areas, leading more effective conservation planning. First, we constructed species distribution models for 179 butterfly species with a presence only modelling, Maxent. We then forecasted their future distributions for three time slices (2020, 2050, 2080), and under three climate change scenarios (RCP2.6, RCP4.5, RCP8.5). The future climate variables were averaged over four climate models (MIROC5, MRI-CGCM3, GHDL-CM3, HadGEM-ES) to consider model uncertainties. Based on the future distribution maps, we identified vulnerable species to future change, which rapidly and severely decline in their range size. We also identified robust areas that will stand as hotspots until 2080 under different climate scenarios as candidate priority areas, which had a higher proportion of landscape heterogeneity than existing nature reserves. Landscape heterogeneity is enhanced by mixture of open lands or agricultural fields with secondary forests, which are significant refuges for grassland species, accounting for 70% of Red Data Book of Japanese butterflies. Considering complementary with existing nature reserves which mainly consist of forested areas, we propose conservation strategies to prioritize the management of open lands or agricultural fields to maintain landscape heterogeneity under the future threat of climate change.

ANALYSIS OF THE DEFORESTATION DYNAMICS IN PRATIGI'S ENVIRONMENTAL PROTECTED AREA, BRAZIL, AND THE IMPLICATIONS FOR CLIMATE CHANGE

Bruno Matta

IPÊ

Clinton JENKINS, IPÊ ; Eduardo DITT, IPÊ ; Alexandre UEZU, IPÊ

The study of deforestation dynamics is extremely important for a better understanding of the processes and phenomena that determine land use change. In the region of the Atlantic Forest



biome along the coast of Brazil (a biodiversity hotspot), such an analyses allows the design of effective actions to conserve the remaining forest fragments. Even with the existence of specific laws to protect and preserve the Atlantic Forest (Federal Law n°11.428/2006), deforestation still exists in the biome and is considered a common practice in many regions. In Pratigi's Environmental Protection Area (EPA) in the Central Corridor of the Atlantic Forest, deforestation increased 9% between 2000 and 2011, representing around 14 thousand hectares and a mean rate of 1273 hectares/year. The goal of our study was to understand the historic processes of these deforestation dynamics in Pratigi's EPA and to estimate the amount and location of deforestation until 2041. Between 2000 and 2006, the mean annual deforestation rate was 1.21%, while in the second period between 2006 and 2011 the rate was a slightly higher 1.55%. In the year 2000, the deforested area was approximately 38,312 ha, which represents 22% of the Pratigi area. In 2011, there was an increase in the deforested area, reaching 31% of the EPA and 52,319 ha. The projected deforestation for the Pratigi's EPA in the period 2011-2041 was 31,322 ha, being an annual mean deforestation rate of 1.2%. This would represent a total emission of 10,443,422 tons of CO₂. The possibility to develop a forest conservation project (REDD+), aiming to generate carbon credits from reduced deforestation, could potentially represent a gross revenue of 43 million dollars in 30 years of a project.

SUCCESSES AND CHALLENGES FROM FORMATION TO IMPLEMENTATION OF ELEVEN BROAD-EXTENT CONSERVATION PROGRAMS

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Integration of conservation partnerships across geographic, biological, and administrative boundaries is increasingly relevant because drivers of change, such as climate shifts, transcend these boundaries. We explored successes and challenges of established conservation programs that span multiple watersheds and consider both social and ecological concerns. We asked representatives from a diverse set of 11 broad-extent conservation partnerships in 29 countries 17 questions that pertained to launching and maintaining partnerships for broad-extent conservation, specifying

ultimate management objectives, and implementation and learning. Partnerships invested more funds in implementing conservation actions than any other aspect of conservation, and a program's context (geographic extent, United States vs. other countries, developed vs. developing nation) appeared to substantially affect program approach. Despite early successes of these organizations and benefits of broad-extent conservation, specific challenges related to uncertainties in scaling up information and to coordination in the face of diverse partner governance structures, conflicting objectives, and vast uncertainties regarding future system dynamics hindered long-term success, as demonstrated by the focal organizations. Engaging stakeholders, developing conservation measures, and implementing adaptive management were dominant challenges. We describe an approach to overcome these challenges using two case studies on large, cross-border national parks of central Europe.

ECOSYSTEM SERVICES AS A RATIONALE FOR ECOLOGICAL RESTORATION IN AUSTRALIA

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Habitat restoration has long been motivated by conservation of biological diversity, but increasingly, it is also called on to restore or protect the flow of ecosystem services (ES) to humans. We examined perceptions of the relative importance of ES and biodiversity as a rationale for ecological restoration projects in Australia, where government funding priorities have alternately favored biodiversity and ES goals for restoration on public and private lands. First, we queried the MERIT database of Commonwealth-funded natural resource management projects, to quantify the frequency of ES and biodiversity goals in >250 restoration and revegetation project summaries. Second, we did 30 semi-structured interviews with land managers charged with implementing restoration projects all over Australia, to understand the role that ES provision and biodiversity conservation played in justifying projects to landowners, funders, and other stakeholders. Third, we developed a survey for members of the general Australian public, to understand what value they place on ecosystem services and biodiversity as goals of restoration. The data analyzed so far quantify a trend of increasing importance of ES goals in motivating restoration projects in Australia. However, the largest and best-funded projects appear to have conservation of endangered species as their principal goal.



BAYESIAN NETWORKS AS A TOOL FOR RECONCILING THE ECOLOGICAL, SOCIAL AND ECONOMIC DIMENSIONS OF CONSERVATION: A CASE STUDY ADDRESSING THE SUSTAINABILITY OF WHALE-WATCHING

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Conservation, acting at the interface between natural and social sciences, requires a dynamic, holistic and multidisciplinary approach. However, in spite of the growing awareness of the need to cross disciplinary borders, effective integration of knowledge originating from different disciplines such as ecology, economics and psychology remains an open challenge. In fact, the tendency towards overspecialization and the lack of common frameworks, languages and tools between disciplines has often undermined attempts to adopt a more integrated approach. Bayesian Networks (BNs) have shown to be a powerful tool for retrieving “the bigger picture”, in a visually accessible and mathematically robust way. By combining graph theory, which effectively represents the relationships between variables, and probability theory, which explicitly incorporates uncertainty, BNs are models able to predict future scenarios and the outcomes of certain actions through complex causal chains. Our work offers an overview on the use of BNs as a framework for integrating the ecological, social and economic dimensions of conservation. As an example, we illustrate the ongoing development of a BN model examining the complex system underpinning the sustainability of whale-watching. Through our case study we show how BNs can potentially integrate any kind of qualitative or quantitative information available, from the outcomes of existing models to expert opinion, from popular knowledge to raw datasets. Once the model is developed, we illustrate how it can be used to identify monitoring and research priorities, to give insight into future scenarios under different management regimes, and to optimise action according to the best available information. Our study demonstrates that BNs represent a viable tool for successfully meeting the challenge of interdisciplinary and holistic management, thus having the potential to contribute to global conservation outcomes.

ELEPHAS MAXIMUS ECONOMICUS : MODELLING THE POPULATION OF LAO CAPTIVE ELEPHANTS USING A BIO-ECONOMICS APPROACH.

Gilles Maurer

Centre d'Ecologie Fonctionnelle et Evolutive

Benjamin RASHFORD, University of Wyoming ; Jean-Dominique LEBRETON, Centre d'Ecologie Fonctionnelle et Evolutive ; Olivier GIMENEZ, Centre d'Ecologie Fonctionnelle et Evolutive

Asian elephant populations (*Elephas maximus*) are in overall decline and classified as endangered by the International Union for Conservation of Nature. Captive populations represent a third to a quarter of the total population, which makes them of paramount importance in terms of species conservation. Interrelationships between wild and captive populations persist in most countries, typically through reproduction between captive cows and wild bulls. However, very few studies have considered captive individuals, and their role in the persistence of elephant populations. As a case study, we focused on Laos that has a tradition of raising Asian elephants for centuries. Yet the captive population has plummeted over the past twenty years due to the intensification of work in the logging industry with the recent opening to the market economy. Elephant owners thus refrained their cows to breed preferring the high incomes generated by their work. We aimed at describing the dynamics of an exploited population of Asian elephants in Laos, paying particular attention to the determinants of fecundity. Using population demography modeling, we demonstrate that fecundity is impacted i) by the dynamics of the wild elephant pool through mating of captive females by wild males and ii) by the financial inducement of elephant owners to breed their animal. As a result, we predict that fecundity will raise again gradually in response to the rapid increase in elephants' prices, confirming the hypothesis of elephant owners profit maximization. The captive population will tend towards an asymptotic limit determined by the dynamics of the wild pool. Overall, our bio-economic approach allows producing new ecological-economic equilibria that will serve as a basis for designing recommendations on a sustainable management strategy for the species.

MAINSTREAMING PROTECTED AREA CO-MANAGEMENT IN BANGLADESH: TWO DECADES OF USAID EXPERIENCE

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USAID/Bangladesh

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Natural capital continues to be a major source of wealth and power around the world and evidence of this reality remains compelling in Bangladesh. In Bangladesh, poverty is mainly rural, and mainly among natural resource dependent and landless communities. The important role of biodiversity in the economy of Bangladesh is quite evident and irreplaceable. Sustainable management of the biodiverse natural capital is; therefore, central to poverty reduction. Once endowed with a rich biological patrimony, vast portions of the major ecosystems have now been lost or degraded. With more



than 160 million people, a population growth rate of 1.8%, and a population density of 2,600/mile², the pressure on the nation's natural resources is already tremendous. Regardless of the national economic growth rate, for at least the medium term, the ultra-poor will continue to depend on natural capital, further affecting biodiversity, food security, nutrition and incomes of the poor. The fundamental question of why a country so rich in natural resources finds itself in such a dire ecological situation is, ultimately, a question of policy, governance and capacity. USAID has been playing a pioneering role in addressing these issues. Working for about two decades with the Government of Bangladesh (GOB), USAID helped establish a formally recognized network of terrestrial and aquatic protected areas (PA) that are being co-managed with natural resource dependent communities at the center of a multi-stakeholder process. USAID's efforts aimed at establishing a pragmatic conservation finance mechanism to establish communities' rights to manage the resources and benefit from the revenues. USAID focused on establishing sustainable community organizations to manage the process and deployed a market-driven alternate livelihood strategy for livelihoods improvement. The experience in working with the co-management model for PA co-management, its opportunities and challenges are worth sharing.

HABITAT ASSOCIATIONS DRIVE SPECIES VULNERABILITY TO CLIMATE CHANGE IN BOREAL FOREST

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Species climate change vulnerability has been assessed for a limited portion of biodiversity. Our knowledge of climate change impacts is often based only on exposure, even if species sensitivity plays a key role in determining vulnerability. We analyse the role of species habitat associations in explaining vulnerability for two poorly-known but species-rich taxa in boreal forest, saproxylic beetles and fungi, using three IPCC emissions scenarios. We found a habitat quality improvement towards the end of the 21st century associated with an increase of deadwood, an important resource for species, as a consequence of the high tree growth under high emissions scenarios. However, climate change will potentially reduce habitat suitability for ~30-36% of the threatened

deadwood-associated species. This loss is likely caused by the future higher timber extraction and decomposition rates causing higher deadwood turnover which have a strong negative effect on boreal forest biodiversity. A projected high level of spatial turnover in habitat availability will further reduce potential species climatic adaptation. Our results are species and scenario specific. Diversified forest management and restoration ensuring deadwood resources in the landscape would allow the persistence of the species whose capacity of delivering important supporting ecosystem services can be undermined by climate change.

THE EFFECT OF RESOURCE ABUNDANCE AND DISPERSION ON THE RANGING BEHAVIOR OF AFRICAN LIONS (PANTHERA LEO)

Moreangels Mbizah

University of Oxford

Marion VALEIX, University of Oxford ; Andrew LOVERIDGE, University of Oxford ; David MACDONALD, University of Oxford

The range of any animal is associated with the spatial abundance and distribution of limiting resources, and these resources determine the size and utilization of the animal's range. Increases in resource abundance leads to smaller ranging areas, but, when resource availability is heterogeneous, larger areas may be needed to encompass the spatial and temporal variability of these resources. We explored the role of spatial and temporal variation in resource abundance and dispersion in the shaping of African lion home ranges. The Resource Dispersion Hypothesis (RDH) predicts that resource dispersion determines territory size, whereas patch richness independently influences group size. Hwange National Park ecosystem provides an unusual opportunity to test the predictions of the RDH in a system where prey abundance and resource patch dispersion and richness are characterized by high variability and are relatively easy to quantify. A two year detailed data set of both lion seasonal movements and the seasonal variation in abundance and dispersion of their ungulate prey in Hwange National Park, was used to: 1) explore the effects of prey abundance on lion home range size, and 2) explore the effects of resource patch dispersion on lion home range size. Our results showed that lion home range size increased with a decrease in prey abundance and that home range size increased with an increase in resource patch dispersion. This supports the first prediction of RDH that territory size increases, as resource patches are more dispersed in the landscape. Our study therefore demonstrates that landscape ecology is a major driver of ranging behavior in lions. Low prey abundance and more dispersed resource patches can therefore force wide-ranging species (such as lions) beyond current reserve boundaries and into communal areas, which often results in conflict with humans.



THE EFFICACY OF THE ONE PLAN APPROACH TO AFRICAN PENGUIN CONSERVATION

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The population of African penguins (*Spheniscus demersus*) has seen a rapid and ongoing decline in recent decades, caused by a severe food shortage due to overfishing and to movement of sardine and anchovy stocks away from the penguins' breeding colonies. The Chick Bolstering Project (CBP) was set up by the Bristol Zoological Society and the Southern African Foundation for the Conservation of Coastal Birds (SANCCOB) to investigate the efficacy of using hand-reared penguin chicks, abandoned by their parents in the Western Cape, to bolster declining colonies, as well as to develop the infrastructure and knowledge required to artificially establish new penguin colonies on South Africa's south coast, closer to the current spawning areas of their prey. The CBP has two main aims: addressing the ongoing population decline by reinforcing extant wild colonies with locally hand-reared birds; and investigating the factors that determine breeding site fidelity in African penguins through monitoring translocated birds, thus enabling the artificial establishment of new breeding colonies of African penguins in places more suitable for their long-term survival. The international zoo and aquarium community is contributing technical expertise and practical help with hand-rearing chicks in South Africa, and it is envisaged that the captive populations will eventually contribute to stocking penguin colonies and reinforcing the wild population. We will discuss the success and the challenges of the CBP, an example of the One Plan approach to integrated species conservation promoted by the IUCN SSC Conservation Breeding Specialist Group whereby captive and wild populations are managed as a larger meta-population. This management is guided by one overarching goal, the conservation of the African penguin in its natural habitat.

ESTIMATING POPULATION SIZE AND TREND IN THE THREATENED GREATER SAGE-GROUSE USING N-MIXTURE MODELS

Rebecca Mcaffery

University of Montana

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The greater sage-grouse is a charismatic species of conservation concern in western North America that is

experiencing ongoing population declines due to habitat loss, energy development, disease, and other factors. It is therefore imperative to have robust estimates of population size and trend in this species across its range as part of monitoring, management, and conservation efforts. Greater sage-grouse are typically monitored by conducting counts of males at breeding leks, but the relationship between this index and true population size is unknown. We tested the performance of N-mixture models to evaluate population size, detection probability, and trend in greater sage-grouse using lek count data collected over space and time. We used simulations to test how well the models recovered abundance and growth rate parameters with increasingly sparse survey data. We found that the models recovered parameters for scenarios with both constant and variable detection probability, even with up to 90% of the data missing, where 94% of population growth parameters fell within the 95% credible interval. We then applied the model to 13 years of lek count data from northern Montana, USA. We determined that the population was decreasing by 5% per year on average, and that mean annual detection probability ranged from 0.31 to 0.95. In contrast, regressions of naïve counts over time showed a 6.2% annual decrease in population size. High interannual variability in detection probability demonstrates that naïve counts do not accurately measure interannual variability in population size, and may lead to misleading trends in population size over time. N-mixture models are thus a promising approach for conducting robust analyses of population trends for species that aggregate at discrete breeding sites, even when datasets are sparse or uneven, and can be applied across large areas in a cost-efficient manner.

GENETIC CENSUSING SUGGESTS AN UNEXPECTEDLY LARGE POPULATION OF CHIMPANZEES (*PAN TROGLODYTES SCHWEINFURTHII*) IN A FOREST FRAGMENT CORRIDOR OF WESTERN UGANDA

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Many threatened animal populations increasingly inhabit fragmented and degraded forests outside protected areas. Across their range, chimpanzees are often distributed among largely unprotected forest fragments in human-dominated landscapes. In western Uganda, a potential wildlife corridor for chimpanzees and other species has been identified



between the Budongo and Bugoma Forest Reserves, but little is currently known regarding the distributions of unhabituated primate populations in this area. Over a two-year period, we noninvasively collected more than 800 fecal samples for 15 months over more than 600 km², and successfully genotyped 662 (77%) at 14 microsatellite loci. These genotypes were attributed to approximately 200 chimpanzees, with a mean of over 3 captures per individual. Associated estimates of population size more than tripled a previous estimate based on nest count surveys, a result in accordance with the reported tendency of nest counts to underestimate population sizes. The spatial clustering of co-sampled genotypes suggests at least 10 communities in the area, with community sizes varying between a minimum of 5 and 63 individuals. These putative communities are further supported by the geographic distribution of 14 Y-chromosome haplotypes defined by genotyping of 8 Y-chromosome microsatellites. Specifically, haplotypes are often shared by geographically proximate males, while closely related haplotypes typically appear in geographic proximity. These findings illustrate the power of noninvasive genetic censusing to assess the status of elusive primates and demonstrate that, despite habitat fragmentation, a relatively sizeable population of chimpanzees remains widely distributed in this region. Their continued persistence remains uncertain, however, if habitat loss and fragmentation continue unabated.

BIOGEOGRAPHY VERSUS RESOURCE MANAGEMENT: HOW DO THEY COMPARE WHEN PRIORITIZING CONSERVATION OF CORAL REEF FISH DIVERSITY?

Tim Mcclanahan

Wildlife Conservation Society

Diversity is broadly influenced by historical, physical, and geographic factors that are often the basis for global prioritization of conservation investments. However, within-region patterns of diversity are often influenced by a number of site-specific factors including abundance, habitat features, and resource management. Conservation programs often prioritize geography or specific types of management systems or specific management systems within specific geographies. Consequently, in order to better understand the potential of these policies to influence biodiversity, I simultaneously evaluated the variance attributable to within-region geography and fisheries management influences after accounting for local habitat effects using an extensive field sample of common coral reef fishes in the southwest Indian Ocean countries. This evaluation allowed an estimate of the contribution of biogeographic and local-factor variance to evaluate site, geography, and management effects. Local diversity was most strongly predicted by an asymptotic relationship with fish biomass, followed by habitat variables, and lastly by the

geographic positions of latitude and longitude. A diversity center or "hotspot" was found between Madagascar and the African coastline but the geographic variance was low after removing biomass and habitat effects, suggesting a tepid hotspot. Evaluation of diversity among existing fisheries management categories indicated that biomass was the main mechanism for controlling diversity and high compliance closures had 17% more diversity than management systems with few gear restrictions. Nevertheless, variable biomass among resource management categories indicated a high potential for maintaining fish diversity through various restrictions. While the diversity center indicates a potential climate refugia – a priority for regional climate change planning, managing to maintain biomass >600 kg/ha is the highest priority for conserving fish diversity.

MARSH RABBIT MORTALITIES TIE PYTHONS TO THE PRECIPITOUS DECLINE OF MAMMALS IN THE EVERGLADES

Robert McCleery

University of Florida

Adia SOVIE, University of Florida ; Kristen HART, U.S. Geological Survey

To address the ongoing debate over the impact of invasive species on native terrestrial wildlife, we conducted a large-scale experiment to test the hypothesis that invasive Burmese pythons (*Python molurus bivittatus*) were a cause of the precipitous decline of mammals in Everglades National Park (ENP). Evidence linking pythons to mammal declines has been indirect and there are reasons to question whether pythons, or any predator, could have caused the precipitous declines seen across a range of mammalian functional groups. Experimentally manipulating marsh rabbits, we found that pythons accounted for 77% of rabbit mortalities within 9 months of their translocation to ENP and that python predation appeared to preclude the persistence of rabbit populations in ENP. On control sites, outside of the park, no rabbits were killed by pythons and 71% of attributable marsh rabbit mortalities were classified as mammal predations. Burmese pythons pose a serious threat to the faunal communities and ecological functioning of the Greater Everglades Ecosystems that will likely spread as python populations expand their range.

EXTINCTION RISK IN ANIMALS WORTH MORE THAN THEIR WEIGHT IN GOLD

Loren Mcclenachan

Colby College

Nicholas DULVY, Simon Fraser University ; Andrew COOPER, Simon Fraser University

Preventing extinction of animal species hunted for international luxury markets has been one of the most



significant conservation challenges of the past half-century. Many of these species have high intrinsic risk of extinction due to their large body size and low rates of reproduction, and also face elevated risk due to the high value of their non-perishable products, which can be stockpiled for global markets. For a taxonomically diverse group of large-bodied animals traded in international luxury markets, we identify (1) factors associated with elevated extinction risk and (2) differences between marine and terrestrial species that can inform conservation. For both marine and terrestrial animals, we find that threatened species are more valuable across three types of economic value (first sale, mean retail, and maximum potential values) and that penalties for poaching these animals are disproportional to the economic value gained from sale of preserved parts. We find that marine species face an additional management challenge because their ranges span a significantly greater area and more countries than those of terrestrial species, making national and regional conservation less likely to be effective. Finally, we find that unlike for terrestrial species for which large ranges are associated with reduced risk, large range sizes are associated with elevated risk in marine species. Together these results suggest that a more diverse suite of strategies than has been employed for terrestrial species hunted for international luxury markets will be needed to successfully manage marine species.

COMMUNITY BENEFITS OF RESTORING HISTORICAL ECOSYSTEMS AND FISHERIES: ALEWIVES IN MAINE

Loren Mcclenachan
Colby College

Restoration of coastal ecosystems provides opportunities to simultaneously restore historical fisheries and ancillary ecosystem and social benefits that were historically derived from functioning ecosystems. In Maine, dam removal and other ecosystem restoration efforts have positively impacted anadromous fish, with local populations of alewives (*Alosa pseudoharengus*) recovering to near historical population abundances in some locations. This research investigates the social benefits conferred by the restoration of habitat connectivity, fish populations, and local small-scale fisheries. Using municipal fisheries data and interviews with stakeholders in coastal Maine, it describes a suite of both direct and indirect benefits: a reversal of the “shifting baselines syndrome” and a motivation to manage fisheries sustainably, diversification of local economies and fisheries, community building and an increased sense of local pride, a demographic broadening of the conservation community, and enhanced ecosystem services and recreational opportunities. Placing restoration efforts into this larger social and historical context—rather than simply evaluating them based on immediate economic benefits—provides a broader framework to assess overall benefits derived from restoration efforts.

PARTIAL IDENTIFICATION IMPROVES THE CREDIBILITY AND TRANSPARENCY OF CONSERVATION IMPACT

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Measuring conservation impact is extremely difficult because researchers must measure the difference between the outcome where an intervention occurred and what the outcome would have been without it, called the counterfactual. Because the counterfactual is unobservable, researchers must make an untestable assumption that some untreated units can be used as a surrogate for the counterfactual (aka the control group). The conventional “top-down” approach is to present a point-estimate (i.e. single number estimate) of impact, using for example regression methods. Point-estimates provide powerful conclusions, but in non-experimental contexts depend on strong assumptions about the counterfactual that often lack transparency and credibility. An alternative “bottom-up” approach, called partial identification, is to first estimate what the counterfactual bounds would be if the least possible assumptions were made. After doing this the researcher narrows the bounds by using weak but credible assumptions based on knowledge of why units were selected for treatment and how they might respond to it. We demonstrate this approach by measuring the cost-effectiveness of clearing invasive trees in the Cape Floristic Region by the Working for Water program. We found that our most cost-effective estimate was 2.5-times less cost-effective than what previous studies predicted. Partial identification holds promise for applications in conservation science because: (1) it encourages researchers to identify and account for selection biases; (2) it can be used to test the robustness of conventional point-estimates; (3) it could reduce the problem of advocacy science where researchers “cherry-pick” assumptions that fit the conclusion they desire; (4) where conservation impacts are contentious, it might be easier for stakeholders to agree on bounded-estimates than a point-estimate; (5) it only requires knowledge of basic arithmetic.

MOLECULAR IDENTIFICATION OF THE WOOD THRUSH DIET AND VALIDATION OF A PROTOCOL FOR STUDIES OF AVIAN DIETS

Dana Nicole Mccoskey
George Mason University



Rebecca FORKNER, *George Mason University*; Masoumeh SIKAROODI, *George Mason University*; Patrick M. GILLEVET, *George Mason University*

DNA barcoding markers and next-generation sequencing (NGS) show great promise in applications to food web studies. By extracting mixed community DNA from an animal's scat or stomach contents and then using polymerase chain reaction (PCR) and NGS with public reference databases, this method can identify prey species DNA while overcoming limitations of traditional foraging studies. For example, field observations are both time and labor intensive and biased by the detectability of focal species. Likewise, scat and stomach content analyses are labor intensive, require expert knowledge of prey morphology, and can be biased by differences in digestibility of prey. We tested the efficacy of these methods to quantify diet diversity and breadth for a declining neotropical migratory bird, the wood thrush (*Hylocichla mustelina*). We compare species detected in partially digested remains to those found with an NGS molecular method. We then compare molecular results from scat samples and stomach contents from the same individuals, to determine how much information is lost during digestion. The success of this approach strongly depends on data generated by universal molecular markers, the processing of samples, and if information is lost during digestion. Our data help to validate a low impact molecular method that will improve our understanding the wood thrush's niche and which can be applied to studies of other bird species.

ERADICATION OF INVASIVE MAMMALS ON ISLANDS COULD PREVENT 40% OF ISLAND VERTEBRATE EXTIRPATIONS GLOBALLY

Erin McCreless

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David HUFF, *NOAA Southwest Fisheries Science Center*; Donald CROLL, *University of California Santa Cruz*; Bernie TERSHY, *University of California Santa Cruz*; Dena SPATZ, *University of California Santa Cruz*; Nick HOLMES, *Island Conservation*; Stuart BUTCHART, *BirdLife International*; Chris WILCOX, *CSIRO Marine and Atmospheric Science*

Introduced human-commensal mammals pose severe and ongoing threats to global island biodiversity. However, the relative severity of threats from different mammals, and the influence of island geomorphological and climatic attributes on native-invasive interactions, remain unknown. These knowledge gaps hinder our ability to identify and protect island populations and species facing imminent threat of extirpation or extinction due to invasive mammal impacts. We used the first comprehensive global dataset of threatened island vertebrates and invasive mammals to characterize global island extirpation patterns for threatened and extinct island vertebrates. Most variability in extirpations was explained by a

logistic regression model with covariates that included native taxonomy, island size and precipitation, and the presence of human populations, invasive rats, cats, pigs, mustelids, and mongooses. Our model predicts that under current conditions, 45% of extant globally threatened vertebrate populations will be extirpated from their breeding islands. The group most at risk is volant birds, with extirpation predicted for 67% of populations, followed by non-volant mammals (44%), amphibians (43%), bats (34%), reptiles (21%), and flightless birds (17%). However, the control or eradication of invasive mammals (i.e. rats, cats, pigs, mustelids, and mongooses) on these islands would prevent 40-75% of these extirpations. Global island conservation efforts should therefore include focused research on improving control and eradication methods for these species, particularly on large and inhabited islands that pose unique technical and social challenges to eradication efforts. Our analysis strengthens conservation prioritization efforts by providing robust, quantitative estimates of the benefits of invasive mammal removal.

STRATEGIC PRIORITIZATION OF ISLANDS FOR INVASIVE MAMMAL ERADICATIONS TO PROTECT GLOBALLY THREATENED VERTEBRATES

Erin McCreless

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Islands are crucial to the conservation of biodiversity. A leading threat to island species is invasive mammals, and invasive mammal eradication is a powerful tool for protecting island species and ecosystems. However, the global scope of mammal invasions greatly outweighs resources available for eradications. Eradication efforts therefore must be prioritized. We quantified the benefits and costs of eradications on islands globally, and implemented an optimization model to identify the most cost-effective sets of islands for eradications. Specifically, we estimated the extinction risk caused by invasive mammals to each IUCN-listed Critically Endangered and Endangered terrestrial vertebrate species. We then identified sets of islands on which invasive mammal eradication would achieve a series of increasingly ambitious conservation thresholds, in terms of the number of island populations of each threatened species, for the minimum cost. Our results indicated that eradications on 135 islands would lead to substantial reductions in extinction risk for 132 of the most threatened island species globally. This approach builds on previous island prioritization efforts by: 1) explicitly, quantitatively evaluating biodiversity benefits, 2) integrating robust benefit and cost estimates across islands to identify



cost-efficient islands for eradication, and 3) treating the island prioritization problem systematically by considering islands as sets rather than as individual, independent entities. In addition to identifying sets of high-priority islands that should be a focus for global eradication efforts, our study illustrates a flexible approach to conservation prioritization that can be easily adapted to other conservation decision-making situations. This type of strategic return-on-investment approach is critical for achieving the greatest possible conservation gains in a world of limited resources.

THE INFLUENCE OF SCALE ON DELINEATING REGIONAL FLOW PATTERNS FOR RESILIENT LANDSCAPES

Jane Mccurdy

Dalhousie University

Karen Beazley, Dalhousie University

Delineating regional flow patterns is critical to identifying directional movements and areas where species are likely to become concentrated, diffused, or rerouted due to the structure of the landscape at large scales. We assessed the influence of scale on delineating regional flow patterns for resilient landscapes. Both the pixel resolution of the input data and size of the calculation area were assessed using four combinations of scale-analyses. Two scales (270 m and 100 m cells) of resistance surfaces were created as a representation of landscape permeability to species movement using land-cover and road data. Two different sized (400 km and 40 km) calculation units were established. The two resistance surfaces were analyzed with each of the calculation areas using Circuitscape. Current was passed across the two resistance surfaces within each calculation area, in four directions. The current maps for each of the four analyses were then mosaicked together to create four omnidirectional connectivity maps. The final output maps were first evaluated by comparing their similarities and differences. Overlaying a protected areas layer in order to simulate known populated and, likely, high-traffic areas assisted with the assessment of the maps perceived level of accuracy. The advantages and disadvantages offered by each output scale-analysis surface were evaluated and weighed. The results indicate that in lieu of increased processing time, finer-scaled land-cover data and resistance surfaces are preferable over more generalized data that can exclude important landscape details. Complications associated with connectivity mosaics created using the tiling method reveal that the use of a larger-scaled calculation area is more likely to enhance the seamlessness of regional scale connectivity modeling.

118 A CONCEPTUAL FRAMEWORK FOR UNDERSTANDING THE INTER-RELATIONSHIP OF EQUITY, POVERTY AND WELL-BEING

Constance Mcdermott

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Melanie MCDERMOTT, Rutgers University ; Sango MAHANTY, Australian National University ; Schreckenberg KATE, Southampton University

This presentation explores the use of an Equity Framework as an overarching conceptual tool for understanding how conservation efforts impact poverty and well-being at multiple scales and among diverse actors. The framework first distinguishes among three dimensions of equity that shape its content or definition. These are 1) distributive, referring to the distribution of material benefits; 2) procedural, referring to equity of decision-making; 3) contextual, referring to the pre-existing conditions that limit or facilitate people's access to decision-making procedures, resources and benefits. The framework then considers three overarching parameters that determine the scope and scale to which conceptions of equity are applied, including 1) the scale and target group of concern (i.e. who is considered a subject of equity), 2) the framing of goals with respect to equity (i.e. whether equity is a goal and to what extent), and, finally, 3) how decisions are made about the content, target and goals of equity. We argue that such an overarching framework is important for situating "poverty" and "well-being" within a broader social landscape involving complex trade offs across actors, objectives and scales.

WHAT THE MATRIARCHS OF THE SEA TAUGHT THEIR DAUGHTERS: JAPANESE AMA DIVERS TRADITIONAL APPROACHES TO MARINE MANAGEMENT AND CONSERVATION

Anne Mcdonald

Sophia University

Nobuyuki YAGI, University of Tokyo

Hereditary fishing rights and community-based management are integral to resource use and social structure of all fishing communities in Japan. Most are patriarchal, but among the female ama diver communities these rights have matriarchal foundations. Harvesting seasons, grounds and species are all determined by fishing rights. Decisions to modify current rules that guide harvesting activities and other resource management decisions, such as enforcing no-take zones in their communal harvesting grounds, are discussed and decided by the collective whole. Community-level collective structures regulate the use of the commonly owned coastal resources. An example is the collective decision to designate no-take zones and the mechanisms such as financial penalties and ostracism, to protect these collectively managed protected areas. Another



examples to explore in their resource management approaches are the decisions to adopt or reject newly introduced technologies - from adopting goggles and the wet suit, to the rejection of scuba tank diving technology. Cultural identity and a non-utilitarian view of their ecosystem were considered in collective deliberations, and took precedence over short-term gains in time or financial efficacy. Such decisions, it may be argued, have led to better outcomes socially and environmentally. This community's path to reconcile tradition and modernity may potentially be an insightful example that compels more research on the use of cultural identity and traditional knowledge for sustainability in a modern context. This paper will explore traditional knowledge and how it is applied to resource use and management through the lens of matriarchal hereditary rights based fisher communities in Japan to try and gain further insight on female approaches to marine resource management and conservation, nature views and technological innovation.

AN ADAPTIVE ASSESSMENT AND MANAGEMENT TOOLKIT FOR DATA-LIMITED FISHERIES WITH A CASE STUDY FROM KARIMUNJAWA NATIONAL PARK, INDONESIA

Gavin Mcdonald

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Stuart CAMPBELL, *Wildlife Conservation Society*; Helen FOX, *Rare*; Raymond JAKUB, *Rare*; Kendra KARR, *Environmental Defense Fund*; Tasrif KARTAWIJAYA, *Wildlife Conservation Society*; Janelle MUELLER, *Rare*; Katherine SIEGEL, *Sustainable Fisheries Group, UCSB*; Lennon THOMAS, *Sustainable Fisheries Group, UCSB*

Data-limited fisheries often go unmanaged or are managed with little or no scientific guidance. This often results in poor fisheries performance and a failure to achieve stakeholder goals. There are an increasing number of data-limited assessment and management approaches being introduced in the literature. However, there are relatively few user-friendly resources at the disposal of fisheries managers who need practical tools to help make on-the-ground decisions. We present an adaptive assessment and management toolkit designed to fill this gap. The toolkit is a step-by-step guide designed to help managers and stakeholders implement an adaptive assessment and management framework appropriate for their goals and available data. Managers and key stakeholders use the toolkit on a periodic adaptive cycle during which they: 1) determine the assessment and management tier that their fishery falls under based on data availability; 2) determine appropriate fisheries management control(s); 3) select multiple data-limited performance indicators and reference points appropriate for the available data and stakeholder goals; 4) define harvest control rules

that will adjust fisheries management controls according to performance indicators; 5) perform the appropriate data-limited assessment methods for their fishery; 6) interpret the assessment results alongside local ecological knowledge to determine if a management response is necessary; and 7) adjust fisheries management controls accordingly using pre-defined harvest control rules. The toolkit is designed to be user-friendly and only requires that users have a general fisheries background and a familiarity with Microsoft Excel. We present a case study from Karimunjawa National Park, Indonesia where the toolkit is being used to inform their fisheries assessment and management process.

185 - USING FOOD WEB THEORY TO CONSERVE ECOSYSTEMS

Eve Mcdonald-Madden

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Food web theory has the potential to guide the management of ecosystems. However, species importance in a food web, based on Jenga[®]-style species removal, is not necessarily akin to a species management priority. We show that management prioritized based on indices of species importance that are commonly used in food web and network theory can be a poor guide to ecosystem management, resulting in significantly more extinctions than necessary. We demonstrate this by using Artificial Intelligence techniques to deriving optimal management strategies for six real and 40 hypothetical food webs. While no single index provides an appropriate guide to management for all food webs, a modified version of Google's PageRank[™] algorithm reliably minimizes the chance and severity of negative outcomes. Our analysis shows that by prioritizing ecosystem management based on the network wide impact of species protection rather than species loss, we can substantially improve ecosystem management decisions and outcomes.

185 AVOIDING PERVERSE OUTCOMES FROM SPECIES INTRODUCTIONS: ECOSYSTEM-WIDE MODELLING AT BOODEREE NATIONAL PARK

Eve Mcdonald-Madden

The University of Queensland
Christopher Baker, The University of Melbourne; *Nick DEXTER, Parks Australia*; *Clair FOSTER, Australian National University*; *Yi HAN, The University of Queensland*; *David LINDENMAYER, Australian National University*; *Christopher MACGREGOR,*



Australian National University ; Sean MAXWELL, The University of Queensland ; Michael BODE, The University of Melbourne

Translocations are a critical and increasingly used part of the conservation toolkit. However, they must proceed with care because each introduction will have impacts on other species in the recipient ecosystem, and there is growing evidence that translocations can have unanticipated outcomes that arise from ecosystem-level interactions. For example, the re-establishment of wolves in Yellowstone National Park, had dramatic and unexpected indirect impacts on vegetation and water flow via the wolves' predation on Elk. Predicting these ecosystem-level outcomes is notoriously difficult because they depend on a very accurate and quantitative understanding of the ecosystem dynamics. Here, we present a novel modelling approach where we use generalised Lotka-Volterra equations to model the uncertain, coupled dynamics of a large group of species. We use these methods to systematically explore the possible outcomes of reintroductions in Australia's Booderee National Park, an iconic protected area that supports key populations of endangered species. The park has previously experienced unexpected outcomes of management actions – most notably, a feral fox control program resulted in the local extinction of an arboreal mammal, the greater glider. The large number of parameters in our model (over 400) makes direct experimental parameter estimation impossible. Instead we use a 'backcasting' method, where we generate candidate parameter values at random and accept only those which re-create a set of past ecosystem dynamics observed at Booderee. Using the acceptable parameter sets allows us to scope out possible outcomes from different species re-introductions. Between 1998 and 2005 there was a two-fold increase in the number of global conservation translocations, and our project offers the first ecosystem-wide risk assessment approach for informing such decisions.

3.10 COMPARISON OF CARBON SEQUESTRATION METHODOLOGIES FOR USE BY ACADEMIC INSTITUTIONS IN TEXAS

Christina Mcglew

St. Edward's University

Suzanne GAMBOA, St. Edward's University ; Erica JOELSON, St. Edward's University ; Gwendolyn BAILEY, St. Edward's University ; Thomas LAPOINT, St. Edward's University ; Michael WASSERMAN, St. Edward's University ; Amy BELAIRE, St. Edward's University

As natural areas continue to be converted for anthropogenic use, it is important to quantify the loss of ecosystem services. Until recently, the study of these services in urban areas has been limited. Specifically, carbon sequestration is critical to climate regulation and universities have shown increased interest in obtaining carbon credits in order to compensate for

their carbon emissions, which ensures protection of natural areas owned by universities through economic benefits. For this process to be effective, appropriate methodology must be readily accessible to universities. Therefore, our objectives were: 1) to compare two sets of methodology for quantifying carbon sequestration and carbon credits based upon ease of use, cost, time requirement, and accuracy: data provided by remote Lidar technology and field measurements incorporated into iTree software, and 2) to provide recommendations to other Texas universities to increase the use of benefits of ecosystem services, such as carbon sequestration, to promote biodiversity protection on land owned by academic institutions. We quantified carbon sequestration for St. Edward's University at Wild Basin Wilderness Preserve in Austin, Texas. Using 30 plots across the preserve we measured for diversity, DBH, and for soil C analysis. These data were then entered into iTree for an estimate of carbon sequestration. These field-based estimates were compared to estimates provided by remote Lidar data. Results indicated that across 12 universities in Texas, only two currently preserve property to offset their carbon emissions with carbon credits. Access to and promotion of effective carbon sequestration methodology to universities has potential for conserving local biodiversity in Texas. By improving access to these methodologies, more universities will choose to conserve and restore existing undeveloped land, which will protect urban biodiversity and enhance the health and well-being of students and city residents.

SEA SHARING OR SPARING: SHOULD WE FOCUS ON MORE HABITAT PROTECTION OR NO-TAKE MARINE AREAS?

Jennifer McGowan

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Unsustainable exploitation of the oceans has led to widespread degradation of marine ecosystems. To maintain the primary benefits humans derive from the sea, namely food supply and biodiversity that generates other ecosystem services, the ocean is divided into three general management regimes: open-access, managed, and reserved areas. Using a theoretical example of a fish stock that depends on habitat type, we explore the conditions by which it is better to spare the sea, by investing more in marine reserves or to share the sea by investing in management to maintain habitat quality. We model the fraction of the seascape in each management regime given a fixed budget and a minimum food supply. Our objective is to create a plausible model with a simple analytic



answer for the purpose of guiding broad policy options. We explored the range of parameters where marine reserves are favored over managed areas and vice versa. The relative costs of reserves vs. management, the growth rate of the fish population, effectiveness of habitat protection and the amount of self-recruitment all influence this decision. Preliminary results suggest that intermediate levels of self-recruitment favor a mixed strategy of both reserves and managed areas. When the cost of reserving area increases in relation to managing for habitat loss, we prefer a management regime that protects habitat. We are working on a simple rule of thumb that determines the optimal management strategy given our constraints.

COMBINED USE OF POINT COUNTS AND AUTOMATED RECORDERS TO MONITOR AVIAN DIVERSITY AND PHENOLOGY ALONG A MONTANE MEGA-TRANSECT

Michael Mcgrann

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Climate change is expected to disrupt the distribution and phenology of birds. By providing access to remote areas, hiking trail networks provide an opportunity to efficiently monitor the effects of climate change on avian diversity along elevation gradients. We evaluated the combined use of point counts and automated recorders along a 697-km segment of the Pacific Crest Trail (PCT) in northern California, USA, to inventory species occurrences and breeding phenology of montane avian communities. We conducted 5-minute point counts of birds at 404 sites along the trail on 2 mornings, 4 days apart. At approximately half the sites, we left automated recorders to make 5-minute recordings (for later interpretation of bird sounds) for 3 times each morning, repeated over 3 consecutive days. Using a multi-species occupancy model of the detection/non-detection data, we found that species richness exhibited a unimodal distribution, peaking at an elevation of 1142 m [90%CI: 1000-1280 m]. We assumed that detection probability was an indicator of singing/breeding phenology and found that average detection probability among 6 warbler (Parulidae) species was greatest on 12 June [90%CI: 9-14 June]. The precision of our species richness and detection probability estimates was greatly improved by the automated recorders for little additional cost. Furthermore, the elevation at which species richness was greatest was lower than what we would have found if we had just conducted point counts, which we attribute to temporal differences in detection probability with elevation. A power analysis ($\alpha=0.1$, $\beta=0.2$) suggests that repetition of these surveys annually should be sufficient to observe an average climate-change-induced advancement of the singing phenology of warblers of 5 days over 20 years. Expansion of surveys to a mega-transect along the entire PCT

from Mexico to Canada would allow conservation planners to monitor regional climate-change effects throughout the Pacific Cordillera.

GRASPING ALBATROSS DIET WITHOUT GRASPING ALBATROSS: A NON-INVASIVE DNA DIET ANALYSIS METHOD TO ENCOMPASS THE WHOLE DIET.

Julie Mcinnes

University of Tasmania

Rachael ALDERMAN, Tasmanian Department of Primary Industries, Parks, Water and Environment ; Mary-Anne LEA, University of Tasmania ; Simon JARMAN, Australian Antarctic Division

Albatross are one of the most threatened seabird groups, yet diet information fundamental to their management is absent for many species. One reason for the paucity of diet data is the invasive nature of current dietary analysis techniques, such as stomach flushing, induced chick regurgitation or blood sampling. DNA-based dietary analysis, which identifies prey DNA sequences, is proving to be a highly effective, alternative analytical approach for many seabird species. The aim of our research is to develop the dietary analysis of scat DNA into a powerful, non-invasive ecosystem-scale monitoring tool for seabird populations worldwide. Shy albatross (*Thalassarche cauta*) scats were collected from Albatross Island in NW Tasmania, Australia, during the austral summer 2014/15. We tested two PCR-based DNA analysis approaches on these samples: 1. Analysis with 'Universal' primers that amplify from any eukaryote, but only identify prey to family or higher level; and 2. A range of taxon-specific PCR primer sets that identify prey to species level, but can only identify prey within one pre-defined group. We identified the strengths and weaknesses of each PCR approach. The diet preferences of shy albatross were ascertained from the scat samples without any handling, making this dietary technique ideal for threatened species where minimising disturbance is critical. By using method one we were able to identify all prey groups, including soft-bodied organisms (e.g. jellyfish), that are rarely detected using other methods. The second approach had a more narrow focus, but gave valuable species information and identified potential foraging overlaps with fisheries. If possible, incorporating both methods into a study provides the best overall dietary information. Understanding seabird dietary needs will further define ecosystem linkages, permitting the institution of improved management and conservation programs.

EVALUATING CONSERVATION PLANNING SUCCESS: ADDRESSING THE SOCIETAL AND GOVERNANCE FACTORS BEHIND EFFECTIVE CONSERVATION ACTIONS

Emma Mcintosh



University of Oxford

Systematic conservation planning (SCP) is continuing to gain popularity with conservation scientists and policy makers worldwide. This is partly due to the suitability of this approach for providing transparency in value-laden decision making and in assisting to bridging the 'knowledge-implementation divide'. Despite this, several retrospective analyses have suggested conservation plans can easily slip back into academic pursuits rather than practical tools. Regional evaluations are starting to be produced, including several examinations of how effectively specific conservation planning initiatives have influenced decisions around the implementation of related policies. However, what is lacking is a global assessment of 'what works' in translating complex conservation plans into on ground action. Several decades on from the widespread application of systematic approaches to designing protected area networks, is it possible to tell how well those networks are helping to meet the conservation goals they were initially intended to achieve? The societal and governance factors behind effective (and ineffective) conservation planning initiatives remain particularly poorly understood. What is the relative importance of, for example, strong stakeholder engagement versus robust scientific information in the planning phase? A global dataset of protected area planning exercises will be discussed, including material not previously published in the peer reviewed scientific literature. I will present a meta-analysis of SCP effectiveness, focusing in particular on socio-political markers of long term effectiveness, and discuss trends and common factors between plans.

TOWARD A HUNTING FOOTPRINT: REGIONAL PATTERNS OF WILD GAME DEPLETION AND DEPENDENCE IN EASTERN AND SOUTHERN AFRICA

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Justin BRASHARES, University of California Berkeley; Tristan NUNEZ, University of California Berkeley; Kaitlyn GAYNOR, University of California Berkeley; Briana ABRAHMS, University of California Berkeley; Lauren WITHEY, University of California Berkeley; Kathryn FIORELLA, University of California Berkeley; Ryan MARSH, University of California Berkeley; Katherine SETO, University of California Berkeley

The consumption of wild game, or "bushmeat," has received heightened attention in the past decade, both as a major threat to biodiversity conservation and as a critical resource for human nutrition and income. As human population growth and expanding infrastructure have increased access to dwindling game habitats, many conservationists have assented that we are in the midst of a "bushmeat crisis" that threatens both wildlife species and the communities that rely

on them. Many studies have explored patterns of hunting surrounding individual human settlements, but the social and ecological forces that ultimately drive the dynamics of game utilization and species extirpation operate at large spatial scales. At these scales, our understanding of patterns of wild game harvest remains glaringly incomplete. Here we present a first-of-its-kind, spatially explicit model estimating hunting offtake in Eastern and Southern Africa, a region where game species declines have been pronounced and where many communities rely heavily on game resources. We completed an extensive literature review to select and weight socioeconomic data – including human population density, poverty level, and livestock density – to estimate potential reliance on wild game across space. We combine this assessment with environmental factors – land cover and a novel model of ungulate biomass – to identify areas where both wildlife and human livelihoods are at risk due to dependence on wild game. A spatial representation of hunting across this region will facilitate effective conservation efforts at a scale fitting the drivers of species decline and help identify communities most vulnerable to the loss of this resource.

191: MARKETING MPAS: LESSONS FROM THE LAND?

Emma Mckinley

University of Chichester

Marine and coastal policy has undergone considerable change in recent years, with increasing emphasis placed on the importance of engaging the public in protecting and managing the use of marine resources. In response to this, Marine Protected Areas have secured their place as an important mechanism for conserving and managing marine ecosystems across the globe. However, the relationship between society and their surrounding environment is complex. Therefore, in order to be successful, MPA planners and managers must not only evaluate their impact on the environment, biodiversity, socio-economics and culture of communities. They must also have an understanding of the public response and sense of public buy in relating to the implementation of MPAs. In comparison to terrestrial protected areas, such as National Parks, MPAs are relatively new as a widespread designation and management strategy, and remain something of an unknown entity. Historically, terrestrial protected areas have succeeded in engendering a strong sense of connection and responsibility amongst society, supported by strong messages of public wellbeing and conservation value. While the contemporary objectives of terrestrial protected areas, to support sustainable tourism and business, balanced with the environmental and socio-economic needs of the local community, may not match exactly to those of MPAs, their use of easily recognisable branding and marketing provides audiences with a focal point, and attracts people to these



protected sites in support of the efforts to conserve. This paper reviews existing literature on branding, marketing and promotion of terrestrial protected areas, identifying success stories which can be used to highlight lessons and best practice that can be applied to the on-going efforts to implement a coherent network of marine protected areas, both in the UK and on a global scale.

PENN STATE CHANCE: IMPACTING STUDENT LEARNING, ATTITUDES, BEHAVIORS, AND CAREER CHOICES THROUGH REAL-WORLD CONSERVATION EXPERIENCES

Jacqueline McLaughlin
Pennsylvania State University

We are drowning in information, while starving for wisdom. The world henceforth will be run by synthesizers, people able to put together the right information at the right time, think critically about it, and make important choices wisely. Edward O. Wilson Today humanity faces this reality - the environment is broken on local, state (provincial), national, and global scales most of which is a result of human impact on natural resources and ecosystems. CHANCE (Connecting Humans And Nature through Conservation Experiences) is an environmental education, professional development and outreach program, whose overarching goal is to teach conservation (the science and practice of conserving the Earth's biological diversity) and global sustainability (the pursuit of social, environmental, and economical balance) at the front line. To do this, CHANCE creates unique learning environments which immerse its participants, students and science teachers, in nature. Participants work online or directly in the field with scientists to EXPLORE species diversity, RESEARCH ecology, and CONSERVE the biological structure of select and threatened ecosystems around the world. The ultimate goal: to prepare global minded citizens, who can analyze, create and implement solutions to maintain biological diversity, and as such, face the challenges of our time such as energy clean air, water quality, food, and climate change. CHANCE's work in Central America and China with several of its key partners exemplifies how innovative, interdisciplinary, and informal (outdoor and international) teaching and learning strategies can effectively teach sustainability while impacting student learning, attitudes, behaviors, and career choices.

DISENTANGLING SAMPLE SIZE AND GEOGRAPHIC EXTENT WHEN MODELING SPECIES DISTRIBUTIONS: A CASE STUDY FROM GUYANA, SOUTH AMERICA

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Species distribution modeling (SDM) continues to gain prominence as a tool to facilitate biodiversity conservation. In SDMs, specimen (point) data from museums and herbaria are used in conjunction with environmental data to project current and future species distributions. Model output can then be used to propose various conservation measures. Model uncertainty is dependent on sample size or number of specimens per species and how well those samples capture the environmental preferences of the species. The minimum number of specimens per species used in SDM often ranges from 25 to 50. However, for many species, especially in tropical locations, the number of specimens in collections is significantly less than 25. If the aim of conservation is to protect the rarest species we must ask how effective conservation measures are at capturing critical sites for rare species. Using Guyana, South America, as a case study, species distributions for seven taxon groups were modeled using MaxEnt, a machine-learning SDM method frequently used for specimen data. Model output for species represented by 5-20 specimens are compared with those for species with >50 specimens. Due to issues of location bias, model output for species represented by >5 distinct locations, based on the analysis grid, are also evaluated. Results show that the number of grid cells the species are represented in is more influential to model output than the number of specimens per species. While the size of the analysis grid should reflect the spatial extent of the rarest species, obtaining compatible environmental data may be problematic.

101 BAT CAVES AS RESERVOIRS OF BIODIVERSITY AND PROVIDERS OF ECOSYSTEM SERVICES

Rodrigo Medellín
Institute of Ecology, UNAM
Laura LOPEZ-HOFFMAN, University of Arizona

Cave ecosystems are grossly underrepresented in conservation planning and implementation around the world. This has become one of the great flaws of conservation. Caves contain great levels of biodiversity – from fungi to invertebrates to vertebrates. Caves also harbor a remarkable degree of microendemism, primarily of invertebrates, but also fish and fungi. In addition, caves often serve as roosts to some of the largest concentrations of warm-blooded animals on earth, bats. Finally, caves act as direct routes to aquifers and groundwater resources. As such, caves provide extremely important ecosystem services to vast areas surrounding them; their influence extends three-dimensionally via subterranean water bodies and the aerial nightly dispersal of the bats. Bats, in turn, provide a host of services from seed dispersal to pollination to pest control, while the nutrients they bring back into the cave fuel the entire cave ecosystem. In a further service to humans, bats create guano, one of



the richest organic fertilizers in the world. Many caves are extremely attractive as ecotourism destinations and provide unique opportunities to educate the public about unexpected biodiversity values and ecosystem services. Many caves have been severely impacted by human activities triggering declines in bat populations and overall cave biodiversity. The main threats to caves include vandalism, solid waste, and misunderstood tourist use. While many caves have been affected beyond repair, conservation measures such as education, land acquisition, and legal protection have proven effective tools. It is time to call the attention of authorities and the public about the urgent need to launch a worldwide cave conservation initiative

CONSERVATION AND MANAGEMENT OF CALIFORNIA'S CHINOOK SALMON: USING GENOMICS TO DEFINE POPULATIONS AND IDENTIFY INDIVIDUALS

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Most populations of California's Central Valley Chinook salmon (*Oncorhynchus tshawytscha*) are listed as federally threatened or endangered under the U.S. Endangered Species Act due to a variety of stressors: harvest, habitat alteration, dam construction, and hatchery influence. Our limited understanding of the current genetic structure of these populations hinders our ability to accurately assign individuals back to their natal populations for monitoring and research purposes. This is particularly problematic given the different listing statuses among seasonal runs (Winter, Spring, Fall, and Late-fall). Newly developed genomic tools allow us to better assess the genetic diversity of non-model organisms and the factors driving population differentiation by sampling across the genome and examining signatures of selection. We use restriction site associated DNA sequencing (RAD-seq) technology to discover over 20,000 new Single Nucleotide Polymorphism (SNP) markers distributed throughout the Chinook salmon genome and constructed a high density SNP linkage map. We found fine-scale population structuring in the Central Valley, and discovered a panel of markers that accurately identifies unknown individuals to run. We interpret these results in the face of current Chinook salmon conservation and restoration efforts being implemented in the Central Valley of California.

HABITAT QUALITY IS A KEY FACTOR TO MAINTAIN FARMLAND BIODIVERSITY

Kim Meichtry

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Simon BIRNER, Swiss Ornithological Institute ; Markus JENNY, Swiss Ornithological Institute

In the last decade many European countries developed agri-environment schemes AES with the aim to halt and reverse the loss of biodiversity. In Switzerland farmers have to implement ecological compensation areas (ECAs) as part of the Swiss AES, like extensively managed meadows of low or high quality, litter meadows, wildflower strips, hedgerows, high-stem trees and orchards and so on. However, positive effects of ECAs on species richness and abundance at landscape level have been rather moderate so far. In our opinion this is due to the low ecological quality of most ECA options. We reveal in three different studies that farmland bird species and brown hare do benefit from ECAs, if they are of high ecological quality and quantity. All three studies were conducted in ecologically highly improved regions owing to extensive advisory support of farmers. The first study was done in the mainly arable farmed Klettgau and shows that the densities of six out of 10 studied species were positively related to the amount of high-quality ECAs (wildflower areas and high-quality meadows). The second study was conducted in a part of the grassland dominated Rhine valley. There the brown hare seems to favour high-quality meadows in early-spring nights, when he is foraging and mating. In the third study, five out of six studied farmland bird species preferred habitat of high quality in the mainly arable farmed champagne genevoise. Compared to other habitat types, the proportion of fallow land and of the ECA option "wildflower strip" was significantly higher in the territories than in the entire region. Our results point out the importance of habitat quality for farmland birds and brown hare in Switzerland. However, high-quality options currently compose only a small proportion of the ECAs in the Swiss lowland. The Swiss AES and its options have to be tailored towards a far higher amount of high-quality ECAs in order to halt the loss of most farmland species of conservation concern.

INTEGRATING POTENTIAL FOR MICROREFUGIA IN PROJECTIONS OF CURRENT AND FUTURE SPECIES DISTRIBUTIONS OVER LARGE GEOGRAPHIC EXTENT

Eric Meineri

Stockholm University

Kristoffer HYLANDER, Stockholm University

Microrefugia are small areas with favourable environment in which populations can survive outside their main distribution area. Microrefugia are mainly caused by topographic variations as microclimate is driven by several climate forcing factors such as elevation, insolation, distance to sea and



major water bodies, soil moisture and relative elevation. Many review papers have stressed the importance of microrefugia for assessing climate change impact on potential species loss. However this recommendation has only been followed by a few studies. These studies i) often use downscaled climate grids that rely on elevation only to predict current species distributions and future species loss and ii) focus on rather small geographic extent. We aim to bridge these two gaps. First, we used a regression approach to produce national scale (Sweden) 50m grained microclimatic grids accounting for the known effects of topography (topogrid). Using these topogrids, we will project fine scale distribution of northern plant species and assess potential future species loss in Sweden. These species distribution models (SDM) will account for potential microrefugia since they will be fitted using fine scale climatic grids accounting for most topographic effects described in the literature. For comparison, we will also repeat the analyses using microclimatic grids based on geostatistic and elevation (elevgrid), as commonly done in the literature. All models are validated using external datasets. The preliminary results show that the two climate downscaling approaches produced good microclimatic grids. However, the topogrids (validation R^2 : 0.85 to 0.95) outperformed the elevgrids (validation R^2 : 0.75 to 85). Thus, we expect to obtain better SDMs using the topogrids than the elevgrids. We also expect that the SDMs based on the topogrids will predict lower species loss for the coming years because of better capturing potential microrefugia than the elevgrids.

A NEGLECTED OPPORTUNITY FOR BIRD CONSERVATION: THE VALUE OF A PERENNIAL, SEMIARID AGROECOSYSTEM IN MEXICO'S CENTRAL PLATEAU

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Mónica RIOJAS-LÓPEZ, CUCBA, Universidad de Guadalajara ; Patrick GIRAUDOUX, Université de Franche-Comté/CNRS et Institut Universitaire de France

As elsewhere in the world, the semi-arid regions of the southern part of Mexico's central plateau have been heavily transformed due to agriculture and grazing. No protected areas exist here, and setting aside large tracks of natural vegetation for conservation is unfeasible. Hence, other conservation strategies must be employed. Perennial, low-input, dry-farmed agroecosystems, especially those focused on fruit production, offer an important opportunity for this. In the region, nopal (*Opuntia* spp.) orchards are widely present, and are economically and culturally important. They are also used heavily by wild vertebrates. We studied the use of nopal orchards by birds and the effect of neighboring vegetation

(shrubland, grassland, and annual rain-fed cropland) at 12 locations throughout one year. We concluded: (1) nopal orchards offer a variety of resources for birds, and are used by about 40% of the potential species for terrestrial habitats in the region; (2) some bird species were more frequent in orchards and shrublands, but there was no typical orchard-shrubland bird assemblages, as there were no grassland or cropland assemblages; (3) nopal orchards, although variable, have bird assemblages richer than those of grasslands or croplands, and as rich as and akin those of shrublands, which whom they integrate when they are adjacent; (4) nopal orchards appear to contribute importantly to the conservation of birds in the region, independently from their surrounding matrix patches; they reflect, in addition to physical conditions (soil, rainfall of a particular year), the idiosyncrasies of the owners regarding orchard and edge constitution and management, attributes that can be managed to achieve specific conservation goals and; (5) the attributes that make nopal orchards a potential venue for bird conservation are likely of similar value in other semi-arid, fruit-oriented agroecosystems.

ECOLOGICAL RETROSPECTIVE OF THE UPPER BASIN OF THE QUEBRADA GRANDE, MUNICIPIO OF SAN ANTONIO DE TEQUENDAMA CUNDINAMARCA, COLOMBIA.

Germán Melo

University of Santo Tomas

As a result of deforestation, pollution, degradation and fragmentation of the ecosystem, the upper reach of Quebrada Grande has triggered secondary succession processes covering pre-existing conditions, which for decades have affected not only plants, but also amendments to high ground. It is remarkable to state that depending on the intensity of disturbance and the nature of ecosystems that dominate the area, the succession has taken an unexpected turn that generates the loss of native species and high-value ecosystems. Firstly, a taxonomic characterization of plant species was conducted, finding that nowadays some wildlife groups make a retrospective ecological system, before human intervention processes. From the previous system, the episodes of disturbance, its current condition can be modified through the replacement of species through time and space in the future. About the information obtained, bibliographic support in the area and/or similar ecosystems, major key species were determined of the watershed, reaching the definition of the reference ecosystem; thus the system was evaluated through their ecological relationships, this generated a reading of post disturbio stress of high micro round. This research contributed to the understanding of ecological relationships in areas with a high degree of human intervention, identification of scales ecological stress disorder and considering the conserved and



transferred areas. Keywords: Vegetation, avifauna, disturbance, taxonomy

LANDSCAPE GENETICS OF JAGUARS FROM BELIZE

Angelica Menchaca

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Jaguars are the only species of the genus *Panthera* that can currently be found in the American continent. During the last 50 years populations have declined dramatically due to habitat fragmentation, poaching of their natural prey and direct killing. They are considered "near threatened" by IUCN and are included on CITES Appendix I. The species represents the largest carnivore in the American continent acting as an important umbrella species. Traditional techniques to study jaguars have provided valuable information on the species, however, more accurate estimates of population density and abundance across a variety of habitats is necessary to properly implement conservation efforts that adequately protect the remaining populations of jaguars. Ecological information alone cannot contribute enough in the long-term survival of the species if its evolutionary potential is not analysed. Non-invasive genetic techniques have only been addressed in the last 15 years but have enabled a more accurate estimation of population size and density; furthermore, they take into consideration diverse genetic parameters such as population structure and demographic history that have more robust implications in wide-range conservation efforts of landscape species such as *P. onca*. Here I present a study on the genetic diversity and population structure of jaguars from Belize using 366 scat samples assessed through amplification of 12 microsatellite loci. And a Landscape Genetics analysis on the most probable habitat utilised for movement across the study area. These results contribute in the characterization of the genetic diversity of the species and provide a phylogenetic approach to its conservation. Furthermore the results presented here could be use in future studies to draw inferences on historical processes, clarify taxonomic issues and provide insight about genetic flow and evolutionary potential of *P. onca*.

UNCOVERING THE WORLD'S BIGGEST FISH, THE WHALE SHARK, NOW IN PERU

Alejandra Mendoza

EcOceánica

Rossana Maguiño, EcOceánica ; Shaley KELEZ, EcOceánica ; Ximena VELEZ-ZUAZO, EcOceánica ; Dení RAMÍREZ, Whale Shark Mexico

The whale shark is epipelagic with a circumtropical distribution. This shark has a K-selected life history whose characteristics make them more vulnerable to exploitation. It is a highly

migratory shark, and because of this, sustainable use of this threatened species depends on international collaboration. The knowledge of its life history is poorly understood, and the information about its ecology is most advanced in the Indian Ocean, with only a little research in the Pacific Ocean. Although Peru has been a member of CITES since 1975, a member of CMS since 1997 and has seven IUCN members, it has no local, regional or national protection laws. The lack of information about the whale shark population from Peru limits the generation of a proper management plan of the species at local level. In order to generate knowledge about the whale shark from the region we conducted interviews of fishermen and dive companies. From 84 interviews a total of 107 whale shark reports were noted. Initial evidence suggests that there are two whale shark seasons in Peru - one in summer and the other in winter - with the highest quantity in summer. Having this information we started a crucial baseline research of the whale shark from Peru in order to determine basic information such as seasonality, abundance, and population structure. We will present the findings of the preliminary investigation of the whale shark population monitoring study. Gathering this information, and working closely with the Peruvian government and fishermen, will help to implement the first management plan for this species and its habitat. Key words: Whale Shark, baseline research, management.

NEW POPULATION ASSESSMENT AND VARIATION IN BREEDING PARAMETERS OF MOGODOR ISLAND COLONY OF ELEONORA'S FALCON, *FALCO ELEONORAE* THROUGH DIGITAL TERRAIN MODELS

Malki Meryem

University Chouaib Doukkali, Faculty of Sciences

Juan ARIZAGA, Urdaibai Bird Center, Aranzadi Society of Sciences ; Adnane HABIB, University Chouaib Doukkali, Faculty of Sciences ; Houda HADI, University Chouaib Doukkali, Faculty of Sciences ; Hamid Rguibi Idrissi, University Chouaib Doukkali, Faculty of Sciences

Eleonora's Falcon, *Falco eleonorae* has been identified as "Rare for Europe" species and its decline is related to habitat loss. Morocco appears to receive number of birds of this species in breeding season. The aim of this study was to provide a reliable estimate of current population size of Eleonora's Falcon in Morocco according to distance-sampling technique. This census was the first of its kind and part of a global population survey in Morocco and the population size at certain colonies was significantly underestimated in 1996 and 2014, as well as at national level in 2014, up 30% the global Mediterranean population size. We gathered data for a two-year period (2013–2014) on the nesting ecology and reproductive performance of Eleonora's falcon in the Mogador Islands. A total of 1,745 individuals were counted in the entire study area. A correction



factor for the detectability of the birds in all transects is calculated. The results indicated a new breeding population estimate of 1.428 breeding pairs in Morocco. By the way, we investigated in an indirect way the relation between clutch size and pre-laying food availability, the significance of site and pair quality on productivity, and the effects of habitat and intraspecific competition on breeding success. We study the nesting-site preferences in Eleonora's falcon *Falco eleonorae* by means of geographic information systems and high-quality high-resolution digital terrain models. Breeding parameters varied significantly between the years, exhibiting a strong spatial yet local effect. The results of this survey provided guideline for reviewing the conservation status of Eleonora's Falcon in Morocco and also help to set an effective national conservation plan for future population monitoring.

ON THE WAY TO BETTER PEST CONTROL: HOW WE COULD IMPROVE THE DIFFICULT BATTLE AGAINST INVASIVE SPECIES.

Rose-Anne Merz

Victoria University of Wellington

Invasive species are the second biggest threat to biodiversity worldwide. The loss caused by invasive species has devastated many ecosystems and the damage is likely to go beyond what we can study and observe. Many remaining species, especially on off shore islands would have likely fallen victim to extinction if it wouldn't be for pest control measures. Nevertheless, today's pest control measures are still remarkably basic and require large amounts of human effort and resources which most countries cannot afford. This talk will give an insight into current pest control measures by outlining their weakest points based on my own research examples. My research focuses on invasive mammalian and invertebrate species on islands, and their behavior and interactions with trapping devices. The aim of my research is to better understand those invasive species which could allow us to achieve more innovative, sustainable, and effective pest control measures worldwide. In this talk I offer a short introduction to these problems and propose key directions to achieve a new path for conservation.

HABITAT MANAGEMENT VARYING IN SPACE AND TIME: THE EFFECTS OF BURNING AND GRAZING ON WETLAND AMPHIBIANS

Béla Mester

Hungarian Academy of Sciences, Centre for Ecological Research, Department of Tisza Research

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Amphibians have declined globally recently due to contamination, degradation, fragmentation and loss of their habitats, and the management of aquatic ecosystems has become a priority in their conservation. Despite numerous reports on conservation actions for amphibians in forests and grasslands, there is limited information on the proper management of wetlands specifically for amphibians in Europe. Our aim was to examine whether and how management by controlled late-summer burning of reed and year-round low-intensity cattle-grazing affect the species richness and abundance of anurans in the Egyek-Pusztakócs alkali marsh system, Hungary. Management was implemented in a 600-hectare, previously homogeneous reedbed between 2006 and 2009 and we surveyed anurans and sampled vegetation in a quasi-experimental design consisting of five transects each in six different treatment levels in 2010-2011. Prescribed fire caused the almost complete loss of reed and increased the diversity of the vegetation. The species richness of anurans and the abundance of Pelophylax species, Common and Green Toads the next spring were highest in areas burned the previous year. While the Fire-bellied Toad, a habitat generalist, was less affected by treatment, it was more abundant in managed than in control areas. By the second spring, the effect of reed burning vanished. However, grazed areas had lower reed cover and higher total anuran abundance compared to other treatments. In conclusion, grazing and burning can effectively remove homogeneous reedbeds and create breeding sites for anurans in the next spring. However, burning leads to quicker, but fast-disappearing results, whereas low-intensity grazing has slower but more lasting results.

INCREASING HABITAT ISOLATION CHANGES THE COMPOSITION OF A SAPROXYLIC BEETLE COMMUNITY AND NEGATIVELY IMPACTS DEAD WOOD DECOMPOSITION

Laia Mestre

Swedish University of Agricultural Sciences (SLU)

Nicklas JANSSON, Linköping University ; Thomas RANIUS, Swedish University of Agricultural Sciences (SLU)

Saproxylic insects depend on dead wood and many of them are endangered due to forest management practices that cause habitat loss or fragmentation. Because saproxylic insects are believed to play a significant role in dead wood decomposition, loss of saproxylic insect diversity is likely to have a negative effect on ecosystem functioning in forests. However, the ecosystem services provided by saproxylic insects have rarely been studied. We set up a field experiment in sites with oak pastures in south-eastern Sweden where we examined the effect of habitat isolation on colonization patterns of saproxylic



beetles and on decay of dead wood. We mounted boxes filled mainly with saw dust to emulate tree hollows with wood mould, which are habitat for specialized saproxylic beetles, on 120 trees across 8 sites and we sampled the beetle fauna and the remaining amount of wood mould in each box at different times. A box belonged to either of two habitat isolation treatments depending on whether it was placed in an oak pasture on a tree with hollows with natural wood mould ("low isolation") or about 100-200 m from the pasture, where only trees without hollows were present ("high isolation"). A year after, "high isolation" boxes hosted a different saproxylic beetle community with fewer species than "low isolation" boxes. Two years later, these biodiversity changes led in turn to a reduction in wood mould decay in the boxes with fewer species of obligate saproxylic beetles. Altogether, our results show that habitat fragmentation negatively affects dead wood recycling, and emphasizes the importance of preserving the diversity of saproxylic species in order to maintain ecosystem functioning.

SENTINELS OF GLOBAL CHANGES: THE FRENCH PACIFIC ISLAND TERRITORIES AS EXCEPTIONAL SITES FOR RESEARCH AND MANAGEMENT OF INVASIVE ALIEN SPECIES

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Islands are often celebrated as laboratories of evolution because of their strong isolation, restricted areas, small populations and simplified communities, allowing the study of evolutionary patterns and processes (e.g. colonization, extinction, speciation and adaptive radiation). Though, in the context of the current biodiversity crisis under global change pressures, thousand of species have already been vanished from Pacific islands in the last five centuries, and many more endemic birds, skinks, insects, snails and plants are experiencing an on-going contemporary extinctions or decline because of introduced invasive species. The French Pacific island territories (French Polynesia, New Caledonia, and Wallis et Futuna), formed by hundred of tropical and subtropical islands (ranging from 1 to 17,000 km²) stretched over a distance of 7,000 km from West (Melanesia) to East (Polynesia), provide a unique experimental ground and excellent model system for both research and management of invasive alien species. Through few examples chosen among conducted programs

(miconia tree, predatory rodents and cats, alien ants), we will introduced some relevant conservation issues that would be better addressed in such high biodiversity insular context, including the rise of novel or hybrid ecosystems, the new relationships between alien and native species (e.g. predation, competition, mutualism), the shift of species altitudinal ranges with climate change, and restoration initiatives to recover endangered species and habitats. We believe that there are strong opportunities to make the difference in conservation in these territories where "the house is still burning"...

TERRESTRIAL MAMMAL COMMUNITIES IN FORESTS OF CENTRAL PANAMA, BOTTLENECK OF THE ISTHMUS OF PANAMA: AN ASSESSMENT USING CAMERA TRAPS

Ninon Meyer

El Colegio de la Frontera Sur/Smithsonian Tropical Research Institute

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The rise of the Isthmus of Panama 3 million years ago facilitated the Great Biotic Interchange between North and South America. Today, the interchange is hampered, as the isthmus has lost more than half of its forests due to economic development, and the remaining forest is fragmented and subject to poaching. Here, we use camera-trap surveys to assess whether forests in Central Panama – the narrowest and most disturbed portion of the Isthmus – still have intact communities of medium- and large-bodied terrestrial mammals. During 2005-2014, we conducted camera-trap surveys in 15 national parks and forest fragments on both sides of the Panama Canal, and compared these to survey data from two sites in the intact Darién National Park in Eastern Panama, the nearest available reference. We found that the communities in two national parks that are still connected to the Darien forest complex resembled those in the reference sites. In contrast, all other sites in Central Panama – including the national parks along the Panama Canal Zone – had lower mammal species richness and evenness, and less structurally-complex mammal communities than the reference sites. Forests in Central Panama had little or no apex predators and large terrestrial frugivores. The national parks along the Panama Canal were biased towards game species, suggesting release from predation, while forest fragments in agricultural landscapes were biased towards culture followers, suggesting heavy disturbance. Our results indicate that the terrestrial



mammal community in forests of Central Panama is currently degraded, even inside national parks, and probably poorly connected to intact forest complexes. These data provide a baseline for evaluating the success of conservation efforts to restore connectivity in Central Panama.

THE EFFECT OF DIFFERENT MOWING REGIMES ON HOVERFLY COMMUNITIES IN LOWLAND GRASSLANDS

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In an increasingly dominated agricultural landscape in Western Europe, an improved management of extensive grassland ecosystems has the potential to benefit several pollinator groups, such as wild bees, butterflies, and hoverflies. Hoverflies have been shown to be important pollinators of native plants and crops, and have the added benefit of providing biocontrol of crop pests. Unfortunately, the current agri-environment schemes (AES) designed to promote pollinator diversity have yet to show clear positive impacts on pollinators. We investigated if slight alterations of the mowing regimes in the Swiss lowlands would have a positive impact on hoverfly abundance, richness, and diversity. We did this by applying a randomized block design with 12 replicates of each treatment: 1. Control: first cut not before 15 June (the conventional Swiss AES management of extensive meadows); 2. Refuge: first cut not before 15 June, but leaving 15% of grassland as a refuge uncut; 3. Delayed: delaying cutting for a month to 15 July. Two sampling methods were applied: sweep netting and pan trapping. Hoverflies were collected once before first cut (15 June) and once after the first cut, but before 15 July. We found the sampling method greatly influenced the hoverfly community that was caught. Pan traps exhibited a higher species richness in control than refuge meadows, as a result of a higher abundance of the saprophagous species. In contrast, sweep netting resulted in a higher abundance and species richness in delayed and refuge meadows compared to control meadows. This can be explained by the abundance of small aphidophagous species that occurred in the unmown (delayed) meadows in July, which feed on the pollen of grasses for egg maturation. Overall, delayed meadows exhibited a higher species richness and abundance than refuge and control meadows, indicating that delayed management could have a positive impact on hoverfly communities in lowland grasslands.

FIELD SURVEYS AND RED LIST ASSESSMENT OF BORNEO'S SLOW LORISES (NYCTICEBUS MENAGENSIS AND N. KAYAN) USING LOCAL KNOWLEDGE IN SARAWAK, BORNEO.

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Oxford Brookes University

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Slow lorises (*Nycticebus* spp.) are small, cryptic nocturnal primates found throughout SE Asia that are threatened by habitat loss and the illegal wildlife trade. Over the last decade, revisions in taxonomy mean that five of the eight species are listed by the IUCN as Vulnerable or Critically Endangered, with three new taxa in Borneo currently Data Deficient. In this research project, I aimed to provide the first systematic field data from Sarawak (Malaysia) focusing two species of lorises: *Nycticebus menagensis* (VU) and *N. kayan* (DD). My preliminary work in the area has already shown that these species occur in both protected forests and in anthropogenically disturbed habitats. In order to gain knowledge on the range and potential overlap of these taxa, as well as their use by humans, I focused on the local knowledge, conducting a series of interviews with local people in remote areas as well as with staff running tourist hotels in forested areas. Abundance estimates of species have been made through forest surveys via occupancy modeling, and observations with the aid of an infrared video camera. Examinations of locally caught pet lorises have also been undertaken. Hopefully, my data provides a strong basis for a conservation assessment for the new species *N. kayan* as well as gain vital population data regarding remaining lorises in these regions of Borneo. The data presented in this poster are the result of a three-month field study to understand how the local beliefs affect slow loris conservation. Results show that ancient taboos about slow lorises are decreasing because of an expanding globalization, and that this issue needs to be addressed with more intensive education projects in the field. Our survey using occupancy modeling allows for a clear idea of the range of the two different species but further investigation is needed to estimate population densities.

POPULATION CENSUS OF HOUSE MARTINS IN SWITZERLAND: A WEB BASED CITIZEN SCIENCE PROJECT

Stephanie Michler

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House martins are in decline in many western European countries, as well as in Switzerland. The reasons for the decline are poorly understood. One probable cause is a diminishing acceptance of homeowners and inhabitants for house martin nests on buildings and a lack of material around buildings to build own natural nests where the birds are still welcome. As part of a long term species recovery project for the house martin, the Swiss Ornithological Institute started a web based citizen science project in 2013. Aim of the project was firstly to collect information on exact addresses of house martin colonies to protect larger colonies. Secondly, we collected information on the amount of natural and artificial nests the birds bred in, the types of buildings the nests were located on and the availability of material for nest construction close to the colonies to learn more about current breeding circumstance of house martins. Thirdly, the project aimed at informing the Swiss public about the status of the house martin and at sensitising to the problems the species faces nowadays. The results of the census show that more than half of the occupied nests were artificial, thus house martins in Switzerland depend to a large extent on human provided breeding facilities. Furthermore, the proportion of artificial nests occupied and also the availability of open ground for nest material differ strongly between regions, thus conservation strategies need to take into account regional factors. Another important result is that about half of the artificial nests remained unoccupied, while many natural nests were reported as damaged or destroyed. We thus need to adapt current conservation strategies to these findings.

UNDERSTANDING THE RESILIENCE OF AFRICAN RAINFOREST TREES, APPLYING NEW GENOMIC TOOLS TO PHYLOGEOGRAPHY

Jérémy Migliore

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Long-term stability has been considered for long as a prime cause of the remarkable biodiversity of tropical rainforests. However, paleoecological evidence of substantial change in the vegetation of tropical regions resulting from global climate

fluctuation call for a reassessment of the temporal dynamics of biodiversity. Through the AFRIFORD program we aim to understand how past environmental changes have shaped the current distribution and composition of African rainforests and the genetic diversity of their constituent trees. Knowing the past to understand the present and forecast the future can rely on the integration of paleoecology, phylogeography and species distribution modelling to characterize the complex spatiotemporal trajectories of species and populations. In this context, we are developing next generation sequencing tools to analyze the genetic polymorphism of rainforest trees at the intra-specific level. The capture and sequencing of chloroplast genomes at deep multiplexing levels have been undertaken on 96 individuals of the rainforest tree *Greenwayodendron suaveolens* (Annonaceae), representative of Central African mature forests. A higher level of polymorphism and a more reliable phylogenetic signal allow inferring the evolutionary history of African rainforest populations. A critical view of this approach will then be possible, comparing this new phylogeographical pattern to those reconstructed by sequencing some cpDNA regions and genotyping microsatellites. Taking into account the evolutionary dimension of tropical ecosystems remains a key challenge to develop conservation strategies, and preserve the resilience and/or adaptation potential of rainforest trees to rapidly accelerating human impact. Maintaining biodiversity at all its levels and provisioning a broad array of ecosystem services in this global biodiversity hotspot imply therefore a close collaboration between ecologists, conservation biologists and natural resource managers.

SETTING AND REALIZING A CONSERVATION RESEARCH AGENDA FOR HUNGARY: OUTCOMES OF A PARTICIPATORY APPROACH

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Participatory research prioritizing exercise in conservation proved to be a useful tool in providing a review of critical challenges based on stakeholder engagement, possibly contributing to, among others, a more effective allocation of research funding. In order to realize the optimal resource



allocation and the research priorities, however, research agendas need to be developed at an operative administrative and management level and need to be successfully channelled into research finance and strategic development. The present paper discusses the results and outcomes of a participatory exercise conducted in Hungary aiming to compile the most important conservation research questions at the national level and provide a set of further tools for dissemination. During the process 792 research questions were collated from conservation practitioners and natural resource managers via interviews and an online questionnaire. Of the 792, the final 50 most important questions were ranked by practitioners and policy makers during a participatory expert workshop. The list of questions indicate country-specific highlights regarding endangered habitats such as the Pannonic wooded steppe and floodplain forests. Many questions address issues significant in contributing to policy- and decision-making processes regarding habitat management, land-use and regional development. Numerous questions highlights conflicting issues between natural resource management and conservation. In addition to the question list as a thematic review of conservation challenges, enhanced collaboration and interaction between stakeholders is also an important result. Outcome derived in the process is therefore assigned with a "lobbying power", which can be used and directed towards academic and research financing institutions. Thus we argue that special emphasis should be put on identifying the target audience of dissemination and the channels of effective information transfer towards them.

CHALLENGES AND LESSONS FROM PREDICTIVE ECOLOGICAL MODELING FOR DESIGNING AN INTEGRATIVE BIODIVERSITY MONITORING PROGRAM

J-B. Mihoub

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Reliable assessments and future projections of biodiversity responses to environmental and anthropogenic changes are keys to improving biodiversity conservation enforcement and management. Yet, important mismatches between predictive ecology requirements and biodiversity monitoring might potentially limit the development of relevant and realistic forecasts. We reviewed recent predictive ecology literature in line with available biodiversity monitoring information and we identified some key limitations. Mechanistic process-based models (MPBMs), in which predictions on ecological patterns

are emergent properties of the system, usually offer more reliable predictions than correlative approaches. However, while ecologists may have gathered sufficient information to design generic MPBMs integrating multiple-ecological components at various scales, the necessary information required to accurately parameterize realistic models and to validate their outcomes is lacking. Current biodiversity monitoring generally skews biodiversity information by collecting a few types of data, for particular taxa or biodiversity levels and with limited temporal and geographic coverage. Whereas biodiversity monitoring provide essential information about patterns in species distribution, population abundances and potentially community composition, most quantitative information about traits, mechanisms and processes required as input parameters in MPBMs come from a few monitoring schemes conducted at small spatial and / or temporal scales. Failure to anticipate changes in biodiversity in response to global changes might therefore be partly due to insufficiently comprehensive biodiversity monitoring. Referring to the developing Essential Biodiversity Variables concept, we advocate for urgently re-prioritizing biodiversity monitoring at global scale, targeting data collection on traits, mechanistic and functional interactions between and within EBVs.

CHANGING SENSITIVITY TO A GLYPHOSATE-BASED HERBICIDE DURING THE TADPOLE STAGE IN THE COMMON TOAD (BUFO BUFO)

Zsanett Mikó

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The worldwide application of pesticides emphasizes the need of investigating the harmful effects that pesticides may have on non-target organisms. Previous studies showed that pesticides can harm aquatic organisms, and that toads are more sensitive to herbicides than other amphibians. However, there is little information about how sensitivity changes during early ontogeny, and how the duration of exposure is linked to the magnitude of malign effects. Without this knowledge, it remains notoriously difficult to formulate recommendations regarding the timing of pesticide application. We exposed tadpoles of the common toad (*Bufo bufo*) to three concentrations (0, 2 and 4 mg a.e. / L) of a glyphosate-based herbicide at seven regimes (never, during the 1., 2., 3., 4., 5. week of larval development, and during the whole experiment). We measured survival, time until metamorphosis and metamorph body mass. Sensitivity changed during development in accordance with our expectations; younger tadpoles were more sensitive to the herbicide in all measured



traits, than older ones, and the older the tadpoles were at the first contact with the herbicide, the less effect was observed. Furthermore, while tadpoles exposed to the herbicide during their entire larval period developed slower than tadpoles exposed only early on, we did not observe a similar difference either in body mass or survival. Our results suggest, that postponed pesticide application would be highly favourable for early-breeding amphibians: tadpoles would be exposed to pesticides for a shorter time during their aquatic life-stage, and would not get into contact with the herbicide during their most sensitive early development.

LOCAL PEOPLE COUNT: USING CITIZEN SCIENTISTS TO MONITOR FRUIT BAT POPULATIONS

Tammy Mildenstein

Cornell College

L. Scott MILLS, North Carolina State University; David PATTERSON, University of Montana

Three quarters (143/196) of the world's megabats (Old World fruit bats; Pteropodidae) are found on islands, where they are ecological keystones as seed dispersers and pollinators. Although nearly half of the species are considered threatened, the conservation status of most Pteropodids remains largely unknown because of the lack of researchers on remote islands. We studied how local community members could be engaged as citizen scientists to monitor and detect trends in populations. We conducted fruit bat exit counts across the Mariana Islands and the Philippines to measure sampling error due to differing levels of counting experience and to demonstrate the impact of observer error on trend detection. As expected, field experience was inversely correlated with observer error; average error was 70% among observers with no field experience, 11% among fieldworkers, and 5% among experienced counters. However, even the largest error (from inexperienced observers) did not greatly compromise trend detection. In a projection model incorporating observer error from our field data, we found estimates of exponential trend to be robust to the measured levels of observer error. There were no misidentifications of trend direction after 20 years of counting even for amateur counters, and few trend misidentifications after only 5 years of counting. Fruit bat conservation in Oceania and insular Southeast Asia is dependent on regular monitoring of populations of concern. Our modeled success in detecting trends from citizen scientist data suggests that community-based fruit bat monitoring programs may be scientifically valid in addition to being cost-effective, sustainable, and relevant to local management.

THE RELATIONSHIP BETWEEN WHITE-TAILED DEER (ODOCOILEUS VIRGINIANUS) POPULATION DENSITY, FORAGING PRESSURE ON VEGETATION, AND FECAL CORTISOL LEVELS

Pamela Millan

St. Edward's University

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The overpopulation of white-tailed deer (*Odocoileus virginianus*) in North America has led to vast effects on vegetation growth and diversity, as well detrimental human-wildlife interactions, such as automobile accidents. Therefore, the goals of our study were twofold: (1) we determined how deer density, activity, and browsing pressure varied across an urban nature preserve, and (2) quantified spatial variation in stress levels of deer across the nature preserve in relationship to roads, neighborhoods, and a field station. We used camera traps to estimate deer population density and activity across Wild Basin Wilderness Preserve in Austin, Texas, by measuring the distance of the individual(s) to the camera when a picture was taken and the angle at which they approached the camera, along with data on average velocity of the deer and average group size in the preserve. To estimate browsing pressure on the plant community, we established vegetation plots around the camera traps and identified plant species, percent coverage, and grazing pressure using the falling plate method. To estimate stress levels we measured fecal cortisol levels across the preserve. Seasonality was observed in number of sightings of deer with the highest activity occurring in November. We also found a significant positive correlation between deer sightings and temperature ($R^2 = 0.32$, $p = 0.05$). These results are vital for understanding temporal and spatial variation in the movement and distribution of white-tailed deer, which influences the plant community through grazing effects. Our results can be used to improve management practices, particularly in urban landscapes where deer density is high. As many urban areas are currently increasing the protection of green space within the city, an understanding of how the dominant large mammalian herbivore in North America can be effectively managed in these systems is critical for both the well being of ecosystems and human society.

THE MISSING MIDDLE: LOCAL GOVERNMENT, INTERNATIONAL BIODIVERSITY AID, AND THE POLITICS OF PROPERTY AROUND BENIN'S W NATIONAL PARK

Daniel Miller



World Bank

Research on the social and ecological impacts of protected areas and conservation aid interventions has tended to focus either at the local (village or protected area) or national (protected area system) level. It has largely skipped over the meso-level, which includes political units such as municipalities, districts, and provinces. Yet politics and policy at this level can be decisive in shaping the outcomes of conservation efforts in protected areas. Understanding the role of this “missing middle” is especially important given that decentralization processes continue to unfold in more than 60 countries across the world. This paper examines the interaction of an international conservation project (ECOPAS - Ecosystèmes Protégés en Afrique Soudano-Sahélienne), the national parks agency, and sub-national political elites around the W National Park in Benin. Using a mixed methods approach based on a quasi-experimental research design, it explains how access, use, and management rights shifted over time in the periphery of the park due to the implementation and subsequent close of the ECOPAS project. Resultant uncertainty over property rights led to negative effects on local livelihoods and undermined sustainable conservation and natural resource governance in the region. Results of this study demonstrate the importance of effective engagement with sub-national political actors and processes for conservation policy and practice and also show how changing property rights can act as a mechanism linking conservation interventions with social and ecological impacts. Note: This manuscript is part of a set of contributed papers organized by L. Glew, M. Mascia, and D. Miller. If accepted, please include this presentation in the program immediately following the presentation by Louise Glew and immediately prior to the presentation by Michael Mascia. If you have any questions, please contact me directly. Thank you.

THE IMPACT OF BRIDGING THE SCIENCE-POLICY BOUNDARY IN ASSESSING RISKS TO ECOSYSTEMS

Rebecca M. Miller

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Aurélien CARRÉ, Comité français de l’UICN ; Marcos VALDERRABANO, Centro de Cooperación del Mediterráneo UICN-Med ; Taibou BA, Centre de Suivi Ecologique ; Edmund G. BARROW, International Union for Conservation of Nature ; David A. KEITH, University of New South Wales ; Jon Paul RODRÍGUEZ, Instituto Venezolano de Investigaciones Científicas

Understanding risks to biodiversity is a pre-requisite for effective action to slow rates of loss, secure ecosystem services and effectively manage ecosystems. However, too often conservation results and recommendations get lost in the gap between science and policy, particularly in the

context of wider socio-economic and political challenges. Bridging the science-policy boundary is crucial for effective communication and uptake of conservation findings. In 2014, the International Union for Conservation of Nature (IUCN) adopted a set of categories and criteria for assessing risks to ecosystems, thereby establishing a new global standard for biodiversity assessment and monitoring. After broad consultation, development and testing, the Red List of Ecosystems is now being implemented at the local, national and regional level around the world, forming the basis for natural resource decision making and investment. This talk focuses on Red List of Ecosystem initiatives carried out to date on the African continent (Madagascar, Morocco, Senegal). Political support of Red List of Ecosystems initiatives through engagement with governments and policy-makers has proven significant for achieving increased efficiency and better results in the application of the categories and criteria, and more direct uptake of results of the assessment process into conservation policies, though it has also presented challenges. Achieving biodiversity conservation targets will require reaching out beyond the environmental community to policy makers in other sectors, land use and development planners, macroeconomic planners, rural communities, and the private sector. This engagement can raise awareness about the drivers and stressors behind ecosystem changes, helping to quantify the value of healthy ecosystems for human well-being and sustainable resource use, and thus inform proactive rather than reactive conservation measures.

SYMPOSIUM ID 108. DEMONSTRATING AN EFFECTIVE MARINE BIODIVERSITY OBSERVATION NETWORK IN THE SANTA BARBARA CHANNEL: THE ROLE OF REMOTE SENSING

Robert Miller

University of California Santa Barbara

Time series data on marine biodiversity is collected at great expense, with the expectation that it will improve our capacity for science-based decision-making aimed at protecting natural ecosystems and sustaining the services that they provide. Unfortunately, most monitoring efforts in marine are done at small scales, and are not linked, rendering them inadequate to address regional and global shifts in biodiversity and ecosystem services that result from climate change, pollution, fishing, and other regional- to global-scale impacts. Existing but under-utilized technologies have the potential to dramatically expand our ability to assess species change at all scales. Remote sensing is one of these tools and is increasingly used to evaluate variables related to biodiversity in marine ecosystems. I present examples of the use of remote sensing to assess major autotrophic habitat elements important to marine ecosystems, phytoplankton and kelp forests, and



future directions to expand the use of remote sensing in the observation of marine biodiversity.

PROTECTING MARINE ECOSYSTEMS: PRESCRIPTIVE REGULATION VS MARKET INCENTIVES

Steve Miller

University of California, Santa Barbara

Robert DEACON, University of California, Santa Barbara

Tradable permit markets, an institution based on creating property rights for access to resources, are gradually replacing prescriptive regulations as a tool for managing U.S. commercial fisheries. The same market-based approach can in principle be applied non-commercial marine conservation goals, such as limiting the unintended catch (bycatch) of protected species. However, applications to this realm are rare and evidence on performance is lacking. We examine fishers' responses to the introduction of tradable bycatch rights in the U.S. West Coast groundfish fishery, finding evidence of adjustment along several margins and producing estimates of the marginal cost of conservation. We demonstrate that fishers responded to bycatch rights by changing fishing location, gear used, time of day fished, and duration of fishing activity in order to avoid protected species. The nuanced nature of these responses indicates that the least-cost way of achieving a conservation goal can involve fine-tuned behavioral adaptations, an outcome that would be difficult or impossible to achieve with prescriptive regulation.

SYMPOSIUM ID: 94 WHEN CONSERVATION GOES VIRAL: THE DIFFUSION OF INNOVATIVE BIODIVERSITY CONSERVATION POLICIES AND PRACTICES

Morena Mills

University of Queensland

Michael MASCIA, Conservation International

Initiatives aimed at conserving biodiversity are widespread and growing, but loss of biodiversity is yet to be mitigated. The factors that shape rates and patterns of adoption of conservation initiatives remain unclear, presenting a puzzle for scientists and a barrier for evidence-based policymaking. Diffusion of innovation theory - the study of how, why, and at what rate innovations spread through individuals, groups, organizations or countries - provides a novel lens through which to examine rates and patterns associated with the adoption of new conservation policies, programs, and practices. In this study, we highlight the potential for diffusion theory to explain spatial and temporal dynamics of different conservation initiatives including their rate of adoption, the degree to which they are adopted within the target population and adoption pattern. First, we introduce basic principles and insights from the innovation diffusion literature. We then

explore the potential for innovation diffusion theory to explain spatial and temporal patterns of patterns of conservation practices, drawing upon case studies in Tanzania and the Pacific. Case studies in Tanzania demonstrate the importance of program design in influencing the success of participatory conservation interventions. Our Pacific cases study demonstrates the importance of context in defining success of an individual initiative. Enabling policies, change agents, the compatibility of an innovation with decision makers' beliefs and values, and the perceived relative advantage of an innovation play a critical role in explaining the diffusion of our case studies. Our study offers insights into strategy of conservation interventions, e.g. the potential for action as a result of strategic versus ad hoc action, and tactical insight into the design of interventions that catalyse conservation at scale.

OPPORTUNITIES AND CONSTRAINTS FOR THE RESTORATION OF THE ATLANTIC FOREST

Morena Mills

University of Queensland

Ana Paula GIORGI, Earthwatch Brazil ; Azevedo THAÍS,

Earthwatch Brazil ; Vanessa M. ADAMS, University of

Queensland ; Andrew T. KNIGHT, Imperial College London ;

Hugh P. POSSINGHAM, University of Queensland[INSTITUTE]

Imperial College London

Forests worldwide have been severely degraded or destroyed by human activity, consequently the persistence of biodiversity and ecosystem services depends not only on habitat protection, but also on large scale implementation of restoration. Participants in forest restoration initiatives experience both costs and benefits associated with restoration activities. While approaches to make restoration more attractive have been suggested, there is little guidance of what approaches work in different socio-ecological systems. Multiple theories explain why people engage in different pro-environmental practices and inform opportunities and constraints in implementing conservation or restoration initiatives. However, these are rarely used to guide implementation. In this study, we investigate the motivations and barriers to participation in restoration initiatives and use the diffusion of innovation theory to predict the percentage of the population that is likely to adopt different programs and the rate of adoption. To do this we conducted 180 household interviews with small-scale farmers living in the catchments surrounding the National Park of the Serra do Itajai, within the Brazilian Atlantic Forest. The Brazilian Atlantic Forest is considered a major global biodiversity hotspot and is one of the most endangered ecosystems in the world, with less than 16% of its original extent. Our population could be separated into two groups based on the motivations and barriers for restoration. We recommend restoration programs tailored specifically to the needs and desires of each group, maximizing



likelihood of restoration uptake and therefore restoration program success.

76: QUICK AND DIRTY EVALUATION OF SOCIAL IMPACTS IN LOW-CAPACITY, DATA-POOR SITUATIONS

E.j. Milner-Gulland

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Katie SAINSBURY, Imperial College London ; Neil BURGESS, Imperial College London

Critical evaluation of the impact of conservation actions is essential to meet the challenges posed by the biodiversity crisis, but in many situations there is not the capacity or budget for proper attribution of impacts to conservation interventions. Often baseline data are unavailable, and programme goals are unclear. We used a new approach, the Ranked Outcomes (RO) method, to evaluate the planned and realised social outcomes of a set of small scale income-generating activities implemented in communities adjacent to the Uzungwa Scarp proposed Nature Reserve in the Tanzanian Eastern Arc Mountains.. RO converts qualitative information on planned and realised outcomes into a score for comparison between projects. We carried out an independent evaluation and also assessed project impacts from the perspective of target communities. We found a high level of heterogeneity of perception between and within stakeholder groups (implementers and target communities), both in terms of which outcomes were most important and how well they had been achieved. Ranked outcomes emerged as a flexible framework that defines the terms of the evaluation for all stakeholders from the outset, even in cases when evaluation and clear goal-setting are omitted from original project design and planning. It can be modified for use as a component of rigorous impact assessment, to incorporate perspectives of all stakeholders, and provides important insights in data-poor situations and where baselines are not available.

PARALLEL CONTRIBUTIONS TO EVOLUTIONARY DIVERSITY, TROPHIC DIVERSITY AND TROPHIC STRUCTURE IN A MAMMALIAN HERBIVORE ASSEMBLAGE

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Biodiversity is a multifaceted concept that comprises taxonomic, structural and functional components. Individual taxa have been shown to unevenly contribute to the different components of biodiversity. An integrative conservation approach that concentrates on the taxa that most strongly contribute to multiple diversity components

could thus facilitate the retention of a sustainable level of biodiversity complexity, and of the derived ecosystem functions and services. We combined phylogenetic and network analyses to quantify species contributions to 2 essential biodiversity components, phylogenetic diversity and diversity of trophic interactions, in an African assemblage of mammalian herbivores. We found positive correlations between species contributions to phylogenetic and trophic diversity. Additionally, we identified a non-random trophic interaction structure between herbivores and their plant resources, which arranged both in a nested (specialists using a subset of the resources used by generalists) and modular pattern (sub-guilds of herbivore–resource relationships). We found a positive correlation between species contribution to such nested interaction structure and their contribution to phylogenetic diversity. The observed congruence between species contribution to phylogenetic diversity, trophic interaction diversity and interaction structure has important implications for conservation, and for maximizing the revenues from investments on conservation actions. Hence conservation approaches that aim at preserving phylogenetically distinct species may simultaneously maximise the retention of trophic interaction diversity and of the nested pattern of trophic interaction structure. Species contributions to modular interaction patterns were instead uncorrelated to their contributions to phylogenetic diversity, indicating the importance of some phylogenetic and trophic redundancy between species for retaining a modular structure in the system.

HUMAN VALUES AND THE BIOLOGICAL SIGNIFICANCE OF LARGE AFRICAN MAMMALS

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Fredrik Dalerum, University of Oviedo

We are currently facing the risks of driving the environment towards hostile states for our species. Public attitudes towards environmental values are important for promoting a societal change to more sustainable structures, since such public opinion largely drive environmental politics. The monetary price of a given good reflects the amount that we are willing to pay to acquire it, and constitutes a potentially useful indicator of human values. Wildlife in Southern Africa is frequently traded at game auctions for transfers between privately owned game reserves. These trade prices generate a unique source of information of the economic value of wildlife species. If combined with biologically relevant characteristics of each species, these game prices thus offer a rare opportunity to evaluate how humans values of particular organisms relate to their biological significance. We evaluated the relationship between trade prices over a 22-year period and the phylogenetic and functional significance of southern African



herbivores and carnivores. We found no correlation between price and either phylogenetic or functional significance of species. Furthermore, there were no trends over time in these relationships over the past 20 years. Since the economic value of southern African wildlife does not seem to reflect their biological significance, neither in evolutionary nor ecological terms, we stress that further work is needed to evaluate what humans value in biological organisms, and how potentially necessary shifts in such values can be initiated.

AGRICULTURE HOMOGENIZES DIVERSITY

Murilo Miranda

German Centre for Integrative Biodiversity Research (iDiv)
Thomas MERCKX, Biodiversity Research Centre, Earth and Life Institute ; Henrique PEREIRA, German Centre for Integrative Biodiversity Research (iDiv)

Global Biodiversity continues to decline at high rates. Currently, the main driver for this is land-use change as many native habitats like woodland, savanna and shrubland are being converted to agricultural land. Many studies show the effect of agricultural intensification at the local scale, whilst its effect is unknown at larger scales. For this reason, we analyzed the beta-diversity of macro-moths in agricultural, forest and shrubland landscapes within the Peneda-Gerês National Park, Portugal. The macro-moths were light-trapped at 84 fixed sampling sites during 2011 and 2012, each of which was sampled six times repeatedly (3 times/year). We collected 22,825 individuals distributed in 377 species. We estimated beta-diversity using Jaccard indices and we developed a simulation-based null model to verify if alpha-diversity may influence beta-diversity. Although beta-diversity in the shrubland landscape (0.51) was higher than in the forest (0.47) and agricultural (0.39) landscape, the null model detected that the low alpha-diversity in shrubland influenced beta-diversity. After correcting for this, beta-diversity of the forest landscape was significantly higher than the beta-diversity of the agricultural landscape, indicating a homogenizing effect of agricultural practices even for extensive agriculture.

STRATEGIC AND COLLABORATIVE CONSERVATION OF CHEETAHS AND AFRICAN WILD DOGS ACROSS THEIR AFRICAN RANGE

Nick Mitchell

Zoological Society of London & Wildlife Conservation Society
Rosemary GROOM, Zoological Society of London & Wildlife Conservation Society ; Audrey IPAVEC, Zoological Society of London & Wildlife Conservation Society ; Sarah DURANT, Zoological Society of London

Cheetah and African wild dogs are listed by the IUCN Red List as Vulnerable and Endangered respectively, but it is the

vast space requirements of both species that has warranted a particular tailored conservation approach. Their very wide ranging behaviour means that many populations exist across national boundaries and require collaborative conservation efforts. In addition, most protected areas are not sufficient to maintain viable populations. They will often roam across communal and private land to find space and will therefore come into regular contact and conflict with farmers and pastoralists. In order to address these unique challenges the Range Wide Conservation Program for Cheetah and African Wild Dogs (RWCP) was initiated in 2007 as a joint project of the Wildlife Conservation Society and the Zoological Society of London. The approach has been to work at the broadest scale possible, the range wide scale, and to define common strategies that allow a coherent approach to conservation across national boundaries. Collaboration between governments and with a broad range of stakeholders has been a hallmark of the program. The first two phases brought the establishment of three regional conservation strategies, and the coverage of 98% of known cheetah range with 17 national action plans. However, one of the major challenges not yet addressed remains that of preventing further loss and fragmentation of suitable habitat. With increasing pressures for land from the human population, the need for land use planning becomes ever more urgent. The third phase of the RWCP begins now with the aim of creating three major cheetah landscapes; each landscape being marked by participatory land use planning making provision for the livelihood needs of both human and cheetah populations. To facilitate this it will feature the training and mentoring of national coordinators who will also be able continue the implementation of the national conservation action plans.

USING BIG DATA TO QUANTIFY THE "CULTURAL VALUE" OF SPECIES FOR CONSERVATION

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Cultural values form one of the core benefits that biodiversity provides to humanity and are an important force in motivating action and engaging interest in conservation. In species conservation, cultural values may influence whether an organism becomes endangered and impact the amount of conservation investment it receives. As a result, they are often as significant as biological and ecological factors in determining the outcome of conservation projects. While the significance of these values has been widely recognized in the conservation literature and enshrined in environmental legislation and international treaties, clear definitions of what cultural values entail in a conservation context and how they differ across taxonomic, social, and geographic scales remain



elusive. Outside of conservation, new technical and analytical tools are developing in the emerging field of “culturomics” that facilitate the synthesis of data stored in massive text archives such as Google Books, Wikipedia, and digitized newspaper corpora. Culturomic and natural language processing methods enable large-scale quantitative analyses of cultural patterns that were until recently infeasible, and offer techniques that may provide novel insight to the long-standing challenge of measuring cultural value in conservation. My presentation describes a new method to quantify the cultural value of species using culturomics and big data analytics and discusses how this can be applied to species conservation projects.

INTEGRATION AND APPLICATION OF POTENTIAL MUSEUM COLLECTIONS OF NATURAL HISTORY DISSEMINATED ON THE WEB FOR BIODIVERSITY DATA ACCUMULATION AND PUBLIC CONSERVATION AWARENESS

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Citizens have uploaded numbers of biodiversity photographs with time and locality information onto websites, including social networking services, blogs, and homepages. We regarded such photographs disseminated on the Web as potential museum collections of natural history and have attempted to accumulate them as actual museum collections of the Kanagawa Prefectural Museum of Natural History (KPM), Japan. Based on these activities, which are centered on the public natural history museum, we are building a new conceptual model for biodiversity data integration and public conservation awareness by systematizing (1) collection/accumulation, (2) research/study, and (3) outreach/education. First, the fish photographs registered in the WEB sakana-zukan, as an example of a platform, archived more than 40,000 items for potential museum collections of natural history and accumulated them into the Fish Image Database of KPM by obtaining the consent forms of the purveyors (i.e., citizens). Second, the accumulated collections were used for studies on fish taxonomy, biogeography, ecology, and conservation biology by scientific experts. Finally, the identification and study results were made available to citizens, including the purveyors, through volunteer programs, exhibitions and media applications, including a serialization in an off-shore recreational fishing magazine. In this presentation, we will provide an overview of the conceptual model with some related issues based mainly on our published papers in order to consider and contribute to development of Citizen Science for biodiversity conservation.

SCIENCE LEADS GOVERNANCE FOR THE CONTROL OF INVASIVE LIONFISH IN BELIZE

Meira Mizrahi

Blue Ventures

Jennifer CHAPMAN, Blue Ventures ; Charlie GOUGH, Blue Ventures

With a voracious appetite for juvenile fish and invertebrates, invasive lionfish (*Pterois volitans*) constitute one of the greatest threats to the Caribbean’s coral reefs as well as the fisheries they support. This paper presents findings from four years of research by Blue Ventures (BV) on lionfish populations in Bacalar Chico Marine Reserve (BCMR), and demonstrates how this research guides management. Analyses confirm that lionfish are firmly established in BCMR and reproduce year-round. Spatial analyses show high variability of lionfish population density with mean abundance and biomass increasing with reef depth. This information is used to prioritise control efforts within BCMR and, considering Belize’s small-scale fishers are only able to harvest lionfish in unprotected areas up to 18 m deep, feeds into Belize’s developing multi-sectorial national strategy for lionfish control. Temporal analyses of opportunistically sighted and culled lionfish show changes in both population size and structure, with an indication of slowed growth rates in the last year. Gut contents analysis supports evidence for a highly diverse diet and in addition observed the first lobster (*Scyllarides aequinoctialis*) to be found in a lionfish stomach in Belize, a finding suggestive of potentially devastating implications for Belize’s dominant commercial fishery, the Caribbean spiny lobster (*Panulirus argus*). Given the outstanding ecological and social value of BCMR and its resources, there is a critical need to develop systems for the effective management of this potentially devastating threat. Although eradication of lionfish in its invaded range is no longer considered possible, population suppression to site-specific densities can allow native fish populations to recover. Using these data and approach, Belize is able to determine lionfish population densities and thresholds for coral reefs countrywide, which in turn supports the development of a holistic lionfish control strategy.

GRAZING EFFECT ON PRODUCTIVITY GRADIENT FOR A C4 PERENNIAL GRASS STIPAGROSTIS CILIATA (DESF.) DE WINTER

Lobna Mnif Fakhfakh

Faculty of Sciences of Sfax

Mohamed CHAIEB, Faculty of Sciences of Sfax

Most ecological studies in North Africa reveal a process of continuous degradation of ecosystems as a result of overgrazing. This degradation appears across the depletion of perennial grass. Indeed, the majority of Mediterranean arid ecosystems are characterized by a low density of perennial



grasses. *Stipagrostis ciliata* (Desf.) De Winter has wide ecological amplitude in North Africa and grows under a diversity of environmental conditions. Its distribution covers the desert regions of South and North Africa. In Tunisia, field studies show a low density and low recruitment of this species. The current study aimed to investigate the effects of grazing in a productivity and conservation of *Stipagrostis ciliata*. The experiment comprised three treatments (overgrazing, moderate grazing, and ungrazing), each at two levels: maximum rainfall (200 mm); normal rainfall (100 mm). The results show that overgrazing causes exhaustion tufts with a biomass mean 25 ± 11.3 g dry matter. The absence of grazing results in a significant tufts development (biomass produced varied from 67.45 to 345 g dry matter). Grazing showed variable results on final biomass. Regarding biomass productivity, we found significant effect of treatment ($F = 37.004$; $P < 0.001$) with higher productivity for non-grazed treatment at level (200 mm) (mean = 137.34 ± 12.3 g dry matter). When grazing increases, *Stipagrostis ciliata* productivity typically declines. Changes in biomass production have been also related to rainfall. Dry matter production of *Stipagrostis ciliata* showed significant differences in aboveground dry matter accumulation between the two rainfall regimes ($F = 9.746$; $P = 0.002$). So moderate grazing helps to enhance the aerial phytomass produced and preserve the tuft for a long time. In conclusion the conservation of perennial grasses steppe in arid bioclimate requires moderate grazing. Further, optimum grazing practices to conserve biodiversity of ecosystems may involve moderate stocking rate.

DARK DIVERSITY ILLUMINATES THE DIM SIDE OF RESTORATION PRIORITISATION

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Ane Kirstine BRUNBJERG, University of Birmingham ; Kevin CLAUSEN, Aarhus University ; Lars DALBY, Aarhus University ; Camilla FLØJGAARD, Aarhus University ; Anders JUEL, Aarhus University

Stopping biodiversity loss by 2020 is currently one of the major global concerns and calls for useful and effective tools for practical biodiversity management and planning at spatial scales relevant for these issues. Recently, scientists came up with a new concept; dark diversity, which could prove to be a central idea for the development of the aforementioned tools. Dark diversity encompasses the diversity articulated by all the species missing in an area, despite the fact that they could potentially thrive there considering current ecological conditions. In other words, dark diversity is the diversity of species represented in the regional species pool for a particular habitat which are not present at a local site within that particular habitat type. Here we present the first national application of the dark diversity concept for

restoration potential identification at a scale relevant to planning and management and covering a wide number of terrestrial habitats. More specifically we use a massive national plant dataset with very high accuracy and a combination of community composition statistics and calculations of maximum dispersal distance based on plant traits to address the following study questions: (1) is it possible to define realistic regional species pools using statistically based knowledge of plant community relationships and maximum dispersal distance modelling? (2) Can a dark diversity approach be used for pointing out local sites with high restoration potential?

BIOMASS INCREASES GO UNDER COVER: WOODY VEGETATION DYNAMICS IN SOUTH AFRICAN RANGELANDS

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Unsustainable fuelwood harvesting is a major driver of woodland degradation in southern African semi-arid ecosystems. The rural poor often depend on natural resources; with a growing human population and non-linear resource base dynamics, coupled human-environment vulnerabilities are set to increase. Bushbuckridge, a densely populated former South African homeland, is characterised by high reliance on fuelwood, despite extensive access to electricity. Changes in woody biomass and vertical vegetation structure serve as an expression of wood extraction in a natural resource use environment. Using repeat light detection and ranging (LiDAR) data between 2008 and 2012 from the Carnegie Airborne Observatory (CAO), we estimated woody biomass in three communal rangelands under different levels of wood extraction pressure and compared the results to changes in three-dimensional canopy cover. Woody biomass in 2008 ranged from 9 Mg ha⁻¹ on gabbro geology sites to 27 Mg



ha-1 on granitic geology sites. Biomass increased at all sites, contrary to previous fuelwood models of the area. Change analysis of the vertical stratification of the vegetation canopy revealed the location of biomass increases as almost solely attributable to the 1-3m and 3-5m height classes within the vertical vegetation structure. These changes are exacerbated by anthropogenic factors. The rangeland under the highest wood extraction pressure had the largest biomass increases, likely a strong regrowth response to excessive harvesting. Within rangelands, areas closest to roads and settlements experienced substantial biomass increases in 'hotspots' as a result of shrub level gains; the greater the wood extraction pressure on the rangeland, the greater the spatial coalescence of biomass 'hotspots'. This research shows bush thickening across the communal rangelands, likely an interactive combination of newly established woody encroachers and strong coppice regrowth in harvested species.

CONSERVATION STATUS OF THE ENDANGERED NUBIAN DRAGON TREE DRACAENA OMBET IN GEBEL ELBA NATIONAL PARK, EGYPT

Usama Mohammed
National Parks of Egypt

The Nubian dragon tree *Dracaena ombet*, which is categorized as Endangered on the IUCN Red List, is found on the highest slopes of Gebel Elba National Park in Egypt, with scattered populations in Sudan, Djibouti, Ethiopia and Somalia. The Gebel Elba population is threatened by drought. Surveys were conducted in the Park to assess the condition and document the distribution of the species to prepare a baseline for conservation efforts. Eight sites were surveyed during 2007–2009: trees were tagged and their locations were recorded using a global positioning system, and tree density, diameter at breast height and population status were estimated. Of 353 trees recorded only 46% (161 individuals) were alive and only 27% (96 individuals) were in a healthy condition. Only 1% (2 individuals) were young trees, indicating a low regeneration level. Field-based observations suggest that 80% of the *D. ombet* population in Gebel Elba may soon be extinct. A conservation action plan is needed for this flagship species in Egypt and throughout its range.

PHOTOVOICE AS A KEY METHODOLOGICAL APPROACH IN CONSERVATION PLANNING

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Established conservation sociology methodologies may no longer be the best means available for collecting socioecological data. Despite the seemingly successful history, for instance, of interview-based approaches in environmental research, more novel methods are beginning to prove more effective at eliciting tacit and hard-to-discover data. A case study from a small island community in the Turks and Caicos Islands is presented here to illustrate how the use of the photovoice technique can garner information beneficial to conservation planning efforts. Community-driven conservation, often reliant on substantial input of local ecological knowledge (LEK) and pro-environment human capital, has been suggested by policy-makers for South Caicos as its local terrestrial and marine ecosystems are coming under increasing stress. However, a previous two year interview-based study found that local residents did not possess the levels of LEK or pro-environment human capital likely required for successful community-driven conservation. In spite of this, community-environment interactions that researchers had made outside of their interview-based study led them to suspect that the study had underreported residents' LEK and conservation beliefs. The research was subsequently re-conducted, this time using a photovoice approach which firstly asked research participants to photograph what they believed to be important to their community, before then asking them to take part in follow-up interviews where they described their motives for taking each picture. This time, high levels of LEK and pro-environment human capital were discovered, with 28.7% of respondent photographs demonstrating community affinity for the natural environment. These results suggest that the photovoice technique can enhance traditional conservation sociology methodology and aid conservation planning efforts by providing researchers with a more comprehensive understanding of community capacities.

WASTE OR RESOURCE? INDIGENOUS USES AND CONSERVATION REIMBURSEMENTS OF COW DUNG BY MEMBERS OF THE MAUNGANI COMMUNITY, THOHYANDOU, LIMPOPO PROVINCE, SOUTH AFRICA

Mokgaetji Georginah Mokganya
University of Venda

Cow dung is the undigested residue of plant matter which has passed through the cow's gut. The main objective of this study was to investigate the uses of cow dung by the different members of Maungani Community. Furthermore, the study looked at the ways in which the uses of cow dung can help in the case of conservation aspects. The study consisted of the



qualitative explorative phase which included the households' visits and conduction of semi-structured interviews with individuals of the selected households. Households were selected based on interval or systematic sampling whereby only a certain number of houses per street were randomly selected to ensure that the survey covered the entire village. A variety of the uses of the cow dung were recorded during the interviews with the members of the community. The most predominant cow dung use was that it can be used as a fertilizer for vegetables like spinach and cabbage; these vegetables were found planted in the backyards of the households visited. Other uses outlined by respondents were to harvest honey, to pave and decorate the yards, to sprinkle over the fertilized vegetables to prevent herbivory and also for making fire. Few responses of all the interviews mentioned the use of cow dung in the generation of biogas which plays a pivotal role in many people's lives from many parts of the globe. The fact that cow dung can also be used as fuel was seen to reduce the collection of trees from the ecosystem and thus assisting in the promotion of conservation of many plant species. The current study recommended that people of the Maungani Community should be introduced to the technology used to harvest biogas from cow dung.

A FUNCTIONAL ASSESSMENT OF SCAVENGING IN MEDITERRANEAN AND AFRICAN SAVANNAH HABITATS

Marcos Moleón

University Miguel Hernández

Cayetano GUTIÉRREZ-CÁNOVAS, Cardiff University ; José Antonio SÁNCHEZ-ZAPATA, University Miguel Hernández

Scavenging is a widespread ecosystem process which provides important benefits to humans. Unfortunately, vultures and other major scavengers are largely threatened worldwide. Assessments aimed at identifying key functional traits in scavenging communities may be fundamental to understand the consequences of scavenger declines. In this study we relate scavenger functional traits and scavenging efficiency (carrion consumption rate) in two diverse ecosystems: the Mediterranean mountains (Spain) and the African savannah (South Africa). We characterised 13 biological traits at the species level, and defined four groups of scavenger species depending on their functional role. Then we examined the relationship between species richness, functional dispersion, functional redundancy and the richness of each functional group with carrion consumption. We also determined which set of traits best explained carrion consumption rate. Species richness, functional dispersion and functional redundancy showed non-significant correlations with consumption rate. However, the richness of certain functional groups correlated significantly with the rate of carrion consumption: terrestrial mesopredators showed a significant negative correlation with

consumption rate in both systems, while obligate scavengers presented a significant positive correlation with carrion consumption rate in the Mediterranean area. Biological traits contributed differently to explain the carrion consumption rates in both scavenger assemblages. In the African savannah, traits typically exhibited by large predators such as lions and spotted hyenas were the most frequent variables used to predict carrion consumption rate. However, in the Mediterranean system, diet (obligate scavenger) was the most important trait. Overall, our study highlights the pivotal and irreplaceable role that vultures and apex predators play in the scavenging process, and claims for their strict protection.

FLIGHT INITIATION DISTANCE AND GENETIC VARIATION

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Predation is a common cause of death in numerous organisms, and a host of anti-predator defenses have evolved. Such defenses often have a genetic background as shown by significant heritability and micro-evolutionary responses towards weaker defenses in the absence of predators. If there is a genetic basis for anti-predator behavior, we should expect a loss of genetic variance to be associated with a loss of efficient anti-predator behavior. Flight initiation distance (FID) is the distance at which an individual animal takes flight when approached by a human and hence it reflects the life history compromise between risk of predation and the benefits of foraging. Here we analyzed FID in 80 species of birds in relation to band sharing coefficient for minisatellites, and observed and expected heterozygosity, number of alleles and inbreeding coefficients for microsatellites. We found consistently shorter FID for a given body size in the presence of high band sharing coefficients, low heterozygosity, few alleles and high inbreeding coefficients. These findings imply that many threatened species with low genetic variability will show reduced anti-predator behavior, and that subsequent predator-induced reductions in abundance may contribute to unfavorable population trends.

BUILDING CAPACITY OF THE NEXT GENERATION OF LIBERIAN CONSERVATION PROFESSIONALS

Mary Molokwu

Fauna & Flora International

Chloe HODGKINSON, Fauna & Flora International ; Matthew VARNEY, Fauna & Flora International ; John WOODS, University of Liberia ; Theo FREEMAN, Forestry Development Authority



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Liberia covers one of the largest remaining intact blocks of the threatened Upper Guinea Rainforest, harbouring globally endangered species, including one of the last significant populations of the pygmy hippopotamus (*Choeropsis liberiensis*). However, years of civil unrest, disrupting the training of natural resource personnel and destroying infrastructure for research and education, has severely restricted conservation capacity. Fauna & Flora International in collaboration with Liberian and international partners have been working since 2012 to address the lack of technical capacity for effective conservation using a three-pronged approach: 1) establishing a training centre in Liberia's only national park, Sapo for practical training through residential field courses; 2) insertion of conservation modules into the curriculums of educational institutions; 3) development of a researcher mentorship scheme to support collaborative research between Liberian and international researchers. The project applies a training-of-trainer strategy all through implementation to promote sustainability and self-sufficiency. Here we present results, lessons learnt and progress so far on the creation and teaching of two biodiversity conservation courses at the University of Liberia, establishment of a novel internship training scheme and development and hosting of field courses at the Sapo Conservation Centre, established in 2013. A research programme was also initiated to empower national researchers to conduct independent research. This attracted a regional collaboration that produced the first detailed ornithological research, documenting 183 bird species at the Sapo National Park and identifying increasing anthropogenic threats within and around the park. A long-term biomonitoring programme implemented by locals identified 27 mammals. We report on results from our long-term monitoring and evaluation programme to assess project impact on conservation efforts in Liberia.

THE IMPORTANCE OF SAPO CONSERVATION CENTRE TO THE PEOPLE AND BIODIVERSITY OF THE SAPO NATIONAL PARK, LIBERIA

Mary Molokwu

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Recent conservation initiatives attempt to marry the protectionist and community-based conservation models to enable more effective conservation of key species through

increased community support for biodiversity conservation. Against this backdrop, in 2013, Fauna & Flora International, in collaboration with Liberian and international partners, established the Sapo Conservation Centre (SCC) as a hub for research and community conservation of biodiversity in Liberia's only national park, Sapo (SNP). SNP holds one of the three most intact blocks of the Upper Guinea Rainforest and harbours several threatened globally important species including the West African chimpanzee. SCC addresses the lack of capacity for effective community-integrated and supported conservation in Liberia through: 1) formation of a steering committee (comprising local, national and international stakeholders), as a forum for stakeholders to address conflicts and other issues relevant to the protection of biodiversity and human interests - a vital link between park management and local communities; 2) establishment of a training course where forestry students and professionals are locally trained and can experience ecological field research and applied conservation; 3) coordination of a long-term biomonitoring project that monitors the status of SNP's biodiversity; and 4) establishment of a research programme incorporating biological and human dimensions. The project approach led to several interesting discoveries, particularly the lack of awareness of locals about the park boundary and legal use of the buffer zone; emerging human-wildlife conflicts (HWC) that may result from community encroachment into the buffer zone; and increasing hunting pressures. Future research and conservation action is now focused on exploring HWC issues and developing a collaborative buffer zone management plan. Here we share details of the project, our challenges and hopes for the future in this important landscape.

SOLVING CONFLICTS AMONG CONSERVATION, ECONOMIC AND SOCIAL OBJECTIVES IN BOREAL PRODUCTION FOREST LANDSCAPES

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Reconciling biodiversity conservation with increasing demands of natural resources and human well-being from ecosystems requires that ecological, economic and social values of the landscape are taken into account in decision-making. Joint production of economic and social values together with maintaining biodiversity is a challenging planning problem because conflicts that exist among the objectives make it impossible to maximize all of them simultaneously. Here, we first develop multi-objective optimization methods to measure conflicts among different objectives. We then propose a new



approach to resolving these multidimensional conflicts through compromise management plans. We exemplify the potential utility of the approach for simultaneous production of timber revenues, several ecosystem services and maintenance of biodiversity (species habitat availability) in large boreal forest landscape. In this production forest landscape, we applied seven alternative management options on 30,000 forest stands across 50 years planning horizon. We show that the conflicts among objectives are typically complex and asymmetric. Even if pairwise conflicts between objectives are severe, a management solution can be found with rather small losses in either of the objectives. For example, conflict between biodiversity and ecosystem services can efficiently be solved. However, incorporating timber revenue objectives narrows the margin for minimizing the conflict. Therefore, the current strong emphasis in boreal forests on timber production incurs into considerable social and ecological costs. We propose a planning approach where conflicts between social and economic values are being solved at a predetermined minimum level for biodiversity. This approach would ensure that societal optima among alternative ecosystem services can be found within the safe boundary levels of life supporting systems.

MODELLING THE PRE-WHALING DISTRIBUTION AND ABUNDANCE OF THE ENDANGERED NORTH ATLANTIC RIGHT WHALE FROM HISTORICAL WHALING RECORDS OF A CONGENERIC SPECIES

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The North Atlantic right whale (NARW, *Eubalaena glacialis*) is one of the world's most threatened whale species. Previously widespread, it came close to extinction after centuries of overexploitation, and was already commercially extinct by the mid-1700s. It currently persists as a small and slowly recovering population of ca. 500 individuals. Setting appropriate conservation targets for this species requires an understanding of its historical distribution and abundance, as a baseline for understanding its decline and measuring progress towards recovery. However, this is made difficult by the scarcity of records over its very long whaling history. In contrast, its congeneric North Pacific right whale (NPRW, *E. japonica*) was exploited more recently, in a short and well-

documented period in the mid-19th century. Here, we combine detailed whaling records for the NPRW with oceanographic data to generate a spatially-explicit statistical prediction of the environmental suitability and carrying capacity of the North Atlantic for right whales. The predicted extent of occurrence matches well historical records for the NARW, supporting the assumption that the two species have similar environmental preferences. Our results suggest that the historical summer range of the NARW extended from the eastern coast of North America to northern Norway, much wider than the current summer grounds off North America. Our estimate of a pre-whaling population of ten to twenty thousand individuals strongly suggests that the current population is extremely depleted, but also show the realms of possibility for future recovery. Our predictions of areas of high habitat suitability and historical abundance suggest priorities for monitoring the current population. More generally, this study illustrates the challenges and opportunities in using historical data to understand the original distribution of highly depleted species and to inform their future conservation.

33-HOW CONSERVATION SCIENCE INNOVATIONS SPREAD AND CHANGE PRACTITIONER BEHAVIOR IN LARGE INSTITUTIONS

Jensen Montambault

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Conservation science innovations are intended to transform conservation practice and decision-making. Social networks have the potential to greatly accelerate the spread of these innovations far beyond what could be possible with traditional change management tactics including institutional policies and training. However, there is little research to help managers understand how science innovations spread and ultimately change the behavior of conservation practitioners. Research has been limited because of the challenges associated with employing experimental designs in large, geographically diffuse organizations. Further, intended outcomes, such as learning and behavior change, present particular measurement challenges. We address these challenges by examining the diffusion and uptake of new science innovations and policies in a large, global, non-governmental conservation organization, The Nature Conservancy. The innovations include methods for iteratively prioritizing, assembling and applying evidence to identify crucial conservation needs and actions, as well as integrating human wellbeing considerations into conservation strategies. We focus on conservation practitioners in a large operating geography and employ a randomized-controlled design to estimate the effects of training interventions on



conservation practitioner behavior and their egocentric networks. We also investigate network structures and characteristics to understand whether such characteristics can predict the spread of new innovations and policies. We present preliminary results on conservation practices and on network structures and characteristics from data gathered through administrative systems and self-reported communication networks. We expect that training combined with networks effects will lead to more efficient and effective spread of innovation, which is especially important when policy mandates are not feasible, innovations involve complex learning and training resources are limited.

NEGATIVE IMPACT OF A MARINE PROTECTED AREA UPON AN EMBLEMATIC MEDITERRANEAN RAPTOR POPULATION.

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Disturbance of charismatic wildlife by eco-tourism has become a major concern in the last decades. In the Mediterranean, sea-based tourism and related recreational activities increased rapidly, especially within marine protected areas (MPAs) hosting emblematic biodiversity. Here we investigated the impact of the Scandola MPA (Corsica, Western Mediterranean) on the population of a conservation flagship, the Osprey *Pandion haliaetus*. Over the 37-years study period, breeding parameters dropped for pairs nesting within the MPA compared to those breeding elsewhere in Corsica, while tourist fluxes increased rapidly. Recent breeding failures within the reserve are not caused by food scarcity, as 98 underwater transects and GPS-tracking of nine breeding adults conducted in 2012-2013 showed that fish consumed by ospreys are more numerous inside the MPA. Further, we performed direct observation in 2013 and 2014, which revealed that the overall number of boat passages and of boat approaches within <250 m from osprey nests were significantly higher within the MPA than in the control area. Finally, observations at osprey nests conducted across 2012-2014 demonstrated that boat traffic modified osprey time-budgets significantly, by lowering the number of prey items brought back to the nest by males, and increasing time spent alarming and flying off the nest in females. Overall, our integrative assessment combining raptor demography, movement ecology, behavioural ecology, with fish and boat surveys clearly demonstrates the impact of the Scandola MPA on the Corsican osprey population. This case study stresses the worldwide importance of rigorously implementing sustainable ecotourism.

THE CONTRIBUTION OF TOURISTS TO THE RESILIENCE OF SOUTH AFRICA'S NATIONAL PARKS

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South Africa's National Parks are an important part of the national conservation strategy and the role of tourists in ensuring the viability of parks should not be overlooked. Tourism is one of the central financial drivers of South Africa's National Parks (SANParks). Thus, understanding how tourists are using parks and their motivations for visiting will assist in building a sustainable and resilient tourism management approach. The aim of this study was to understand how tourist movements within SANParks, as well as the broader protected area network within Southern Africa, could contribute to resilience. Tourist surveys were distributed at all SANParks during 2013-2014, asking tourists about their movements within SANParks and protected areas within Southern Africa, as well as their motivations for visiting parks. Using a network analysis approach we found that each of South Africa's National Parks has a unique tourist base, with some appearing more resilient than others. For example, Kruger National Park was found to have a diverse tourist base, including many repeat visitors, frequent SANParks users and Private Protected Area users. Tourist profiles at other parks varied, with some parks relying more on one type of user such as repeat users or first time users. Additionally, the motivations of tourists also varied between parks, however, many expressed the intrinsic and cultural benefits of parks as being very important. The tourist movements and motivations studied here indicate that tourist base diversity is important in promoting the resilience of South Africa's National Parks.

EXPLORING THE BIOGEOGRAPHY OF HERBIVORE - PLANT COMMUNITY INTERACTIONS AND ECOSYSTEM FUNCTIONING

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Biotic interactions can shape landscape-scale ecosystem processes, thus understanding the connections between the biogeography of biotic interactions and ecosystem function will enhance our ability to inform management decisions.



The presence of herbivores, via their interaction with plant communities, can alter fire regimes. However, it is less clear if the impact of small mammals, which are common in many managed ecosystems, on fire regimes is similar to that of mega-herbivores like elephants. Using an experimental approach, we found that the presence of small rodents reduced the amount of area burned during a fire by 61%, indicating rodents can alter how a fire disturbance moves through an ecosystem. However, plant response to herbivory is not globally constant; it would follow that herbivore effects on fire regimes depend upon a combination of local mitigating factors. By building a global-scale database to explore how mammal-plant interactions vary across biomes, climatic regimes, and land-use histories I will discuss: (1) are there global patterns in small mammal-plant community interactions; (2) are there global patterns of large herbivore effects on fire regimes; (3) will combining the results from my first two questions provide insight on how small mammals may influence ecosystem response to changing fire regimes. Preliminary data indicate that the effects of large herbivores on fire regime are highly dependent upon grazer type, precipitation, and past land use history across ecosystem-types. These results suggests that the current research approach that seeks to predict how species, and ultimately ecosystems, will respond to climate change without considering interactions is flawed and may lead to poor management decisions. Thus integrating interactions into predictions will better inform local, regional, and global conservation strategies (e.g. ecosystem maintenance) and management choices (e.g. timing of prescribed fires).

THE RED LIST OF ECOSYSTEM IN BRAZIL -SUBNATIONAL PILOT EXPERIENCES TOWARDS A BROAD IMPLEMENTATION STRATEGY

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The IUCN Red List of Ecosystems (IUCN-RLE) is a quantitative tool for assessing the conservation status of natural ecological systems and their risk of collapse. It considers both biotic and abiotic aspects, and it is thought off as a standard methodology with global achievements. During the Rio + 20 Conference, IUCN presented the methodology, initiating a broad debate on its potential application at the country level, and as a means to support definition of priority areas for conservation. With the World Commission on Ecosystem Management (CEM-IUCN) and Provita-Venezuela, IUCN Brazil mobilized a working group to build capacities and to develop a national implementation strategy. Subnational pilot experiences were designed to help build a strong case of successful RLE stories and raise awareness of their usefulness as a tool to support existing

public policies. Satellite images were used to quantify and evaluate the effects of current reduction in the geographical distribution of the ecosystems assessed. Existing land use data and modeling tools were applied to estimate future reductions. Data on heat spots served as proxy for fire events and environmental degradation. Information available in the literature complemented the assessments. Results show that it is feasible to produce a Red List of Ecosystems in Brazil using existing data and tools. Furthermore, they show that such a list would be very helpful for strengthening existing policies on biodiversity conservation, leveraging on-going efforts. The articulation of the IUCN-RLE with other methodologies already institutionalized in the country, such as the Red List of Species and Priority Areas for Conservation, can contribute to the consolidation of more effective political instruments. Brazil presents opportunities for the development of new approaches for the RLE implementation and is strategically positioned to lead a South American articulation focused on trans-boundary ecosystems conservation.

THE RESILIENCE OF MANGROVE FOREST TO MAJOR DISTURBANCES: A CASE STUDY IN SUMATRA, INDONESIA

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Sumatra lies in an area of high seismic activity. The infamous earthquake that caused the Tsunami in December 2004, and another one in March 2005 - 9.1 and 8.7 on Richter scale respectively - caused the land to rise up to 1m in certain areas, which in turn caused the gradual death of coral reefs and mangrove forests. In this study, we analyze the change in extent and condition of mangroves in the Pulau Banyak Archipelago, located off the southwest coast of Aceh. We carried out a multi-temporal analysis of Landsat satellite images, obtained pre-tsunami (2003), pos-tsunami (2007) and current state (2014). The image classification was guided and validated with the use of 128 ground truth points collected during 2009; field observations included the state of recovery, classified as: high, medium or low depending on the height and density of saplings. The results show that in 2003, approximately 2592 ha of mangroves were present. Four years after the earthquakes, approximately 60% of this mangrove had died as a result of the changes that arose from the uplifting of the land. Only in approximately 30% of the area that was destroyed, some type of recovery was observed. The death of these mangroves represents the loss of ecosystems services. For example, local fishermen commented to have noticed a reduction in the number of fishes and molluscs; moreover, considering a mean above ground carbon pool for Indonesian mangroves of 159 MgCHa⁻¹, approximately 200 000 MgC could have been liberated into the atmosphere. The next step of



this study includes a further analysis on the recovery process in order to obtain further insights on the resilience of this ecosystem.

EVALUATION OF THE NETWORK OF PRIORITY FEEDING AREAS FOR SCAVENGERS IN SPAIN: FROM BIODIVERSITY CONSERVATION TO ECOSYSTEM SERVICES

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Political decisions and legal regulations may have important implications for the functioning of ecosystems and the services they provide. Due to the outbreak of the bovine spongiform encephalopathy (BSE) in Europe, a sanitary regulation (EC 1774/2002) forced farmers to remove livestock carcasses from the field and transport them to authorized plants for their transformation or incineration. This led to a strong food shortage for vultures and other scavengers of conservation concern, with negative effects on their populations and the ecosystem services they provide. Moreover, carcass transportation meant a new source of greenhouse gases (GHG) emission. As a result of these environmental costs, new legislation was approved (EC 142/2011) to allow farmers to abandon extensive livestock carcasses in certain areas (priority feeding areas for scavengers, ZPAEN), both in the field (where they die) and at feeding stations. This legislation was incorporated in Spain through the Royal Decree 1632/2011, which urged every region (autonomous community) to design their own ZPAEN. Our aim was to evaluate the potential effects of this new regulation on a) the conservation of endangered scavengers and b) the GHG savings. By means of a GAP analysis, we evaluated the effectiveness of the network of priority feeding areas for the conservation of vultures and other endangered facultative scavengers. Then, we quantified the GHG emissions associated with the transport of extensive livestock carcasses that would be saved after the implementation of the ZPAEN. Our results show that these priority feeding areas for scavengers enhances both scavenger conservation and the associated ecosystem services when compared with the effects of previous restrictive regulations. However, the regional regulations must assimilate that obligate scavengers are highly mobile organisms that require large scale

planning, so their improvement should focus on incorporating larger areas to the ZPAEN.

LARGE BIODIVERSITY CONSERVATION GAINS ARISE BY BEING STRATEGIC ABOUT BROAD-SCALE AGRICULTURAL DEVELOPMENT IN NORTHERN AUSTRALIA

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The tropical savannas of northern Australia are one of the few remaining large natural areas on earth, supporting many endemic species. Their biodiversity values are currently under threat from Australian Government policies aimed at encouraging agricultural development in the region. We explored the tradeoffs between biodiversity conservation, agriculture production and carbon farming in northern Australia. We examined land-use change scenarios to identify areas of potential land-use conflict, where high agricultural development potential intersected high biodiversity values. We also identified areas of high biodiversity value and high carbon farming potential, presenting an opportunity for complementary land management. We used spatial prioritization to find the optimal solution from two different perspectives: (1) a conservation organization seeking to maximize biodiversity value and minimize cost; (2) a public policy-maker seeking to balance land-uses in the best interests of the public. We assessed how the solutions for these two perspectives differed in terms of which areas were prioritized for protection and agricultural development. We found substantial overlap between agricultural potential and biodiversity value: development of agricultural lands based solely on agricultural potential will have large negative effects on biodiversity values. If all suitable soils were converted to agriculture, three species would go extinct and 44 would lose more than 50% of their current distributions. Conversely, joint consideration of agriculture and biodiversity values allows 22,000+ km² of agricultural development with little biodiversity loss. Carbon farming represents a good alternative to agriculture in the 8,000+ km² of the tropical savannas identified as high-priority areas for biodiversity conservation. Our study shows the importance of planning strategically for multiple, and potentially conflicting land uses when making large land-use policy decisions.

27 PRIORITY QUESTIONS FOR BIODIVERSITY CONSERVATION IN MEDITERRANEAN-TYPE REGIONS

Francisco Moreira



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This will be the concluding presentation of a symposium on the identification of priority questions for biodiversity conservation in Mediterranean-type regions. Resulting from a joint initiative of the Society for Conservation Biology (SCB) – Europe Section and the International Society of Mediterranean Ecologists (ISOMED) it aimed to identify questions that, if answered, would have a high probability of increasing the success of actions targeted at the conservation of biological diversity in the five Mediterranean regions of the world. In this presentation we will summarise the current state of implementation of the initiative and present the first results. Patterns in types of questions and thematic priorities will be compared across Mediterranean-type regions and stakeholder types, in order to identify topics of overall and regional importance. After the presentation, the floor will be open to exchange ideas and receive further comments from the participants.

FINDING MIDDLE GROUND: FROGS, PINES AND SUSTAINABLE FORESTRY IN CHILE

Virginia Moreno-Puig

Massey University

Dianne H. BRUNTON, Massey University

Telmatobufo bullocki is one of the most rare and endangered amphibian species in Chile's temperate forests. It is the top 5 EDGE amphibian, and one of the world's 100 priority species for conservation (ZSL, 2011). This ancient stream-breeding frog is micro-endemic to the coastal Nahuelbuta mountain range, a hot-spot for conservation that has suffered the recent replacement of nearly 70% of its natural forest by extensive commercial plantations of exotic pines and eucalyptus. Despite its potential detrimental effects, the impact of this land-use change on this critically endangered species has not been studied before. Some of the questions to be answered are: Are frogs using exotic plantations? Have plantations caused recent declines? Are plantations limiting amphibian dispersal? Can plantations and T. bullocki coexist in the long term?

Here I will present the results from a 4-year doctoral research project looking at several aspects of the species ecology and behaviour, aiming at finding ways to improve the current conservation status and securing the long-term survival of this Gondwanan relict. Some of the main results include improved and new knowledge about the species distribution, habitat use, movements, population genetics and life-history. Frogs were found migrating from breeding streams into adjacent forest, including mature pine plantations, up to 500 m upland. This suggests terrestrial habitat use is an important part of the life cycle, and that current legal protection of riparian zones (i.e. 5 to 20 m) might not be enough. Therefore, unless bigger riparian buffer zones, and permanent connectivity corridors are established, the future of this species might be in jeopardy. This highlights the urgent need for a more sustainable management of plantation forestry in Chile, a move that would not only benefit T. bullocki but also many other native species from these endemic-rich temperate forests.

HOPPING FROM THE FRYING PAN INTO THE FIRE: THE FUTURE OF TELMATOBUFO BULLOCKI UNDER CLIMATE CHANGE

Virginia Moreno-Puig

Massey University

Dianne H. BRUNTON, Massey University

Telmatobufo bullocki is a rare and critically endangered stream-breeding amphibian, endemic to Chile's temperate forests. Recent studies have shown they have complex habitat requirements, and have identified habitat loss, degradation, and fragmentation due to exotic forestry plantations as major threats. The species is known to occur in only a few localities within the Nahuelbuta mountain range; a hot-spot for conservation that has suffered a rapid, recent, and substantial loss of native forest. Using recent presence records and maximum entropy (Maxent) modeling, a species distribution model was created for T. bullocki in the Nahuelbuta range. The model reflects the relationship between the species presence and several relevant variables including topographic, climatic, and land cover. The best-performing model included elevation, precipitation, temperature, and percentage of native forest in the landscape as important variables predicting T. bullocki presence. To estimate the impact of recent native forest loss on the species distribution, the model was projected backwards into hypothetical past conditions of native forest cover. In addition, the potential impact of climate change was assessed through projecting the model into a future climate scenario under an intermediate representative concentration pathway (RCP4.5). The results suggest that not only T. bullocki distribution has been severely affected during the past century due to land-use change, but a further 70% reduction can be expected in the near future due to climate change alone. This highlights the urgent need to take immediate



and commensurable management measures in order to protect remaining habitat and populations, and minimize the predicted negative effects associated to climate change.

ECOSYSTEM SERVICE SUPPLY IN EUROPE: WHERE ARE WE NOW AND WHAT SHOULD WE EXPECT FROM THE FUTURE?

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The complex relationships among multiple ES supply and between the variety of demands for ES challenge landscape planning and environmental policies. Specifically, it is critical to foresee the impact of changes in one ES provision on other services or to set up an efficient management of multi-functionality. In the context of the EU FP7 VOLANTE project on the environmental and socio-economic consequences of transitions in land use, we developed a three-step methodological framework to analyse the interactions of multiple ES: (i) detecting ecosystem services associations, (ii) identifying bundles of ecosystem services and their geographic distribution, and (iii) the drivers of these bundles and trade-offs. Using this framework, we assessed current ES associations across Europe. We then investigated the evolution of ES associations under contrasting scenarios of land use transitions derived from SRES scenarios. We show that European ecosystems currently provide a variety of services, with often high multi-functionality (i.e. supply of multiple ES at a given location). Several services are closely and positively associated like biocontrol services, forest-related services and, to a lesser extent, carbon sequestration. Conversely, food-feed-fibre production is, not surprisingly, negatively associated to pollination, carbon sequestration and forested-related services. Future ES associations, on the other hand, vary across scenarios but also depend on the assumptions made about the evolution of bundles (i.e. the composition and number of bundles may or may not be constrained by our knowledge on current bundles). Here, we present one of the first spatially explicit assessments of ecosystem services supply across Europe and land use change scenarios. We will further discuss how the conceptualization of the evolution of ES bundles can modify projected trade-offs and synergies and interfere with future decisions of land use management in Europe.

MIGRATORY CONNECTIVITY OF THE ORTOLAN BUNTING

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The Ortolan Bunting (*Emberiza hortulana*) is a sub-Saharan migratory passerine breeding mostly across central and north of Europe. While it is a widely distributed and abundant species, important population declines have been recorded for several breeding populations, for instance in the Scandinavian and Baltic countries. The reasons for these declines are complex, although habitat loss through land-use change, intensive agricultural practices, climate change and hunting pressure are certainly involved. Further pressures could be applied at other times in the yearly cycle, during migration or at over-wintering sites. Unfortunately, the lack of information on migratory flyways, stop-overs or wintering areas precludes effective protection throughout the year. In such a context, the Museum of Natural History in Paris is leading an international program that aims to establish the migratory connectivity of this species and to estimate the origin and size of migratory population captured in south west France during annual traditional hunt. Geolocators are fitted to breeding males to establish migratory flyways and overwintering areas. Feathers collected on breeding birds and migrants are analysed for stable isotopes and genetics. A deuterium isoscape is built at the European scale using breeding bird samples and used to assign migrants to their probable breeding origin according to their deuterium value. Lastly, the genetic diversity and genetic structure of breeding populations were described after the development of specific microsatellite markers. Migrants can then be assigned to their putative breeding population according to their genotype. Here we give an account of the first results obtained from these genetic analyses on the migratory connectivity of the Ortolan Bunting.

CLIMATE CHANGE AND THUNBERGIA ATACORENSIS (ACANTHACEAE), A RARE AND ENDEMIC SPECIES OF THE ATACORA'S CHAIN: IMPLICATIONS FOR BETTER CONSERVATION STRATEGY

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Conservation of endangered species occupies an important place in conservation biology because in theory they are most at risk of extinction. However our knowledge of the behavior of their ecological niche under climate change is limited. With a small number of occurrence records (15), we used maximum



entropy combined with Geographic Information System (GIS) to model the ecological niche of *Thunbergia atacorensis* and how climate change could affect the future geographical range (2050) of its suitable habitats. Presence records were collected and combined with current and future climate data from the considered study area. For future climate projections, the Miroc-H model was used under the new Representation Concentration Pathways' scenarios. Currently the most suitable habitats for *T. atacorensis* represent 8.68% of the national area. They were predominantly located in the Soudan endemism centre (mostly in the phytogeographical district (PD) of the Atacora chain) and a small part of the Soudan-Guinea transition zone (PD of Bassila). Currently only 4.69% of the protected areas' network is found to be highly suitable to the preservation of *T. atacorensis*. In other words 12.77% of suitable area of species are located in protected area network. This percentage will increase by 2050. The protected area network is relatively favorable to *T. atacorensis* conservation but conservation action of *T. atacorensis* should put an emphasis on riparian forest's protection, especially along the Atacora's chain which is the endemic zone of this endangered species. Key words: endangered species, Maxent, ecological niche, modeling, climate change, West Africa.

SELECTION OF DYNAMIC MODELS FOR BIRD POPULATIONS IN FARMLANDS

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Agricultural changes have caused a severe decline in common bird community in Europe. Mitigating this loss requires to both understand and predict how agriculture affect biodiversity. The objective of this paper is to test different dynamic models coupling bird abundances and farming land-uses in the description and the prediction of birds to agricultural changes. The agro-ecological calibration relies on 2002-2009 data for 34 bird species and 14 agricultural systems in 620 small agricultural regions of metropolitan France. The models are compared through an indicator of goodness-of-fit and indicators of predictive quality. The results first stress the relevance of systemic, functional and mechanistic relationships between agriculture and bird populations both in descriptive and predictive contexts. However, it turns out that the best dynamic models to describe the past trends are not necessarily the most relevant to predict future trends. In particular, the role played by farming habitat is reinforced in the predictive context. Our study also suggests a new classification of farmland bird species according to the functional form of the intra specific competition and habitat quality.

CORAL REEF FISHES IN THE PHILIPPINES: FISHERIES AND CONSERVATION

Richard Muallil

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The Philippines is within the Coral Triangle region, which is the global hotspot for coral reef biodiversity. Overfishing and various other anthropogenic disturbances are seriously threatening the coral reef fish communities in the country. In this study, we conducted fish visual census on coral reefs in over 40 municipalities all over the Philippines to assess the condition of coral reef fish communities, focusing on commercially important species. In each municipality, 8-10 10m by 50m belt transects, half of which were established inside marine protected areas (MPAs) and the other half in adjacent fished areas (FAs), were surveyed. Results showed that fish biomass in MPAs was generally higher by about 30% than in FAs. Fish biomass in MPAs was much higher for large individuals (i.e. ≥ 25 cm total length), the high trophic level species and those which are included in the IUCN red list of threatened species. There are also more species found in MPAs than in FAs. Unfortunately, only very few of the assessed reefs, including those inside MPAs, were in pristine condition suggesting that the current MPAs may not be strong enough to protect coral reef fishes from the negative effects of overfishing. We also conducted interview surveys with at least a hundred small-scale fishers in each municipality to gauge fishing pressure on coral reef fishes and to determine fishers' perception toward MPAs as coral reef fish conservation tool. Further, we discussed why some MPAs performed better than others using available ecological and socio-economic attributes of the sites. Our findings provide valuable science-based insights that will inform policy makers in prioritizing management actions for effective conservation of the valuable but highly threatened coral reef fishes.

CLIMATE CHANGE VULNERABILITY ASSESSMENT TOOL FOR CORAL REEF FISHERIES (CCVA-COREFISH)

Richard Muallil

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Coral reef fisheries provide the livelihood of millions of population in the Philippines. However, overfishing and other anthropogenic disturbances, which are further aggravated by impacts of climate change, are seriously threatening the sustainability of coral reef fisheries in the country. In this study, we developed a tool called Climate Change Vulnerability Assessment Tool for Coral Reef Fisheries (CCVA-



CoReFish), which assesses the vulnerability of coral reef fisheries to impacts of climate change. CCVA-CoReFish follows the Intergovernmental Panel for Climate Change's (IPCC) framework of vulnerability assessment (VA), where Vulnerability is a function of Sensitivity, Exposure and Adaptive Capacity. It is also patterned from another VA tool we developed earlier called the Tool for Understanding Resilience of Fisheries (VA-TURF), which is designed mostly for localized (i.e. among villages within a municipality) VA. CCVA-CoReFish, on the other hand, is designed to cover much larger spatial scales in order to allow comparison of vulnerability levels among sites that are spatially far from one another (i.e. among municipalities). Like VA-TURF, CCVA-CoReFish also uses three sub-components, namely, (i) fisheries, (ii) coral reef ecosystems, and (iii) socioeconomic, both for Sensitivity and Adaptive Capacity components. For Exposure component, CCVA-Core Fish uses more parameters in addition to wave exposure such as sea level rise and sea surface temperature, which are more relevant for municipality-level VA. In this study, we demonstrated CCVA-CoReFish using data collected from more than 30 municipalities all over the Philippines. Insights are provided to inform policy makers for prioritization of management actions that can effectively and efficiently address the threats of climate change on coral reef fisheries and the millions of highly fishery-dependent population in the country.

FISH FOREVER: HOW MANY, FOR HOW LONG? MEASURING CONSERVATION AND SOCIAL RESULTS ACROSS FIVE COUNTRIES IN A GLOBAL SMALL-SCALE FISHERIES INITIATIVE

Janelle Mueller

Rare

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Improving the management of struggling small-scale fisheries has become a major focus of numerous governments and international conservation organizations. The approaches vary by region and by the implementing partners involved, yet some form of co-management has been successful in many contexts. Building on this, the "Fish Forever" program was launched in February 2014 by Rare, Environmental Defense Fund, and the Sustainable Fisheries Group of UC Santa Barbara to work with governments and communities in Indonesia, the Philippines, Belize, Brazil and Mozambique through the

implementation of territorial use rights in fisheries (TURFs) combined with marine reserves (aka TURF-Reserves). We hypothesize that TURF-Reserves can align incentives and increase the stewardship in small-scale fisheries through two mechanisms: 1) the managed-access of a TURF reduces the ability of non-local fishers to exploit the resource and increases the proportion of total catch available to local households while creating a way to implement catch or effort controls with potentially high levels of compliance; 2) the reserve enables fish stocks to recover within its borders, presumably leading to spillover of these stocks into the nearby TURF. The application of this model in 5 countries with different ecological, cultural, economic, and governance contexts provides an opportunity to evaluate these hypotheses, and the extent to which the model is generalizable. Fish Forever is designed to achieve a variety of social and ecological goals, making comprehensive monitoring and evaluation essential, since these outcomes are the basis of the "benefits exchange" that drives the Fish Forever model. To evaluate progress toward goals and adaptively manage, we anticipate collecting data on the same metrics across sites. Here we present the monitoring framework, how it has been adapted to account for country-level variability while retaining comparative ability, and preliminary results.

LEVELS AND TYPES OF HUMAN WILDLIFE CONFLICTS IN KENYA FROM 2008 - 2012

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Human wildlife conflict (HWC) is a severe and growing problem in today's world. The rate of human wildlife conflict in protected and unprotected areas in Kenya over the last decades has been a matter of concern by the both government and stakeholders involved in conservation efforts. The costs incurred by the communities living close to these areas in terms of human deaths, injuries, threats and loss of property is extensive. Conservation of wildlife has also been affected as people retaliate by killing animals responsible for the conflict and poaching for their economic gain leading to near extinction of some species. This study assessed the levels and types of (HWC) in Kenya. HWC data from Kenya Wildlife Service (KWS) was used to analyze the type and trends of HWC. About 50 people and 100 wild animals die yearly as a result of HWC. To reduce these conflicts, there is need to have good resolution strategies that aim at changing people attitudes. This can be done through education and by ensuring that affected communities benefit from proper wildlife management. Harmonization of both wildlife management and human development goals can help resolve conflicts since it involves bringing the two groups together to come up with sustainable solutions for wildlife and people.



PROTECTING THE FORESTS WHILE ALLOWING REMOVAL OF DAMAGED TREES MAY ECOLOGICALLY DEGRADE THE HYRCANIAN BEECH FORESTS OF IRAN

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The 1.8 million ha of Hyrcanian forest south of the Caspian Sea represent a remarkably intact ecosystem with numerous old-growth features and unique species assemblages. To protect these forests, Iranian authorities passed a law which protects healthy trees but permits the removal of injured, dying and dead trees. To quantify the ecological effects of such a strategy, we sampled saproxylic beetles and true bugs in 24 plots distributed across the entire altitudinal gradient of Oriental beech forests. Of all environmental variables tested, dead wood volume best explained overall species richness, richness of endemics and of 'Urwald relicts', as well as community composition. Due to the striking evidence that dead wood is the major driver of saproxylic diversity in these forests, we urge Iranian authorities to reconsider their law and to restrict logging to healthy trees. Otherwise, a similar ecological degradation as experienced in European beech forests can be expected.

163: ECOSYSTEM BASED ADAPTATION (EBA) FOR MOUNTAIN ECOSYSTEMS: LESSONS AND EXPERIENCES FROM NEPAL, UGANDA AND PERU.

Musonda Mumba

United Nations Environment Programme

Resilient ecosystems have been seen as an important foundation to human well-being and also necessary for better adaptive capacity for the communities that depend on them. Resilience has been described as the ability of a social or ecological system to maintain basic structural and functional characteristics over time regardless of external stressors. It's on this premise that the concept of Ecosystem based adaptation (EbA) is particularly relevant. Evidence has shown that mountain ecosystems are particularly vulnerable to climate change and as such the ecosystem services that they provide for communities and species within and without the proximity of these areas are also threatened. This paper discusses the Ecosystem based adaptation (EbA) approach that has been applied to mountain ecosystems of Nepal, Peru and Uganda. Vulnerability Impact Assessments (VIAs) were undertaken in all three countries to understand community

vulnerability, mapping the important ecosystems services provided and options offered for reducing this vulnerability for resilient ecosystems. The outcomes from the VIAs informed the EbA interventions options in all three countries. The EbA implementation in all three countries also demonstrates a move from EbA conceptualization to realization on the ground and at the policy level. Finally this paper will also examine the policy implications of this approach nationally and ability for the work to be up-scaled to other mountain ecosystems and other ecosystems as well. Key words: Ecosystems services, Climate change adaptation, mountains, Ecosystem based Adaptation, Uganda, Peru, Nepal

INFLUENCE OF VINEYARD EXPANSION ON CALIFORNIA'S WOODLAND BIRD COMMUNITIES

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The agricultural matrix has long been a part of Mediterranean-climate ecosystems and is the primary factor for why these ecosystems are among the most threatened on Earth. Vineyard expansion is one of the main drivers of land use change for these regions today. California oak woodlands are one of the richest mediterranean-climate ecosystems, providing habitat for more than 300 terrestrial vertebrates. The goal of this study is to determine how vineyard landscapes influence bird abundance and richness in California's north coast woodlands. Bird survey plots were done at 137 oak woodland locations for two years across a gradient of surrounding vineyard development. The surveyed areas were characterized at local and landscape scales through vegetation plot data and aerial photographs to quantify land cover. Generalized linear models were used to analyze the relationship among bird assemblages, local vegetation, and surrounding vineyard land cover. Measures of local woodland structure contributed more to explaining the abundance of cavity nesters, agricultural adapters, and granivorous birds than surrounding land cover information across the vineyard development gradient. These results emphasize the importance of maintaining remnant patches of woodland in Mediterranean-climate wine grape growing regions where biodiversity conservation is a high priority.

PRIORITIZING FRESHWATER HABITATS FOR CONSERVATION IN INDIA

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Freshwater systems harbour a wide range of biodiversity, provide a range of ecosystem services and are important for sustaining human wellbeing. Freshwater systems, being the hotspots for human activities, have been overexploited, polluted and habitats are degraded. Until recently, water bodies in India did not have any special policy enactments for their conservation. Their management was largely dependent on the legal status of the larger ecosystem in which they are located. Lack of policies and anthropogenic pressures not only led to loss of biodiversity, but have also greatly altered the quality and quantity of safe water available for human use. Thus, freshwater habitats require immediate conservation efforts. However, with increasing human population demanding for more space, it is not possible to convert large areas into conserved areas in India. Thus for conserving these habitats, it is practical to identify sites that are of high conservation value. In India, all previous attempts of prioritization for conservation were restricted to terrestrial systems and have looked only at the biodiversity factors, without considering the livelihood benefits. The present work was carried out to develop a protocol by combining biodiversity factors along with informations on threats, resource use practices and biophysical factors to identify high conservation value sites. This is the first ever attempt in India to look at the freshwater prioritization in a comprehensive manner. The model helped in identifying and mapping sub-basins that require immediate attention. Identification of these sub-basins not only helps in improving conservation efforts, but the result can also be used in developing management plans at local sub-basin level to develop sustainable strategies that support both biodiversity conservation as well as livelihood opportunities.

CLARIFYING CONNECTIVITY PATTERNS IN THE MEDITERRANEAN SEA BY A MULTI-DISCIPLINARY APPROACH: THE ROLE OF EARLY LIFE HISTORY STAGES OF RED MULLET (MULLUS BARBATUS)

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Integrating connectivity patterns into marine ecosystem management is a fundamental step, specially for stock subjected to the combined impacts of human activities (overfishing, habitat degradation, etc.) and climate changes. Thus, management of marine resources must incorporate the spatial scales over which the populations are connected. Notwithstanding, studying these dynamics remains a crucial and hard task and the predictions of the temporal and spatial patterns of these mechanisms are still particularly challenging. This research aimed to puzzle over the red mullet *Mullus barbatus* population connectivity in the Western Mediterranean Sea, by implementing a multidisciplinary approach. Otolith sclerochronology, larval dispersal modelling and genetic techniques were gathered in this study. More particularly, this research project focused on early life history stages of red mullet and their role in the characterization of connectivity dynamics. The results show that *M. barbatus* larval dispersal distances can reach a range of 200 km. The differences in early life traits (i.e. PLD, spawning and settlement dates) observed between various areas of the Western Mediterranean Sea suggest a certain level of larval patchiness, likely due to the occurrence of different spawning pulses during the reproductive period. The dispersal of individuals across distant areas, even not significant in demographic terms, is accountable for the maintenance of the genetic flow among different demes. Fluctuations in the level of exchange among different areas, due to the variability of the source-sink dynamics, could have major implications in the population connectivity patterns. These findings highlight the reliability of combining several approaches and represent a benchmark for the definition of a proper resource management, with considerable engagements in effectively assuring the beneficial effects of the existent and future conservation strategies.

91: AN EVIDENCE ASSESSMENT TOOL FOR ECOSYSTEM SERVICES AND CONSERVATION STUDIES

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The 1.8 million ha of Hyrcanian forest south of the Caspian Sea represent a remarkably intact ecosystem with numerous old-growth features and unique species assemblages. To protect these forests, Iranian authorities passed a law which protects healthy trees but permits the removal of injured, dying and dead trees. To quantify the ecological effects of such a strategy, we sampled saproxylic beetles and true bugs in 24 plots



distributed across the entire altitudinal gradient of Oriental beech forests. Of all environmental variables tested, dead wood volume best explained overall species richness, richness of endemics and of 'Urwald relicts', as well as community composition. Due to the striking evidence that dead wood is the major driver of saproxylic diversity in these forests, we urge Iranian authorities to reconsider their law and to restrict logging to healthy trees. Otherwise, a similar ecological degradation as experienced in European beech forests can be expected.

ECOLOGICAL EFFECTS ON PRIMATE SOCIAL NETWORK STRUCTURE AND IMPLICATIONS FOR INFANT SURVIVAL

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For social animals, the social environment is arguably as influential as the ecological environment in determining individual fitness. An individual's social environment determines its ability to acquire and pass on information, its susceptibility to disease, and even its longevity and reproductive success. The social environment, however, also responds to fluctuations in local ecological conditions. We used social network analysis to determine the effects of the ecological environment on the network structure of a free-ranging troop of chacma baboons. We found that individuals display seasonal, cyclical patterns of sociality, but these patterns were perturbed by ecological drivers, such as variation in rainfall levels within seasons, and a disease epidemic. We then investigated the impact of the social environment experienced by a mother baboon on her infant's chances of survival to independence. Allogrooming, an important social behaviour among old world primates, was particularly important in predicting infant survival. While mothers of young infants typically receive more grooming and attention from other females, we found that the amount of grooming mothers directed towards others was a more important predictor of infant survival. Females increased their rate of grooming others after becoming mothers, and those mothers who groomed others very little had very low probability of their infants surviving to one year. Grooming interactions were also affected by rainfall levels. In dryer seasons, females groomed a more diverse group of partners, but engaged in grooming less often than in wetter seasons. Our results suggest that females actively alter their patterns of sociality following the birth of an infant, and do not simply engage passively in social interactions. However, their ability to choose the optimal response for their infant's survival may be restricted by environmental pressures.

CAN REDD+ DELIVER BIODIVERSITY BENEFITS? SPATIAL PATTERNS OF CARBON, BIODIVERSITY AND REDD+ PROJECTS IN INDONESIA

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There are concerns that Reduced Emissions from Deforestation and Forest Degradation (REDD+) may fail to deliver potential biodiversity co-benefits if it is focused on high carbon areas. We explore the spatial overlaps between carbon stocks, biodiversity, projected deforestation threats, and the location of REDD+ projects in Indonesia, a tropical country at the forefront of REDD+ development. For biodiversity, we assembled data on the distribution of terrestrial vertebrates (ranges of amphibians, mammals, birds, reptiles) and plants (species distribution models for eight families). We then investigated congruence between different measures of biodiversity richness and carbon stocks at the national and sub-national scales. Finally, we mapped active REDD+ projects and investigated their carbon density, potential biodiversity richness, and modelled deforestation pressures, relative to protected areas and non-protected forests. The results show little internal overlap between hotspots (richest 10% of cells) of different measures of potential species richness. There is also no consistent spatial congruence between carbon stocks and the biodiversity measures: a weak negative correlation at the national scale masks highly variable and non-linear relationships island by island. Current REDD+ projects are preferentially located in areas with higher species richness but lower carbon densities than protected areas and non-protected forests. Although a quarter of the total area of these REDD+ projects face relatively high deforestation pressure, the majority of the REDD+ area do not. In Indonesia at least, first-generation REDD+ projects are located favorably to deliver biodiversity benefits (possibly reflecting the high involvement of conservation NGOs). However, if REDD+ is to deliver additional gains for climate and biodiversity, it will need to focus more on forests with the highest threat to deforestation which will have cost implication for future REDD+ implementation.

INDIVIDUAL VARIATION IN TEMPORAL AVOIDANCE OF TRAFFIC IMPACTS SURVIVAL FOR AN URBAN CARNIVORE

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Many species living in developed areas adjust their activity and habitat selection to avoid humans. Such avoidance might reduce the risk of vehicle collisions, which tend to occur most frequently in spring and fall and at dusk and dawn. The ways by which animals might avoid vehicle collisions are poorly understood, but could be investigated in species that thrive in areas with high road densities such as cities. We explored potential mechanisms for avoiding vehicles by examining relationships between vehicle mortality and movement in coyotes (*Canis latrans*), an urban-adapted carnivore that inhabits many North American cities. We measured seasonal patterns of mortality for 80 road-killed coyotes and compared these patterns to the movements of 19 coyotes fitted with GPS collars. Specifically, we used steps between 3-hour GPS locations to compare the activity patterns and road crossings made by coyotes that were or were not killed in vehicle collisions. Reports of road-killed coyotes were highest in spring and fall, and during this time collared coyotes that were killed on roads ($n=7$) were more active at rush hour than were surviving collared coyotes ($n=12$). Vehicle collisions were most associated with crossing roads when traffic volume was higher; road-killed coyotes crossed most often at dusk, and earlier in winter when days were shorter, while surviving coyotes crossed roads mainly at night in all seasons. Temporal avoidance of human activity appears to vary across individuals and to be important for the co-existence of humans and wildlife, especially in highly fragmented areas where avoiding roads may be less feasible. Management strategies that foster separation of humans and wildlife in time, for instance using hazing techniques or by deploying on-demand deterrents at dusk in spring and fall, may help to mitigate vehicle-caused mortality for many species.

MANAGING SCALE DEPENDENCE OF DISTRIBUTION MAPS IN ECOSYSTEM RISK ASSESSMENT

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In 2014, the IUCN launched the Red List of Ecosystems, which is founded on a set of five criteria for assessing the conservation status of ecosystems. Two of the criteria rely on accurate measurements of the extent and distribution of ecosystems; criterion A requires estimates of ecosystem area over time to assess declines in ecosystem extent, and criterion B utilises two standardised measures of spatial distribution, the area of occupancy (AOO) and the extent of occurrence (EOO). With increasing use of a wide range of remotely sensed data for ecosystem mapping, the spatial data used for developing ecosystem maps often differs in grain size (resolution). Grain size can significantly influence area estimates and distribution patterns, and the potential consequences of ignoring grain

size include erroneous classifications of the risk of ecosystem collapse, incorrect identification of areas of high conservation priority and potentially invalid comparisons of ecosystem status across time and space. Through a series of simulations using a global dataset of more than 1000 ecosystem distributions, we investigate the influence of grain size on assessment outcomes under the Red List of Ecosystems criteria. Our results indicate that the Red List of Ecosystems criteria are robust to grain size for the majority of ecosystems assessed. However, our analysis suggests that the Red List of Ecosystems spatial criteria could be improved by using scale-area relationships to explicitly incorporate grain size into criteria thresholds, reducing information loss and utilizing the full benefits of high-resolution sensor data currently available. In addition, we provide practical guidance on the application of the Red List of Ecosystems to a variety of ecosystem types.

RUN-OF-RIVER HYDRODAMS CHANGE HABITAT QUALITY BY INCREASING TEMPERATURE VARIABILITY AND STRANDING RISK FOR COASTAL TAILED FROG TADPOLES.

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Around the world small Run-of-River (RoR) hydrodams are largely touted as a low-impact alternative to large storage dams as they maintain relatively natural flow regimes and have regulated minimum flows designed to conserve an acceptable amount of wetted habitat. However, acute fluctuations in flow, due to changes in electricity generation, introduce extreme variation in water level, while chronic low flow below the dam may increase temperature. The link between acute flow disruption and adverse effects such as stranding – when animals cannot keep pace with rapid reduction in water level – has been established for some vertebrates, such as salmonids, but the response of benthic vertebrates is unclear. We used an in situ mesocosm to test the response of the Coastal Tailed Frog tadpole to changes in stream water level and found that tadpoles were 30 times more likely to be stranded during reductions in water level faster than 5cm/hr. Additionally, we monitored stream water levels and temperature throughout the south coast of British Columbia, Canada along cross-sections of a variety of channel morphologies above and below RoR dams to quantify the proportional increase in 'shallow habitat' (<20cm) that may expose tadpoles to increased stranding risk and warmer temperatures. We found that stream sections below the dam had proportionally more shallows than would be expected if discharge rates were the same as above the dam, and that disruptions in flow exceeded the naturally observed variation, causing rapid changes in water level. Additionally, streams were on average >1°C warmer below



the dam. Our results indicate that RoR dams are changing the quality of habitat by increasing temperature and the risk of stranding for tadpoles. Future work will focus on the effects of increasing temperature on performance and growth of Coastal Tailed Frog tadpoles.

ALPINE GRASSLAND PALAEOECOLOGY OF THE VIRUNGA VOLCANOES: A NEW PHYTOLITH RECORD FROM MT. MUHAVURA, EASTERN AFRICA

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The Virunga volcanoes are located in the Albertine Rift, one of the most important conservation areas in Africa but until recently, very little has been published regarding how their vegetation has responded to the environment over the past several millennia. A recent pollen study has been conducted with the aim of reconstructing the vegetation history and associated environmental changes at high altitude. Phytolith analysis (plant microfossils) offers complimentary data and the opportunity to refine our knowledge of such palaeoenvironments where grasses dominate. This paper presents results of an analysis of phytoliths from sedimentary records from a crater lake at the summit of Mt. Muhavura (4127 m asl) and selected alpine flora that provide insights into the grassland history of an alpine setting estimated to the last two millennia. C3 Poaceae characteristic of cold climate/ high altitude and Panicoideae grasses (mainly C4) that are characteristic of warm and wet climate seem to co-exist throughout this period. Whereas phytoliths prove to be an important tool in reconstructing past grasslands, we discuss the issues involved in interpreting phytolith records from such high altitudes and the tentative results present a foundation for future interpretations of the palaeoenvironmental data.

ECOLOGICAL AND GENETIC TRAITS OF THREATENED CARIBOU: CONSERVATION PLANNING FROM THE INDIVIDUAL TO THE METAPOPULATION

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The Canadian government proposed the use of ecologically and evolutionarily discrete Designatable Units (DUs) as primary management units for threatened caribou under the Species at Risk Act. Overall, caribou units are organized hierarchically, with ecotypes (sometimes called "populations") including multiple DUs, and DUs including multiple "local populations", or herds. Recovery strategies were recently released for two ecotypes:

"Boreal" and "Southern Mountain". However, these strategies adopt contrasting definitions for finer-scale units within each DU. To reconcile the discrepancies, we used for the first time an individual-based approach to detect distinguishable caribou units and at the same time to determine the drivers of population differentiation and isolation. First, we employed autosomal microsatellites to estimate gene flow among individuals in herds representing 2 ecotypes and 3 DUs. Then, Causal Modelling was used to examine the factors contributing to isolation of caribou units. Migratory or sedentary behaviour of individuals was documented with satellite-GPS technology and also tested as contributing factor. We found that geographic distances, habitat (un)suitability between units and low population size had a direct effect on gene flow, with far lesser influence by anthropogenic habitat fragmentation or by presence of predators. Our results therefore indicate the need to evaluate and maintain quality of habitat between caribou conservation units to avoid population isolation –i.e. not just amount of habitat within herd ranges. Moreover, genetic variation was influenced by whether individuals were migratory or sedentary, which calls for a more nuanced approach to conservation planning. Overall, we argue that using herds as conservation units within a DU is often too fine a scale for recovery planning. Instead, the emphasis on maintaining meta-population dynamics within DUs is essential for the long-term recovery of caribou in Canada.

A FRAMEWORK FOR MEASURING CONFLICT IN CONSERVATION

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Conflicts are ubiquitous and occur when different groups pursue incompatible goals, and where one side is imposing their views or has more power to act. In the context of conservation, conflicting goals typically include farming, hunting, recreation, forestry or other industry. There is growing recognition among conservationists that conflicts must be managed in order to assure positive outcomes for biodiversity and human livelihoods alike. Conservation conflicts have two main elements: one related to human-animal interactions and one related to human-human conflict. In general the focus has been on the impacts of wildlife on humans, such as crop-raiding by large herbivores or losses of livestock to predators. This approach belies the more complex conflicts between the various people involved, which might include differences in values, damaged relationships or feelings of injustice. So, even in situations where the impact of wildlife on people has been reduced, the conflicts may still be present. Here we argue that



conservationists need to understand the social conflicts which underlie such human-wildlife impacts. In order to identify where conflict management interventions are most needed we need to be able to measure conflict in a way that allows comparisons to be made. Here we draw upon literature from applied development, peace-building and social psychology to propose a framework structure which details the different components of conservation conflicts including both the issues which are a source of conflict, and the behaviours which those involved display. We also propose methodologies to measure the various components of conservation conflicts, so that we can begin to map out the conflicts which hinder our conservation efforts.

LONG-TERM DEMOGRAPHY AND RECENT IDENTIFICATION OF DISEASE: USEFUL INFORMATION FOR CONSERVATION

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Information about population dynamics prior to perturbation (i.e., baseline data) is lacking for many species. Perturbations, caused by climate change, disease or other stressors can lead to population declines and conservation concerns. A dearth of baseline information challenges our ability to anticipate and respond to agents of population decline. Without a picture of what a system looks and behaves like in a steady or healthy state, it is difficult to identify the effects of perceived stressors and thus implement actions to ameliorate those effects. There are only a handful of boreal toad (*Anaxyrus boreas*) populations remaining in the southern Rocky Mountains (SRM), USA and very few are disease-free. Boreal toads in the SRM putatively represent a distinct population segment and are being considered for Federal listing as endangered. Despite the apparent region-wide occurrence of the amphibian chytrid fungus (*Bd*), our focal populations have revealed no evidence of this pathogen. Long-term data and disease-free status elevate these populations to a vital resource for understanding the dynamics in a system without disease and thus informing conservation efforts to secure this toad in the SRM. We assessed demographics at three sites to bolster our understanding of a disease-free system and to determine if earlier work was peculiar to the single site or representative of toad populations in this region in general. Despite care in clean protocols, one of our sites tested positive for *Bd* in 2014. While this new information did not change the aims of our analysis, the presence of *Bd* shifts the context for our demographic data, adds immediacy to our conclusions and allows for a discussion of differences in vulnerability among sites.

AGRO-DIVERSITY IN A COMMERCIAL SUGARCANE CULTIVATION LAND MATRIX IN A SUBSISTENCE ECONOMY

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Understanding the impacts of commercial agriculture on biodiversity in a landscape is critical for biodiversity sustainability and meeting natural resources dependent households' needs in the face of increasing human population and climate change. In this study, the level of agro-diversity and its contribution to rural household livelihood strategies within a commercial sugarcane cultivation landscape was assessed with a view to enhance our understanding of the impacts of commercial agriculture on agro-diversity conservation and household livelihood strategies. A total of 68 crop species from 27 families and 46 genera were recorded from 120 home-garden patches within a commercial sugarcane cultivation land matrix. Plant species richness within the home-gardens was low ranging from 6 to 19 species. The sampled home-gardens featured high species diversity with Alpha diversity based on a Shannon-Weiner diversity Index (H') ranging from 0.6 to 2.3 and 104 out of 120 sampled home-gardens having a Shannon's Index greater than 1. Agro-diversity differed significantly ($F_{11,108}=2.165, p<0.05$; Global RANOSIM = 0.153, $p<0.001$) across study villages. The crops, which are most important and commonly maintained in the home-gardens, are the ones utilised for food and income generation. Commercial sugarcane growing is the major factor resulting in reduced land available for food crop. This is a threat to food crop availability and conservation consequently affecting household food security. Trees that provide fuel wood and food are those that are commonly maintained in the home-gardens. In conclusion, home-gardens continue to maintain crop diversity making their management very important for food security, biodiversity conservation and diversification of rural household livelihoods in the face of climate change and declining land availability and fragmentation. Key words: Biodiversity, climate change, commercial agriculture, home-gardens, rural livelihoods.

HOW TO OVERCOME A BUSY ROAD: THE WOLF CANIS LUPUS MOVEMENT ACROSS MOTORWAYS IN POLAND

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The transport infrastructure is considered one of the most harmful for wildlife. Roads may act as a barrier to animal movement and reduce habitat connectivity hampering



dispersal and limiting access to vital sources. The development of motorways in Poland accelerated after accession to the European Union becoming a potential treat for terrestrial animals, including wolves recovering in western Poland. Currently the largest wolf subpopulation in Polish lowland inhabits the Lower Silesian Forest (ca. 2,000 km²) located near the Polish-German state border. The area is intersected by two major roads – partly upgraded A18 motorway and the newly built section of A4 motorway. During our study conducted in 2010-2013 we applied non-invasive DNA monitoring in order to recognize a potential barrier effect of the transport infrastructure for wolf dispersal, as well as intensive field tracking to assess habitats utilization by wolves in relation to main roads and railways within forest. We also evaluated the use of 16 wildlife crossing structures by wolves and their primary prey on the 51 km-long section of A-4 motorway using sand-beds and video cameras. We recorded exchange of wolves between the Lower Silesian Forest and other forest tracts located both in Germany and Poland. Wolves utilized proximity of motorways during their hunting activity, but avoided setting dens and rearing pups closer than 1.9 km from major roads. Both wolves and their prey used wildlife crossing structures, however those with high human activity were avoided. Wolves used all sorts of wildlife crossing structures, but with preference for overpasses. We recorded differences in behaviour of individuals crossing overpasses and underpasses, with number of fear responses observed in wolves using underpasses. We conclude that adequate wildlife crossing structures are able to sustain an exchange of individuals between subpopulations and utilization of wolf territories intersected by motorways.

STUDIES ON SOME ASPECTS OF REPRODUCTIVE BIOLOGY OF CUTTLFISH SEPIA OFFICINALIS IN THE SOUTHERN MOROCCAN ATLANTIC (BOUJDOUR, CAP BLANC)

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Study of reproductive biology of any fish species is important to get information for successfully management its stocks. The cuttlefish *sepia officinalis* is the second fished cephalopod species along the Moroccan coasts and most valuable commercial cephalopods. However, their reproductive biology, essential for fishery management, is poorly known. So, some aspects of reproductive biology of cuttlefish, *Sepia officinalis* in the southern Moroccan Atlantic (Boujdour, Cap Blanc) are studied: Sex-ratio, length at first sexual maturity, gonadosomatic index (GSI) and spawning periodicity. The samples used for this study are sorted monthly from

commercial catches of coastal trawlers operating in this area from March 2014 to October 2014. Multi-modal size-frequency distributions were apparent in both sexes. Sexually mature cuttlefish were found throughout the year, with generally more mature cuttlefish in spring-summer and fewer in autumn-winter. The maturity in both sexes peaked in spring and a spawning period in April is revealed by the study of the gonadosomatic index (GSI). The Size at maturity is different between both sex, with female maturing over a greater size range (125-140 mm (mantle length ML)) than male (70-85 mm ML). Fecundity was estimated by counting the number of maturing and mature ova of *Sepia officinalis*, in the southern Moroccan Atlantic Sea, estimated from (1000 at 100) eggs per female. Mean egg diameters of matures oocytes is recorded to 50 mm. The results could be useful in drawing up more suitable management measures for *sepia officinalis* stocks

CAPACITY BUILDING KEY TO IMPLEMENTING SPECIES CONSERVATION PLANS MALAWI'S PROTECTED AREAS: LIWONDE NATIONAL PARK CASE STUDY

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Effectively managed protected areas (PA's) are a proven method for safeguarding biodiversity. Research and monitoring are among the key components of PA effective management. In most developing countries, financial and human resources available limit monitoring and research of biodiversity in PA's. Liwonde National Park (LNP) in southern Malawi is one of the 'popular' PA's in the country. In 2014 a conservation plan for the near threatened small parrot, the Lilian's Lovebird *Agapornis lilianae*, was submitted to the management of LNP. LNP is the only PA in Malawi where a breeding resident population of the species occurs. This study was conducted to evaluate the human and financial capacity of LNP to implement the conservation plan. Furthermore, alternative ways in which the conservation plan could be implemented were presented. Findings confirmed that in its current state, LNP is unable to implement the conservation plan. Financial capacity is low with only large mammals having a specific designated annual budget for research and monitoring. Human capacity is also low with only 2% of the staff qualified with the necessary skills to implement proposed activities. The largest need for research capacity building is amongst the park rangers/scouts who coincidentally are the largest human resource for the park. We suggest that institutional partnerships for capacity building of these rangers are the key in achieving biodiversity research and monitoring for conservation. University post- and under-graduate students are also an untapped resource to be explored.



FARMERS KEY ROLE IN CONSERVATION OF ENDEMIC AGROBIODIVERSITY IN GEORGIA

Kakha Nadiradze

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Georgia is a richest country in terms of Biodiversity and due to global warming and climate change ongoing processes Biodiversity is declining sharply. We are losing species at a rate that is by some accounts up to 1000 times the natural rate of extinction. As a consequence, the ability of ecosystems to provide valuable services to us and our economy is weakened with each and every disappearance. The conservation of our endangered animals, plants and ecosystems is one of the greatest environmental challenges facing Georgia today. The key reason for our historically high extinction rates is habitat degradation and loss, initially from over-grazing and clearing for agriculture, and more recently from the clearing of native vegetation for urban development. Innovative approaches are needed to tackle the challenge of balancing development needs (to provide the community with new housing, jobs and amenities), while also conserving biodiversity for the future. BioBanking is a market-based scheme that provides a streamlined biodiversity assessment process for development, a rigorous and credible offsetting scheme as well as an opportunity for rural landowners to generate income by managing land for conservation. Biodiversity Conservation and Bio Banks in Georgia are our areas of our activities with close cooperation with IUCN, Global Genome Initiative (GGI) and Global Genome Biodiversity Network (GGBN), ESBB, Planta Europe, REDD, UNCCD. Local Farmers can manage their biobanking activities in order to improve or maintain the overall biodiversity values by using in vitro, in-vivo, in-situ, ex-situ, in-farm and on-farm activities.

94-COMPARING AND CONTRASTING BENEFITS DERIVED FROM TOURISM AND HUNTING ON COMMUNAL CONSERVANCIES IN NAMIBIA

Robin Naidoo

WWF-US
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Tourism and hunting both generate significant revenues for communities and private operators in Africa, but few studies have quantitatively examined the tradeoffs and synergies that may result from these two activities. Here,

we evaluate benefit streams from tourism and hunting on 74 communal conservancies in Namibia from 1998 to 2013, where community wildlife conservation has been promoted as an alternative form of land-use to traditional subsistence agriculture. In aggregate, total benefits from hunting and tourism over all conservancies have grown at roughly the same rate. Disaggregation of data reveals that benefits from hunting are largely income that goes to conservancy management committees and meat to the community at large, while most tourism benefits are salaried jobs at lodges. On average conservancies start generating benefits from hunting twice as fast after their formation as from tourism (3 versus 6 years post-establishment). A simulated ban on trophy hunting significantly reduced the number of conservancies that were able to cover their operating costs, whereas eliminating income from tourism did not have as severe an effect. Given that the benefits generated from hunting and tourism typically begin at different times (earlier versus later) and flow to different parts of local communities, these two activities complement one another and together provide the greatest incentives for conservation. Notably, the removal of benefits from either hunting or tourism would likely reduce the competitiveness of wildlife as a viable form of land-use, and have serious negative implications for the viability of Namibia's Community-Based Natural Resources Management program.

CAUCASUS PLANT INITIATIVE: A REGIONAL PLANT CONSERVATION STRATEGY AND PLANT CONSERVATION IN GEORGIA

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From 2006 to 2010, the project Coordination and Development of Plant Red List Assessments for the Caucasus Biodiversity Hotspot was implemented by the IUCN Species Survival Commission in collaboration with Missouri Botanical Garden, USA, the WWF Caucasus Programme Office, and botanists from six countries of the Caucasus (Armenia, Azerbaijan, Georgia, Iran, Russia, and Turkey). The project aimed to provide a series of Red List training and validation workshops specifically tailored to the Caucasus region so that local botanists could use internationally accepted methods for plant conservation assessment and monitoring (the IUCN Red List Categories and Criteria) and the Species Information Service as tools for data management and analysis. The work has resulted in a comprehensive overview of the distribution and conservation status of the endemic plant species of the Caucasus region based on current knowledge. A map of the Caucasus region produced by WWF Caucasus was initially used for the project; however, it was suggested that the border of the Caucasus region be extended southwards into the territory of Iran based



on local plant cover characteristics. The map with the extended borders was then used as base map to distinguish endemic plants of the Caucasus. This resulted in a comprehensive list of the region's endemic taxa containing as many as 2,810 species, subspecies, and varieties, a significant increase over the 1,600 species estimated in the original project proposal and mentioned in the Ecoregional Conservation Plan for the Caucasus. The Caucasus Plant Red List Authority was established under the auspices of the IUCN Species Survival Commission developed the present Caucasus Plant Initiative: a regional Plant Conservation Strategy, targets of which correspond to the targets of the Global Strategy for Plant Conservation. We consider the objectives of the Strategy in connection with plant conservation in Georgia, one of the countries of the Caucasus.

CROP-RAIDING BARBARY MACAQUES, *MACACA SYLVANUS* (PRIMATES: CERCOPITHECIDAE) AND CONSERVATION IMPLICATIONS AT THE HIGH OURIKA VALLEY, WESTERN HIGH ATLAS, MOROCCO

Salwa Namous

Cadi Ayyad University, Faculty of Science-Semlalia
Mohammed ZNARI, Cadi Ayyad University, Faculty of Science-Semlalia ; Mohamed AOURIR, Ibn Zohr University, Faculty of Science ; Jan SIESS, Lycée Agricole de Montmorot ; Soraya MOKHTARI, Direction Régionale des Eaux et Forêts, Haut Atlas, Parc National Toubkal

In areas with agriculture and wild primate species, the coexistence of these and their human neighbors often turns to conflict, as many primate species eat cultivated plants. This study is aimed to get an overview of the problem of crop-feeding Barbary macaques (*Macaca sylvanus*) in the western High Atlas Mountains, Morocco from the farmer's perspective in order to evaluate the severity of the damage experienced by the farmers. More than 100 interviews were conducted with local farmers in 13 villages along the Ourika valley during spring-autumn 2014 in order to gain information about their perception of the local crop-feeding macaques. The overall mean annual percent eaten or damaged by the macaques was about 30%, although the incurred loss of agriculture varied among villages and plant types. The macaques have a slight preference for walnuts, plums and apples, yet these differences are likely a result of the frequency and abundance in which the preferred crops are grown. Time of harvest is also a likely factor, especially when natural food sources are lacking for the macaques. Interviewed farmers view the amount of damage caused by macaques to be substantial, particularly for the most important items in the local economy. Most farmers believe that the situation had worsened with time, and try to reduce crop-raiding damage by guarding fields but macaques disproportionately raided farms in the early hours of

the day, presumably to avoid conflict with farmers. Setting up a local reforestation plan in order to plant palatable trees for the macaques, such as oak and possibly multiple kind of fruit trees, could possibly shift the macaques ranging patterns. With declining populations in almost all known ranges, Barbary macaques are not usually seen as pests. Thus mitigating the issue of crop damage in the Ourika valley is needed in order to keep the image of this species in a positive light, as viewing a species negatively will undoubtedly lead to less conservation support.

GENOME-WIDE SNP DATA REVEAL FINE-SCALE POPULATION STRUCTURE OF INDIAN TIGERS

Meghana Natesh

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Conservation genetics has seen a shift towards the use of genomic approaches to make inferences about population structure and local adaptation. Single Nucleotide Polymorphism (SNP) data provide independent bits of information from potentially thousands of loci, allowing greater access to the genome. Additionally, lower error rates and ease of transferability across laboratories makes them highly advantageous in comparison to microsatellites. In the present study, we employ SNP markers to study population structure of the Bengal tiger. Tigers have undergone a dramatic range contraction in the recent past and currently occupy barely 7% of their historical range. Loss of habitat connectivity is known to cause greater genetic differentiation. Understanding population structure is an important component of delineating evolutionary significant units. A previous study using 8 microsatellite loci identified three genetic clusters from the sampled populations across India. One of these clusters encompasses the whole of peninsular India, a broad geographical region with wide separation between the populations therein. We used SNP markers to test if they could further resolve population structure. For SNP discovery, we used the double digest RADseq approach. We obtained 57 samples, either blood or tissue, representing the geographical range of tigers in India. The Siberian tiger genome was used as the reference to call SNPs. By allowing for varying amounts of missing data and retaining different samples, we obtained data sets with different number of SNP markers. We tested for population structure with over 2000 SNPs and recovered additional genetic clusters corresponding to Central and Southern population groups within Peninsular India. We conclude that SNPs are a powerful set of markers to infer fine-



scale population structure. We plan to develop a panel of SNPs suitable for individual identification from non-invasive samples to help improve long-term monitoring projects.

NATIVE POPULATION OF ANTHERAEA ASSAMENSIS HELFER (MUGA SILKWORM) OF NORTH EASTERN INDIA AND STRATEGY FOR CONSERVATION

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DHING COLLEGE

Dipali DEVI, SERI-BIOTECH LAB, LIFE SCIENCES DIVISION, INSTITUTE OF ADVANCED STUDY IN SCIENCE AND TECHNOLOGY

The sericigenous Saturniid *Antheraea assamensis* Helfer, 1837, (muga silkworm) having the lowest chromosome number $n=15$ is known as the ancestral form of the genus *Antheraea*. This insect is exclusively confined to the Brahmaputra valley of Assam, India and some parts of neighboring states of North Eastern region of India due to its unique ecological niche. Although it is a monotypic species, it has four distinct larval color morphs, namely green, blue, orange and yellow and these are non diapausing multivoltine in nature. A diapausing wild morph is also found in the forests of this region. The wild types are very important for breeding and evolution of new muga silk worm strains with desired characters. The wild stock of muga silk worm, available in nature comprises both diapause and non-diapause forms. Due to various reasons, the populations of wild counterparts have declined and it had led to inbreeding depression in *A. assamensis*. Lack of systematic study of this natural population instigated to study the distinguished morphological characters in egg, larva, cocoon and moth stages. During the study variation was observed among the color morphs in respect of voltinism, geotropism, chorion structures, larval tubercle, setae number, cocoon characters, wing pattern, male genitalia and antennae between the color morphs and the wild morph. Based on this study the three color morphs viz. green, blue and orange could be clubbed together and the wild morph remains separately. It is expected that this study will help in designing the breeding programme for improved hybrid vigor as the population is suffering from inbreeding depression as well as to maintain the stable and sustainable population, thereby saving the precious germplasm of *A. assamensis* from extinction. The suitable strategy should be made to conserve their natural habitat with co-ordinated activities on germplasm collection, documentation, evaluation and utilization.

IDENTIFYING KEY HABITATS TO CONSERVE THE THREATENED BROWN BEAR IN THE HIMALAYA

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The threatened Himalayan brown bear has a fragmented range in the Himalayas. However, its habitat has never been documented, which hinders conservation efforts. The Deosai Plateau in northern Pakistan has long been recognized as the core area for this subspecies. To provide knowledge to help conserve the remnant populations in the Himalayan region, and especially in protected areas, we investigated habitat selection of brown bears and the influence of human presence in Deosai National Park, Pakistan. We used an Ecological Niche Factor Analysis to assess brown bear habitat selection, using scats sampled along transect routes throughout the park as location data. Our analyses indicated that brown bears avoided higher elevations and steeper slopes and selected more productive parts of the park (marshy, grassy, and stony vegetation types). The marshy vegetation was the most preferred habitat, probably because it had the highest forage production and density of golden marmots. Brown bears tolerated human infrastructures, like roads and camps, but strongly avoided grazing areas with high livestock density. The habitat suitability map generally followed the biomass productivity patterns of the park. It indicated the central part as suitable, and classified half of the park, mainly peripheral areas, as unsuitable for brown bears. The vegetation and habitat suitability maps provide an objective criterion for evaluating present and future developments in the park. Until recently, communities seem to have used the park's resources without significantly affecting the brown bear population. However, in recent years a large influx of nomadic communities with their livestock has become a challenge, which needs urgent attention to continue the present brown bear population recovery and to secure its habitat. We recommend monitoring the livestock and conducting a detailed inventory of the rangeland to understand grazing dynamics in the park and to maintain sustainable stocking rates.

PROTECTION FROM GRAZING INDUCES SHIFT IN THE PLANT COMMUNITY IN THE WESTERN HIMALAYAS

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Foundation for Ecological Research, Advocacy and Learning Mayuresh Gangal, Researchers for Wildlife Conservation

Livestock grazing is one of the most prevalent and oldest forms of human interventions experienced by terrestrial ecosystems. Several ecosystems are believed to have reshaped by grazing by large ungulates. However, over the last few decades, there is an increasing concern about the detrimental effects of overgrazing by livestock on biodiversity



and ecosystem processes and grazing has been restricted in several landscapes worldwide. In most cases, such restrictions are based on perceptions and their effectiveness is limited by a lack of knowledge on grazing-vegetation relationships. We investigated the effects of recent restrictions and changes in livestock grazing practices on herbaceous vegetation characteristics in the Western Himalaya, which has a long history of livestock grazing. We found that livestock grazing had a greater influence on vegetation at the level of plant functional groups. Both richness and abundance of annual species were higher in grazed sites compared to non-grazed sites. This suggests a shift in vegetation composition from a system with both annual and perennial plants to a system dominated by perennials under protection from grazing. The western Himalayas, with a long history of pastoralism and human use, have very low density of wild herbivores. Under these circumstances, grazing by livestock might play an important role in maintaining the existing diversity and abundance of palatable annual plants in the landscape. We observed a higher percentage of bare ground in grazed sites resulting from overcrowding and subsequent over grazing of available pastures outside protected areas. We conclude that the future management efforts should be directed towards establishing maximum permissible levels of grazing in each of the pastures based on regular monitoring and experimental studies. This can help in developing better strategies to manage both wildlife and livestock and to conserve the existing biodiversity in this landscape.

RESPONSES OF AFRICAN ELEPHANTS IN THE KRUGER NATIONAL PARK TOWARDS A BEE THREAT: ITS IMPLICATIONS FOR MITIGATING THE HUMAN-ELEPHANT CONFLICT.

Mduduzi Ndlovu

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Human settlement expansions into elephant ranges, coupled with increasing elephant *Loxodonta Africana* populations within confined areas has led to heightened levels of human-elephant conflict in southern African communities living near protected areas. Several methods to mitigate this conflict have been suggested including the use of African bees *Apis mellifera scutellata* as an elephant deterrent. We investigated whether bee auditory and olfactory cues (surrogates for live bees) can be used to effectively deter elephants. We evaluated the responses of elephants in the southern section of Kruger National Park to five different treatments (1) control noise, (2) buzzing bee noise, (3) control noise with honey scent, (4) honey

scent, and (5) bee noise with honey scent. Elephants did not respond or displayed less heightened responses to the first four treatments. All elephants exposed to the bee noise with honey scent responded with a defensive behaviour and 15 out of 21 individuals also fled. We concluded that buzzing bees or honey scent as isolated treatments (as may be the case with dormant beehives) were not effective elephant deterrents, but rather an active beehive emitting a combination of auditory and olfactory cues was a viable deterrent. However, mismatches in the timing of elephant raids and activity of bees may limit the use of bees in mitigating the prevailing human-elephant conflict.

“ADVANCING THE LIMITS OF CORAL REEF SENSING IN A TIME OF GLOBAL CHANGE: THE CATLIN SEAVIEW SURVEY”

Benjamin Neal

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Coral reefs worldwide are suffering dramatic declines, with an estimated 40% of coral reef habitat degraded within the last 50 years due to a suite of factors, including pollution, overfishing, destructive fishing and climate change. This degradation will affect the ~500 million people globally who utilize coral reefs for food, tourism income and coastal protection, along with the potential future losses to the still partially unknown biodiversity of these ecosystems. The Catlin Seaview Survey is a multiyear program creating a baseline record of coral community composition over 150 worldwide coral reef locations, using multi-camera, high-resolution, panoramic underwater imaging. These images are processed by a novel, computer-vision driven, automated benthic image analysis system capable of producing summary statistics of population and community composition. This system, called CoralNet, reduces underwater ecological image processing time by at least two orders of magnitude, making this a potentially valuable tool for many field managers. I will present both the underwater imaging and benthic community analysis processing systems in detail, along with coral reef case studies and data from expeditions to the Caribbean, The Great Barrier Reef, and the Coral Triangle. The standardized data produced will enable comparison for the first time of impacts and changes to coral reef ecosystem across large-scale world regions and across differing regimes of anthropogenic and natural disturbances, assisting local conservation managers and scientists to place local changes into a global context.

BIRDS, BATS AND BETA-DIVERSITY: BIODIVERSITY PATTERNS IN A FOREST PRODUCTION LANDSCAPE.

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Habitat loss and fragmentation are major drivers of biodiversity loss in modified landscapes. Yet recent work suggests the erosion of beta-diversity, i.e. the loss of compositional variation, across a landscape could be an underestimated driver of biodiversity loss. Our research surveyed bird and bat assemblages in a natural fragmentation experiment of remnant eucalypt forest patches within a 50 000 ha pine plantation in temperate Australia. We investigated whether increased heterogeneity in landscape structure results in an increase in beta-diversity of birds and bats, after controlling for habitat amount. Species responses were analysed at patch and mosaic (i.e. among patch) scales. The diversity of both bird and bat faunas differed between mosaic types and habitat types within the mosaics. Our data suggests that elevated levels of beta-diversity among patches within heterogeneous mosaics may outweigh the loss of biodiversity at local scales.

HOW SCIENTIFIC RESEARCHES CAN CHANGE CONSERVATION PRIORITIES? -THE DECADE-LONG RESEARCH OF EURASIAN BLIND MOLE-RATS (RODENTIA: SPALACINAE) IN THE CARPATHIAN BASIN

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A research program that started 10 years ago in Central Europe, focusing on Eurasian blind mole-rats, not only provided novel information on the phylogeny, taxonomy, distribution and ecology of this scarcely investigated and enigmatic group of rodents but also influenced the conservation biological approach of decision makers. It was also evidenced, that blind mole-rats of this region are not locally endangered, peripheral populations of a wide-ranging species, but very localized endemics some of them with extremely low population sizes, facing extinction. Thanks to the wide communication of these results, - a species action plan laying down the strategy required to protect the blind mole-rat populations of Hungary was officially accepted; - a Mole-rat Protection Consulting Committee was established by the relevant ministry in Hungary; - a good working relationship had been established between the Hungarian Committee and the Novi

Sad Department, Institute for Nature Conservation of Serbia; - the intergovernmental Hungarian–Romanian Joint Committee on the Environment set the investigations of all blind mole-rat species occurring in the two countries as one of its main priorities; - Red List categories for all species of Carpathian Basin blind mole-rats were assessed; - a new protected area was established in Hungary; - the Hungarian protected species' list had been updated and elevated species of the Lesser blind mole-rat complex to the highest conservation rank; - the first-ever relocation program of a subterranean mammal started. These studies not only emphasized the importance of scientific investigations for conservation purposes, but also highlighted a phenomenon in which less known and cryptic species can be pushed to the brink of extinction as a result of the lack of information, unclear taxonomic status and unrecognised tasks in conservation. In their specific habitat, blind mole-rats can serve as umbrella species to protect the wildlife of Central European steppes.

THE NETWORK OF KNOWLEDGE APPROACH - MANAGING THE COMPLEXITIES OF KNOWLEDGE INTEGRATION ACROSS SCALES AND KNOWLEDGE DOMAINS

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A better functioning interface between knowledge and decision-making especially in environmental issues has long been called for by policy as well as science. Recent advancements at the global scale, such as the recent launch of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) and the integration of several Science Policy Interfaces (SPIs) into the global platform Future Earth, may open a window of opportunity for the development of proactive SPIs at national and regional levels. In Europe, a number of functions of this interface have been highlighted as needed to be further improved: the provision of consolidated knowledge to policy, the identification of research needs, the integration of networking and capacity building, and a sustained link between European and international activities. All these aspects need to be addressed in this interface in order to be relevant, credible and inclusive. In this paper, we explore these functions and their implications for improving



the science-policy-interfaces at the European level. We introduce a concrete proposal for a “Network of Knowledge on Biodiversity and Ecosystem Services – BiodiversityKnowledge” which acknowledges the high diversity of knowledge holders and governance levels in Europe and offers a framework for improved interaction by building a joint Community of Interest. BiodiversityKnowledge offers a model to jointly address requests from decision-makers using established methods (e.g. systematic reviews, expert consultation formats, adaptive management approaches among others). The main focus of the model proposed is to reach a high level of transparency and to ensure the required balance of relevance, legitimacy and credibility.

ARE PROTECTED AREA NETWORKS REPRESENTING BIODIVERSITY AND ECOSYSTEM SERVICES? CASE STUDIES FROM CAMBODIA AND MADAGASCAR

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Will R TURNER, Conservation International

Protected areas (PAs) are considered the cornerstones of conservation, touted for their positive impacts on biodiversity and benefits to people. Globally, the coverage of PAs has expanded in the past decade, however PAs are not always strategically located. We conducted spatial modeling of ecosystem services in order to analyze whether PAs are representing these important benefits of ecosystems to people. We focused on protected area networks in two countries with high biodiversity and a high level of human dependence on ecosystem services: Cambodia and Madagascar. We analyzed the PA networks’ spatial representation of biodiversity priority areas, forest cover, carbon stock, inland fisheries, freshwater services and non-timber forest products. We examined whether PA networks are spatially representing biodiversity and ecosystem services better than would be expected if they were located randomly throughout each country, and whether spatial representation has improved in the past ten years. PA networks have expanded from 2003 to 2014, from 4% to 11% of land area in Madagascar and from 20% to 29% in Cambodia. We found that PA networks are spatially representing forests, biodiversity priority areas, carbon stocks, and inland fisheries better than would be expected if they were randomly configured. In Cambodia, the PA network configuration is “better than random” in terms of representing freshwater ecosystem services, but this is not the case in Madagascar. In both countries, the PA networks are doing no better than random in terms of representing non-timber forest products. In both countries, PA expansion has led to greater representation of biodiversity and ecosystem services over the past decade, but major gains would be possible if PA networks were spatially configured to optimize these benefits. While major gains have been made, there is more work to be done to ensure that PA

networks are securing biodiversity and providing benefits to people.

THE ROLE OF TRIBAL COLLEGES IN PRESERVING TRADITIONAL ECOLOGICAL KNOWLEDGE AND BIOCULTURAL DIVERSITY

Teresa Newberry

Tohono O’odham Community College

Over the past decades, biocultural studies have shown that diversity in language and culture are strongly linked to biological diversity and have established that a loss of diversity in one domain negatively impacts diversity in the others. The rapid decline in both biological and cultural diversity has increased awareness about the urgency to preserve not only the diversity of life but the diversity of culture and language as well. Over 40% of all the world’s languages today are at risk of disappearing and this loss signifies a monumental loss of cultural heritage and traditional ecological knowledge. Indigenous languages encode the world views and traditional knowledge systems of indigenous peoples gained by extended histories of interactions with the natural world and therefore, carry intricate understandings of natural processes and landscapes. In addition, indigenous culture and language incorporate knowledge about human relationships and rules of engagement with nature which are crucial to promoting long-term sustainability of the land. Therefore, a thriving linguistic and cultural diversity sustains the vitality and resilience of our planet, while a loss of it threatens the sustainability of all life on earth. In spite of the growing awareness of the interrelationships between loss of traditional knowledge and loss of biodiversity, there has been a lack of broad, systematic initiatives to preserve traditional knowledge. The tribal college system in the U.S. which consists of thirty eight tribal colleges and serves 65,000 Native American undergraduate students plays a pivotal role in the biocultural preservation and resilience for indigenous communities. The unique science curriculum developed at tribal colleges that incorporates language and validates traditional ecological knowledge can provide curricular models which may be applied across institutions of higher learning and play an important role in preserving biocultural diversity.

INTEGRATING CULTURAL TECHNOLOGY IN CONSERVATION PLANNING

Martin Nganje

Individual Researcher

This research, on a conservation-based traditional ecological practice was undertaken in 2010/11 around the Ankassa, Bia and Kakum conservation areas in Ghana. Based on



responses from conservation area managers and local community leaders, the research assessed how abstention from harming the elephant as a cultural interdiction affected the planning and delivery of elephant conservation objectives specifically and biodiversity conservation efforts generally. The purpose was based on the principle of “selective attention,” (Worchel., et al, 2000), which postulates that people will take responsibility for issues that support their group values and attitudes; implying that, taking account of cultural values in the planning and management of biodiversity had the potential to commit communities to such plans and in their execution. Forty-five percent of the 300 research respondents indicated that the elephant abstention culture was evidently relevant for conservation, but it was not specifically captured in conventional conservation plans. Despite broad interest by conservation area managers and policy makers to integrate such cultural values in conservation plans, limited knowledge and skills in handling the traditional ecological technology of communities was noted to be the main handicap. The research captured favorable culture-based technology that could be integrated to conservation plans, noting that; neither culture as a conservation technology nor conventional conservation efforts could succeed alone (without the other) in long-term conservation efforts. As a way forward, the research made use of ‘task analysis’ to generate indicators for cultural technology also expected to help explain, familiarize and build the capacity of conservation stakeholders in handling cultural technology. The resulting outcome may also be used to capture intangible biodiversity conservation heritage for registration in the new UNESCO Intangible Heritage Register.

INDIGENOUS AND LOCAL COMMUNITIES’ WILLINGNESS-TO-PAY FOR FOREST ELEPHANT CONSERVATION IN THE DJA-ODZALA-MINKEBE LANDSCAPE - CONGO BASIN

Jonas Ngouhou Poufoun

INRA - Laboratory of Forest Economics

Jens ABILDTRUP, INRA - Laboratory of Forest Economics ; Denis SONWA, CIFOR - Center for International Forestry Research - Central Africa Regionl Office ; Philippe DELACOTE, INRA- Laboratory of Forest Economics

In 2011, the Central African forest elephant (*Loxodonta cyclotis*) population was less than 10% of its potential size, occupying less than 25% of its potential range due to poaching and ivory illegal trade for trinket and Asian medicine. Currently, *Loxodonta Cyclotis* is increasingly threatened with extinction, while it is crucial for the socio-cultural identity of local people and indigenous Baka. It contributes to their main ritual practices, cultural enriches as well as sustainable livelihood. By disseminating seeds of important and multiple-use tropical tree species like *baillonella toxisperma*, *Loxodonta Cyclotis* also

provide biodiversity conservation beyond carbon storage. The extinction of such iconic species would lead to irreplaceable costs. This paper aims to determine and characterize the social-cultural opportunity cost of forest elephant extinction in the Dja-Odzala-Minkebe’s cross-border (Tridom) landscape. Its tests the hypothesis that, (1) the extinction of forest elephant can lead to a significant loss in the household’s wellbeing. (2) The implication of the households for elephant’s conservation increases with the distance of their locations to the nearest protected area and decreases with the human-elephant conflicts presence and that (3) the household’s willingness-to-pay is significantly influenced by their autochthonous status and their various Forest Land Use, Land Access and other social factors such as education, Income, religion and the household size. Using data from a double-bounded contingent valuation survey with a random sample of 1100 households conducted between December 2013 and July 2014 in 102 villages of the Tridom landscape between Cameroon, Congo and Gabon, it estimates and characterizes the Willingness-To-Pay of local households using a binary Probit model. This study will provide decision makers with additional incentives and relevant information to better shaping the forests’ elephants conservation into the Tridom landscape.

FLORISTIC, STRUCTURAL AND FUNCTIONAL CHARACTERISTICS OF TREE DIVERSITY IN THE DENSE HUMID FOREST OF SOUTHERN - CAMEROON

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The floristic diagnostic in three forest stations of Cameroon helps us to understand that, these ecosystems knew natural and anthropogenic disturbances in the pass. Mangombé (about 10 years), Bidou (60 years) and the site of Campo in the national park is more stable. According to Letouzey (1957; 1968), several centuries ago, human communities lived in the dense humid forest of Cameroon. The recorded disturbances constituted the engine of sylvigenesis and one of the major constraints to the conservation of the forest resources. These disturbances affected the density, basal area, structure and diversity of the studied sites. Some authors (Bedel et al., 1998, Chazdon et al., 2007 ; Lebrija-Trejos et al., 2010) indicate that a setting in rest of a forest having no important disturbance can make it possible to reconstitute in meaning or long term a forest very close to the initial settlement. Therefore, which differences can exist on the structural level, floristic and functional between the studied stations? The studied sites are diversified as indicated by their index of Shannon, the generic



coefficient of diversity and the specific richness. Mangombé (38 families and 91 species), Bidou (32 and 88) and Campo (29 and 75). Basal area is significantly low in Mangombe station (49 m²/ha) compared to Bidou (54 m²/ha) and Campo (87 m²/ha). Zoochory concerns more than 71% of the censured species. According to the sample, floristic composition of Mangombé is very different from those of Bidou and Campo. The restoration of forest cover can be done naturally taking into consideration the large spectrum of ecological distribution of species, the high density of small stems and the importance of animals for the dispersion of the diaspores.

THE CONSUMERS OF IVORY AND RHINO HORNS

Trang Nguyen

University of Cambridge

There is a high demand for wild animals and products made from them worldwide. Despite efforts undertaken by governments, non-government organisations and other parties to tackle unsustainable wildlife consumption, the consumption of wildlife products, including threatened species, in China and Vietnam have risen rapidly. Law enforcement action to apprehend poachers and illegal traders is the primary mechanism for stemming these crimes. However, enforcement action alone may not be sufficient to eliminate this threat in the long term. The nature of the market is changing rapidly, with economic growth stimulating a status driven consumption that goes beyond traditional uses. Consumption is now about complex social issues, such as lifestyle, recreational choices, social, corporate status and aspirations. This research provides the first in-depth and comprehensive review of a wide range of communication materials that reached hundreds of millions across major markets in Southeast Asia, particularly Vietnam and China in order to raise awareness about rhino horns consumption and its impact. It mapped the demand reduction activities that are currently planned for major market countries for rhino horn and ivory, identified values could be added to different approaches, distinct interventions could be made more mutually supportive and complementary, and avoid conflicting messages to the public. Some of the most successful techniques in changing consumer behaviour in other sectors have also been documented, including sustainable lifestyles, consumer choice and public health, can be adapted to demand reduction for elephant and rhino products.

PERSPECTIVES IN DEVELOPMENT OF THE MARINE PROTECTED AREA NETWORK IN VIETNAM: CHALLENGES AND LESSONS LEARNED

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A marine protected area (MPA) network is an organized collection of individual sites, designed to link individual areas and to comprehensively represent the region's spectrum of marine life characteristics. International commitments to MPA networks recognize that they fulfill ecological and social aims that a single MPA alone cannot. With the long term political commitment and will, a network of the marine protected areas consisted of 16 MPAs has been declared by the Vietnamese government under the decision No 742/QD/TTg dated 26th May, 2010. Among of them, 5 MPAs were efficiently managed, others kept on going the zoning plan procedures and all would be put on running in the year of 2015. There are several constraints and challenges in relation with the development network of the MPAs in Vietnam, including gaps in laws and integrated governance frameworks, conflicts among sectors and stakeholders, variation in the central/local government interests, and maintenance of the funding sources. This paper will propose some directions for sustainable development of the MPAs network in the vision of the green economy aspects and human wellbeing.

TAXONOMICALLY-DEFINED SAMPLING EXTENT IMPROVES THE PERFORMANCE OF SPECIES DISTRIBUTION MODELS

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Species distribution models are now an essential tool in conservation studies. The use of species atlas data and correlational modelling approaches has become a common practice in species distribution modelling. However, the effect of sampling extent on the performance of the models remains unclear. We proposed using species taxonomy to delineate sampling extent, and assess how this affects the performance of species distribution models. Using species atlas data, two taxonomically-defined species occurrence datasets (i.e. family and order datasets) were created for 356 terrestrial species of mainland Spain. Species presences were identical in both datasets, while an absence was only recorded for localities



where another species of the same family (in family dataset) or of the same order (in order dataset) was known to be present. We then assessed the effects of sampling extent on the predictive performance of five classical species distribution models, namely on model calibration and discrimination capacity, comparing the results to those obtained with the original atlas dataset. Using taxonomically-defined datasets significantly improved the calibration of the species distribution models. The discrimination capacity slightly decreased for several species when using the family dataset, this drop was significant when the models were trained with the order dataset. Enhancement of atlas data by excluding non-informative absences based on species taxonomy significantly improved the calibration of species distribution models and thus their capacity to predict environmental potential. We therefore recommend the inclusion of species taxonomical extent when atlas data are employed in distribution models.

AN OPTIMAL APPROACH TO MANAGING TWO-SPECIES COMPETITION: STOPPING THE GAMBUSIA FISH INVASION OF EDGBASTON MOUND SPRINGS

Sam Nicol

CSIRO

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Interactions between pest species and endangered species that share the same niches are particularly difficult challenges for conservation managers. In these situations, attempts to eradicate the pest species may often also negatively affect the native species. Similarly, attempts to aid the endangered species must also be designed so that they do not unwillingly promote the spread of the pest. Management approaches need to be carefully planned in space and time to ensure the desired outcomes are achieved for the two species. Using a case study of two interacting fish species from desert spring systems in central Queensland, Australia, we demonstrate how we can learn the factors that predict occupancy for both species, and then show how we can exploit differences in occupancy predictors to design an optimal plan for the eradication of the pest fish (mosquitofish, *Gambusia holbrooki*) and translocation of the endangered fish (the red-finned blue-eye, *Scaturiginichthys vermeilipinnis*). Our approach uses a modelling technique called Markov Decision Processes, which allows us to find the optimal management action for any state of a stochastic system that can be influenced by management intervention. We use a classification tree to simplify the complex results of our optimization into a general 'rule of thumb' that is easy for managers to understand and implement. An additional challenge is presented by climate change, which may change the future water balance in the

springs, affecting both colonization potential and extinction probability. We demonstrate how to design a control policy to optimally manage the two fish species under uncertain future rainfall scenarios. Our novel approach provides managers with a robust optimal plan to effectively control a major global aquatic pest species and simultaneously prevent extinction of a critically endangered fish.

A NOVEL BIODIVERSITY FOOTPRINT BASED ON EXTINCTION RISKS TO EVALUATE THE EFFECT OF INTERNATIONAL WOOD TRADE

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Trading of various resources among countries can degrade biodiversity far from the place of consumption, but a previous biodiversity footprint (BF_{prev}) of international trade may be imprecise because of a qualitative, spatially-implicit evaluation. In this study, we propose a novel biodiversity footprint based on extinction risks (BF_{ex}) to evaluate the effect of international wood trade. Using more than 500 bird species that are categorized as threatened by wood harvesting in the IUCN Red List, we firstly quantified per species extinction probability from population sizes and habitat loss rates computed by overlapping species distribution maps and a forest loss map. We then calculated the expected number of bird species that would go extinct in the future, or BF_{ex}, and revealed the associations between producers and consumers using a bilateral wood trade data. We compared this BF_{ex} with BF_{prev} obtained from the same data, and found that whereas Indonesia was by far the most threatened from abroad in BF_{prev}, Brazil was an important exporter that was comparable, or superior in the short run, to Indonesia in BF_{ex}. Moreover, the impacts of major importers, such as China, Japan and USA, on overseas relative to those on their own countries are larger in BF_{ex}, suggesting a big responsibility of wood importers for bird extinctions abroad. A scenario analysis using BF_{ex} also showed, surprisingly, that total BF_{ex} would slightly increase if each country produced woods so as to satisfy its own demand. This is because extinction risks in two major importers, or China and Japan, and several tropical countries including Mexico and Philippines would increase greatly by self-supporting, and suggests that other scenarios are needed for preventing bird extinctions. Our developed BF_{ex} is useful to identify countries whose birds are so threatened as to be extirpated due to wood consumption and trade, and to search effective trade patterns for biodiversity conservation at a global level.



ABUNDANCE AND DIVERSITY RESPONSE OF BIRD COMMUNITIES TO LANDSCAPE MATRIX EDGES IN NYUNGWE NATIONAL PARK, RWANDA.

Protais Niyigaba

WCS Rwanda/Nyungwe Project

Beth KAPLIN, University of Rwanda & Antioch University ; Aisha NYIRAMANA, University of Rwanda

This study examined and compared the edge effects created by two landscape matrixes (tea and pine) around Nyungwe National Park – Rwanda, on bird communities in function of the distance from edges into the forest interior. In total, 324 point counts were established along transects perpendicularly to pine and tea buffer zones (3 adjacent to pine buffer zone, 3 adjacent to tea matrix) and 3 control-transects in the forest interior. Circular plots of 20m radius were visited six times and birds were detected audibly and/or visually. The distance of edge influence on bird diversity for pine and tea was found to be 600m but with the highest impact penetrating deeper in the forest adjacent to tea (at 400m) than in the forest adjacent to pine (at 200m). The overall predominance of frugivores and frugivore-insectivores are characteristics of tropical forest bird communities. Bark-gleaning insectivores were the most negatively affected by both edges and can therefore be used as ecological indicators to track the effects of edges and disturbance. The proximity of both pine and tea matrixes, positively affects the abundance of forest independent species, and showed no significant influence on forest-interior dependent species. Among habitat attributes, percentage canopy cover strongly increased near pine matrix, stem density strongly increased with the distance from tea matrix, while the average tree dbh strongly decreased when moving from both pine and tea matrixes into the forest-interior. The physiognomy of landscape matrixes contiguous to Nyungwe National Park was found to influence the edge effect penetration into the natural forest; therefore, any buffer-zone management practices that induce abrupt hard edge near the forest is likely to deepen the effects further than 600m into the forest. Further continuation of this study was recommended on other land-uses around Nyungwe, and on other bird groups of particular conservation interest.

MORPHOLOGY AND MANAGEMENT OF THE AGGRESSIVE ENCROACHER PLANT SERIPHIDIUM PLUMOSUM IN BANKENVELD GRASSLAND, SOUTH AFRICA

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University of South Africa

Leslie Robert BROWN, University of South Africa ; Alan Sean BARRETT, University of South Africa

Seriphidium plumosum is an aggressive encroacher dwarf-shrub threatening grasslands in most of the provinces of South Africa. It is an indigenous pioneer plant that invades poorly managed natural veld and cultivated areas. In this study we investigated the morphology of *S. plumosum* and looked at different ways of controlling it at Telperion Nature Reserve, Mpumalanga, South Africa. Plants were classified into three height classes <0.5 m, 0.5–3 m, and >3 m. Above and below ground morphology of plants growing in flat and sloping areas were investigated. Biomass was estimated at 25 cm intervals above and below the soil surface. Ground cover and root spread was estimated for all samples. Treatment options that were investigated for controlling *S. plumosum* included chemical control, proportional removal and fire. For monitoring herbivore impact, treatments were applied in enclosure plots and replicated in areas accessible to herbivores. Morphology investigations revealed a comprehensive underground root system for *S. plumosum*. Our preliminary results indicate that an integrated approach should be adopted for controlling the plant. A combination of burning and herbicide application proved most effective. Findings from this study provide valuable information for the management of *S. plumosum* in different growth stages and growing in different terrain types. Recommendations for the control of *S. plumosum* can be used in similar environments to effectively control encroachment.

DO POLLARDED TREES SUPPORT A HIGHER SPECIES DIVERSITY OF LICHENS, BRYOPHYTES AND FUNGI THAN LARGE UNPOLLARDED TREES?

Björn Nordén

Norwegian Institute for Nature Research

Marianne EVJU, Norwegian Institute for Nature Research

Pollarding of trees for leaf fodder was historically an important practice in many temperate regions of Europe, but now previously pollarded trees mainly occur as remnants in forests. Old pollarded trees are often assumed to have exceptional value for biodiversity compared to other trees, but this was rarely tested. In this study, we compare the species diversity of lichenized fungi, wood- and bark-living fungi, and bryophytes among equal number of trees (n=350) that were either 1) Previously pollarded at least once, or 2) Never pollarded. All trees had a diameter at breast height > 40 cm, and pollarded trees were significantly coarser than unpollarded trees. We ask if the two categories differ in the number of trunk cavities (often used as a proxy for biodiversity), and in species richness and species composition. Sampling was balanced regarding geographical and climatic regions, and slope exposition. On 400 *Ulmus glabra* and 300 *Fraxinus excelsior* trees at 66 sites in southern and western Norway, we found 207 lichenized



fungi, 123 wood- and bark-living fungi, and 109 bryophytes (in total >13000 records). Using GLMM, we found that coarser trees had higher species richness than thinner trees, and that Fraxinus trees had higher species richness than Ulmus trees. Interestingly, there were no significant differences between pollarded and unpollarded trees regarding total species richness or species richness of nationally redlisted species of lichenized fungi or bryophytes. For wood- and bark-living fungi, total and redlisted species richness were both higher on pollarded trees, probably due to more dead wood habitat on the previously pollarded trunks. Pollarded trees had significantly more trunk cavities, but the number of trunk cavities was not correlated to, and thus not a good proxy of, cryptogam diversity. Based on our results, we conclude that the value of (re-)pollarding as a conservation effort can be questioned, at least for epiphytic cryptogams.

URBAN MIRES REMAIN HOTSPOTS OF EPIGAEIC ARTHROPOD DIVERSITY DESPITE THE DETRIMENTAL EFFECTS OF URBANIZATION

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Urbanization causes a considerable loss of natural habitats worldwide. Furthermore, regional biodiversity within cities is shrinking due to the homogenization of remnant habitats through the loss of specialist species. However, this phenomenon can be reduced if urban biodiversity hotspots are identified and conserved. Mires have the potential of being such refuges, since many mire specialist species of, e.g. arthropods, are documented. Little is known about the effects of urbanization on mire specialists and subsequently whether urban mires are able to sustain mire specialist species and communities. Therefore, it is essential to evaluate processes shaping mire communities and affecting specialist species at both local and regional scales. We investigated twenty pine mires that differed in urbanization level (from highly urbanized to non-urbanized) in southern Finland by evaluating the responses of epigaeic arthropod (carabid beetles and spiders) species and communities. Pitfall trapping was used to collect the arthropods. Local (pH of peat, vegetation cover, wood volume) and regional (level of urbanization, amount of peatlands in the landscape, total mire area) variables were measured to determine how they affect the structure of arthropod communities and individual species. We showed that high levels of urbanization have a negative effect on mire arthropod biodiversity. However, urban mire community structure seems not to be very different from rural ones and they are still inhabited by mire specialists. Furthermore, tree-covered parts of urbanized mires can serve as refuges for rare forest specialist species and Sphagnum mosses play an

important role in predicting the responses of mire species and communities, thus their growth should be promoted. It appears that urban mires can be considered urban biodiversity hotspots and their protection should be emphasized while planning urban development.

LANDSCAPE RELATEDNESS: INSIGHTS INTO CONTEMPORARY SPATIAL STRUCTURE OF A TOP PREDATOR

Anita J Norman

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Population sub-structuring is typically identified through genetic differentiation between spatial areas. However, a lack of genomic resolution, uninformative markers, skewed sampling, or a lack of sampling resolution can lead to inferences that are not representative of the actual underlying substructure. In this study, we use a set of 96 SNPs designed for the purpose of inferring relatedness in the Scandinavian brown bear (*Ursus arctos*). Consequently, the SNPs lack the characteristics to properly show population sub-structuring since they are fairly evenly distributed throughout the geographic range. To maximize the utility of the SNPs, we take a different approach to studying spatial structuring. Our approach uses pairwise relatedness with 412 individuals to predict overall relatedness across a landscape larger than 46,000 km². The results of this interpolation reveal novel insights into kin-structuring of brown bear. We show that some areas contain individuals that are significantly more related and others that are significantly less related than what is expected by chance. We also show how these areas vary with males and females. These findings have implications for conservation efforts as they contribute a contemporary, fine-scale spatial analysis of an important umbrella species.

#165: SYSTEMS AND DESIGN THINKING FOR CONSERVATION ACTION AND IMPACT

Cameron Norman

CENSE Research + Design

How do we take the best evidence and transform it into outcomes that create conservation impact? Quality science is not enough, nor is simply having motivation to create change. Science, practice and policy are all embedded within nested systems of conservation, requiring modes of thinking, action and evaluation that reflect systems not just individuals or organizations (Hiatt, Best & Norman, 2008). Connecting



intention with action to achieve impact falls within the purview of the field of design, which is focused on the process of creation for reproduction (Van Alstyne & Logan, 2007). Design thinking is the process of using creative principles to guide actions intended to produce and reproduce an outcome consistently. Conservation science seeks to generate new knowledge, practices and policies that produce change within these systems, thus systems and design thinking hold promise. The dominant models for translating science into impact focus on improving research quality as a driver of change. This has been shown to be incorrect: achieving impact involves understanding the social, structural, and procedural systems where knowledge is embedded and the human relationships that mediate throughout. Systems thinking introduces theoretical and practical tools to make sense of these relationships. Design thinking comprises set of skills, activities and ideas that allow for the development of strategic options to best navigate these relationships. In this presentation, participants will be introduced to these two fields and the manner in which they can be used to support conservation efforts. Examples will be provided drawing on the work of the Silwood Group, a multidisciplinary collaborative focused on linking systems thinking, evaluation and conservation. The implications for using systems and design thinking to support conservation science and practice will be discussed and supported with real-world case examples and from the literature.

194. ESTABLISHING SOCIAL-ECOLOGICAL BOUNDARIES: FOUNDATIONS FOR ASSESSMENT AND INNOVATION

Karma Norman

NOAA Northwest Fisheries Science Center
Kevin St Martin, Rutgers University ; Melissa POE, NOAA Northwest Fisheries Science Center ; Chris HARVEY, NOAA Northwest Fisheries Science Center ; Sara BRESLOW, NOAA Northwest Fisheries Science Center ; Greg WILLIAMS, NOAA Northwest Fisheries Science Center ; Phillip LEVIN, NOAA Northwest Fisheries Science Center

The inclusion of human wellbeing within ecosystem assessments emerges from the assertion that humans are indeed part of ecosystems. Even within traditions of single species approaches to environmental management, where human roles are reduced to those that are extractive in nature, we see this approach transformed by ecosystem-based management. Within these new frameworks, human wellbeing is often thought of as a benefit provided by well-managed ecosystems. Such work suggests that the value of ecosystems often exceeds our ability to account for them, and that humans are fundamentally linked to, if not directly dependent upon, ecosystems near and far. In this presentation we explore the ontological dilemma of humans as both part of these systems,

and as recipients of these systems' services. The recognition of systems that are both social and natural requires that we also recognize a need for new hybrid objects that are ontologically and spatially grounded, that can be measured and assessed, and may be integrated into and constituted by socio-technical practices and processes. These new objects problematically force us to draw boundaries, inclusive of humans and human communities, but are also open to new possibilities. Our work focuses on which metrics and measures we may use to assess the human dimensions of such systems, and which metrics and measures we may use to assess human wellbeing within the context of assessing ecosystems. To do so, our work provides guidelines that make clear when we are assessing the wellbeing of those humans who are ontologically part of the system and when we might be assessing the wellbeing of those humans who serve as recipients of services from the system. Establishing the boundaries of "the system" for state sponsored ecological assessments and management cannot be divorced from establishing what is internal and what is external to the system. Such boundaries are socially constructed but, nevertheless, do necessary work.

OBSERVER EFFECTS AND THE RISK-DISTURBANCE HYPOTHESIS IN SAMANGO MONKEYS

Katarzyna Nowak

Durham University
Kirsten WIMBERGER, University of Cape Town ; Russell HILL, Durham University ; Aliza LE ROUX, University of the Free State

A fundamental step in the management and conservation of wild species is advancing understanding of how an animal perceives its habitat. Variation in risk – either from natural predation or anthropogenic pressure – across space generates a "landscape of fear" that can be measured and assessed using an experimental patch approach such as giving-up densities (GUDs). For primates inhabiting a matrix of human habitation, exotic plantation and indigenous forest, it is possible to explore the "risk-disturbance hypothesis", which posits that human risk parallels natural predation risk in its effects on animals' habitat use and decision-making. Here we report on a combination of studies conducted on samango monkeys' (*Cercopithecus mitis* ssp.) risk-sensitive foraging at two sites in South Africa subject to varying anthropogenic pressures. Using GUDs experiments and ranging data, we documented pronounced effects of human observers and human habitation. However, the impact of humans did not simplistically follow predictions from the risk-disturbance hypothesis. At a site with limited human infrastructure, monkeys exploited typically high-risk food patches more intensively in the presence of researchers, who they likely perceived as shields against terrestrial predators. Meanwhile, at a predator-poor site where monkeys regularly come into contact with human infrastructure and gardens (adjacent to natural forest), monkeys regularly exploit exotic



garden resources in the food-scarce winter periods. Here, experiments indicated high sensitivity to risk at lower strata in garden trees, and monkeys' preference for indigenous forest, if given the choice of foraging at experimental patches in the forest versus the gardens. We also explore the effect of prior experience on monkeys' risk-taking behavior in the presence of humans.

LEGAL PROTECTION DRIVES THE RECOVERY OF WOLF POPULATIONS IN DISTANT REGIONS

Sabina Nowak

Association for Nature 'Wolf

Robert MYSLAJEK, University of Warsaw, Faculty of Biology

Wolves became strictly protected in Poland in 1998, after over 20 years of the wolf control program followed by over 20 years of trophy hunting. Several years after, they started to re-settle forests in Western Poland (WPL) far from the source population in the eastern part of country. Since 2002 the population increased from 7 to approximately 140 wolves living in 30 family groups in 2012, with the annual rate of increase reaching 38%. The area of permanent occurrence increased from 600 to 10,900 km². Among 35 recorded wolf groups 17% persisted for one year, while the rest survived at least two years. Most (70%) of 10 ephemeral groups were recorded before 2005, and they mostly disappeared after ≤ 2 years of presence. Since 2009 no single wolf group ceased to exist. The mean pack size was 4.6 individuals. It increased up to the eighth year of the group duration, from 2.3 to 7.3 individuals, and then fluctuated from 6 to 8 members. On average 93.8% of packs produced offspring annually. From birth 84% of pups survived until August and 56% until November. On average 1.6 pups per pack were recorded in late winter. Of 28 wolves found dead, 64% were killed by vehicles, 25% were poached, 11% died because of natural factors. Wolves in WPL preyed mostly on red deer *Cervus elaphus*, roe deer *Capreolus capreolus* and wild boar *Sus scrofa*, while damage to livestock was sporadic. The re-colonization starts from jump dispersal, but along the recovery the dispersal pattern shifts to stratified, being a mixture of the diffusion and jump dispersal. We conclude that legal protection, rather than hunting management, supports fast recovery of wolves in distant but suitable habitats when the source population provides dispersers of both genders following reduced anthropogenic mortality and maintained connectivity.

DO WOLVES CANIS LUPUS SETTLE IN AREAS PREDICTED BY HABITAT SUITABILITY MODELS?

Sabina Nowak

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Robert MYSLAJEK, University of Warsaw, Faculty of Biology

Habitat suitability models (HSM) are widely applied in conservation of endangered taxa, although their predictive power has been hotly debated. We attempted to compare predictions of HSM for wolves in Poland with the actual distribution of the species after over a decade of its spontaneous recolonisation of western Poland. Data were analysed in a grid of cells 10×10 km with predicted relative probability of wolf occurrence calculated for every cell. We compared habitat variables and relative probability of wolf occurrence in: (1) cells with the permanent wolf occurrence, where no reproduction was recorded; (2) cells with the permanent wolf occurrence, where reproduction was confirmed; (3) cells with the sporadic wolf occurrence; (4) cells randomly selected within study area, where wolves were absent. In 2001–2013 wolves were recorded in 182 cells in western Poland, among which 118 were permanently inhabited by these animals at least during one year. In remaining 64 cells wolves were observed sporadically. Cells with the permanent wolf occurrence were characterized by a higher probability of wolf occurrence predicted by HSM when compared with cells sporadically visited by wolves and cells randomly selected from outside of the wolf range. Reproduction of wolves was confirmed within 31 cells. These cells were characterized by the highest probability of occurrence predicted by HSM, a higher forest cover and lower area of arable fields and a lower density of public roads compared to cells with the permanent wolf occurrence but without reproduction. Over the time there were no differences in the quality of cells where the permanent wolf occurrence was recorded, but the sporadic wolf occurrence was registered in cells of lower quality.

ID195 THE GOOD, THE BAD, AND THE WELL-INTENTIONED: THE EVOLUTION OF COMPENSATION AND INSURANCE PROGRAMS AS WILDLIFE CONFLICT MITIGATION TOOLS

Philip Nyhus

Colby College

Human conflict with wildlife is an important driver of population decline among species that compete with humans for space, resources, or that threaten the safety of people and their property. Eliminating the frequency and severity of conflict is typically a preferred management goal but may not be achievable because of the characteristics of the wildlife species of interest, human behavior, or factors associated with governance and institutions. When prevention is not possible, strategies are needed to reduce the negative social and economic impacts of conflict. Compensation and insurance are two tools to accomplish post-conflict mitigation. I review changes in the growth and types of compensation and



insurance programs, describe factors that promote or constrain the effectiveness of these tools, and discuss the evolution and future of these strategies as tools in the conservation toolbox. Characteristics of interest include those related to verification and payment, such as eligibility criteria, payment amount, type, and timing; institutional considerations, such as the type and effectiveness of managing agencies and organizations, type and quality of rules and procedures, and trust and transparency; biological considerations, including species abundance, conservation status, and the degree, type, and frequency of conflict; equity and justice considerations, including gender and socio-economic status; perceptions of risk and reward; technology for reporting and verification; type, size, and responsibility for payment of premiums and subsidies; geographic variations; linkages to improved husbandry and conservation; and degree of coupling with other conservation tools and goals.

90 HERBICIDE TOLERANT CROPS IMPLICATED IN DECLINING MONARCH BUTTERFLY POPULATION

Karen Oberhauser

University of Minnesota

Kelly NAIL, University of Minnesota ; Carl STENOIEN, University of Minnesota ; Myron ZALUCKI, University of Queensland ; John PLEASANTS, Iowa State University

Each fall, the vast majority of the eastern North American population of the monarch butterfly migrates to overwintering sites in central Mexico. The area occupied by the overwintering population, a proxy for the whole population, has decreased since measurements began over two decades ago. While many factors could be contributing to this decline, increasing use of herbicide tolerant, genetically modified crops and the resultant loss of the monarch's primary host plant, mainly *Asclepias syriaca* (common milkweed), in crop fields in the Upper Midwestern U.S. has been strongly implicated. Before the advent of these crops, it is likely that the vast majority of monarchs that migrated to Mexico each fall originated in corn and soybean fields, but the milkweed in these fields has been almost completely eliminated as the adoption of herbicide tolerant crops has approached 100%. While monarchs could potentially compensate for this loss by laying more eggs in the remaining habitat, this is not happening. In fact, monarch egg density is declining, perhaps indicating that there are too few monarchs to find the remaining habitat in the same numbers as before, and supporting modeling work that suggests declining fecundity as host plants are removed from the agricultural matrix.

DEVELOPMENT VS CONSERVATION DILEMMA: CASE STUDY OF LAIKIPIA UNIVERSITY AND THE IGUAMITI STREAM IN KENYA

Benson Obwanga

Laikipia University

Veronica NGURE, Laikipia University ; Outa OMONDI, Egerton University ; Kennedy OCHIENG, Egerton University

Universities all over the world are key in providing solutions to global challenges. Communities around them benefit from disseminated research outputs. Such solutions are needed to cope with environmental degradation & climate related challenges. This study investigated the importance of Laikipia University in protection of vegetation at the source of Iguamiti stream in Laikipia County Kenya, a small but crucial system for downstream communities. Selected physico-chemical parameters showed a variation in trends between September 2013 & April 2014. Four sampling points along the stream were selected: Upstream within the University (I1, I2, I3) & Downstream I4 outside the University. Conductivity ranged from 53.25 μScm^{-1} at the I1 in November 2013 to 132.85 μScm^{-1} in April 2014 at the I2. Highest TP mean values recorded were at I2 and I4 ($0.22 \pm 0.46 \text{mg/L}$ and $0.22 \pm 0.47 \text{mg/L}$ respectively). For PO4-P the highest recorded values were at I2 & I4 ($0.21 \pm 0.45 \text{mg/L}$ & $0.22 \pm 0.47 \text{mg/L}$ respectively). High values of NO3-N ($0.76 \pm 0.58 \text{mg/L}$) were recorded at I2 compared to other sites. NO2-N concentration did not exceed 0.01 mg/L for all the sampling sites while for NH4-N did not exceed 0.04 mg/L for all the sampling sites. There was no significant difference in concentrations for Total P, NO2-N and PO4-P between the sites for the whole study period. These trends highlighted the significance of a series of wetlands along the stream which play a critical role in maintaining good water quality. Results highlight a significant role Laikipia University has played conserving this freshwater ecosystem. The study also raises the need for extra efforts by the institution to train the community on the relevance of protecting the wetlands against degradation. There is need for continued data collection to show the trends of the parameters over years to develop climate change mitigation strategies. Key words: Higher Education Institutions, Iguamiti Stream, physicochemical parameters, trends

CAN POWERLINE RIGHTS-OF-WAY CONTRIBUTE TO CONSERVATION OF GRASSLAND BUTTERFLIES?

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With decreasing areas of natural and semi-natural habitats, the importance of anthropogenic habitats for biodiversity conservation is increasing. Infrastructure rights-of-way, such as road verges and power-line corridors cover large areas of



land. In Sweden their combined area exceeds that of semi-natural grasslands. Hence, they have a great potential for conservation of species associated e.g. with grasslands. As linear habitats they also have the potential to act as dispersal corridors and increase landscape connectivity. We compared species richness and community composition of butterflies in power-line corridors and semi-natural grasslands, and tested how this was influenced by local management and landscape configuration. Power-line corridors had higher species richness than semi-natural grasslands, but contained a partially different set of species. Butterfly communities in power-line corridors were not affected by the amount of grasslands in the landscape. Instead, power-line corridors appeared to act as source habitats and influenced butterfly communities in semi-natural grasslands and road verges in the vicinity. Studies of dispersal behaviour indicated that the power-line corridors function as habitat rather than as dispersal corridors only, and did not direct dispersal movements. We conclude that power-line corridors and other rights-of-way habitats are important butterfly habitats in forest-dominated landscapes, and can at least to some extent be managed to act as a substitute for rapidly declining semi-natural habitats.

ID 34 TOWARDS SUSTAINED, LONG-TERM AND GLOBAL OBSERVATIONS OF LAND COVER CHANGE FOR BIODIVERSITY CONSERVATION

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Global biodiversity is facing a crisis as evidenced by ongoing global declines in species populations and numbers as well as their habitats. In response, the Convention on Biological Diversity (CBD) set out the "Strategic Plan for Biodiversity 2011-2020" whose vision is to restore, value and conserve biodiversity for the benefit of all people by 2050. In order to implement this plan, 20 Aichi Biodiversity Targets were adopted and supported by a suite of 98 indicators as the basis for a reporting progress target by target. Land Cover Change (LCC) monitoring from satellite remote sensing has the potential to contribute data to a number of these indicators for assessing biodiversity status and trends. Firstly, we introduce the basic principles of land cover classification followed by why it's important for biodiversity conservation. Secondly, we review a suite of current LCC products summarising their strengths and weaknesses. Thirdly, we use illustrative examples to demonstrate the performance of these LCC products at a national-scale in Tanzania. This is followed by a discussion of why land cover classification has not worked to date to meet the needs of the global biodiversity and conservation policy community in tracking progress towards the Aichi

Targets. We also show what can work as highlighted by some recent product developments. We conclude that a multi-decadal global LCC product could improve some biodiversity indicators in support of the 2020 Aichi Targets in areas as diverse as tracking protected area management effectiveness, quantifying the loss of critical habitat to human activities, inferring species diversity and abundance and monitoring the impacts of human pressures such as urban development and agriculture. Finally, we make recommendations on how the remote sensing and conservation community can work collaboratively toward a global LCC product and what the key challenges are to achieving this goal.

#129 USE OF THE OPEN STANDARDS TO DEVELOP A NETWORK OF MARINE PROTECTED AREAS OFF THE WEST-COAST OF SWEDEN THAT MEETS EUROPEAN NATURA 2000 OBLIGATIONS

Jens Odinga

Van Hall Larenstein University

Lena TINGSTRÖM, Swedish Agency for Marine and Water Management; Maria KILNÄS, County Administration Board Västra Götaland; Ilke Tilders, Foundations of Success

Dealing with national policies and international treaty obligations (i.e., those related to Oskar, Helcom, Natura 2000, the Marine Strategy Framework Directive) in MPA management is challenging. Policies and obligations are at best complementary, and often overlap and are couched in ambiguous language. Authorities responsible for the management of individual Marine Protected Areas and the network they form are struggling to practically interpret and implement these policies in their management efforts. The Swedish Agency for Marine and Water Management in collaboration with various County Administration Boards and Foundations of Success teamed up and delivered a "proof of concept" that shows how the use of the Open Standards can help integrate these policies in a useful and practical standardized MPA Network design. The proof of concept shows how this standardized design can be applied to a suite of individual MPAs. It also shows how this design enables meaningful roll-up of data across MPAs to inform management decisions on the MPA network level and to track the performance towards policy objectives and treaty obligations. Ultimately, this system will enable systematic conservation and learning within and across this network of MPAs.

DEGRADATION IN A CRITICAL WATERSHED OF NORTHERN HAITI: THE RIVER HAUT DU CAP AND CAP-HAITIEN BAY

Samantha Oester

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More than 5.5 million people occupy the Republic of Haiti's 27,750 km². A dense population, historically unstable government, intense agriculture, premature urbanization and utilization of charcoal as a chief fuel source led to extreme degradation and destruction of Haiti's watersheds. Little natural vegetation remains. This has caused hydrologic malfunctioning throughout the country. Several rivers and lakes have dried up completely or no longer have permanent flow. Aquifers have been contaminated due to these factors, as well as unmanaged underground pumping and quarries. Extreme vegetation removal and pollution also led to the deterioration of coastal and marine environments. Several coastal mangroves, considered critical ecosystems, are located on the northern coast, near Cap-Haitien, Haiti's second largest city. The River Haut du Cap that feeds the Cap-Haitien Bay has been subject to severe overexploitation and degradation. This was exacerbated after the 2010 earthquake by much of the country fleeing the Port-au-Prince area, heading north to the Cap-Haitien region. After the earthquake, this area contained the only medical facilities and the little resources the country maintained. Furthermore, most Haitians do not have access to potable water. Water-borne diseases have increased due to lack of natural filtration, infrastructure for water treatment, and healthcare resources, as well as intense population shifts to more condensed regions. This three-part project will assess the Cap-Haitien Bay watershed, identify point and non-point sources of pollution and evaluate the prevalence of waterborne infectious diseases in Cap-Haitien waterways. Working with the Fondation pour la Protection de la Biodiversite Marine—Haiti's only marine conservation NGO—results will be used to design and implement community conservation projects, outreach and education, as well as a plan to improve ecosystems of the Cap-Haitien region.

ECOSYSTEMS AND PEOPLE ADAPTING TO CLIMATE CHANGE IN NEPAL

Judy Oglethorpe

WWF US

Sunil REGMI, CARE Nepal ; Eric WIKRAMANAYAKE, WWF US ; Gokarna Jung THAPA, WWF Nepal ; Dev Raj GAUTAM, CARE Nepal ; Dipesh JOSHI, WWF Nepal ; Shant JNAWALI, WWF Nepal ; Pabitra JHA, CARE Nepal

As climate in the Himalayas, mid-hills and plains of Nepal becomes more variable, many impacts are occurring, and significant longer term climate change impacts are projected. The Hariyo Ban (Green Forest) Program promotes climate adaptation for people, ecosystems and species in the Gandaki river basin and Terai Arc Landscape. Work has included over 300 vulnerability assessments and adaptation plans at different scales from community forest level through

village development committee (lowest administrative unit), protected area, and landscape. Different methodologies were used, including Integrated Vulnerability and Capacity Analysis at local level, and Flowing Forward methodology at protected area/landscape level. This is backed with climate information, and modeling of possible vegetation shifts, climate refugia and species distribution changes. Resilience building and adaptation are being implemented both through stand-alone climate adaptation plans, and mainstreamed into sectoral and protected area/landscape plans. At community level these include ways to empower the most marginal and vulnerable people to participate, and ensure interventions are locally appropriate. Many lessons come from integrating ecosystem and community adaptation, which brings benefits and helps avoid maladaptation, but requires work at multiple ecosystem scales beyond site level. Water catchments are useful units for adaptation despite institutional challenges. Ecosystem impacts often take longer than community impacts; hence planning for different timescales is important at different levels. A multi-sectoral approach is essential for successful adaptation, including conservation, forestry, agriculture, water, energy, health, disaster risk reduction, and infrastructure. Lessons show that multiple approaches at multiple scales are necessary, with flexibility, innovation and learning, especially given the growing climate uncertainty and rapid social, economic and political change in Nepal.

ECONOMIC BENEFIT OF WILD ANIMALS; A POSSIBLE THREAT TO CONSERVATION IN OVIA SOUTHWEST, EDO STATE, NIGERIA

Bukola Oguntuase

Federal University of Technology Akure

Motunrayo OLOFINSAE, Federal University of Technology Akure

This study was carried out to assess the contribution of bush meat to Edo people's livelihood and the consequence of utilization on conservation. Five markets were selected in Ovia Southwest local government area of Edo State, twenty bush meat sellers were selected from each market. Direct observations were made to document the composition of wild animals under sale in the study area. A total of one hundred questionnaires were administered to the respondents. The questionnaires were all retrieved and analyzed using descriptive analysis. The results show that thirteen animal species are being traded in the area. The price for the animal species (whole animal) ranged from N200 to N9,520. Respondents reported that there is a decline in the animal population over time. Between 64% and 95% of the respondents acknowledged population decline in seven of the thirteen animal species available for sale compared to what it used to be some ten years ago. Sales of Wild animal species could be regarded as a profitable business in the rural community, supporting livelihood of the community, but could



have devastating effect on conservation as already observed in this study if harvesting of Wild animals is not regulated on controlled or sustainable basis.

BROWSING BY HARES ON FOREST VEGETATION IN RESPONSE TO SUPPLEMENTARY FOOD

Sara Öhmark

Mid Sweden University

Baiting and supplementary feeding causes change in distribution and foraging behaviour of wild herbivores and are extensively used methods for management and conservation purposes. However, these methods remain controversial as they bring about ecological effects that are sometimes detrimental. Further, responses by herbivores to added food are ambiguous and depend on characteristics of both the target population and the environment. We investigated how browsing pressure imposed by mountain hare (*Lepus timidus*) on mountain birch (*Betula pubescens* ssp. *czerepanovii*) vegetation near feeding stations varied with a) amount and b) type of offered food and with c) vegetation density and d) previous browsing distribution. An increased rate of browsing was observed near added food even where a relatively little preferred food type (oat straw) was added in small amounts (120 g). Vegetation density had a clear impact on the rate of browsing near feeding stations while the rate of previous browsing by hares had a marginal effect. A higher visiting frequency of hares near feeding stations relative to at control sites was evident three weeks after the removal of the added food, but no difference in browsing pressure on birch remained one year after the study. The results show that browsing pressure on vegetation that is induced by baiting and supplemental food can be controlled both by the design and location of feeding stations. Further, the high potential impact of artificially placed food on ecological systems was demonstrated. We recommend that added forage should be separated from sensitive vegetation and that baiting and supplemental feeding always should be planned with due consideration for associated ecological impact.

UNDERSTAND THE SKIN TO BETTER UNDERSTAND THE DISEASE: THE ROLE OF SKIN SLOUGHING IN THE SUSCEPTIBILITY OF AMPHIBIANS TO A FUNGAL FROG-KILLER

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The fungal pathogen *Batrachochytrium dendrobatidis* (Bd), which causes the amphibian disease chytridiomycosis,

has resulted in the declines and extinctions of amphibians worldwide and is a major conservation concern. This generalist pathogen infects a wide range of amphibian hosts, and a combination of ecological, physiological and environmental variables likely influence differences in susceptibility within and between species. As a skin pathogen, variation in susceptibility to Bd may also be influenced by aspects of skin functioning, such as the rate of routine amphibian skin sloughing or shedding. It has been demonstrated that sloughing may be involved in immune defence by regulating the growth of skin-associated microbes, and thus could play an important role in the pathogenesis of chytridiomycosis. To determine the relationship between skin sloughing and disease progression, we exposed adult Australian green tree frogs (*Litoria caerulea*) to Bd, and monitored the change in sloughing rate and infection load over time using infrared cameras and quantitative PCR. We found that sloughing rate increased with Bd infection load in infected frogs, but the act of sloughing did not reduce Bd load on the ventral skin surface. In this susceptible species, sloughing does not appear to limit the progression of disease and may actually exacerbate the loss of physiological homeostasis seen in terminally ill frogs by further inhibiting water and electrolyte transport across the skin. By measuring sloughing rates directly for the first time, our results provide insight into how variation in sloughing may influence susceptibility, and we are currently examining sloughing rates across amphibian species to investigate this relationship within a phylogenetic context. Understanding the factors driving variation in intra- and interspecific susceptibility can improve our predictions of amphibian responses to Bd in wild populations, allowing for better species conservation planning.

62. A SOCIO-ECOLOGICAL APPROACH TO HUMAN VALUES

Shigehiro Oishi

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Human values are often defined as “desirable transsituational goals, varying in importance, that serve as guiding principles in the life of a person or other social entity” (Schwartz, 1994, p. 21). The dominant approach in the study of values explored the origins of individual differences in human values in terms of genetics versus family environments, and examined correlates of human values ranging from political ideology, religiosity, to environmental preservation and pro-social behaviors. The traditional approach views values as an internalized entity (“inside the person”) and a predictor of individual differences in social behaviors (e.g., “Who recycle?” “Who vote?”). The socio-ecological approach to human values emphasizes the mutual constitution of human values and social ecology, namely how physical, societal, and interpersonal environments give rise to certain human values, and how certain human values create



certain physical, societal, and interpersonal environments. The main insight from the socio-ecological approach to human values is that values are the product of dynamic adaptation to environments. The prevalence of pathogens, for instance, gave rise to the importance of security, tradition, and collectivism (as a collective defense against pathogens) in many parts of Africa and Southeast Asia, whereas the relative lack of pathogens gave rise to the importance of autonomy and individualism in many parts of Northern Europe and North America. Likewise, climate changes and natural disasters should give rise to change in human values (e.g., victims of major earthquakes value collectivism more than non-victims). The socio-ecological psychology of human values sheds new light on individual, group, institutional, and societal adaptations to environmental changes.

HUMAN ACTIVITIES AND THEIR RELATIVE THREATS TO BIODIVERSITY AT SELECTED FOREST RESERVES IN NIGERIA

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University of Ibadan

Oladapo. O Oduntan, Federal University of Agriculture

Thousands of years of cutting and burning, especially in Africa have so transformed vegetation and subsequently land that it bears little resemblance of its original state in which tree cover was probably denser than it is today. Concern has developed about the rapid rate of tropical deforestation, the temporary or permanent clearance of forest for agriculture and other purposes. Evaluation of pressure degrees and threats imputed by human activities on protected areas was determined in the study area. Four forest reserves out of seven in the division were randomly selected as representative samples, namely: Ilaro, Imeko, Oja Odan and Aworo forest reserves. Primary data were used for this study. Data were collected through the use of Rapid Assessment and Prioritization of Protected Areas Management (RAPPAM) designed questionnaire that was recommended for evaluation of threats and Pressure on protected areas (WWF, 2003). Descriptive statistics and ANOVA were the statistical tools used for data analysis in this study. The findings show that all the reserves are severely threatened by logging while only Oja-Odan F.R. is severely threatened by conversion of land use. In addition, Oja-Odan and Imeko are the only reserves that are severely threatened by hunting, although Aworo F.R. is also highly threatened. Oja-Odan F.R. and Imeko F.R. are severely threatened by harvesting of non-timber forest products while Aworo is also highly threatened by same activity. Furthermore, all the forest reserves are highly threatened by grazing except Ilaro F.R. while cross boundary influence severely threatened Oja-Odan F.R., although severity of threat in Ilaro F.R. and Aworo F.R. is high as well. No significant difference ($LSD = 9.04$; $p < 0.05$) between activities in each forest reserves; although analysis of variance shows a

significant difference between the pressure and threat across the forest reserves. Policy recommendations were made based on the outcome of this study.

IMPACTS OF METAPOPULATION DYNAMICS ON OVERFISHING RISK AND VULNERABILITY IN MULTISCALE FISHERIES

Daniel Okamoto

Simon Fraser University

Salomon ANNE, Simon Fraser University; Margot HESSING-LEWIS, Simon Fraser University

Fisheries management generally strives to balance trade-offs between complex economic, social and ecological systems. Yet estimates of overfishing risk under individual harvest guidelines are likely to be biased where the spatial and temporal scales of science and management are improperly aligned with that of either the biology and/or the socioeconomic dynamics of the fishery participants. These biases have the potential to be especially pronounced in the presence of individual sub-stocks (i.e. metapopulation structure). Moreover the consequences of those biases are likely asymmetric when multiple fleets operate at different spatial scales. Specifically fleets targeting the entire metapopulation may be less vulnerable to risky harvest guidelines or naive biological assumptions than those dependent upon a subset of local stocks. We explore the degree to which bias in overfishing risk and asymmetry in vulnerability among fleets result from the nature of harvest control rules, patterns of synchrony and connectivity among populations, and the scientific uncertainties in spatial and temporal population dynamics using a combination of metapopulation modeling and management strategy evaluation. We first use a basic simulation framework to illustrate how population connectivity, synchrony and harvest guidelines influence both local (single population level) and regional (metapopulation level) overfishing risk and extirpation probabilities. We then apply the models to a case study of Pacific Herring in British Columbia. Here, both transient industrial fishing fleets and local First Nations fleets target a complex suite of herring stocks whose spatial structure is poorly understood at smaller scales. Results are valuable in demonstrating which scenarios may benefit from improved knowledge of the temporal and spatial dynamics of the target species or the risk tolerance of individual fishery fleets.

WILDLIFE DETECTION DOGS; HELP OR HINDRANCE IN TROPICAL CONSERVATION CONTEXTS?

Hannah O'Kelly

Wildlife Conservation Society



Due to their extremely powerful sense of smell, trained wildlife detection dogs can greatly increase the efficacy of field surveys in a range of contexts. Dogs can search large areas and difficult terrain more easily than human search teams and they will detect targets (i.e. animals or animal sign) that human observers may miss, thereby potentially alleviating sources of bias. Detection dogs can be used to rapidly and reliably establish presence in certain scenarios and also to increase detection rates and therefore sample size. However, the training and handling of these dogs is a specialized skill and the logistical and financial costs associated with deploying canine survey teams in the tropics can be high compared to, for example, employing local field assistants. There is nonetheless growing interest in this method in areas outside its traditional sphere of use and it is particularly appealing where rare and elusive species are concerned, as is so often the case in the tropics. By presenting several short case studies we identify circumstances where detection dogs can yield tangible gains in challenging field contexts, but we also highlight potential situations where the use of dogs may not represent an optimal approach in terms of overall efficiency. Through these contrasting examples we formulate some general guidelines on when the use of detection dogs might be warranted and emphasize key considerations which should be taken into account by any conservation practitioners contemplating this approach.

AVIAN SPECIES DIVERSITY AND PHYSICO-CHEMICAL PARAMETERS OF WATER BODIES IN UNIVERSITY OF LAGOS, NIGERIA.

Fatsuma Olaleru

UNIVERSITY OF LAGOS, NIGERIA

Ann UDEH, UNIVERSITY OF LAGOS, NIGERIA ; Michelle FASONA, UNIVERSITY OF LAGOS, NIGERIA

The richness and diversity of avian species in wetlands can be influenced by physical and chemical parameters in their habitat. This study considers the interactions between abiotic factors and bird richness and diversity in the wetland and its water bodies around Faculty of Science, University of Lagos, Nigeria. Point count method was used for the bird census and physico-chemical parameters such as temperature, pH, conductivity, turbidity, salinity and depth of the water bodies studied using Horiba U50G. Morning and evening bird surveys were conducted for three months, April – June. Twenty four (24) species of water birds belonging to 12 families were recorded. These were Accipitridae, Alcedinidae, Antidae, Ardeidae, Charadriidae, Ciconiidae, Columbidae, Indicatoridae, Musophagidae, Phalacrocoracidae, Scolopacidae, and Threskiornithidae. Large waders such as *Ardea cineila* and *Ardea albawere* the most abundant species group (45.8%);

too tiny such as *Halcyon malimbica* and *Halcyon senegalensis* constituted 29.2% of the birds. The relationship between species richness and diversity was significant ($P = 0.0026$) with r value of -0.78 . There was a significant relationship between the water pH and species richness ($P < 0.05$, $r = 0.56$); while all other parameters were not significant ($P < 0.05$). Activities and the physico-chemical parameters of the wetlands in the University of Lagos should be monitored regularly for the conservation of wildlife species in general and avian species in particular that depend on it as their habitat.

FARMERS ADOPTION OF SOIL MANAGEMENT PRACTICES FOR IMPROVED CROP PRODUCTION IN THE FEDERAL CAPITAL TERRITORY, ABUJA, NIGERIA.

Rotimi Saka Olaleye

Federal University of Technology

F.e ONWUMERE, Agriculture and Rural Development

Secretariat, Federal Capital Territory Administration ; Bolaji, O.

ADENIJI, Federal University of Technology

Study examined farmers adoption of soil management practices for improved crop production. Data collected from 264 randomly selected farmers were analyzed using descriptive and inferential statistics at 5% significant level. Mean age was 43.5yrs and family size was 8, while 58.3% were literate, Mean annual farm income was N416, 059.28 and farm size was 7.44 ha, Major information source was extension agent (96.2%). Most adopted soil management practices were crop rotation (90.9%), use of inorganic fertilizer (89.8%), cover crops (83.3%) and mulching (81.1%). Regression analysis shows that age has negative but significant relationship with adoption. Annual farm income and family size were positively significant with adoption of soil management practices. Correlation analysis shows a positive relationship ($r = .258$) between attitude and adoption. Therefore, more awareness should be created on the most adopted soil management practices. Study examined farmers adoption of soil management practices for improved crop production. Data collected from 264 randomly selected farmers were analyzed using descriptive and inferential statistics at 5% significant level. Mean age was 43.5yrs and family size was 8, while 58.3% were literate, Mean annual farm income was N416, 059.28 and farm size was 7.44 ha, Major information source was extension agent (96.2%). Most adopted soil management practices were crop rotation (90.9%), use of inorganic fertilizer (89.8%), cover crops (83.3%) and mulching (81.1%). Regression analysis shows that age has negative but significant relationship with adoption. Annual farm income and family size were positively significant with adoption of soil management practices. Correlation analysis shows a positive relationship ($r = .258$) between attitude and adoption. Therefore, more awareness should be created on the most adopted soil management practices



ASSESSING THE RISK OF COLLAPSE OF NEOTROPICAL FOREST ECOSYSTEMS

María A Oliveira-Miranda

Provita

Jon Paul Rodriguez, Instituto Venezolano de Investigaciones Científicas ; Irene ZAGER, Provita ; Andrés ETTER, Universidad Javeriana ; Bernal HERRERA-FERNÁNDEZ, CATIE ; Carlos M. ZAMBRANA-TORRELIO, EcoHealth Alliance ; Pat COMER, NatureServe ; Carmen JOSSE, NatureServe ; Edmund G BARROW, International Union for Conservation of Nature ; David A KEITH, University of New South Wales

In 2014, the International Union for Conservation of Nature (IUCN) adopted a set of categories and criteria for assessing risks to ecosystems, thus establishing a new official global standard for biodiversity assessment and monitoring. Over the last six years, the IUCN Red List of Ecosystems Thematic Group developed the science underlying the criteria, tested them widely, and received feedback from the global community of conservation scientists and practitioners. This talk will be the first synthesis of the implementation of the Red List of Ecosystems protocol at the continental level, contrasting results at various spatial scales. We begin by summarizing the outcomes of "From Alaska to Patagonia: Red List of Continental Ecosystems of the Americas," our first major research effort, which ends in mid-2015. Outputs at the sub-national and national level (e.g. Colombia, Costa Rica, Venezuela), are compared to those at regional (e.g. tropical Andes) and continental levels. Our focus in this talk is on forest ecosystems of Meso and South America, as data on their change in extent and quality are less uncertain than other ecosystem types (e.g. grasslands). Data on potential and current extent were used to quantify "historical" rates of decline, while recent change was measured by projecting observations made between 2000 and 2010 into the future. At this broad geographical scale, ecosystem degradation was illustrated by examining moisture variation in montane ecosystems, as determined by remote sensing. We highlight that assessments carried out at different spatial scales lead to different policy recommendations, thus assessors must begin by clearly delimiting the assessment unit and justifying the preferred typology of ecosystem types. Future stages of our analysis will focus on questions such as: How can information on species losses and global climate change be integrated into the Red List of Ecosystems protocol? Which are their best indicators of risk of collapse?

DIVERSITY-STABILITY RELATIONSHIPS: FROM THEORY TO NATURAL COMMUNITIES

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National Museum of Natural History

Benoit FONTAINE, National Museum of Natural History ; Marianne ELIAS, National Museum of Natural History ; Colin FONTAINE, National Museum of Natural History

The diversity-stability relationship is one of the most debated topics in ecology, but mostly using theoretical or experimental approaches. Such approaches usually focus on the stability of randomly assembled communities experiencing common experimental conditions. However, the composition of natural communities is not random but depends on both local environmental conditions and perturbations. Here we analyzed the temporal stability over 8 years of 131 local butterfly communities spread all over France. We used path analysis to disentangle the direct and indirect effects of habitat degradation on community stability. Our results indicate that habitat degradation affects both the species richness and the phylogenetic diversity of butterfly communities which in turn affect community stability but via different mechanisms. While species richness increases stability directly, phylogenetic diversity increases community stability via a decrease in population synchrony. Interestingly, we also found that the temporal stability at the population level also increases in richer communities. A finding that contrasts with experimental and theoretical results carried out on plant communities. Thus two distinct mechanisms appear to drive the stability of natural butterfly communities: a portfolio effect where more species induces a stronger statistical averaging of the population dynamic and a response diversity effect where more distantly related species tend to respond more differently to environmental fluctuations. Finally, the higher stability of populations might also contribute to the higher stability at community level. These results highlight additional pathways by which habitat degradation threaten the conservation of butterfly communities.

BUSHMEAT COMPARED TO OTHER ECOSYSTEM SERVICES FROM A TROPICAL FOREST

Ola Olsson

Lund University

Agnes ANDERSSON-DJURFELDT, Lund University ; Magnus JIRSTRÖM, Lund University ; Laura GUIA DIAZ, Lund University ; Edu EFFIOM, Lund University

Bushmeat hunting threatens many mammal species, but it also leads to a disruption of the ecological functions that these mammals provide, such as seed dispersal. This leads to diminished regeneration of many tree species with large seeds and/or fleshy fruits. We present results from both ecological and socio-economic surveys from a tropical forested area in Cross River, Nigeria. Much of the hunting, of all species including primates, is for local consumption in the villages near the forest. Bushmeat provides an important part of the protein intake in these communities, but provides very little monetary



incomes. Compared to 10 years ago, hunting of apes, drills and pigs has declined, whereas that of rodents has increased. Meat is only one of the resources that the households obtain from the forests. They also collect large amounts of fruits and nuts, as well as leaves, for food, other non-timber forestry products, and some timber. Economically, fruits and nuts are the most important ecosystem service that the communities get from the forest, and the harvest might be sustainable. By contrast, the economically much less important bushmeat hunting not only threatens some of the hunted species, but in the long run also the forest's capacity to provide the non-meat foods.

SPATIAL ASPECTS OF LAND USE THROUGH TIME: A GIS BASED STUDY OF THE EARLY LEVANTINE SITES OF GATH (ISRAEL) AND GADARA (JORDAN) AND THEIR SURROUNDINGS

Linda Olsvig-Whittaker

German Protestant Institute of Archaeology in the Holy Land
Dieter VIEWEGER, German Protestant Institute of Archaeology in the Holy Land ; Katja SOENNECKEN, German Protestant Institute of Archaeology in the Holy Land ; Liora KOLSKA HORWITZ, National Natural History Collections, Hebrew University of Jerusalem ; Ehud WEISS, The Tel es-Safi/Gath Archaeological Project, The Institute of Archaeology, The Martin (Szusz) Department of Land of Israel Studies and Archaeology, Bar-Ilan University ; Suembikya FRUMIN, The Tel es-Safi/Gath Archaeological Project, The Institute of Archaeology, The Martin (Szusz) Department of Land of Israel Studies and Archaeology, Bar-Ilan University ; Oren ACKERMANN, The Tel es-Safi/Gath Archaeological Project, The Institute of Archaeology, The Martin (Szusz) Department of Land of Israel Studies and Archaeology, Bar-Ilan University ; Aren MAEIR, The Tel es-Safi/Gath Archaeological Project, The Institute of Archaeology, The Martin (Szusz) Department of Land of Israel Studies and Archaeology, Bar-Ilan University

Many factors influenced the manner in which past societies used the landscape, including their cultural traditions, which are reflected in their subsistence base, type of agricultural and pastoral practices, extent and character of commerce, trade and industry, nature of infrastructure developed (such as roads), site function and socio-political system. By studying diachronic patterns of past land use, we can begin to understand the changing dynamic between societies and their environment over time. We present here two cases studies from the Near East. Tell es-Safi (Canaanite and Philistine Gath) in Israel and the Tall Zira'a (ancient Gadara) in Jordan, are two major archaeological sites spanning the Early Bronze Age to modern times, representing about 4,000 years of human occupation. Data obtained from archaeological surface surveys recording all anthropogenic activity in the landscape around these tells by period, was compiled. Using GIS mapping of

modern habitats derived from orthophotos, we developed a modern standard against which to compare and contrast the archaeological surface survey data for the two regions, looking for patterns of correlation with biological and physical features over time. The results of this study enabled us to understand the degree to which land use is determined by the landscape geography and ecology on the one hand, and by the culture of the people using the land, on the other.

SPATIAL DISTRIBUTION OF ECOSYSTEM SERVICES AS PERCEIVED BY NATURE CONSERVATION PROFESSIONALS AND LAY PEOPLE - AN EXPERIMENTAL STUDY USING FACILITATED WORKSHOPS

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We aimed to investigate the spatial distribution of ecosystem services perceived in protected and adjacent non-protected areas. We analyzed the convergences and divergences in perceptions of two stakeholder categories: (1) professionals working on spatial planning and nature conservation (the "experts") and (2) local leaders not professionally involved, yet potentially interested in nature conservation (the "lay people"). We conducted our research on five study sites in Poland. The study sites differed in size, shape, as well as socio-economic and ecological aspects (e.g. population and land use characteristics or habitat structures). Using the CICES classification, we developed a list of ca. 20 ecosystem services potentially present in the study areas. During 10 facilitated workshops – one with experts and one with lay people on each study site – participants drew polygons of land that they perceived as providing particular ecosystem services. Each workshop aimed at finding a common vision of ecosystem services distribution and exploring the reasoning and argumentation behind particular opinions. As a result, two different ecosystem services maps were prepared for each site, one representing experts' view, and one representing lay people's perceptions. Using GIS software, we measured spatial correlations of various ecosystem services. Subsequently, we analyzed the extent to which experts' and lay people views were convergent in relation to types of ecosystem services and their distribution. As we hypothesized, most of ecosystem services were more widely perceived in protected in comparison with non-protected areas. We conclude



that the spatial distribution of the ecosystem services over protected and non-protected landscape as perceived by different stakeholders is crucial for spatial planning and nature conservation processes at both local and regional level.

THE MODERN CONSERVATION BIOLOGY INITIATIVES IN THE DEMOCRATIC REPUBLIC OF CONGO (DRC): THE EXAMPLE OF THE CONSERVATION OF BONOBOS BY THE NGO MBOU-MON-TOUR (MMT)

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The bonobo (*Pan paniscus*) is an endemic great ape of the Democratic Republic of Congo (DRC) that suffers a rapid decline due to the pressure induced by human demography, the abandonment of taboos on hunting, the economic and political crises, the epidemics and its habitat degradation by deforestation. This species is fully protected in DRC by Congolese laws and is cited in Appendix 12, Class A CITES and in the red list of the IUCN / SSN as « vulnerable » and « in danger ». The Grouping Mbee-Nkuru local communities in the Chiefdom of Batékés North, decided to protect by their own the bonobos populations occupying their surrounding area. To do this, in 1997, these communities have created a Non Governmental Organization (NGO) and asked the Congolese government to offer them a forest concession of 500 square kilometers in the forest-savannah mosaic area about 300 km north of Kinshasa, capital of DRC in order to develop the Bonobo conservation. In this area they promoted new methods of land use and agriculture, guard by themselves the Bonobos populations and developed a participative supervision of the area. In this context, we initiated a study that aimed at simultaneously acquiring the basic knowledge of ecology of the species in this area (population size, habitat use...) and the sociological factors related to this conservation action (factors that led this community to protect this species, but also consequences of this involvement). We also performed the same study on both the bonobos and humans in another reserve managed by the state only to compare the results. This approach that study the ecology but also the human dimension of species protection seems to be a promising way to develop an efficient and modern conservation biology in Africa.

EXPLORING MULTIDISCIPLINARY POSSIBILITIES IN UNDERSTANDING HUMAN-WILDLIFE CONFLICT ALONG A FOREST-AGRICULTURE FRINGE IN THE WESTERN GHATS HOTSPOT IN SOUTHERN INDIA

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Lying at the nexus of farmland and forest, the fringe is a contact zone for people and wildlife. In the tropics, these productive zones are beneficial to wildlife such as pigs, deer, monkeys, elephants and carnivores. In this study, we explore the dynamics of a heavily populated forest fringe in Kerala, India, where extended periods of crop depredations and agrarian distress have resulted in an atmosphere of conflict resulting in retaliatory killings of wildlife and widespread opposition to forest protection. In this multidisciplinary enquiry, we use a mixed methods protocol ranging from Bayesian Belief Networks to oral histories and ethnographic enquiry to interrogate the interlinked components of conflict. Probabilistic networks are used to predict not only ecological suitability of different land use types for conflict, but are also useful in incorporating socio-economic and cultural components, linking decision-making frameworks and evaluating the effectiveness of predictions. Expanding these networks based on ethnographic enquiry shows that in addition to visible causal mechanisms (e.g. crop damage, direct attacks), opposition to wildlife is also a reflection of numerous typically unaccounted costs (e.g. opportunity costs, repercussions on food security), invisible impacts (e.g. emotional distress, poor physical health), historical contingencies (e.g. migration, agricultural choices) and consequent perceptions of distributive justice. Tracing the history of contrasting attitudes towards elephants and pigs in the region, we also emphasize the importance of species level differences especially in relation to their invisible impacts on psycho-social wellbeing. The negligible levels of conflict with indigenous forager-trader communities who live within the forest is in marked contrast to that of marginal farmers along the fringe indicating the critical role of differing expectations of place and lifestyles in determining human-animal relationships.

ECOLOGICAL RESEARCH ABOUT NATURA 2000 FOCUSES MAINLY ON FORESTS AND VASCULAR PLANTS

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Natura 2000 is regarded as one of the most important and extensive nature protection networks worldwide, designated to support long-term survival of Europe's most valuable and threatened species and habitats. Based on the Birds Directive and the Habitats Directive, Natura 2000 is considered the key biodiversity conservation tool in the EU. Currently, the network encompasses 18% of Europe's landmass and over 251 000 km² of marine environment across all 28 EU member states. We conducted a literature review of the Natura 2000 topic using the Web of Science™ database for 1998-2014. We found 682 English-language publications relevant to Natura 2000, with focus areas of ecological (62%), social (21%), and socio-ecological (18%). Our review concentrates on in-depth analyses of the ecological publications. Spain, Poland, Italy and Greece produced the most articles of ecological scope. Scale-wise, the majority of publications focused on a region within a country or a single Natura 2000 site; most represented habitats included forest, undefined, freshwater and grasslands. Plants, abiotic factors, insects and birds were the most commonly-represented research subjects. Low elevation sites were considered more often than were montane sites. There was also an even split between community/guild versus ecosystem approaches, and fewer articles focused on a single species. Quantitative empirical study was the most common method used, followed by modeling and then by qualitative/analytical methods. Future research should investigate alpine, agricultural and marine habitats as well as taxonomic groups such as fish, reptiles and amphibians, and lichens. Furthermore, there are relatively few studies of northern and western Europe, or of EU-wide range, nor have the social and socio-ecological aspects of Natura 2000 been adequately investigated.

POPULATION EFFECTS OF TRANSIENT INDIVIDUALS AND CONSERVATION CONSEQUENCES FOR ENDANGERED SPECIES

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IMEDEA (CSIC-UIB)

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We assess the implications that transient individuals can have on dynamics of local populations, with special attention to vertebrates. Transients are individuals that are detected only once in a population and then disappear. Despite being detected in many studies, the significance of transients for population analysis and the consequences for population stability have never been addressed before. In the capture-recapture (CR) modelling framework, transients have to be analyzed separately to avoid a bias in local survival estimates. Nevertheless, beyond the technical importance of taken this effect into account in survival CR analysis, transients have

also several biological meanings. A transient in CR may result from either an age effect (when newborns are marked) or by movement into the study area by adults or juveniles that is rapidly followed by permanent emigration. Alternatively, transience can also be true mortality (when adults are marked) when costs of first breeding are high and selection filters act on recruiting individuals. The occurrence of transients can be influenced by environmental stochasticity (e.g. increasing transience when conditions are harsh), population features (e.g. density-dependence) or individual covariates (e.g. age). We first assessed how frequent transience is in animal populations and which factors influence its magnitude. We then used stochastic population models to assess how the existence of transients influence population dynamics and the viability in endangered populations.

ROADS AND AFRICAN ELEPHANTS IN A SMALL SOUTH AFRICAN PRIVATE GAME RESERVE: A CALL FOR GREATER UNDERSTANDING OF THE IMPACTS OF ROADS ON SPACE USE OF WILDLIFE

Katherine Orrick

Columbia University

The ecological effects of roads are considered to be one of the most significant sources of ecosystem disturbance. As the human population continues to expand there is an increasing demand for more extensive road systems that overlap wildlife's home ranges. In many instances roads will constrict the movements of the wildlife. It is critical to recognize species true use of space versus available space, especially individuals already in small, protected areas. While many studies have observed the direct effect of road disturbance on wildlife, such as road mortality and fragmentation, few studies have looked at indirect effects, such as noise pollution and visual disturbance. This study analyzes the impact of public roads surrounding Karongwe Private Game Reserve, an 8000ha fenced reserve in the Limpopo Province of South Africa, on a herd of African elephants (*Loxodonta africana*). Six years of elephant data are examined to determine if the bordering roads within 50m of the reserve impact the individuals. GIS and Generalized Linear Mixed Effects models were created based on the distance of elephant locations from different anthropogenic disturbances (public roads, fences, lodges) and natural features (vegetation, rivers, water sources). Home ranges indicate a clear avoidance of the paved roads for all individuals. General trends suggest that public roads negatively impact both the breeding herd and the adult bulls. The research will provide vital information about the future of small, protected areas on large mammals such as elephants. If a species avoids roads due to disturbance, conservation measures must be taken to prevent further human-wildlife impacts and address infrastructure expansion near preserved



lands. The results of this study can contribute to improving development around conservation areas in South Africa as well as refine elephant-inhabited protected areas all over the world.

EVALUATING THREATENED SPECIES RECOVERY PLANS: PROPOSED FRAMEWORK AND UNIVERSAL LESSONS FOR MONITORING AND EVALUATION

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El Colegio de la Frontera Sur

Benjamin MORALES-VELA, El Colegio de la Frontera Sur

Recovery planning of threatened species is a complementary approach to establishing protected areas for biodiversity conservation. It is also incorporated into international treaties and the national legislation of several countries. Research and practice have shown that recovery planning is a very challenging task given the complexity of its ecological, socioeconomic, political and managerial aspects. One of the weakest aspects is the lack of a universal methodological framework and adequate criteria by which to assess recovery success. In this presentation, a monitoring and evaluation framework is illustrated with practical application in the Caribbean Manatee recovery plan in Mexico. A participatory evaluation framework was employed with support of the federal agency in charge of implementing recovery plans and the national manatee recovery team. Evaluation objectives comprised: 1) assessment of recovery plan progress and main achievements; 2) estimation of the degree of plan implementation towards meeting goals and objectives; 3) definition of the priority recovery actions and budget for the next five years; 4) establishment of the management mechanisms to strengthen coordination of the manatee recovery team and other stakeholders and 5) define a new five-year period work plan. Forty-four evaluated recovery actions were classified into six categories: species management, habitat restoration, protection, knowledge, culture, and operational management. Evaluation results indicated that 41% of recovery actions are behind schedule or remain to be addressed, 45% show medium progress and 14% have recorded significant progress. A discussion will address the facilitators and barriers that most influence recovery plan progress. General lessons were drawn from the analysis of this case study and comparison with similar evaluations in other countries.

LOCAL PEOPLE PERCEPTION ON FOREST GOVERNANCE IN PROTECTED AREAS IN NIGERIA

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Despite the fact that for a long time many local communities contributed to the conservation and protection of biological

resources, only recently has their importance in natural resources protection and the need for deriving benefits from protected areas has been recognised. Survey of the villageges around four Nigerian National Parks was carried out to determine the peoples' perception of purpose of establishment of Park and protection responsibility. Questionnaire were administered to respondents to elicit information from the villagers around the parks. CRNP(Cross River;985), Gashaka-Gumti(GGNP;1079);Kainji-Lake(KLNP;1134) and Old Oyo(OONP;1013) Natinal Parks. The result shows that many of the respondents in CRNP knew the purpose for the establishment of the Park(64.6%), while majority of the respondents in GGNP (66.7%), KLNP (51.1%) and OONP (57.3%) claimed not to know the purpose for the Park establishment. All the respondents in CRNP (100%) and more than half of the respondents in GGNP (65.3%) and KLNP (63.9%) reported that Park only advocates for the non intervention of the Park reources, while in OONP 57.8% reported that the Park authourity do request for their participation in the management of the Park. Respondents in CRNP indicated that the Park should be protected by the community because the land is closer and belongs to them. Respondents in GGNP and KLNP indicated that the Park should be protected by the Government that owns it. The result of the Chi-square showed that there was significant relationship ($p < 0.01$) between age, sex, occupation, income, educational qualification and the peoples perception on the parks protection responsibility. The issue of forest governance is an important aspect of the conservation which the people must be involved and hence the need to involved the local people in the management of the Protected areas

NEGATIVE INSECTICIDE IMPACTS ON POLLINATORS ARE REDUCED IN COMPLEX SMALL-SCALE AGRICULTURAL LANDSCAPES

Mark Otieno

Embu University College

Chanpreet Sheena SIDHU, Department of Entomology, University of California, Riverside ; Ben Alex WOODCOCK, NERC Centre for Ecology and Hydrology ; Andrew WILBY, Lancaster Environment Centre, University of Lancaster ; Ioannis N. VOGIATZAKIS, School of Pure and Applied Sciences, Open University of Cyprus ; Alice L. MAUCLINE, Centre for Agri-Environmental Research, University of Reading ; Mary W. GIKUNGU, Zoology Department, National Museums of Kenya ; Simon G. POTTS, Centre for Agri-Environmental Research, University of Reading

Pollinators face many challenges within agricultural systems due to landscape changes and intensification which can affect resource availability that can impact pollination services. This paper examines pigeon pea pollination and considers how



agricultural intensification affects the abundance of bees characterized by species guilds. The study was conducted on six paired farms across a gradient of habitat complexity based on the distance of each farm from adjacent semi-native vegetation in Kibwezi District, Kenya. The study revealed the strongest relationships between fruit set and bee abundance to be with the carpenter bee, social bee and solitary bee guilds, which are among the most abundant bees visiting pigeon pea flowers in this system. We found that farms which do not use insecticides in farm management, but are in close proximity to natural habitat have greater bee guild abundance, but at further distances, overall abundance is reduced with or without insecticide use. At 1 km landscape radius, the complexity of habitats but not patch size had a positive impact on the abundance of cavity nesting bees and mason bees, which can be attributed to the interspersed of the small-holder farms with semi-native habitats across the landscapes producing mosaics of heterogeneous habitats. Our findings provide the foundation for conservation efforts by identifying which bee guilds pollinated pigeon peas. From this study, we suggest managing the floral and nesting resources that would best support the most abundant crop pollinators, and also reducing insecticide application to the crop.

ECONOMIC VALUATION OF RICE CROP DAMAGE BY RED-BILLED QUELEA AND OTHER GRANIVOROUS BIRDS ON A RURAL IRRIGATION SCHEME IN WESTERN KENYA

Nickson Otieno

National Museums of Kenya

A MUTATI, National Museums of Kenya ; C AKOTH, National Museums of Kenya ; D OGWANG, Ahero Rice research Station ; P ALARO, Ahero Rice research Station

The study, conducted at Ahero Rice Irrigation Scheme in western Kenya from 2011-2012, aimed at estimating economic losses incurred by farmers from damage of rice crop by Red-billed Quelea *Quelea quelea* and other granivorous pest birds, assessing the implication of this for sustainable food security and exploring viable options to mitigate losses to pest birds. Pest bird densities were estimated from through sampling along varying-width line transect with spatial and temporal replications and their feeding rates determined per-season and per annum for valuation of rice damage rates. Total rice crop loss was then quantified from bird density and feeding rates for each bird group, calculated per season and annually. We then valued economic damage as a factor of the rice crop loss and prevailing paddy producer market price and finally estimated net economic loss by subtracting the cost of hiring labour to scare birds from damaging mature crop. The period of bird damage was restricted to the period between crop-maturity to harvest. Estimated total annual loss was 407 tonnes or 7.7% of potential yield for the whole

irrigation scheme excluding bird scaring costs. This was equivalent to Ksh. 40.7 million annually at 1 USD=87 Ksh. representing a 31.1% loss of net income. Inclusive of bird scaring costs, annual losses were Ksh. 20,763/ha equivalent to 39.5% of net income. Estimated annual rice damage due to *Q. quelea* was more than that due to the other granivorous birds combined (215 compared to 192 tonnes). We concluded that this loss magnitude considerably undermines efforts to reduce rural poverty and attainment of sustainable food security in the western Kenya region. In addition to the crop-guarding method, reducing losses from damage by the pest birds requires integration of several measures that have proved successful elsewhere, adoption of improved farming technologies and planting recently developed higher yielding rice varieties.

133 ASSESSING THE POTENTIAL OF INTERFAITH ENVIRONMENTAL NETWORKS IN CONTRIBUTING TO ENVIRONMENTAL CONSERVATION IN EAST AFRICA

Allen Ottaro

Catholic Youth Network for Environmental Sustainability in Africa

Since the 1986 gathering of leaders of the world religions in Assisi, Italy, religious communities have worked together on a variety of biological conservation issues from the perspectives of their particular sacred texts and traditions. These religious communities are regarded increasingly as key stakeholders in conservation efforts. Within the last two years, three faith and environment networks have been launched in Kenya, Tanzania, and Uganda, the three largest countries belonging to the East African Community. These networks seek to contribute to environmental conservation by influencing national, regional and international policy, education, awareness among their faithful, and sustainable land management practices. The contributions these interfaith networks make to the existing conservation efforts in East Africa will be underscored with focus on climate change, loss of biological diversity, and a rapidly growing population.

95" FISH, WATERWAYS AND ROADS - THE CHALLENGES OF COMBINING HYDROLOGY AND DYNAMIC SYSTEMS WITH STATIONERY AND STATIC INFRASTRUCTURE

Fabrice Ottburg

Wageningen UR, Alterra



Matt BLANK, Western Transportation Institute (WTI), Montana State University ; Paul WAGNER, Washington State Department of Transportation, Environmental Services Office.

This presentation focuses on fish that use fresh-water systems and provides solutions to minimise the effects of roads and road-stream crossings on fish and fish habitat. In order to complete their life cycles, fish need to move throughout waterways in their range to reach their spawning grounds, rearing areas or food resources. Streams providing necessary habitat are often in close proximity to or crossed by roads and railways, which can lead to habitat degradation and barriers fish movement. By degrading and isolating habitats, barriers can decrease fish populations and in some cases contribute to the total loss of a species. Steps typically taken to create and protect roads near streams include straightening channels or placing very large rocks or concrete reinforcement to stabilise banks. These generally result in loss of habitat and potential impacts to fish and wildlife populations. The dynamic character of streams and rivers and their changing nature needs to be accommodated in planning, expanding or operating transportation infrastructure where roads and other linear infrastructure cross water or occur in floodplain. This is necessary not only to minimise direct ecological effects to habitat and fish, but also to help reduce the potential damage to infrastructure from flooding, erosion and channel movement. Damage to infrastructure can often lead to additional environmental impacts. New infrastructure should avoid waterways where feasible and any crossings that are needed should be designed to allow the natural flow and function of the waterway. Existing road crossings that are barriers to the movement of fish should also be modified to be more natural and improve connectivity for fish and the support of natural stream function.

PARTICIPATORY ESTABLISHMENT OF FISH CONSERVATION ZONES IN THE MEKONG RIVER

Sinsamout Ounboundisane

FISHBIO Laos

Samuel LESLIE, FISHBIO Laos ; Erin LOURY, FISHBIO ; Shaara AINSLEY, FISHBIO ; Harmony PATRICIO, Griffith University [INSTITUTE] FISHBIO Laos

Human communities in the Mekong River Basin depend on fishing for food and income, but many species are declining. Because of the river's central role in livelihoods, many villagers support fish conservation. The national fisheries law in Lao PDR gives communities authority to establish Fish Conservation Zones (FCZs). While many community members possess relevant local ecological knowledge, they typically do not have the technical knowledge needed to design the FCZ effectively or the political knowledge to engage the government for formal establishment of new FCZs. We supported three villages

along the Mekong mainstream with the establishment of FCZs using a participatory approach and Knowledge, Attitudes, Practices (KAP) surveys. The FCZs were located specifically to protect the threatened Jullien's golden carp (*Probarbus jullieni*). Through consultations the communities helped design the FCZs and structured fishing restrictions based on what was feasible for their lifestyle. At three points during the project, a KAP survey was conducted with a subset of villagers to assess, 1) Local ecological Knowledge related to fish, aquatic ecosystems, and natural resource law; 2) Attitudes towards fish conservation strategies, government and NGO collaboration on local-level resource management; and 3) Current Practices related to aquatic resource use, food sources, income sources, enforcement of existing laws, and management strategies. 20 people were interviewed in each of the three villages, representing primary resource users (fishers), village elders, village committee members, and women's union members. Results from the initial survey revealed a strong knowledge of fish biology and a high level of support for conservation. The communities developed a strong sense of pride in their collective achievement, and unexpectedly chose to keep the areas closed to fishing year-round. This project can serve as a useful model for harmonizing human resource needs and conservation.

PSYCHOPHYSICAL ASSESSMENT OF GIANT PANDA HEARING SENSITIVITY: IMPLICATIONS FOR CONSERVATION AND MANAGEMENT

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Human generated noise may negatively impact wildlife, however the nature and severity of impacts are dependent upon the interaction of environmental, acoustic, and biological factors. Because regulatory and ethical constraints typically preclude controlled noise exposure experimentation with conservation-dependent species, there is a need to develop species-specific predictive models of disturbance. Fundamental to this approach is the inclusion of data describing a species' sensory ecology, including hearing sensitivity. As a first step towards developing a sensory-based model of noise disturbance in giant pandas, we have developed an audiogram for the species. We used psychoacoustic techniques to measure behavioral hearing thresholds of 5 captive giant



pandas between 0.125 kHz and 50 kHz. Our results suggest that giant pandas have good hearing sensitivity between 8 and 14 kHz, with best sensitivity centered at 12.5 – 14 kHz. Hearing sensitivity declined by about 8 dB per octave from 8 kHz to 125 Hz, 2.3 db per octave from 8 kHz to 1 kHz, and by 7.5 dB per octave from 12.5-50.0 kHz. Functional hearing was measured as high as 50 kHz, and we developed estimates of upper limits of hearing by extrapolation. These results suggest that panda hearing sensitivity is similar to that of other terrestrial carnivores, however, panda hearing thresholds above 16 kHz were significantly lower than those of the polar bear. Integrating sensory data, along with a broader understanding of how reproductive condition, body condition, and habitat characteristics act in synergy to produce both species typical noise reception and the range of potential responses to noise, is essential for developing a biologically rational, context-based model of noise disturbance.

ID 68 MANAGING INVERTEBRATE DIVERSITY IN CONTRASTING FOREST ENVIRONMENTS: LESSONS FROM NATURAL FORESTS IN CANADA AND IRISH PLANTATIONS

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Typically, approaches to sustainable forest management that support biodiversity focus on maintaining large scale habitat heterogeneity (between forest stands) or promoting diversity of plants, mammals or birds. With the exception of saproxylic species, invertebrates are largely overlooked despite their importance to ecosystem function and resilience. This paper presents spider and beetle diversity data from contrasting managed forest types in the boreal mixedwoods of Alberta, Canada, and mixed spruce-ash plantations across Ireland, collected using the same sampling methods (pitfall traps and Berlese-Tullgren funnels). Analyses examine common responses in spider and beetle diversity to forest management and determine impacts on functional traits across both regions. Results are discussed with a focus on incorporating the needs of invertebrates in sustainable forest management in these contrasting forest environments.

SHORT TERM EFFECTS OF EARLY-SEASON FIRE ON HERBACEOUS COMPOSITION, DRY MATTER PRODUCTION AND SOIL FERTILITY IN NIGERIA'S GUINEA SAVANNA

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Friday Joseph ONUCHE, University of Ilorin ; Clement Oluseye OGUNKUNLE, University of Ilorin ; Oludare Oladipo AGBOOLA,

University of Lagos ; Augustine Onwuegbukiwe ISICHEI, Obafemi Awolowo University

The ecological impact of fire regimes on plant diversity and soil fertility has become subject of intense discussions, especially in savannas where recurring incidences are common. This study assessed the short-term effects of early-season fire on herbaceous composition, dry matter yield and soil fertility in the guinea savanna belt of Nigeria. Data on ground cover, dry matter yield (DMY) and concentration of C, N, P, K, Ca and Mg were collected from 10 delineated subplots in the burned and unburned zones of four sites after annual wildfire had occurred. Ground cover of species was significantly higher in the burned zones and increased progressively from January through April (dry season). Eleven (11) herbaceous species, in addition to 2 tree seedlings, occurred and were distributed among families of Asteraceae, Cyperaceae, Fabaceae and Poaceae. *Digitaria nuda*, *Brachiaria lata*, *Aeschynomene indica* and *Daniellia oliveri* were limited to the burnt zones while *Cyperus tuberosus*, *Mariscus alternifolius* and *Rottboellia cochinchinensis* were restricted to the unburned zones. Dry matter yield range between 0.32 g m⁻² (*Desmodium tortuosum*) and 52.96 g m⁻² (*Megathyrus maximus*). Average biomass was higher in the burnt sites (35.86 g m⁻²), but not significantly different from the unburned sites (28.42 g m⁻²). Soil C, N and P decreased (positive deterioration index - DI), while K, Ca and Mg improved (negative DI). No significant differences exist for soil nutrients in the burned and unburned zones of the sites. The study concluded that burning altered growth (ground cover) and composition of species in a short-term, but may significantly influence soil nutrient dynamics on a long-term, especially with recurring fire events.

BUILDING RESILIENCE WITH FOREST: INDIGENOUS KNOWLEDGE SYSTEMS IN SOUTH WEST NIGERIA

Oyetayo Oyelowo

Forestry Research Institute of Nigeria

Adegboyega ADURADOLA, Federal University of Agriculture ; Olayide OYELOWO, PT Skills Limited ; Akin OLOKETUYI, Forestry Research Institute of Nigeria

Local communities in Nigeria have successfully conserved natural resource of interest to them. This study was conducted to investigate existing indigenous knowledge systems adopted by 5 communities (Aye, Ibere, Oba-ile, Igbo-Olodumare and Igbara-oke) in South West Nigeria, where Igbo-Gbopo, Igbo-Ile, Igbo-Oba, Igbo-Olodumare and Igbo-Olua sacred groves are located respectively. Questionnaires were administered randomly to custodians (16), community heads (40) and residents (94). The results showed that the respondents were 72.82% males and 27.18% females. Local people, community leaders and custodians share the responsibility of protecting the sacred groves. Majority of respondents see the groves



as their heritage and protect it by not going against taboos. They all affirmed that the biodiversity within the groves are still intact because knowledge is being transferred to the next generation mainly through the parents. The indigenous knowledge has been preserved, transferred or adopted and adapted in all the communities. Apart from spiritual purposes, Aye community adopted the strategy of protecting the forest to the roles of the grove in providing more dependable source of water. Ibere community maintains the grove against heavy winds into the community (windbreaker). Laws and punishment varies among the sacred groves, but all affirmed that punishments of the intruders go beyond physical, but affliction through deities. Conservation policies should therefore acknowledge and incorporate values and local practices to reduce loss of both cultural and biodiversity. The country's ability to build and mobilize knowledge is essential for sustainable development.

DEVELOPING AN APPROACH FOR THE INTEGRATION OF FOREST BIODIVERSITY CONSERVATION INTO FOREST MANAGEMENT PLANNING IN TURKEY

Deniz Özü

Nature Conservation Centre

Uğur ZEYDANLI, Nature Conservation Centre ; Ayşe TURAK, Nature Conservation Centre

Forest ecosystems comprise nearly 65% of all terrestrial biodiversity worldwide but 90-95% of forests do not have any protection status. Therefore the future of forest biodiversity greatly depends on how unprotected forests are managed. One effective way to conserve biodiversity in the "managed forests" is by integration of biodiversity conservation into the forest management system. More than 27% of the land area of Turkey is within the forest regime, owned by the state and managed by the General Directorate of Forestry (GDF) through a 10-20 years cycle of planning and management by forest management directorates (FMD). Nature Conservation Centre has been working in collaboration with GDF since 2009, to develop a new approach for integration of biodiversity into forest management plans. The resulting work was applied in four pilot FMDs (Istanbul–Demirköy, Muğla–Marmaris, Trabzon–GümüÅ'hane, and Artvin–Å'avÅ'at). Our approach utilized five main steps for each FMD: i) determining of target species and ecological processes to be used in integration, ii) enhancement of the distributions of the select biodiversity targets by modeling of presence records, iii) creating a conservation zone map of the planning units using the distribution models and conservation goals for each biodiversity target, iv) evaluation and finalization of the conservation zones with the foresters in FMDs, v) preparing silvicultural prescriptions for conservation zones (in forest stand scale). In this presentation we submit the general outline of our approach and the results of the pilot studies,

which led to establishment of a total of 92,431 ha. of protected forest areas out of 782,093 ha. total area (12%) of four FMDs. No forestry practice is allowed in the core zones (3%) and a biodiversity-focused forestry is planned in the buffer zones (9%). A nationwide integration can create ~400,000 ha. of core conservation zones and 4,000,000 ha. of buffer zones within managed forests of Turkey.

ISCHIA SUBMARINE CANYONS, A CRITICAL HABITAT FOR CETACEANS ENDANGERED SPECIES

Daniela Silvia Pace

OCEANOMARE DELPHIS ONLUS

Angelo MIRAGLIUOLO, OCEANOMARE DELPHIS ONLUS ;

Barbara MUSSI, OCEANOMARE DELPHIS ONLUS

There is support within the international community for special consideration to be given for marine areas that are deemed significant ecosystems for particular species. Within Italy, Ischia Island is already acknowledged as a significant coastal/marine ecosystem, and habitat for seven cetaceans species, and is given special status through Regno di Nettuno Marine Protected Area. The region has been listed in the IUCN Cetacean Action Plan as a critical habitat for the endangered short-beaked common dolphin (*Delphinus delphis*) Mediterranean subpopulation, giving strong arguments for specific management strategies to be developed and applied for species that rely on this region for important biological processes (i.e. feeding/breeding). Herein, we present evidence that common dolphins occur year-round in the area (characterized by a submarine canyon system and high biodiversity), in contrast to other Mediterranean regions, providing also data to support the hypothesis that they use this region as a calving and nursery area. Observations of *D.delphis* were made in 2000-2013. We analyzed spatial patterns in occurrence and distribution, relative abundance, group size and composition. There were 62 encounters with 2222 common dolphins in a region corresponding to the central heads of two canyons, within a wide range of depth and middle-high slope. Common dolphins were predominantly sighted in groups containing ≤ 50 animals, frequently including immature individuals (juveniles/calves/neonates). The regular occurrence of *D.delphis* in Ischia waters is probably the result of a combination of factors, including prey availability and the need to meet the energetic demands related to calving and lactation. The consistent use of these waters by the species is of notable importance given the apparent susceptibility of the Mediterranean subpopulation to anthropogenic effects. Real conservation actions toward common dolphins around Ischia remains an issue.



ASSESSING THE SPATIAL EXTENT OF WOLF-DOG HYBRIDIZATION IN REAL-TIME AND AT A POPULATION LEVEL USING NON-INVASIVE DNA SAMPLING

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The crossbreeding between wild species and their domestic counterparts when followed by the introgression of domestic genes into the wild population may lead to disruption of local adaptations or genetic homogenization of the two gene pools. Recently, sporadic but spatially spread reports of wolf-dog hybridization events across European populations have led to a growing conservation concern. Yet, understanding the conservation and management implications of this process requires, for instance, knowing the spatial extent of this process at the population level; which remains largely unknown. During the 19th century, European wolf populations have suffered an intense regression, persisting only in some isolated regions, as in Northwestern Iberia, where the population persisted in a human-dominated landscape. In this work, we focused on assessing the geographical extent of hybridization in this region where sporadic hybridization events have been reported. This was accomplished through a non-invasive genetic survey of a 5000 km² area, covering the territory of 13 packs. Our results revealed a low hybridization rate between the two taxa (5%) and a clear differentiation between the two gene pools. Interestingly, the detected hybrids were found spread throughout the study area. Further, the identification of two distinct and spaced home-packs of two hybrids shows the spatial component of hybridization events in the study area. The results showed a previously unseen scenario of multiple and widespread hybridization events. However, they also support the hypothesis that wolf populations can present overlapping distributions with their domestic counterparts without having high hybridization rates or similar gene pools. Implications of our results are substantial for the management of this process, for instance to design and implement

management interventions, and therefore we recommend to continue improving our knowledge on the underlying process of hybridization dynamics.

ECOLOGICAL AND BIOLOGICAL CHARACTERISTICS EXPLAIN THE RESPONSE OF SPECIES TO RECENT CLIMATIC CHANGES

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Species have evolved to live within certain temperature ranges, and many of them might simply be unable to adapt to the rapidly changing, probably unsuitable new climatic conditions and thus will be threatened with extinction. A variety of studies have stated that species displaying certain intrinsic characteristics are more vulnerable to extinction to climate warming than others, and authors have often assigned species to risk categories according to these characteristics based on expert opinion. However, the assumption of a relationship between species' characteristics and their response to climate change has never been validated against observed data. In this study we performed a meta-analysis of documented (published) responses of mammals and birds to past climate change to relate changes in climatic variables, such as annual temperature and annual precipitation, to changes in geographic distribution, abundance, body size, time of migration, and other life-history traits of mammal and bird species globally. We conducted a statistical analysis on the relationships between the type of response and each selected trait by building partitioning classification models and multinomial logistic regressions, and we found that intrinsic characteristics like activity patterns and reproductive traits play an important role in determining the responses of mammals, while those of birds depend primarily on external factors like the extent of the breeding range and the temperature experienced by the species in the area in which they live. To date, this is the first study investigating the quantitative relationship and the causality between biological and ecological characteristics of birds and mammals, and their observed responses to climate change. Additionally, this study may provide a data-driven validation of the expert-based criteria so far used to assess extinction risk from climate change of species based on their intrinsic characteristics.

ID65 CAN OPPORTUNISTIC OCCURRENCE RECORDS IMPROVE THE LARGE-SCALE ESTIMATION OF ABUNDANCE TRENDS?

Joern Pagel

University of Hohenheim



Barbara J. ANDERSON, Landcare Research ; Robert B. O'HARA, BIK-F ; Wolfgang CRAMER, IMBE ; Richard FOX, Butterfly Conservation ; Florian JELTSCH, University of Potsdam ; David ROY, NERC Centre for Ecology & Hydrology ; Chris D. THOMAS, University of York ; Frank M. SCHURR, University of Hohenheim

Data on spatio-temporal variation and trends in population abundance form a cornerstone of biogeography and also an important criterion for the assessment of a species' conservation status. Citizen-science projects can be a valuable data source, where in particular opportunistic occurrence records are collected in high numbers and across large geographic areas. While the interpretation of these data is usually handicapped by inhomogeneous sampling effort, they can still have the potential to inform about abundance variation, in particular when combined with data from more systematic surveys. A particularly well suited approach for the integration of data from multiple sources is provided by hierarchical Bayesian modelling techniques. We present a model framework that links annual population densities on a spatial grid to both long-term count data and to opportunistic occurrence records as they result from citizen science programs. Specific observation models for both data types accommodate uncertainties at all stages of the link between observational data and the modelled abundance and account for differences in the structure and quality of data from various sources. In a case study we combined opportunistic occurrence records from the British Butterflies for the New Millennium (BNM) project with systematic transect counts from the Butterfly Monitoring Scheme (UKBMS) for the estimation of long-term abundance dynamics across the range of the Gatekeeper (*Pyronia tithonus*) in Great Britain. The application of the hierarchical observation model facilitates the estimation of variation in abundances across space and time and thereby improves our ability to detect, partly opposing, regional trends in different parts of the butterfly's range. These spatially comprehensive estimates of abundance dynamics from citizen science data have not only implications for conservation monitoring but can also enhance the empirical basis for basic ecological and biogeographic research.

WHAT MOTIVATES CITIZENS TO TAKE PART IN THE MANAGEMENT OF AN INVASIVE NON-NATIVE SPECIES? THE CASE OF TREE MALLOW CONTROL ON THE ISLANDS OF THE FIRTH OF FORTH, SCOTLAND

Marie Pagès

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Invasive Non-Native Species (INNS) are seen as a major driver of environmental change and INNS managers increasingly seek to engage citizen volunteers in control and monitoring activities.

Because INNS management often require long-term control and surveillance, it is particularly important to understand why volunteers initially take part as well as their reasons for staying involved over time. We explore volunteers' motivations in the case of the SOS Puffin project, a seabird conservation initiative aiming to manage the invasive tree mallow (*Lavatera arborea*) on the islands of the Firth of Forth in Scotland. Taking a mixed qualitative and quantitative approach, we scope volunteers' motivations at two distinct points in time and examine changes in motives across the group of volunteers and for each individual participant. Preliminary results show that volunteers first got involved to contribute to a good cause and to help the puffins nesting on the islands. However, they also expressed self-interested motives, notably the desire to have a unique experience and to be in and learn about nature, and the enjoyment of other volunteers' company. These aspirations were positively met by specific elements in the project's social and environmental context, e.g. the views and wildlife on the islands and the presence of like-minded and knowledgeable volunteers. Longer term participants evoked the satisfaction of seeing progress and a sense of duty towards a well-organised project and a respected leader. The example of SOS Puffin, a volunteer-based initiative with remarkable success, illustrates the key role of special environments (uninhabited islands) and iconic species (the puffin) in drawing people towards conservation activities such as INNS management. It also shows the importance of the project organisation in keeping volunteers on board, particularly a strong leadership and an environment favourable to social interactions and learning.

HUNTING FOR ALIENS: A CONCEPTUAL FRAMEWORK TO ASSIST STAKEHOLDER ENGAGEMENT IN THE MANAGEMENT OF INVASIVE NON-NATIVE SPECIES.

Marie Pagès

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Invasive Non-Native Species (INNS) are seen as a major driver of environmental change. Top-down eradication programmes have proven effective at controlling certain INNS in insular systems but transposing such approaches to a mainland context may be less successful without the collective effort of local eyes and hands in detecting, controlling and monitoring INNS in the long term. Stakeholder involvement in INNS management can help deliver conservation objectives and motivate local communities to engage with and care for their natural environment. However, we need to better understand the factors that influence the social and ecological outcomes of volunteer-based INNS management. Using exploratory interviews with project officers and volunteer group coordinators in Great Britain, we propose a conceptual



framework mapping and linking the social, organisational and environmental factors underpinning stakeholders' engagement. Characteristics of the social context, such as leadership, land tenure and local views on INNS and nature conservation, influence the success of stakeholders' mobilisation. More surprising however is the role of biophysical conditions in local engagement, in particular the abundance of INNS, the proximity of the invasion and the technicality and physicality of control activities. Programme managers should take into consideration the specific social and ecological context of the project when designing approaches to stakeholder and community engagement. Importantly, environmental conditions and material aspects associated with hands-on control and surveillance activities should not be overlooked. Adapting public engagement and capacity building interventions to the characteristics and changing condition of the target species and habitat could therefore help recruit and retain a voluntary workforce.

ASSESSMENT AND MANAGEMENT OF MARINE LITTER POLLUTION IN THE SLOVENIAN PART OF THE ADRIATIC SEA

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Marine litter has been defined as one of eleven descriptors evaluating good environmental status of marine environment under the EU Marine Strategy Framework Directive (MSFD, 2008/56/EC). Water Framework Directive (WFD 2000/60/EC) recognized litter as an important pressures that needs to be addressed as well. In 2013 EU Member States reported on first evaluation of status of marine environment according to Article 8 of the MSFD. Marine litter quantities and distribution in Slovenia were estimated for all required indicators with most comprehensive data on beach litter coming from clean-up activities and floating microplastic. Slovenia was one of the few countries in the Mediterranean sea with data set long enough to evaluate and report on trend of beach litter quantities. Data on beach litter weight from January 2009 until December 2014 showed that quantities of litter on the Slovenian coast were decreasing from 0.23 kg/m in 2009 to 0.09 kg/m in 2014. The negative trend of weighted beach litter could be attributed to the successful combination of regular monthly clean-up and sporadic raising awareness activities performed by public authorities, research institutes and non-governmental organizations. Plastic was most commonly found material on all locations. First assessment on floating microplastic (<5mm)

quantities in the Slovenian sea showed strong pollution with microplastic litter, ranging from 3.000 particles/km² to 140.000 particles/km². New measures dedicated to eliminating marine litter inputs at sources are identified in new Programme of measures in 2015 under MSFD process. Efficiency of existing measures is also presented in the article.

SUPPORTING A SCIENCE-BASED DIALOGUE AROUND WIDESPREAD SMALL HYDROPOWER DEVELOPMENT IN BRITISH COLUMBIA, CANADA

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The last decade has seen renewable electricity technologies surge as globally significant components of many regional and national energy portfolios. However, producing renewable electricity at scale requires that networks of many individual projects distributed over large areas be developed. Despite their low-carbon footprint, the potential for such networks to generate cumulative ecological effects, in addition to site-level impacts, challenges traditional environmental assessment and fuels rancorous public debate about the value of renewable energy. British Columbia (BC), Canada has a progressive carbon-neutral mandate as well as tremendous small hydropower potential, with >7000 technologically feasible development sites identified throughout the province. Using potential development locations, we created a non-technical web-based tool that melds strategic land use planning with cumulative impact assessment to quantify tradeoffs between renewable energy development and biodiversity conservation in BC. The tool is aimed at elevating the entrenched dialogue between diverse stakeholders, including private energy and public utility companies, government agencies, First Nations groups, and environmental organizations in the region. The web-tool provides the opportunity for users to explore a range of alternative scenarios that attempt to balance energy gains and species conservation, and highlights that despite sharp tradeoffs, energy-biodiversity conflicts can be partially mitigated by strategic spatial planning. While complex, time-consuming, and challenging, creating a stakeholder-driven framework for quantifying cumulative effects of renewable energy holds promise for identifying common ground as debate surrounding low-carbon energy production escalates.

INVASIVE MAMMALS IMPACT AT A BIODIVERSITY HOTSPOT SCALE: THE CASE OF FERAL CAT ON THE NEW CALEDONIAN ARCHIPELAGO

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Biological invasions represent one of the main threats to biodiversity, especially on islands where invasive are the first cause of biodiversity loss. Alien mammalian predators have been responsible for numerous island species extinctions worldwide, and feral cats are among the most successful and damaging invaders due to their generalist predatory behavior and high reproductive success. This study focuses on cat predation at a biodiversity hotspot scale, the New Caledonia archipelago (south Pacific) harboring numerous endemic and endangered species. Feral cat have invaded these islands from seashore habitat to highest altitude forest (1628m). Cat diet was studied through scat analysis, collected on a wide range of representative habitats and during different seasons. We collected more than 6000 cat scats from 14 sites, during 4 to 6 sampling sessions and over 1 or 2 years. To understand this top predator impact on an ecosystem originally freed from mammal predators, we evaluated (i) cat population consumption of endangered prey species and also (ii) cat density estimation from capture-mark-recapture data with a

camera-traps set. At the archipelago scale cats preyed mainly upon introduced rats (Frequency of Occurrence, FO: 78%), that could increase cat population dynamics and their impact on native prey. However cats preyed strongly upon reptiles (FO: 40%) and flying foxes (FO: up to 30% in some humid forests), most of them being endemic, and petrels (FO: up to 25% in some mountain areas). However cat predation and its impact varied according to the different habitats where conservation management will be adjusted according to these differences. This study also confirmed the high diet plasticity of feral cat and highlighted original cat predation patterns upon alien and endemic species. This study will give recommendations to prioritize management and conservation strategies in a region where such actions are urgently needed.

108. ON-LINE TOOL TO MONITOR FIRES IN GLOBAL PROTECTED AREAS

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Fires are central in the ecology of tropical ecosystems: they can lead to habitat degradation but also help maintain habitat functionality and biodiversity in fire-adapted ecosystems. For these reasons park managers need up-to-date information on fire occurrence to take appropriate decisions in their day-to-day management (e.g. control of threats, law enforcement) as well as long-term planning. Field surveys and patrolling activities are key to effective management, but may not always be sufficient to monitor fires over large areas or long periods. Satellite observation offers a unique means to assess fire dynamics and it has been extensively used to map and understand the effects of burning over large regions and also globally. Although satellite products have been made more accessible, their use in conservation still requires specific processing and analysis capacity, which is not always available to end-users, like park managers. The aim of the on-line Fire Monitoring Tool we developed is to facilitate the use of EO products to assess fire activity and support conservation and decision making. We process MODIS fire products, distributed by NASA-FIRMS and University of Maryland, to provide near-real time and long time-series information of fire occurrence in and around the sites listed in the World Database on Protected Areas (WDPA, UNEP-WCMC). In addition to this we include conservation areas from other sources, forest reserves and concessions that are key to conservation. For a selected area of interest the tool calculates on-the-fly statistics, indicators and maps of fire using web-services; the fire metrics include fire density, intensity and the burned area extent in the main vegetation classes. The tool is being used in protected areas



and conservation programmes in support of decision making and planning. As many illegal activities, like poaching, are associated with fire, this tool can also be used to monitor human-induced threats and pressures.

DISTRIBUTION AND HABITAT PREFERENCE OF RED PANDA (AILURUS FULGENS FULGENS) IN JUMLA DISTRICT, NEPAL

Saroj Panthi

District Forest Office

Reliable and sufficient information regarding status, distribution and habitat preference of red panda (*Ailurus fulgens fulgens*) is lacking in Nepal. The research activities on red panda in the mid-western Nepal are very limited, so the status of red panda in the region is quite unknown. The study conducted during May, 2013 in three Village Development Committees (VDCs) namely Godhemahadev, Malikathata and Tamti of Jumla district was an important step for providing vital information including distribution and habitat preference of this species. The study included the reconnaissance, key informants survey, interviews and consultation for the most potential area identification, opportunistic survey comprising the direct observation and indirect sign count method for the presence and distribution, habitat assessment consisting vegetation sampling and ocular estimation. The study revealed the presence of red panda in three forests namely Bahirepatan, Imilchadamar and Tyakot of Godhemahadev, Tamti and Malikathata VDCs respectively. The species was found distributed between 2880 and 3244 m with an average dropping encounter rate of 1.04 per hour of searching effort and 12 pellets per dropping. Red panda mostly preferred the habitat in the elevation range of 2900 - 3000 m with southwest facing steep slopes (36° - 45°), associated with water sources at the distance of ≤100 m. Trees such as *Acer* spp., *Betula utilis* and *Quercus semecarpifolia*, shrub species of *Elaeagnus parvifolia*, *Drepanostachyum* spp. and *Jasminum humile*, and the herbs like *Polygonatum cirrhifolium*, *Fragaria nubicola* and *Galium asperifolium* were found to be the most preferred species by red panda. The red panda preferred the habitat with dense crown coverage (>20% - 100%) and 31% - 50% ground cover. Fallen logs (39%) were the most preferred substrate used for defecation.

BEE RICHNESS RESPONSE TO WARMING CAN BE MODIFIED BY LANDSCAPE STRUCTURE

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Climate change is expected to affect species communities. The effect of climate change on wild bee communities is of major concern since loss or decline of bee species could imperil the provision of pollination service. Meanwhile, habitat loss and fragmentation are considered threats to wild bees' populations as well. However, the interactive effects of climate and landscape structure on wild bee communities remain unknown. In the present study we aim to understand how the structure of agricultural landscapes can alter the effect of weather on wild bees. More specifically, we assess the potential of semi-natural areas to maintain robust communities under changing weather conditions. To this end, we use monitoring data from six different field sites analyzing 16 local pollinator communities per site. Abundance data for wild bees have been collected using pan traps annually since 2010 (six times per year). Species richness is estimated per trap and monitoring period as the number of species identified. A generalized mixed effect model is built in order to investigate how species richness is affected by the interaction between weather (temperature, precipitation) and landscape (landscape composition, connectivity, habitat diversity). Subsequently, a multimodel inference approach is followed to specify the most important landscape and weather variables, as well as interaction terms. All the plausible models are compared based on the second order Akaike Information Criterion (AICc) and a suitable set of models is selected. According to the selected set of models, favorable landscape composition could mitigate the detrimental effect of temperature increase on bee species richness. This finding could have important implications on conservation decision making, since it suggests that maintaining a fair amount of semi-natural areas could serve as a countermeasure against climate change for wild bees.

THE CONSERVATION VALUE OF PERIPHERALLY ISOLATED POPULATIONS OF MEDITERRANEAN ENDEMIC PLANTS: A COMPARATIVE ANALYSIS OF ECOLOGICAL NICHE VARIATION AND ORIGINALITY

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The geological and climatic histories of the Mediterranean have left a series of major traits in the patterns of contemporary species distribution. Well known for its high percentage of endemic plants, the region is also the scene for fascinating patterns of disjunct distributions and the occurrence of peripheral isolate populations in many species. This pattern is particularly apparent in Mediterranean France where a large



number listed (locally rare) species occur at their northern distribution limits. Such isolated populations may constitute an important demographic relay for northward colonization in a warming climate and may harbor a unique evolutionary potential. However, faced with an ever increasing human footprint many of these examples of peripheral isolates involve populations are in rapid decline. We show that these populations can occur in a different broad climatic niche compared to populations in the central part of their distribution. However, nothing is known about the fine-scaled ecology of these species in terms of their abiotic and biotic niche components. We have thus conducted a comparative field-based study of the ecological niche of 11 species (each in a different family and all rare with a listed status in France) in central (Spain/Italy) and peripheral (Mediterranean France) populations. The results provide interesting new insights into the potential for species persistence and evolution in peripherally isolated populations whose habitat is particularly endangered. Actually, thermophilous garrigues in France count as one of the most endangered habitats, particularly threatened by human population growth, tourism and development projects. Our study also informs site selection procedure and methods for reinforcement and reintroduction policy for many species whose populations are currently being destroyed.

161-DEFINING SEASCAPES: SOCIAL-ECOLOGICAL LESSONS LEARNED FROM FOCUS GROUP EXERCISES

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Pascal Marty, Ecole normale supérieure de Lyon

Defining seascape is not only a matter of describing bio-physical factors. Human practices activities are key elements to understand seascape characteristic and transformations. Seascapes characteristics can also be defined by users. In this presentation we will address the issue of seascape perception by three categories of users during three focus group exercises. We will discuss to what extent terrestrial landscapes definitions and concepts can be used to define seascape.

DIFFERENT LAND USES ALTER THE ASSIMILATION OF 15N AND 13C BY MACROINVERTEBRATES IN NEOTROPICAL SAVANNA STREAMS

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To support management actions in aquatic ecosystems is essential to understand how changes in land use influence trophic relationships in headwater streams. Changes resulting from the replacement of native vegetation by cultivation and grazing systems have great potential to influence trophic relationships of aquatic ecosystems. They usually can lead to simplification and also promote changes in the food habits of different groups of macroinvertebrates. Our objective was to evaluate how the vegetation cover influence food resources for macroinvertebrates in streams under different land uses. We compared nine streams in three areas in the Brazilian neotropical savanna (Cerrado): streams surrounded by native vegetation (reference), pasture and sugarcane cultivation. Macroinvertebrates, categorized into functional feeding groups (FFG), and their possible carbon sources (CPOM, FPOM, seston, leaves, periphyton, algae), were sampled and evaluated for the isotopic composition of $\delta^{13}C$ and $\delta^{15}N$. Higher $\delta^{15}N$ values were found in streams under sugarcane or pasture influence, probably due to soil management that usually increase the $\delta^{15}N$ of the soil in the Cerrado region. The $\delta^{13}C$ values were different between predators and filterers, comparing the reference streams and the others. Finally, there was an increase in the niche size of macroinvertebrates in the streams under anthropic influence. This information could support proposals for watershed management measures in the Cerrado biome and contribute to the conservation of aquatic biodiversity in headwater streams.

APPLIED CONSERVATION LITERACY: FROM LOCAL LEARNING TO GLOBAL ACTION

Julia Parrish

University of Washington

Benjamin HAYWOOD, Allegheny College ; Shawn ROWE, Oregon State University ; Cynthia CHAR, Char Associates

Environmentally focused science education strategies have customarily placed substantial focus on the development of "critical thinking skills" with the hope that upon learning to think more critically "participants will be better able to analyze information about environmental issues and to make sound decisions about the environment" (Krasny and Bonney 2005, p 192). Within conservation, an assumption is that critical thinkers will be scientifically literate citizens who actively lobby for, and participate in, conservation-oriented change. However, the question remains: Does simply knowing more lead to a higher level of action, and if not, what other factors help to create citizen-based conservation change? We use data from both quantitative surveys and qualitative interviews of participants in the Coastal Observation and Seabird Survey Team (COAST) to explore how participation in biodiversity-



based citizen science can lead to conservation action. Specifically, we: propose a 4 step model of individual learning, link learning efficacy to locality via participants' sense of place and community, and examine the degree to which participants move from learning to action. Finally, we demonstrate that individual action can scale to conservation change through citizen science, exactly because these programs recruit and retain hundreds to thousands of people for years to decades. Our work suggests that rigorous citizen science programs providing a place-based, data-rich experience linked explicitly to local, regional and global issues can lead to measurable change in both understanding and action - the two components of applied conservation literacy - without imposing a pre-determined, normative vision of science (e.g., science is good, environment is good).

165 HISTORICAL TRENDS AND INSIGHTS FROM THE FIELD OF EVALUATION

Beverly Parsons
InSites

The formal practice of evaluation has been developing into a transdisciplinary field over the past 60 or more years in countries around the world. The first professional associations of evaluators were in Canada and the United States about 40 years ago. Associations in Europe, Australasia, Africa, and other parts of the world followed. By the end of 2013, over 188 regional, national, and international organizations for professional evaluation existed and the number continues to grow. Consequently, evaluation is a rapidly growing and maturing field with continually expanding theories, methodologies, and uses. Additionally in recent years, the evaluation field and the systems field have developed increasing connections that have strengthened the range of evaluation approaches now in use across many disciplines and sectors, for example, in health, education, human services, agriculture, criminal justice, governmental departments, the military and more. Increasingly the evaluation of human systems such as those just mentioned is connecting with the evaluation of natural resources and systems. In this session, the presenter will provide an overview of how the field of evaluation is developing in terms of its expanding theories, methodologies, uses, and attention to values across many disciplines. The variety of orientations provides expanded options for how conservation biologists might approach evaluation and applied research. Many of the advances in evaluation address the complexity of the issues that are being faced at the intersection of human and natural systems and resources. The presenter will describe how interdisciplinary collaborations in other fields have benefited from considering a wide range of evaluation practices. These examples are intended to stimulation ideas among the participants about

ways that conservation biologists may incorporate evaluation into their interdisciplinary collaborations and other activities.

NORTH AMERICAN PERSPECTIVES ON CLIMATE CHANGE ADAPTATION POLICY

Douglas Parsons
Society for Conservation Biology

Exploration of climate change adaptation in North America as a tool for conservation policy will be discussed, and how SCB members can lead in this emerging conservation field. As communities begin to grapple with the impacts of climate change, adaptation to these changes will become an increasing focus of conservation policy. Until recently, significant attention has been focused on climate change mitigation, the act of mitigating carbon emissions from human sources, and less on the impacts of climatic changes. Adaptation is defined as: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC). Recently, governments and non-governmental organizations have begun to focus on adaptation to climate change impacts. It is uncertain how significant these impacts might be, but nations are beginning to develop policies in anticipation of these changes that are increasingly likely to occur, regardless of progress in mitigating carbon emissions. This oral presentation will highlight federal, state and non-governmental approaches to climate adaptation and how it will affect ecosystem conservation in North America. The presentation will discuss different approaches to integrating conservation into climate change adaptation policy and it will also explore near and long term challenges associated with this emerging field. The speaker has worked extensively in adaptation planning at both the state and federal government level, and now with the Society for Conservation Biology as the North America Policy Director.

#191 - HOW NOT TO GET AHEAD IN ADVERTISING - WHAT MANY CONSERVATION NGOS ARE DOING WRONG

Edward Christien Michael Parsons
George Mason University
Mel COSENTINO, Aberdeen University ; Andrew J WRIGHT, George Mason University ; Jenell WALSH-THOMAS, George Mason University

Studies show that the general public knows little about the conservation status of species or habitats. If NGO and Government Agency strategies were effective at outreach and engagement this would not be the case. Several NGOs have large memberships, in some cases exceeding the membership of all the political parties combined, which could be a major



lobbying tool or the basis for major shifts in public behavior. However, NGO materials to the general public are often geared towards recruiting members or funds, rather than actually educating the masses or eliciting more sweeping pro-conservation behavioral changes. NGOs, like most scientists, often cling to the “deficit” model: that simply providing information will lead to societal change. This is clearly not the case. What informational outreach materials that are produced are often “passive” (e.g. mailed letters, web-based fact sheets), rather than “active” outreach. Some NGOs have developed social media campaigns, such as online petitions, which are more active, but that typically have little long-term impact. Many people believe they have “done their bit” if they simply share materials (known as “slacktivism”). Conservation NGOs (and agencies) need to think beyond passive methods of education and stop using their marketing departments purely for fundraising. Learning from product advertising, conservation outreach could be more effective by (a) delivering simple messages, but with (b) accurate facts that (c) evoke surprise or emotion to (d) make messages more memorable by (e) providing information in an interesting “story” format, (f) motivating to learn more and (g) providing concrete actions for the public to do that could make a significant difference, be this supporting a specific election issue or boycotting goods, such as unsustainable palm oil. Out of the box outreach could be very effective (e.g. “product placement”, such as lobbying TV show writers to insert conservation story lines).

EFFECTS OF ARTIFICIAL CANOPY GAPS ON RESTORING TREE DIVERSITY IN BOREAL CONSERVATION AREAS

Hannes Pasanen

University of Eastern Finland

Seppo ROUVINEN, University of Eastern Finland ; Jari KOUKI, University of Eastern Finland

Creation of canopy gaps can be used as a restoration measure to diversify structural variability and tree species composition in forests. We examined tree seedling regeneration in 94 small canopy gaps that were established for restoration purposes in two protected Scots pine-dominated forests in eastern Finland. Diameter of the gaps was 0.5, 1, 1.5, or 2 times the height of the dominant trees. Both study forests were located on dry and nutrient-poor mineral soils (*Vaccinium*-type). In particular, we aimed at assessing the effect of gap size and soil preparation (exposing mineral soil) on post-disturbance seedling establishment ten years after the restoration measures. We found that tree species composition on the plots consisted mainly of *Pinus sylvestris* (73 %) and *Betula* spp. (16 %) seedlings. Most of the *Pinus* and *Betula* seedlings were growing on plots that were disturbed and only 6 % of the seedlings were found on undisturbed plots, reflecting the importance of regeneration microhabitats for the early development of

seedlings. The mean number of *Pinus* and *Betula* seedlings per disturbed plot (40 x 60 cm) was 0.5 and 0.1, respectively, and did not significantly differ in gaps of different size. As the mean height for *Pinus* was 9.2 cm and that for *Betula* 51.5 cm, development of the seedlings in the gaps seemed slow and hindered probably due to insufficient amount of radiation as well as due to root competition. Both factors are affected by the gap size, which in our study sites was probably not large enough to reach a threshold value that meets the requirements of *Pinus* and *Betula*. We conclude that very small gaps – in particular when implemented without soil disturbance – may not be the most effective method to restore tree diversity in boreal pine-dominated forests. Further studies that manipulate gap size more widely than what was analysed in the current study are needed.

BIODIVERSITY AND ECOSYSTEM SERVICES: META-ANALYSIS, MIND-MAPPING AND BAYESIAN BELIEF NETWORK MODELLING TO BETTER CAPTURE THE ROLE OF BIODIVERSITY ON ECOSYSTEM SERVICES.

Marta Pascual

Basque Centre for Climate Change (BC3)

Elena PÉREZ-MIÑANA, Basque Centre for Climate Change (BC3) ; Eva GIACOMELLO, Centre of IMAR of the University of the Azores, Department of Oceanography and Fisheries, and LARSyS Associated Laboratory

Biodiversity plays a wide range of functional roles in ecosystems and supports all ecosystem services to some extent. However, a quantitative understanding of the biodiversity-ecosystem functioning-ecosystem services relationships is still limited and the exact nature of the links between them is not well understood or easy to identify due to: the multi-layered biodiversity-ecosystem services relationship, and the complexity of the interactions between biotic and abiotic components in ecosystems influencing processes and services. Despite the extensive research on biodiversity, its impact on ecosystems, and its benefits to humans, many researchers across different scientific fields agree on the need for a better understanding of the functional links between biodiversity-ecosystem functioning-ecosystem services. To address this need, a meta-analysis of almost 300 peer-reviewed papers, including up-to-date contributions describing the links between biodiversity and ecosystem functioning and/or biodiversity and ecosystem services was carried out. The results show most effort has focused on investigating biodiversity and ecosystem functioning towards obtaining provisioning services such as food or raw materials, whilst the linkages concerning biodiversity, ecosystem functioning and supporting, regulating and cultural ecosystem services, albeit a slow growth, remain largely unexplored. Research results from the publications reviewed, information on the physical and



biological processes underpinning ecosystem services, their interactions and responses, was gathered and merged into a set of conceptual mind-maps. In certain cases, these mind-maps were translated into Bayesian belief networks in an effort to demonstrate, the explicit description and management of the uncertainty still evident. This contribution aims to expand the scope of research developing new ways of collaboratively representing and modelling these linkages to enable better informed decision-making.

STAKEHOLDER PERCEPTION OF CONFLICTS AND ECOSYSTEM SERVICES OF AN EXOTIC UNGULATE

Roberto Pascual

Universidad Miguel Hernández de Elche

Francisco BOTELLA, Universidad Miguel Hernández de Elche ; Sergio EGUÍA, Universidad Miguel Hernández de Elche ; Andrés CASALDUERO, Universidad Miguel Hernández de Elche ; José Antonio SÁNCHEZ, Universidad Miguel Hernández de Elche

Ecosystems provide humans with services that can be valued from the point of view of human well-being. Among the less studied group from this perspective are ungulates, currently expanding across Europe and North America due to rural abandonment, a decline in direct persecution and the introduction and reinforcement of native and exotic species for sport hunting. The increasing population trends of these ungulates has led to a widespread human-wildlife conflict derived from their effects on collisions with vehicles, crop damage, disease transmission. Thus the conflict perspective might be imposing over their functional role in ecosystems. We wanted to know the perception of conflicts and services of the Aoudad (*Ammotragus lervia*), an African ungulate that was introduced in 1970's in SE Spain. So we evaluated it by means of personal interviews with stakeholders (environmental groups, government, gamekeepers, game warden, hunters, farmers, scientific community) with special interests in Sierra Espuña Natural Park, Murcia, where Aoudad was released. Our results show that stakeholder perceptions are divided between negative (human-wildlife conflict) and positive (ecosystem services) visions according to their own interests. As principal conflicts we found damage crops, damage to native plants, competition with others ungulates (principally with Iberian Ibex) and the risk of collision with vehicles. As ecosystem services highlight tourism and hunting. Thereby we are facing a complex problem where coexisting positions ranging from eradicating the species to avoid negative effects until promote its populations for services it provide in the region, therefore would be recommendable elaborate a proper management plan for the Aoudad with the participation of stakeholders.

THE FIRST PARTICIPATORY MARINE MEGAFUNA BY-CATCH ASSESSMENT IN MAIO, CAPE VERDE

Leno Passos

Maio Biodiversity Foundation

Katia LOPES, Maio Biodiversity Foundation ; Amanda DUTRA, Maio Biodiversity Foundation ; Edita MAGILEVICIUTE, Maio Biodiversity Foundation ; Tamas SZEKELY, Maio Biodiversity Foundation

Cape Verde supports the third largest population of nesting loggerhead females, over 20 species of cetaceans and over 60 species of elasmobranch including whale sharks and manta rays. Those species are under growing pressure of illegal fishing and incidental take. Our goal was to investigate the prevalence and frequency of marine megafauna by-catch by Cape Verdean artisanal and semi-industrial fishing boats. To determine the level of by-catch off Maio's waters interviews were carried out with local fishers in spring 2014. Information was collected on fishing techniques, animals incidentally caught, mortality rate, attempts to release and local perceptions towards by-caught marine species. 71% of fishers reported catching sharks, 32% reported catching turtles and 9% reported catching dolphins (139 fishers were interviewed). Fishers who reported catching turtles also recorded catching sharks. Artisanal boats reported fewer dolphin and shark bycatch than non-artisanal boats ($p = 0.012$, $p < 0.001$, respectively), whereas there was no difference in turtle by-catch between artisanal and non-artisanal boats ($p = 0.823$). Together with local fishing community we will aim to identify cost-effective and locally acceptable methods to mitigate shark by-catch, and fill in knowledge gaps on the roles of top predators in maintaining healthy marine ecosystems.

175-IPBES GUIDE ON VALUES AND VALUATION

Gyorgy Pataki

Corvinus University of Budapest

What is the value of a songbird? What is the value of an ancient woodland? How to express and attribute value to nature and biodiversity? Values are multiple and diverse and many times contested by different stakeholders. Values are formed and nurtured within different worldviews held by individuals and populations, their interactions with biophysical environments, as well as socio-cultural and political contexts and institutions that facilitate their articulation. Values attributed to nature, biodiversity and ecosystem services change through time, across spatial scales and among type of social organization. Valuation methods are diverse and include biophysical and ecological, cultural and social, economic, public health, and holistic, indigenous, and local knowledge-based types of methods. Valuation is a culturally embedded process never independent from existing social structures and power relations. Which values, whose values and how should be



accounted for in a valuation process? Is it possible to be inclusive to the extent that makes justice to the multiple and diverse values and valuation methodologies different stakeholders nurture? The IPBES conceptual framework acknowledges the different paradigms and worldviews guiding the human expressions of value and aims to integrate definitions, classification of biodiversity and stakeholders, concepts and valuation methodologies as well as culturally rooted success criteria within this broader framework. The IPBES guide on values and valuation methodologies aims to provide conceptual and methodological support to integrate the diverse and multiple values and valuation methodologies into different assessments being conducted in the IPBES first work programme (2014-2018).

CONSERVATION OF TWO THREATENED AND MEDICINALLY IMPORTANT ASCLEPIADACEOUS SPECIES OF INDIAN THAR DESERT THROUGH IN VITRO TECHNOLOGY

Ashok Kumar Patel

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Indian Thar Desert is one of the profusely populated hot deserts of the world. These populations (human and livestock) and anthropogenic activities exert various pressures on phytodiversity of desert and brought un-sustainability and therefore require immediate conservation actions. Indian Subcontinent is a secondary centre of diversity for Asclepiadaceae species. This abstract highlights in vitro techniques as a conservation tool applied to two threatened and medicinally important asclepiads of Thar Desert. *Caralluma edulis* (Edgew.), rich source of antioxidants, is an endemic, edible and nutraceutically important plant of the extreme arid regions of Desert. Collection of whole plant before attaining the maturity restricts its propagation through reproductive means. Furthermore, poor reproduction and absence of proper seed setting aggravate the problem and hence natural propagation is significantly affected. We developed an efficient in vitro multiplication system for large-scale plant production and conservation of germplasm of *C. edulis*. Another plant, *Pentstemon spiralis* (Forsk.), is a perennial climber and medicinally important tuberous plant. This is one of the "Life Supporting Plant" of Little Rann of Kachchh, Gujarat (a natural heritage place for wild ass, India), as this plant is an important source of food (root tubers are sweet

and edible), fruit and fodder/forage. Owing to edible nature of young seeds, local people collect them which aggravate the problem of natural propagation. We defined an efficient in vitro propagation system for *P. spiralis* using nodal segments as explant. Micropropagation protocols developed for both the species were followed by ex vitro rooting technique for making the protocols cost effective, less-labour intensive and for increasing their transplant survival rates. Both protocols may effectively be employed for large-scale propagation and conservation of these two threatened and medicinally important Asclepiadaceae species.

EFFORT TOWARDS GREAT APES CONSERVATION IN LOGGING FORESTS: TESTING ADAPTIVE SAMPLING TECHNIQUE FOR CHIMPANZEES IN CAMEROON

Mbosso Patrick Armel

Environmental Resources Management and Social Issue Centre

Conservation efforts to protect chimpanzees in their natural habitat are of the highest priority. Although the formal management of biodiversity in Central Africa countries is realised mainly through protected areas, forest companies, being beneficiaries of 39% of the forests against only 16% for protected areas remain an important hope for conservation issue. Therefore, logging companies who manage these concessions have the influence and opportunity to promote the long-term conservation of these apes, as in reality more than 80% of ape habitat lies outside protected areas. The objective of this study was to set up and test an adaptive sampling technique protocol in order to promote chimpanzees' conservation in logging forests. Since direct sightings of chimpanzees are rare, data were collected on the most obvious indirect observation – nests. We applied distance sampling methods to examine species abundance, and performed home range analysis with ArcView. We proposed a survey protocol where neighbouring units are added to the sample whenever the value of the variable of interest satisfies some criteria. On a basis of four predefined transects of 1.5 km each to cover, 63 additional transects of 250 m each were generated by adaptive sampling following the detection of new nesting sites. Thus spreading out the survey on 21.750 km instead of 6 km, 152 nests were detected on a total of 64 nest sites. We found an absolute density of 2 ind./sq-km (95% CI [1.40-2.93]; CV 18.8%) in a mapped area of 4.6 sq-km. On a positive note, the technique enables identification and mapping of core areas of chimpanzees' territories, which can then be assigned high conservation value status in order to adapt logging practices to minimise negative impact on the chimpanzees accordingly.



A GLOBAL META-ANALYSIS OF PROXIMATE CAUSES AND UNDERLYING DRIVERS OF TROPICAL DEFORESTATION

Stephanie Pau

Florida State University

Tropical deforestation simultaneously eliminates critical habitat for wildlife in world's most diverse locations and is the second largest contributor to greenhouse gas (GHG) emissions behind fossil fuel burning. There is increasing recognition that complex and interacting factors lead to land use change, nonetheless general patterns are emerging from different geographical locations. Of a total of ~1300 studies that address forest cover loss in tropical regions published between 2010-2013 (ISI Web of Science search), only 10% explicitly quantified forest cover change and attributed the change to at least one proximate cause or underlying driver. Fifty-five percent of studies focused on Latin America, 28% on Asia, and 14% on Africa (the remainder are global scale studies). In all three regions and at all spatial scales of study (local, regional/national, global) agricultural expansion was most frequently identified as a proximate cause and economic factors were most frequently identified as an underlying driver; in global scale studies, demographic underlying drivers were identified as commonly as economic drivers. Differences in the rate of forest cover loss were associated with particular proximate causes and underlying drivers in different regions. Agroforestry was addressed in less than 1% of studies. These results highlight the overwhelming consensus that agricultural expansion driven by economic incentives is the leading cause of tropical deforestation and should guide future conservation and management in tropical regions. Furthermore, agroforestry is a common agricultural land use in the tropics that can significantly alter forest cover, yet is seriously understudied.

UNDERSTANDING THE NEGATIVE IMPACT OF ILLEGAL WILDLIFE TRADE ON LOCAL COMMUNITIES IN ARANI-KO-TRAIL, NEPAL

Kumar Paudel

School of Environment Science and Management

Wildlife trade is the biggest threat to biodiversity conservation. China is an important source of demand for wildlife products and harvesting from its neighboring Asian states via Araniko-trail (Kathmandu-Kodari) and other routes, criminal organizations have developed to procure and dispatch wildlife products. Their organizational form adjusts to reduce the most significant transaction cost faced at each stage in the supply chain. Transport to the Chinese border is the tough job and local people has been using on scale economies to transport

wildlife products. This paper mainly focused to analyze the concept of Illegal wildlife trade & negative impacts on involved local communities in Araniko-trail Nepal. Household survey, key informant interview and interview with ex-poacher/trader have conducted on 6 most affected communities in Araniko trail. The total illegal wildlife trade phenomenon is widely supported by local people because of ease means of earning for them. Among the total arrested more than two third are the locals and never attended high school. The 20-35 yrs age group is most active in the wildlife trade. The every child of the region has experience wildlife crime one and another way. The illegal exploitation of wildlife has severe impacts on biodiversity and involved local indigenous communities are also suffering in long run. In the developing country like Nepal unemployment, illiteracy, poverty, resource scarcity has empirical relationship with poaching, illegal trade and habitat destruction of the wildlife. Conservation programs must able to create some additional visible economic benefits to local people. This can only save pangolins and other endangered species with the active participation of community citizen.

RECOVERING STRATEGY FOR THE MOST ENDANGERED REMAINING POPULATION OF GANGES RIVER DOLPHIN IN NEPAL

Shambhu Paudel

Kathmandu Forestry College

Grant Abel, Ocean Park Corporation

With the most endangered conservation status, Ganges river dolphin *Platanista gangetica gangetica* is now limited only in three river systems of Nepal with very questionably viable population. This small population is urgently seeking robust field based conservation strategies to recover into survival population. Our 2 years intensive study reported with the population less than 30 individuals in Nepal stressing urgent attention from concerned conservation authorities nationally and globally to recover this species into living planet for the next generation. Population abundance and occupancy was highly sensitive with season (pre monsoon) and habitat type (depth greater than 3m). Shifting southern distribution pattern (closer to Nepal/India boarder) with very sparsely sightings nature indicates the species at the brink of extinction from Nepal river systems. With the light of these behaviors, conservation on hotspots is strongly recommended with season specific conservation approaches involving local river dependent communities. But, national and international conservation agencies support is imperative to initiate meaningful conservation of this species by understanding spatial and temporal behaviors of this species using acoustic survey.



LOSING THE APEX PREDATOR: AN EVALUATION OF THE REMAINING JAGUAR POPULATIONS OF THE ATLANTIC FOREST OF SOUTH AMERICA

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The Atlantic Forest (AF), a global biodiversity hotspot in eastern Brazil, eastern Paraguay and northern Argentina, has lost ≈90% of its range. In an international effort, we analyzed the AF's jaguar population status and proposed a spatial prioritization for conservation actions. We used jaguar records and Maxent

to develop a habitat suitability model and to estimate the area still occupied by jaguars. Using SECR models, we estimated jaguar densities from 29 camera-trap surveys in different areas, and calculated population size of the occupied fragments. We defined the AF Jaguar Conservation Units (JCU) based on size of the habitat fragment, presence of the species, confirmation of female presence, and population size. We developed a least-cost-corridor analysis to find the best options for corridors among the JCUs. Our analyses show that 85% of the original habitat has been lost, 8% is marginal, and only 7% of the AF is suitable for the species. The jaguar is present in only 2.8% of the region and potentially present in other 1.2%. Densities in areas where jaguar still occurs were low and varied from 0.62-2.41 ind/100km², but we could not estimate densities in 21 surveys due to the scarcity of records, suggesting even lower jaguar densities in some areas. We estimate the total jaguar population in the AF to be between 130 and 270 individuals. We identified seven JCUs and seven potential JCUs, but only three JCUs can sustain a population size of >50 individuals. Although some JCU could be connected by corridors, many of the remaining occupied fragments are isolated. We documented a dramatic jaguar habitat loss and fragmentation in the AF, but the species disappeared also in areas with good habitat, suggesting that human induced mortality is also a major drive for jaguar decline. The species is under high risk if urgent measures are not taken. Disappearance of jaguars and its ecological role will have unpredictable consequences for this biodiversity hotspot.

SYMPOSIUM ID CODE 191: DOES PRIDE WORK? AN APPLIED MODEL FOR INSPIRING BEHAVIOR CHANGE FOR CONSERVATION

Monica Pearce

Rare

As the conservation community begins to recognize that achieving positive change in human behavior is the key to protecting our natural resources, many are just scratching the surface toward implementing interventions that target social change coupled with biological change. Rare and its partners however have been conducting behavior change interventions for conservation (also known as a Pride campaign) for an extensive amount of time and is now completing its first comprehensive long-term impact study. This meta-analysis evaluates the long-term impact of the Pride campaign using both social and biological data from a significant sample size of 35+ sites, spanning throughout 13 countries, with some sites having begun their interventions up to 10 years ago. Through the evaluation of qualitative interviews that measure the level of continued intervention at each site post the initial 2-year intervention against quantitative data from social surveys and biophysical monitoring, this study seeks to answer the



following 3 questions: 1) Does Pride affect behavior change long-term? 2) Does the level of continued effort toward Pride post-two years affect changes in behavior change? 3) Do fluctuations in behavior change correlate to a conservation result? That quantitative data is measured along each aspect of Rare's Theory of Change that includes social indicators such as knowledge, attitudes and behaviors of the community to various biological indicators related to the site's conservation result. This study aims to statistically prove or disprove the assumption that the level of continued effort made toward the intervention post Rare's initial 2-year investment correlates to changes in behavior change and thus changes in conservation. The results provide comprehensive recommendations backed from scientifically valid data for how conservation interventions can achieve lasting impact.

181 ASSESSING SPECIES VULNERABILITY TO CLIMATE CHANGE IN AN UNCERTAIN WORLD

Richard Pearson

University College London

There is a pressing need to develop effective vulnerability assessments for evaluating the conservation status of species under twenty-first century climate change. Several modelling approaches have been used to predict responses of biodiversity to climate change, with recent developments offering several advances. In this talk I will provide a brief overview of alternative predictive approaches, with a focus on methods that couple ecological niche models (species distribution models) with demographic models. This coupled modelling approach estimates extinction risk as the probability of abundance falling to zero, rather than by inferring extinction risk from the contraction of bioclimate envelopes. Using case studies from the Arctic and North America, I will exemplify different methods and discuss some of their pros and cons. I will show how the attributes that cause species to be at high risk of extinction due to climate change may be estimated and how this information can be useful for vulnerability assessments. Set against a backdrop of multiple sources of uncertainty, I will argue that new methods provide increasingly robust predictions and I will point to important new research directions.

ONLINE PARTICIPATORY MAPPING OF ECOSYSTEM SERVICES AND LAND USE PREFERENCES IN THE POLISH TATRAS - EXPERIENCES AND CHALLENGES.

Barbara Peek

Institute of Nature Conservation Polish Academy of Sciences
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Sciences [INSTITUTE] Institute of Environmental Sciences, Jagiellonian University ; Marcin RECHCINSKI, Institute of Geography and Spatial Management, Jagiellonian University ; Malgorzata GRODZINSKA-JURCZAK, Institute of Environmental Sciences, Jagiellonian University ; Joanna CENT, Institute of Environmental Sciences, Jagiellonian University

Online participatory mapping has been widely used in different research contexts, it is also applied to explore spatial distribution of the ecosystem services, yet it is still a fresh and challenging approach in Central Europe. Our study was the first attempt in Poland to use an online tool for collecting spatial data on ecosystem services from local society of non-urban territory. We used an internet public participatory geographical information system (PPGIS) mapping tool to gather and evaluate the spatial perception of ecosystem services and preferences of land use among residents and non-residents of the Tatrzyski county (southern Poland, Tatra Mountains and Tatra Foothills). The area is situated in the alpine biogeographical region and characterized by high biodiversity, having three Natura 2000 sites and Tatrzyski National Park within its borders. The application and web design was based on previous PPGIS studies and adjusted to the study site in Poland. To collect data, we set a website www.mapujTatry.pl that was open in December 2014 and January 2015. Data collection was based on random sampling of household addresses within five municipalities within the case study area (in total 3000 addresses), supported by an open invitation to participate in the survey, distributed via social media, municipalities offices and national park. We gathered responses from ca. 600 application users, who placed over 6000 markers and gave over 250 comments. Based on the markers distribution and densities, we created the ecosystem services and preferences hotspots maps and detected perceptual differences among various groups of respondents. We also analysed spatial correlation of generated hotspots with basemap features, with a special focus on borders of protected areas. Finally, we conclude that collecting preferences and values can be of use for planning or decision making process in conservation practice.

ID142 GREEN INFRASTRUCTURE, CONNECTIVITY, AND THE AGRICULTURAL LANDSCAPE: A STORY OF DEPENDENCY AND CONFLICTS

Guy Pe'er

UFZ - Helmholtz Centre for Environmental Research
Jennifer HAUCK, UFZ - Helmholtz Centre for Environmental Research ; Jenny SCHMIDT, UFZ - Helmholtz Centre for Environmental Research ; Klaus HENLE, UFZ - Helmholtz Centre for Environmental Research

The ideas of Green Infrastructure (GI) stem from the principle that a strategically planned network of natural and semi-natural



areas, combined with other environmental features, can provide a haven to biodiversity while delivering many benefits to humans. In 2013 the European Commission adopted a Green Infrastructure Strategy, “to promote the deployment of green infrastructure in the EU in urban and rural areas”. One key challenge of this strategy is the question how to maintain or enhance landscape connectivity, while agricultural expansion and intensification creates an increasingly hostile “matrix” separating natural and semi-natural areas from each other. The greening of the Common Agricultural Policy (CAP), which allocates almost 40 % of the EU’s budget to farmers, could provide some potential. However, despite much effort and the recent incorporation of three new greening measures, the reformed CAP for 2014–2020 seems to offer little benefits for biodiversity or means for the effective implementation of the GI strategy. Too many exemptions were made with regards to the requirement for 5 % “Ecological Focus Areas”; further losses of permanent pasture are permitted; and management criteria, to ensure habitat quality, are lacking in all greening measures. Effective GI would also depend on a spatial design that can maximises the benefits of environmental investments, but none such guidance was given so far. Agri-Environmental Schemes (AES) could still be used to support GI, but the budget for these is at risk of declining in many Member States. Despite these weaknesses, there are some improvements and reasons for hope. For instance, the requirement for a Farm Advisory System could facilitate a closer dialogue between (ecological) experts and farmers. Additionally, there is much flexibility to develop bottom-up initiatives that could pave the way for larger scale improvements. We conclude with some recommendations and integrative solutions.

ID #7: ZONOTIC ORIGIN OF HUMAN RETROVIRUSES AND IMPACT OF RETROVIRUSES ON SURVIVAL OF NON-HUMAN PRIMATES

Martine Peeters
IRD

Simian retroviruses (SIV, STLV and SFV) from non-human primates (NHP) have crossed the species barrier to humans at several occasions, leading to the HIV and HTLV epidemics and to sporadic cases of human infections with SFV. Efficient infection and spread in humans differs between SFV, STLV and SIV, but also among different viruses from the same simian lineage. SIV from chimpanzees and gorillas are at the origin of the four HIV-1 groups (M, N, O and P), but only HIV-1 group M has spread worldwide. Sooty mangabeys in west Africa, transmitted their virus on at least nine occasions to humans leading the nine HIV-2 groups. HIV-2 did only spread to some extent in West Africa. Simian counterparts of the four types of HTLV, type 1 to 4, have been identified in multiple NHP species (apes, cercopithecus spp, mangabeys, etc). HTLV-1

predominates in humans and is present throughout the world as clusters of high endemicity. Humans are susceptible to a wide variety of SFVs and seem to acquire these viruses more readily than SIVs or STLVs but no signs of disease in humans nor human-to-human transmission of SFV has been documented yet. Little information is available on pathogenicity of simian retroviruses in their natural NHP hosts and observations on captive NHP suggested until very recently that they are non-pathogenic. Today several studies showed clearly that SIV infection has a negative impact on health, reproduction and survival of chimpanzees in their natural habitat and immunological and clinical evidence for AIDS-like disease has been observed. Overall, our knowledge on cross-species transmissions of simian retroviruses and the impact of SIV infection in their NHP primate host are still incomplete.

CONSERVATION DEVELOPMENT: A WIN-WIN FOR DEVELOPERS, HOMEOWNERS AND BIODIVERSITY?

Liba Pejchar

Colorado State University

Sarah REED, Wildlife Conservation Society ; Cooper FARR, Colorado State University ; Steve LAPOSA, Alvarez and Marsal ; Chris HANNUM, Istanbul Technical University

The rapid conversion of private land to residential development and limited funding available for conservation make this a critical time to examine new tools that incorporate conservation objectives into development. Conservation Development (CD) is a private land conservation strategy designed to decrease the negative impacts of residential sprawl by clustering houses in a small portion of a property, while preserving the remaining land as protected open space. Although CD accounts for up to 25% of private land conservation in the United States, little is known about its contributions to biodiversity conservation and human well-being. We adopted a multi-disciplinary approach to evaluate the economic and ecological value of CD subdivisions in Colorado, USA. First, we used hedonic modeling and real estate transaction data for homes in 80 CD subdivisions and 125 nearby conventional subdivisions to assess the value of the conservation amenity to homeowners. We found widespread and significant sales price premiums of 25-29% for homes located in CDs relative to other types of rural residential development. Next, we investigated whether this strong economic benefit for developers and homeowners corresponds with an ecological benefit for biodiversity. Using point counts and remotely-triggered cameras, we examined the effects of subdivision design and open space stewardship on songbirds and mammals in 15 CD subdivisions. We found that CDs with a higher proportion of protected open space supported greater species richness; CDs with over 85% open space had 1.5 the number of bird species than CDs with less open space. Native plant cover was positively and housing



density was negatively associated with occupancy of human-sensitive bird and mammal species. Our findings suggest that CD can both provide economic benefits and support biodiversity if the protected open space is sufficiently large and contiguous, and if the property is managed to sustain natural plant communities.

SYSTEMATIC MONITORING PLANNING: OPTIMIZING WILDLIFE SURVEY SCHEMES

Jerome Pellet

N+p wildlife ecology

Gérard MAZE, Universität Zürich ; Yves GONSETH, CSCF/karch ; Benedikt SCHMIDT, CSCF/karch

Most biological monitoring programs rely on multi-species surveys (birds, amphibians, butterflies, dragonflies...). These programs usually rely on multiple visits during pre-defined, expert-based time windows. The goal of this approach is to encounter as many species as possible. Here, we present a novel method to optimize these time windows using a mathematical framework maximizing the detectable species pool. The approach is conceptually similar to spatial systematic conservation planning, but shifting from a spatial to a temporal perspective. We present an example using 20 years of butterfly records in Switzerland. We illustrate the link between financial investment in monitoring (number of visits) and loss of information (proportion of detected species), thus allowing for a rigorous return-on-investment analysis of monitoring scheme scenarios. The general framework offered by systematic monitoring planning can be used in a wide range of biological survey schemes and offers a new practical tool for adaptive monitoring.

MONITORING AND ASSESSING THE INTEGRITY OF A LARGE WORLD HERITAGE MARINE SITE USING UNBAITED VIDEO

Dominique Pelletier

French Institute for The Exploitation of the Sea
William ROMAN, French Institute for The Exploitation of the Sea ; Abigail POWELL, French Institute for The Exploitation of the Sea ; Thomas BOCKEL, French Institute for The Exploitation of the Sea ; Liliane FIANT, French Institute for The Exploitation of the Sea ; Charlotte GIRAUD-CARRIER, French Institute for The Exploitation of the Sea ; Charles GONSON, French Institute for The Exploitation of the Sea ; Jessica GARCIA, French Institute for The Exploitation of the Sea ; Thierry LAUGIER, French Institute for The Exploitation of the Sea

The World Heritage (WH) Convention adopted in 1972 protects natural and cultural sites considered to be of "Outstanding Universal Values" (OUV) and "worthy of special protection against the dangers that increasingly threaten

them". Management of inscribed sites must prove OUV conservation through periodic reporting. For WH natural sites where OUV is linked to biodiversity features, this is achieved through monitoring-based periodic assessment. In 2008, the New Caledonian lagoons were inscribed on the WH list in the light of the exceptional diversity of their reefs and associated ecosystems. They display intact ecosystems, with healthy populations of large predators, and a great number and diversity of big fish. This WH site covers 15743 km², thus requiring considerable monitoring effort. Since 2012, a series of surveys using a remote unbaited underwater video technique were conducted in a number of areas in the WH site, with the aim of assessing fish assemblage and habitats. The technique used enables a large number of observations to be collected per day, resulting in extensive geographical coverage and high local spatial replication of data. Data were analyzed to provide consistent assessments across areas. In addition, we investigated the effectiveness of Marine Protected Areas located within the WH site as conservation instruments. In this paper, we present the results of this comprehensive analysis. First, each sampled station was assigned to a habitat based on a multivariate typology of biotic and abiotic cover. A number of indicators describing fish assemblage were computed and we studied the influence of both habitat and protection status on these indicators. Our results show the overall good health of fish assemblages and living cover, while they reveal interesting qualitative and quantitative differences between sites. In many instances, protection effects were clearly evidenced for a number of indicators, in particular those involving fished species.

208 CITIZEN SCIENCE, SOCIAL LEARNING AND TRANSFORMING EXPERTISE

Taru Peltola

Irstea, Representative of AHIA group of ALTER-Net

Citizen science (CS) is currently gaining momentum in many different research fields, including biodiversity research, boosted by novel technologies that allow new modes of participation, inviting new social groups and extending the scope of collaboration between scientists and volunteers. CS is envisioned to bring mutual gains for the participants, as well as for society at large, facilitating, for example, 'scientific literacy', collaborative skills or empowering different social groups. While such learning processes taking place on an individual, collective or societal level are claimed to have high priority in CS projects, we provide a review of the development and state of the art of CS, focusing on the learning processes/arrangements and outcomes of CS projects. We critically assess how learning has been discussed in the context of CS, and how CS projects have been designed and implemented to facilitate learning. In this context we also discuss approaches,



such as public participatory GIS, which are not currently framed as CS but provide valuable experiences and methodological approaches for it. We also explore new cutting-edge collective learning processes such as Companion Modeling and Multi-Agent Behavioral Games. Through a number of case studies in the field of biodiversity research we explore the ways in which participants are involved, new knowledge is generated, and the potential benefits derived by different groups. We conclude with recommendations for the future development of CS processes to ensure mutual learning for improved biodiversity conservation and enhancing ecosystem services and suggestions on „appropriate avenue” for future biodiversity research that is relevant for addressing social challenges of collaborative knowledge production between citizens, scientists, and educators.

LAKE LERMA SALAMANDER (AMBYSTOMA LERMAENSE) OCCUPANCY IN THE NATURAL PROTECTED AREA CIENEGAS DE LERMA, MÉXICO

Karla Pelz Serrano

Universidad Autonoma Metropolitana Lerma
Rurik LIST, Universidad Autonoma Metropolitana Lerma ; Renata CHAVEZ VIZCARRA, Universidad Autonoma Metropolitana Lerma ; Odette ALCANTARA RAMOS, Universidad Autonoma Metropolitana Lerma

Lake Lerma salamander is an endemic species of the wetlands Cienegas de Lerma in Mexico, and is of remarkable importance for the wetlands and for human communities associated to this ecosystem. Unfortunately the Cienegas are still threatened by anthropogenic activities such as urbanization, water pollution, and introduction of exotic species. These activities have caused the reduction of the wetlands to 10% of their original size. Therefore many of the species that inhabit this ecosystem are threatened. *A. lermaense* is considered critically endangered by the IUCN and is under the category of especial protection of Mexican Environmental Law. Nevertheless, the lack of information about the status of the populations of *A. lermaense* limits the conservation efforts that can be applied to it. Therefore, the objective of this study was to estimate site occupancy of *A. lermaense*, as well as the relationship of occupancy and environmental variables (water turbidity, depth, and temperature) in order to contribute to the conservation strategy of this species. We conducted a single season survey in three wetlands (Almoloya, Guadalupe Victoria, and Capulhuac) within the natural protected area Cienegas de Lerma. We sampled 94 random points using minnow traps. Measurements of the environmental variables were taken at each point. Occupancy rate was 60% (95% C.I. from 0.39 to 0.81) for the study area, however, probability of detection varied across sites. Almoloya had a detection probability of 0.17, whereas Guadalupe Victoria and Capulhuac had a probability of 0.82, and 0.63 respectively. The findings of this study provide

insights into the status and distribution of the populations of *A. lermaense* in the Cienegas de Lerma. Furthermore, this study sets the baseline for the long-term monitoring of the species, which is part of the conservation strategy of *A. lermaense*.

#193 ECOLOGICAL REWILDING - OPPORTUNITIES AND CHALLENGES FOR A NEW APPROACH TO RESTORATION

Henrique Miguel Pereira

IDiv

Over the last few decades, landscapes in Europe have undergone major changes as people moved from rural areas to urban centers, marginal lands were abandoned and fertile soils were intensified. While, agricultural intensification has caused biodiversity declines in many places, farmland abandonment has opened the opportunity for biodiversity restoration elsewhere. But this is a controversial topic. Some conservationists see farmland abandonment has a major threat and something that should be stopped or even reverted. Others, have embraced the concept of rewilding abandoned landscapes and potentiating the return of biodiversity associated with forest and late successional stages, including some of the continent's megafauna. Here I discuss the concept of ecological rewilding. Ecological rewilding is distinct from other approaches to rewilding in that it does not use a specific baseline to which ecosystems should be restored. Instead, ecological rewilding is about decreasing the human control of landscapes and promoting natural ecosystem processes. I discuss the main opportunities and on-going initiatives on rewilding and present some of the main challenges. I conclude with a discussion on how the CAP subsidies could be reformed to promote rewilding.

INVESTIGATING THE SCALE DEPENDENT ROLE OF HERBIVORY AND SEED LIMITATION IN DETERMINING SUCCESSIONS IN EUROPEAN ABANDONED LANDSCAPES

Andrea Perino

German Centre of Integrative Biodiversity Research (idiv)
Laetitia Marie NAVARRO, German Centre of Integrative Biodiversity Research (idiv) ; Henrique Miguel PEREIRA, German Centre of Integrative Biodiversity Research (idiv)

In high-income countries, a decrease in land cultivation lead to large abandoned areas. Agricultural abandonment is associated with the transition from open areas to shrub-land and forest. This carries the risk of habitat homogenization but also has the potential to benefit biodiversity by providing habitats for species that have declined due to the loss of large natural areas. Restoring such landscapes to self-sustaining



ecosystems that are maintained without human interaction is the aim of the rewilding approach. One objective of rewilding is the recolonisation of abandoned lands by large herbivores to promote heterogeneous habitats suitable for a wide range of species. We investigate the dynamics of large mammals and their effect on natural succession across scales in the national park of Peneda-Gerês in Northern Portugal. The area is highly fragmented and comprises habitat patches at varying stages of abandonment. The cultivation legacy on the abandoned fields and the matrix of surrounding habitats may have important implication for the transitions subsequent to abandonment. We hypothesize that two opposing processes influence succession in abandoned landscapes: While seed availability in the surrounding habitats may influence succession processes, changes in density and activity of herbivores may alter disturbance via grazing or browsing, thus hindering succession. We present our approach to investigate the potential for ecological rewilding and the ecosystem response in Peneda-Gerês. Using a combination of camera trapping and herbivore exclosures, we will examine the influence of herbivore pressure and seed availability on abandoned fields and the scale at which these processes operate. Investigating the impact of these factors at different spatial scales will lead to a better understanding of the mechanisms driving succession and of the spatial extent at which they are effective.

THE USE OF RICE FIELDS BY WINTERING DUCKS: SEARCHING FOR MUTUAL BENEFITS TO DUCKS AND FARMERS

Claire Pernollet

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Michel GAUTHIER-CLERC, Centre de Recherche de la Tour du Valat ; Matthieu GUILLEMAIN, 1Office National de la Chasse et de la Faune Sauvage, CNERA Avifaune Migratrice

Rice is cultivated in 114 countries and represents the primary food source for over three billion people. Rice fields also represent foraging, roosting and nesting habitats for >50% of waterfowl worldwide. To better understand the interactions between rice farming and ducks, we first performed a literature review to identify the principal constraints and levers of action associated with the management of rice-production areas in a waterfowl-friendly way. Winter flooding of rice fields has been identified as habitat management providing potential benefits to ducks through its direct translation into wintering habitat creation, and to farmers through the increase of straw decomposition rate and the reduction of weed seed viability. To test this hypothesis, we first assessed if the average duck numbers at the flyway scale were positively explained by winter flooding areas in five main European rice-production regions. Once this was confirmed, we carried out four different analyses (two empirical and two experimental). In the first

two cases, rice field use by wintering ducks was assessed in the Camargue (France) and in Doñana (Spain), where post-harvest agricultural practices and the use of winter flooding are very different. In the two experimental studies, we tested the effect of winter flooding on the viability of three major rice weeds and the effects of attracting ducks by flooding on weed seed bank and straw stubble. All these tests suggested winter flooding of harvested rice fields were indeed a valuable management option benefiting both wild ducks and farmers. A cost-benefit analysis eventually allowed us to evaluate if such management could realistically be promoted in the Camargue considering the constraint of high flooding cost.

SYMPOSIA ID: 177. TACKLING ISSUES OF COEXISTENCE BETWEEN PROTECTED AREAS AND COMMUNAL LANDS: FROM A ROLE PLAYING GAME TO AN AGENT BASED MODEL

Arthur Perrotton

Cirad

Michel DE GARINE-WICHATITSKY, Cirad ; Christophe LE PAGE, Cirad

Coexistence between actors living in a common environment is a recurrent issue throughout the world. In southern Africa, issues at the interface between agriculture and conservation are inescapable. Livestock herding for instance is a particularly relevant phenomenon to consider if one wants to study coexistence between protected areas and farming households leaving on their edges. Role playing games and agent based model can be used both to elicit local knowledge and strategies, and also to simulate the possible evolution of a given system. In this presentation we propose to describe a work conducted with farmers and livestock herders living in what we define as the Hwange National Park-Sikumi Forest SES (HNP-SF-SES), Zimbabwe. In our study area, cattle are driven within one of the protected areas (SF) throughout the year, resulting in (i) cattle predation by wild predators, and (ii) concerns about the capacity of the SF to effectively conserve wild herbivores. In order to better understand herders' strategies, we co-designed a role playing game with 10 members of this community. Such game is a tool that allows us to elicit herding practices, and to test different scenarios (e.g. climatic variations, alternative governance rules). We assume that a co-designed game will better represent players' reality, thus enhancing appropriation and finally allowing us to collect relevant data. The design process is already a direct first step towards an agent Based model as we co-formalized the local environment with the design team. Results of the playing sessions will be presented, so will the process of translating them into an autonomous agent based model used to simulate possible trajectories of our studied system.



WHY ISN'T TANZANIA'S JOINT FOREST MANAGEMENT PROGRAM A TRIPLE WIN? CAUSAL MECHANISMS FOR GOVERNANCE, LIVELIHOODS AND FOREST CHANGE

Lauren Persha

University of North Carolina at Chapel Hill

Researchers and policymakers have long sought strategies to more effectively couple poverty reduction with sustainable forest use – particularly in the impoverished tropics where conservation and human development challenges continue to strongly align. Decentralized co-management policies are now widely implemented, with this aim, however there is surprisingly little consensus on their ability to meet any of their conservation, socio-economic or governance objectives. Here we use a quasi-experimental matching approach to determine average impacts of Tanzania's forest sector co-management program (JFM). Three questions drive the analyses: (1) What is JFM's average impact on forest governance and household livelihoods, and conditions in forest reserves? (2) How do governance and livelihoods impacts differ for poorest households? (3) What mechanisms and context factors drive these outcomes? We draw on data from 110 villages and forest reserves, and 3,363 households surveyed across eastern Tanzania. Results point to significant positive impacts of JFM, relative to the centralized alternative, on village governance of forests; but no impact on income or asset-based livelihoods or deforestation rates over the 12-years assessed. We find strong evidence for wealth-based differences, with the poorest quintile of households experiencing a smaller governance impact, and non-poorest households experiencing a negative impact on forest-based livelihoods. We test mechanisms for governance improvement, and livelihoods and forest change. Results contribute to a more nuanced understanding of the causal effects of forest sector decentralization, and policy-relevant knowledge on conditions under which such strategies can effectively meet their ambitious land use, governance and socio-economic goals. This manuscript is part of a set organized by L. Glew, M. Mascia and D. Miller. If accepted please include this paper in the program immediately following the presentation by Mike Mascia.

130-DEVELOPING IMPROVED FOOTPRINT ANALYSES TO ASSESS THE DISTANT DRIVERS OF BIODIVERSITY LOSS

Martin Persson

Chalmers University of Technology

Javier GODAR, Stockholm Environment Institute ; Toby GARDNER, Stockholm Environment Institute

With international commodity trade on the rise, local environmental impacts are increasingly being driven by the behavior of distant consumers. A better understanding of these distant drivers of environmental degradation is crucial for formulating effective conservation policy responses. However, footprint analyses to date omit land-use change—a key driver of biodiversity loss in the tropics—and are limited to country-to-country analyses, thereby failing to capture the fine-scale spatial heterogeneity of land-use change and associated biodiversity loss. Here we present advances in linking land-use change and associated biodiversity loss to consumption drivers across the globe, by combining a newly developed land-use change footprint methodology with a spatially-explicit trade model. The model links country level trade flows in agricultural commodities to sub-national level (e.g. counties) using customs, trade and production data. With the Brazilian Amazon as an example, we discuss options for assessing biodiversity impacts using a tiered approach, combining national and biome-wide data on global biodiversity patterns with remote-sensing and forest fragmentation metrics, as well as detailed biodiversity assessments from the Sustainable Amazon Network. We show that globally, a third of all tropical deforestation can be linked to the production of just four commodities (beef, soybeans, palm oil and timber products) in just seven countries, while results from the spatially-explicit trade model applied to Brazilian farming production reveals marked differences in the production areas that supply different consumers (e.g., the EU and China), leading to heterogeneous biodiversity impacts within and between regions. We interpret these findings in the context of how international and national conservation policies can be strengthened through an improved understanding of trade dynamics and the use of more spatially-explicit data.

CREATING A BUZZ IN THE CITY: AN EXPERIMENTAL CROSS-CITY COMPARISON OF THE PUBLIC'S PREFERENCES AND VALUES FOR CONSERVING URBAN POLLINATORS

Tristan J. Pett

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Ecology, School of Anthropology and Conservation, University of Kent

Increasingly research is demonstrating that urban greenspaces (UGS), if suitably managed, have the potential to provide important habitats and resources for biodiversity, as well as improving the health and well-being of people living and working locally. However, the role that biodiversity plays in delivering such ecosystem services within UGS is poorly understood. Wildflower meadows can be implemented as a management initiative to support and augment pollinating insect populations. Such interventions could also provide co-benefits to park users in terms of increasing the opportunity and quality of interactions with nearby nature. This study used experimental meadow plots planted in UGS across three UK cities (Bristol, Leeds and Edinburgh), as part of a wider urban pollinators research project. Areas of UGS were assigned to one of three treatment groups: control sites constituting amenity grass, native perennial meadows and non-native annual meadows. Biodiversity surveys established the diversity and abundance of flowering plants and pollinators within meadows and control sites, and responses to questionnaires were collected in situ across 17 sites during the peak flowering period of summer 2014. We used a suite of methods to assess public preferences and values including psychological scales of connection to the natural world, choice modelling and items to establish perceptions of species diversity and function. These results indicate that the public are generally positive about the creation of flower meadows but that individuals value and prefer meadows for different aesthetic and functional characteristics, depending on the social profile of individuals, their perceptions of species richness and the ecological traits of the flower meadows (such as diversity, colour and nativeness). Our findings suggest that provisioning of wildflower meadows in UGS, as well as providing key resources for pollinators, enhance the value of UGS to park users.

ID34: SATELLITE REMOTE SENSING AND ENVIRONMENTAL POLICY

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Satellite remote sensing (SRS) provides a wealth of opportunities to monitor the different constituents of the planet's natural environment, allowing access to standardized, global, continuous data directly relevant to the monitoring of, and pressures on, biodiversity. Because of this, satellite-based information can underpin the construction of useful indicators of ecological change that measure past ecological impacts and provide early warning signs of impending change. Such information could facilitate the implementation of a number of international, regional and national environmental

agreements and policies, and various initiatives (e.g., essential biodiversity variables initiative from GEO-BON; Biodiversity task from the Committee on Earth Observations Satellites) are currently trying to maximise such a potential. The methods, costs and benefits of traditional biodiversity indicators are however relatively familiar to environmental decision makers, as opposed to the financial and technical challenges, as well as the complexity associated with the various components of SRS. This may ultimately preclude the adoption of SRS by environmental legislators. In order to gain widespread support for the use of SRS in management and conservation, satellite data and analyses need to become more accessible to the community of ecologists. Training opportunities in SRS tailored to the biodiversity and conservation community also need to become more common, as the current lack of training opportunities hampers the emergence of a new generation of scientists able to carry out integrated, multi-disciplinary approaches.

122 LEVERAGING THE POTENTIAL OF HIGH-YIELD FARMING TO MAKE SPACE FOR NATURE

Ben Phalan

University of Cambridge

Lynn DICKS, University of Cambridge ; Graziela DOTTA, Museu de Ciências, PUC-RS ; Claire FENIUK, University of Cambridge ; Toby GARDNER, Stockholm Environment Institute ; Rhys GREEN, University of Cambridge ; Anthony LAMB, University of Cambridge ; Bernardo STRASSBURG, International Institute for Sustainability ; David WILLIAMS, University of Cambridge ; Erasmus ZU ERMGASSEN, University of Cambridge ; Andrew BALMFORD, University of Cambridge

Evaluations of trade-offs between species populations and food production suggest that a promising way to reconcile these conflicting demands for land in many places is to increase yields while sparing land for nature. However, high yields are insufficient to protect natural habitats from conversion, and can even increase rates of conversion, unless they are introduced alongside specific policies and incentives to link yield increases with habitat protection. I will discuss a range of promising mechanisms that could help to create such a link, ranging from regional land-use planning to landholder knowledge-exchange networks. These mechanisms are most likely to succeed in the presence of certain enabling conditions, including conducive technology, inelastic demand, strong institutions, secure finance, stakeholder buy-in and political support. Furthermore, there is a need for such mechanisms to address other important objectives, such as reducing the negative externalities of farming. Notwithstanding these challenges, there is considerable potential to leverage the potential of high-yield farming to make space for nature, and we argue for greater efforts to test promising mechanisms that could assist this process.



LESSONS LEARNED FROM SEAGRASS RESTORATION IN THAILAND

Sathika Phaokanta

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Seagrass plays a valuable role in Thailand's coastal ecosystems, but it is facing particularly large threats from both natural disasters and anthropogenic activities. To restore lost habitat, six seagrass restoration projects have been initiated by the government since 2013. The aims were to establish seagrass in sea water pond habitat (abandoned shrimp ponds), or to restore seagrass to natural seagrass meadows. Eight species were transplanted into abandoned shrimp ponds. Plantings of seedlings of *Enhalus acoroides* into sea water ponds survived over one-year. Vegetative propagation of *E. acoroides* into natural seagrass beds survived eight-months. Other seagrass species did not survive over one year. Important factors affecting the restorations concerned: water current and flow, light, soil characteristics, season and transplantation techniques, and seagrass species. Overall, seagrass in Thai waters is in good condition and transplantation is unnecessary. Seagrass restoration efforts should shift to establishing seagrass conservation areas together with rules which emphasize protecting them from habitat loss, rather than investing in seagrass transplantation. Participatory seagrass planning with local communities is the key to sustainable seagrass management.

CAN CITIZEN SCIENCE YIELD CONSERVATION OUTCOMES? A FRAMEWORK DESCRIBING PATHWAYS TO CONSERVATION.

Tina Phillips

Cornell Lab of Ornithology

Heidi BALLARD, University of California, Davis

Citizen science projects focused on environmental or biodiversity monitoring, involving volunteers in any stage of the scientific research or monitoring process, have exploded in number in recent years, yet evidence of their impacts on conservation remain under-examined. While evidence is growing that these projects achieve science and environmental educational goals, many have explicit or implicit conservation outcomes as their goal, such as improved health of species and habitat. Few projects, however, evaluate or provide evidence of such outcomes stemming from citizen science. Through a critical examination of a range of projects, we suggest that citizen science affects conservation indirectly through application of research findings, education of stakeholders, implementation of policy or regulations, and individual and community-level actions, as well as, directly through traditional measures for site and species management (Kapos et al. 2008). This oral presentation introduces an evaluative framework for articulating and measuring intermediate but necessary outcomes that are prerequisites to achieving ultimate targets. By analyzing the pathways from citizen science activities to conservation outcomes across different projects, we will highlight evidence, strategies, and barriers that influence conservation outcomes. Our findings have implications for the field of conservation biology both in leveraging the ways in which citizen science can contribute to conservation outcomes, and elucidating challenges when incorporating citizen science into social-ecological systems.

SEA TURTLE CONSERVATION AND HATCHERY MANAGEMENT PRACTICES IN SOUTH AND SOUTH-EAST ASIA

Andrea D. Phillott

Asian University for Women

Nimisha KRISHNANKUTTY, Asian University for Women ; Jibymol MATHEW, Asian University for Women ; Rokhsana HASIB, Asian University for Women

Sea turtle hatcheries are common in South and South-east Asia, but their management practices are relatively undescribed and unregulated. We used a mixed-methods research approach, including a review of published literature and interviews with hatchery managers or owners, to identify hatchery practices that are likely to contribute to sea turtle conservation and negatively impact upon hatch success and hatchling survival. We present data about hatchery construction and practices for handling, transporting and incubating eggs, and releasing and holding hatchlings in South Asia (Bangladesh, India and its territories, Pakistan, and Sri Lanka) and South-east Asia (Malaysia, Myanmar, Philippines, Thailand, and Vietnam). While the goal of most sea turtle hatcheries is to protect nests



from poaching, predation, habitat loss and beach erosion, and/or promote public awareness about sea turtle biology and conservation through ecotourism, of great concern are practices (e.g holding hatchlings up to 3 weeks) and outcomes (e.g. low hatch success, sometimes <10%) that do not contribute to sea turtle conservation.

THE LAND ETHIC AND OLD, NEW, AND INCLUSIVE CONSERVATION

John Piccolo

Karlstad University

The past few years have seen a debate building within the field of conservation biology, between so-called "Old" and "New" conservation. Most recently, a call for Inclusive conservation was published in the pre-eminent journal *Nature*, which has resulted in a long list of signatories from around the world – myself included. Inclusive conservation highlights the common ground between Old and New conservation, despite apparent differences that pertain particularly to values in nature; Old conservation tends to expound intrinsic values in nature whereas New conservation tends towards instrumental values in nature. Conservation itself differs from ecology in that it is necessarily a subjective pursuit; it must include a normative base because we are called upon to make choices as to what ought we to do about a species decline or ecosystem impact. Old and New conservation stand on common ground in that both recognize that we ought to conserve nature. But they appear to differ as to why we ought to do so – for the good of nature versus for the good of humankind (our own "naturalness" notwithstanding). Since its inception, however, conservation biology has explicitly recognized intrinsic values in nature, as outlined in Micheal Soulé's defining 1985 essay in *Bioscience* (35:727-734). Inclusive conservation calls for "a unified and diverse conservation ethic; one that recognizes and accepts all values in nature". I argue that although this may be in practice the only realistic way forward, conservation biologists must continue to strive for recognition of what is right. Aldo Leopold's well-known Land Ethic, and the discipline of environmental ethics, provide an ethical argument that nature is good in its own right. I discuss why I think this is true, and how conservation biologists might come to better extoll nature's intrinsic value.

SPATIAL HETEROGENEITY IN ATTITUDES AND BELIEFS TOWARDS BROWN BEARS IN THE FRENCH PYRENEES

Blaise Piedallu

CEFE

Pierre-Yves QUENETTE, ONCFS ; Coralie MOUNET, PACTE ; Nicolas LESCUREUX, CEFE ; Olivier GIMENEZ, CEFE

The raise in awareness towards human-wildlife coexistence has led to studies focusing on the attitudes and beliefs of local populations towards species that have problematic interactions with human societies. Among them, large carnivores often generate a wide range of views, from strong support to complete opposition. However, studies on the perception of large carnivores have usually been limited to a few relevant sociological parameters (age, gender or life in rural vs. urban areas). Besides, these studies have not explored small-scale spatial variability in perception. Here, we studied the Pyrenean Brown Bear the coexistence between local people and the species raises concerns. We investigated the factors that influence the attitude and beliefs of local populations towards bear presence, controlling for many potentially confounding parameters. We sent a questionnaire to 3000 residents spread over the Pyrenees to investigate their perception of bear's presence. Our results confirmed the effect of factors that were found in other studies on attitudes towards large carnivores, such as age or hunting practice. The originality of our findings lied in attitude being significantly correlated to the administrative division the respondents lived in and their place of birth. People who were born in the Pyrenees had a more negative opinion on bear presence than people born away from the mountains, and residents of different administrative divisions displayed contrasted attitudes towards bear presence. We suggest that attitudes towards bear presence are affected by local geographical factors, and that being raised close to the conflictual area leads to develop a negative opinion on bears. Overall, we hope that our results will lead to a better description of conflicts surrounding bear conservation and will contribute to suggesting new management approaches in the future.

A GLOBAL ASSESSMENT OF THE CONSIDERATION OF GENETIC FACTORS IN THREATENED SPECIES RECOVERY PLANS

Jennifer Pierson

The Australian National University

David COATES, Flora Conservation and Herbarium Program, Department of Environment and Conservation ; J. Gerard OOSTERMEIJER, Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam

A fundamental goal of threatened species recovery planning is to recover species or populations to the point of being viable in the long-term. Ecologists have acknowledged for decades that long-term viability is a function of both demographic and genetic processes. We set out to determine 1) if genetic processes are considered in Recovery Planning, 2) If so, what type of genetic processes are considered, and 3) What factors



are associated with the inclusion of genetic factors in Recovery Planning? We designed a questionnaire and applied it to over 300 Threatened Species Recovery Plans in three distinct regions: Australia (n=108), USA (n=100), and Europe (n=111). In the USA and Australia, over half the Recovery Plans consider genetics a risk factor to population viability, however in Europe, only a third of plans considered genetics a risk factor. Overall, plant plans considered genetic factors a risk less often than animal plans ($P = 0.006$). A majority of the plans in the USA (82%) recommend collecting genetic data with fewer plans in Australia (52%) and Europe recommending genetic data collection (17%). Nearly half (46%) of plans in the USA included genetic data, while few plans in Australia (12%) and Europe included genetic data (11%). Population genetic factors (genetic variation, structure, gene flow), were most commonly considered. Effective population size was considered in Recovery Plans at a similar, but low rate, in the USA (13%), Australia (10%) and Europe (9%). Fitness-related (inbreeding, outbreeding, introgression) and life-history (mating system, chromosome variation, clonal propagation) factors were seldom considered regardless of region or taxonomic category. These results highlight that when genetic processes are considered, they are seldom processes that can be directly related to population fitness. Thus, more careful consideration of the genetic processes important to target for recovery planning may be warranted.

STRENGTHENING CAPACITY THROUGH A REGIONAL LEARNING NETWORK: A CORAL TRIANGLE CASE STUDY

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Conservation programs that promote building capacity and social learning among participants often lead to the formation of learning networks: social networks where learning is both a goal and potential outcome. Through forming relationships and sharing information, participants build social capital that can help a learning network achieve socio-ecological goals. We explored social capital in a network that emerged through a multi-country marine governance effort, the Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF). Through social network surveys and key informant interviews, we examined patterns of information exchange among participants in CTI-CFF regional learning exchanges (REXs) – ongoing meetings centered on CTI-CFF goals (e.g., marine protected areas). We evaluated whether the network's structure promoted information sharing and the role of key individuals in the network, and considered implications for strengthening network sustainability and learning. We found that the REX network fostered new pathways of information

sharing among participants across national and organizational boundaries. While some members were more central to information sharing, the network structure was generally decentralized, suggesting resilience to changes in leadership and membership. Participants stressed the importance of the knowledge and capacity they had acquired through the network; however, they expressed doubts regarding its sustainability and noted the need for a coordinating entity. Our findings suggest that conservation learning networks have the ability to bridge cultural divides and promote social learning; however, strong coordinators and continued efforts to support information sharing are crucial to a network's strength and sustainability. The tangible learning and capacity development outcomes cultivated through REX network underscore the value of and need to invest in conservation networks that support peer-to-peer learning.

HOW IS BIODIVERSITY FRAMED BY POLICY-EXECUTORS? INSIGHT FROM REGIONAL AND LOCAL PRACTITIONERS IN MAŁOPOLSKA REGION, POLAND

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While many conservation initiatives is launched and promoted at the international level, there is still lack of comprehensive knowledge about their sub-national implementation. We highlight that one of the important elements of policy realization are decisions made by sub-national, executive administration employees. Yet, the knowledge on their attitudes and opinions is mostly based on incidental observations or secondary opinions of particular people or institutions. We contribute to fill this gap by presenting a quantitative, representative data on how practitioners from sub-national administrative levels actually frame biodiversity and how do they perceive factors influencing its state. The study was conducted among local authorities and regional nature conservation and environmental institutions (both having discretion over nature conservation realization) in Malopolska region, Poland. The total number of 219 questionnaires (144 from the local and 75 from the regional level) was collected with responses rates: 60% and 71% at local and regional level respectively. We investigated how biodiversity and biodiversity conservation are understood by people actually responsible for conservation realization and verified the extent to which there is a common or divergent opinion on local and regional scale threats to biodiversity. We revealed significant differences between local and regional policy-executors, indicating that local level representatives tended to think and perceive biodiversity and its threats in a very narrow, local scope only. Regional level representatives



instead lean toward seeing much more positives of both state and trends of change in biodiversity. Still, regional level policy executors much more often acknowledged various factors influencing biodiversity, such as habitat fragmentation, river regulation or monocultures in agriculture. Interestingly, only climate change was unanimously perceived as having low impact on biodiversity.

SYMPOSIUM ID: #191 CONSERVATION MARKETING: HOW TO PROMOTE YOUR RESEARCH OR CAUSE MORE EFFECTIVELY

Kathleen Pilfold

None.

Are you promoting your conservation research or cause to the entire general public? Are you having trouble quantifying tactics? If so, your strategy may need tweaking to be measurable and ultimately more effective. Marketing is both an art and a science. In essence, it is storytelling with three main objectives: 1) to create awareness and ensure the intended audience understands the basic concept behind an idea and its relevance to them; 2) to reduce or remove barriers surrounding the idea so that a proposed action takes minimal effort; and 3) to develop and manage relationships with the intended audience. Marketing always focuses on the audience's perspective. It begins with defining a communications objective that is separate from the conservation research objective. Then, an audience is segmented for specific sets of values and interests, including demographics, geographic segmentation, behaviors, political values, social status, and others variables. An ideal target audience is made of decision makers and/or influencers, who will ultimately be in charge of fulfilling a call to action. Clearly-defined messaging is then crafted for the audience by bridging psychology, sociology and often graphic design principles. A call to action is asking for a behavioral shift by the target audience, such as visiting a website, calling a number, buying a product (or not buying a product), switching brands, or sharing knowledge with friends. According to Schwartz's Norm Activation Model, behavioral change is influenced by the awareness of the need for change and the perceived notion that others are also acting. Attitudes can be shifted by targeting the right segment of an audience at precise moments that most influence decisions. Once attitudes change, actions can change. McKinsey's loyalty loop, or consumer decision journey is an industry standard in marketing, which can equally be applied to audiences regarding conservation topics.

DESPOTIC ANIMALS AND IDEAL DISTRIBUTION MODELS

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University of Alberta

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Identifying and protecting suitable habitat is a cornerstone of conservation. Species Distribution Models (SDMs) have become a preeminent method in quantifying habitat use and preference. SDMs are generally applied to the location patterns of individual animals, and the strong assumption underpinning these models is that density of use reflects habitat quality, also known as the habitat-matching rule. Habitat matching is a derived prediction of the Ideal Free Distribution (IFD), which suggests that if animals have perfect knowledge, are equal competitors, and can access high quality habitat with no cost, fitness will be homogeneous across a population and the density of individuals will reflect habitat suitability. Despite the acknowledgement that many animals have non-ideal distributions, limited study has occurred on how sensitive SDMs are to violation of IFD assumptions. We used a combination of simulation and empirical research on polar bears (*Ursus maritimus*) to investigate how metrics of habitat preference are influenced by despotic behaviour. In this presentation, I will discuss how robust SDMs are to violations in IFD assumptions, and examine practical ways of mitigating the influence of despotic behaviour on habitat quality metrics. Finally, I will relate these findings to the distribution of polar bears in the spring in the Beaufort Sea, Canada, and provide an empirical example of the effects of despotic behaviour on measuring habitat quality.

IMPACT OF FOREST EXPLORATION ON NATURAL REGENERATION OF AN ENDANGERED AMAZON SPECIES VIROLA SURINAMENSIS (ROL.) WARB: CONSEQUENCES FOR CONSERVATION

Fatima Piña-Rodrigues

Universidade Federal de São Carlos

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Along 80-90 decades, plywood industries explored natural areas of *V. surinamensis* (Myristicaceae). Later that, a new exploration started after 2000 for seed harvesting to cosmetic productions. In order to propose a management for in-situ conservation, we surveyed natural areas with different intensity of exploration in the Amazon estuary as follow: (a) low (Gurupa) and high (Labrea) floodplain conserved forests; (b) explored areas in low (Laguna) and high (Anajas) floodplain zones and (c) floodplain forest with no wood exploration along the last 15-20 years (Abaetetuba). Perpendiculars to the tides we established transects (10 m x 100 to 300 m) and we evaluated seedlings



(0.20<H<1.0 m) in plots of 1 m², sticks (circumference < 0.30 m) in plots of 7.5 m² and adults (plots of 200 m²). We applied Paired Squared Variance (PSV) followed by Green Index (IG) to estimate spatial distribution among groups of individuals and T-square (C) to evaluate individuals inside the groups. In conserved areas (Gurupa and Labrea) the density of natural regeneration (seedlings and sticks) showed a "J" inverted distribution with a slight bottleneck from sticks to adults while in the explored ones (Laguna, Gurupa and Abaetetuba) there was a strong narrowing from seedlings to sticks, which were density-similar to adults. The type of forest affected spatial distribution; in lowland floodplain forest, groups were formed by 5 m distance adults-seedlings dispersed 80-120 m from each other, with sticks randomly distributed among them; in high floodplain forest, groups of adults and juveniles (seedlings and sticks) were distant from each other 40-80 m in Labrea and 120-240 m in the explored ones (Anajas and Abaetetuba). We suggest that species regeneration is more sensitive to exploration in high floodplain forests and that number of sticks can estimate endangered areas to potential conservation in-situ and management.

108 A DECISION SUPPORT SYSTEM TO MONITOR CHIMPANZEE HABITAT HEALTH IN AFRICA USING LANDSAT SATELLITE IMAGERY, CROWDSOURCING AND OPEN STANDARDS

Lilian Pintea

The Jane Goodall Institute

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The Open Standards for the practice of conservation is a science-based, collaborative and adaptive management framework that strategically focuses conservation decisions on clearly defined objectives and prioritized threats and measures success in a manner that enables adaptation and learning over time. However, to date, the process of setting and monitoring measurable goals can be particularly challenging. Recent developments in remote sensing and cloud computing enable the use of satellite observations to provide a synoptic view of habitats at fine spatial and temporal resolutions that are locally relevant and consistent across the entire species range. In this paper we present a practical Decision Support System to be used by the Jane Goodall Institute and partners to annually monitor and forecast chimpanzee habitat health in Africa. The system integrates Earth observations from 30-meter resolution Landsat data with a species-specific habitat model and a model forecasting future land use change, enhanced by crowd-sourced field data collected by local communities and rangers

using the Open Data Kit app and Android mobile smartphones and tablets. Current habitat health status of the chimpanzee in Africa between 2000 and 2013 and future habitat health until 2030 will be presented and discussed. While coarser-scale and static chimpanzee habitat models have been previously developed, this project is the first to develop a dynamic monitoring system updated annually via Earth observations data that will systematically monitor threats and changes in habitat over time. Since the chimpanzee is an important keystone, flagship and umbrella species, an annual chimpanzee habitat health index would support conservation goals of other species within its large 2.5 million sq km range and could be an important indicator of overall ecosystem health of tropical forests in Africa.

20 FOREST WATCHER MOBILE APP: A NEW TOOL TO INFORM HABITAT MONITORING AND LAW ENFORCEMENT

Lilian Pintea

The Jane Goodall Institute

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Deforestation is a key driver of loss of habitat, climate change, diminishment of ecosystem services, and destruction of the natural resources. The Global Forest Watch (GFW) platform represents a ground-breaking advance in democratizing satellite information by putting real-time, globally-consistent yet locally-relevant data on forest change into the hands of all. In this paper we present Forest Watcher, a new and free mobile app that enables users with limited and occasional Internet connectivity to access, navigate to and ground-truth GFW forest loss alerts using Android smartphones or tablets. Forest Watcher is developed by the Jane Goodall Institute, World Resources Institute, Google Earth Outreach and TouchLab. We will discuss the potential of the app and GFW forest loss alerts to conservation in practice using three user case studies as part of the joint efforts to monitor threats to chimpanzee habitats and forests in western Uganda. First we will present the results of using Forest Watcher app by the private forest owners associations to support accountability and transparency among its members and inform the collective management of the private forests in Budongo-Bugoma corridor. We will evaluate then the potential of the app to the local communities and National Forest Authority rangers to patrol Budongo Forest reserve and enforce the law. Finally we will discuss how the app can be used by other organizations and citizens to crowdsource forest monitoring worldwide. With some GFW forest loss alerts coming in monthly updates, decision-makers could potentially move from simply documenting the forests already lost toward



faster action to stop illegal activities on the ground, slowing and preventing habitat loss before it happens.

INTEGRATING STATISTICAL METHODS, DYNAMIC MODELS AND MULTIPLE DATA SOURCES TO INFORM CONSERVATION MANAGEMENT DECISIONS.

Cecilia Pinto

University of Aberdeen [INSTITUTE] Marine Scotland Science
Stephen PALMER, University of Aberdeen ; Francis NEAT, Marine Scotland Science ; Peter WRIGHT, Marine Scotland Science ; Beth E. SCOTT, University of Aberdeen ; Justin M. J. TRAVIS, University of Aberdeen

Understanding the spatial population dynamics of many species of conservation interest is often made challenging by sparse availability of data. This poses major challenges for developing robust conservation management strategies. Here, we demonstrate how by using and integrating multiple sources of data (each one of moderate information value) through a set of contemporary statistical methods we can gain improved insight into the behaviour and spatial dynamics of an endangered marine apex predator, the flapper skate (*Dipturus intermedius*). This species used to be a widely distributed species across the North East Atlantic, but suffered a 90% decline in the last 40 years due to high levels of by-catch by fisheries. The West Coast of Scotland still hosts a number of relict populations in its sea lochs which were studied in order to better understand the biology of this species and define effective conservation measures. Demographic parameters including survival and residency were estimated from a Bayesian multisite capture recapture model which accounted both for individual and effort heterogeneity. Habitat suitability was estimated from opportunistic scientific survey data analyzed with GAMs and it was validated from independent geolocation data obtained from data storage tags. Demographic parameters together with habitat suitability maps were used as inputs for RangeShifter (an individual based modelling platform) to define the species population dynamics and seascape respectively. The model was applied to explore potential outcomes of different plausible conservation scenarios. Importantly, we establish the degree to which model-informed management decisions are robust to the uncertainty in parameter estimates. Using the flapper skate as a case study, we have demonstrated how novel dynamic modelling approaches, coupled with emerging statistical methods can enable us to inform conservation management, even for data poor species.

THE EFFECT OF NEST BOX CLEANING ON THE BREEDING SUCCESS OF RED-FOOTED FALCONS (FALCO VESPERTINUS)

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The Red-footed Falcon is a small raptor species of high international conservational interest. Like other falcons they occupy nests built by other species for breeding. Its main nest host species in the Carpathian Basin is the colonially breeding Rook. The Rook population dramatically decreased in Hungary in the late 20th century narrowing down the Red-footed Falcon's opportunities for breeding, and making their population in Hungary endangered. In the past decade circa 4000 nest-boxes were provided to overcome the lack of nesting opportunities, and nowadays approx. over two thirds of the Hungarian population breeds in these kinds of artificial boxes. In the current situation it is crucial to know what kind of maintenance these nest-boxes require to remain suitable for successful breeding. Due to their closedness a substrate made of mainly food remains and faeces piles up in these boxes. The goal of our study was to investigate whether the removal of this substrate have an effect on the breeding success of Red-footed Falcons. The study was conducted in 2012, at artificial Red-footed Falcon colonies located in the Körös-Maros National Park in southeast Hungary. After the breeding period, the substrate was removed and replaced with dry grass in 106 of 251 randomly selected nest-boxes in 7 colonies. We used the nest-box monitoring and nestling ringing data of 2013 to measure the breeding success of the Red-footed Falcons. Using Generalised Linear Mixed Models we found no difference in the number of eggs laid, in the proportion of nestlings fledged, in the wing length and mass of nestlings between clutches of cleaned and untreated boxes. Our results suggest that cleaning of the boxes doesn't improve the breeding success of Red-footed Falcons, so the efforts previously put in these kinds of activities can be used for other conservational actions. Although providing some kind of cushioning like placing dry grass in the boxes is necessary to prevent eggs from rolling around.

PREDICTING THE EFFECTS OF HUMAN DEVELOPMENTS ON INDIVIDUAL DOLPHINS TO UNDERSTAND POTENTIAL LONG-TERM POPULATION CONSEQUENCES

Enrico Pirotta

University of Aberdeen



John HARWOOD, University of St Andrews ; Paul THOMPSON, University of Aberdeen ; Leslie NEW, U.S. Geological Survey ; Barbara CHENEY, University of Aberdeen ; Monica ARSO CIVIL, University of St Andrews ; Philip HAMMOND, University of St Andrews ; Carl DONOVAN, University of St Andrews ; David LUSSEAU, University of Aberdeen

Human activities that impact wildlife do not necessarily remove individuals from populations. They may also sub-lethally change their behaviour. This has driven interest in developing analytical tools that predict the population consequences of these short-term responses. Recent research has shown that modelling behavioural dynamics that arise from underlying motivations is an effective way to simulate the processes affecting individuals' decision-making. However, there are relatively few examples where this was done using a robust evidence base. Here, we integrate empirical information on the ecology of a population of bottlenose dolphins in an individual-based model that predicts individuals' behavioural dynamics and any potential change resulting from the interaction with boat traffic and dredging activities. We simulate the effects of proposed coastal developments and show that the operational phase, but not the construction phase, is predicted to affect the animals' motivations. For such results to be relevant for management, the effects on individuals' vital rates need to be quantified. These are mediated by the animals' ability to maintain their condition. However, it remains challenging to measure changes in an individual's condition in the field. Alternatively, we investigate whether the relationship between an individual's exposure and reproductive success can be directly estimated using a Bayesian multi-stage model for calf survival. We carry out a power analysis to assess any bias, as well as the sample size and effect size required to detect an effect. The results suggest that this approach could only detect significant relationships in large, closely-studied populations. Our work can be used to guide management decisions, accelerate the consenting process for coastal and offshore developments and direct targeted monitoring. However, more proximate measures of female condition are needed if long-term population consequences are to be robustly predicted.

106 - MANAGING THE WILDLIFE TOURISM COMMONS

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The non-lethal effects of wildlife tourism can threaten the conservation status of targeted animal populations. In turn, such resource depletion can compromise the economic viability of the industry. Therefore, wildlife tourism exploits resources that can become common-pool and that should

be managed accordingly. We used a simulation approach to test whether different management regimes (tax, tax and subsidy, cap, cap-and-trade) could provide socio-ecologically sustainable solutions. Such schemes are sensitive to errors in estimated management targets. We determined the sensitivity of each scenario to various realistic uncertainties in management implementation and in our knowledge of the population. Scenarios where time quotas were enforced using a tax and subsidy approach, or they were traded between operators were more likely to be sustainable. Importantly, sustainability could be achieved even when operators were assumed to make simple rational economic decisions. We suggest that a combination of the two regimes might offer a robust solution, especially on a small spatial scale and under the control of a self-organized, operator-level institution. Our simulation platform could be parameterized to mimic local conditions and provide a test-bed for experimenting different governance solutions in specific case-studies.

LAND USE, HABITAT DEGRADATION, AND EASTERN HELLBENDER (*CRYPTOBRANCHUS ALLEGANIENSIS ALLEGANIENSIS*) DISTRIBUTION CONSTRICTION WITHIN THE SUSQUEHANNA RIVER DRAINAGE

Amber Pitt

Bloomsburg University

Jamie SHINSKIE, Bloomsburg University ; Sean HARTZELL, Bloomsburg University ; Joseph TAVANO, Bloomsburg University

Eastern hellbenders (*Cryptobranchus alleganiensis alleganiensis*) are long-lived, large-bodied, fully aquatic salamanders native to the eastern United States. Hellbender populations have declined precipitously throughout their range due to a variety of factors including habitat degradation, disease, and collection for scientific investigations, educational purposes, and the pet trade. Habitat degradation associated with land use changes continues to be a primary threat to hellbender populations, yet much of what is known about the impacts of habitat degradation on hellbenders has been derived from a few studies that have documented long-term trends in hellbender populations and their habitat within a single stream, or based on primarily anecdotal evidence of declines. We sought to examine the relationship among land use, within-stream characteristics (i.e., habitat), and hellbender population persistence and extirpation within the greater Susquehanna River drainage in Pennsylvania, USA. We surveyed streams from which historical hellbender populations were known, but for which no recent status assessments existed. We used remote sensing to categorize the land use surrounding each stream. We also evaluated the within-stream characteristics, including water quality and stream substrate composition. Our results indicated that only 10 of the 25 sites tested still contained hellbenders. Hellbenders have undergone



distribution constriction within the greater Susquehanna River drainage in Pennsylvania, USA, and this corresponded with changes in land use and habitat degradation. These results can be used to inform hellbender conservation and reintroduction programs throughout their range.

161 BIOGEOGRAPHIC ASSESSMENTS: AN INTEGRATIVE FRAMEWORK FOR INFORMATION SYNTHESIS IN MARINE SPATIAL PLANNING

Simon Pittman

NOAA & Plymouth University

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Spatial planning is a considerable challenge for marine stewardship agencies because of the need to synthesize information on complex socio-ecological patterns across geographically broad spatial scales. This challenge is compounded by relatively short time-frames for implementation and limited financial and technological resources. To address this pragmatically, NOAA in collaboration with marine managers have developed the Biogeographic Assessment Framework (BAF) which provides a rapid, flexible and multi-disciplinary approach to integrate geospatial information into formats and visualization tools readily useable for spatial planning. Central to BAF is four sequential components: (1) Planning; (2) Data Evaluation; (3) Ecosystem Characterization; and (4) Management Applications. The framework is continually evolving with technological advances, information availability and needs, but has already been applied to support the development of several marine spatial plans in the United States. This presentation describes the structure of the BAF framework, some of the associated analytical techniques with examples of how synthesis products have had real world impacts in marine spatial planning.

SURVIVING URBANISATION: AVIFAUNAL DIVERSITY IN MILLENIUM DRIVE, MALABE, SRI LANKA

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Increasing urbanisation poses a major threat to biodiversity. Even though a considerable amount of studies have been conducted on urban biodiversity, knowledge about how biodiversity respond to urbanisation is limited in Sri Lanka. Therefore this study compares the species richness and diversity of bird communities in remnant forest patches and exotic manmade landscapes in Millennium drive, Malabe Sri Lanka. Study site is located in a semi urban environment which

is undergoing rapid development and is surrounded by both manmade and natural wetlands and forest remnants. After a rapid recognisance survey 4 remnant forest patches and 4 exotic urban landscapes were selected within the millennium drive out of 2 were terrestrial and two were aquatic. In each site belt transects of 200X50 m were laid. Birds were identified using Line transect, opportunistic observations and point count methods. A total of 106 individuals which belongs to 53 bird species including 7 migrants, 4 endemic species, and 3 nationally threatened species were recorded in the study area. Total number of bird species observed in exotic landscapes and remnant forest patches were 37 and 45 respectively. High species richness in forest remnants may be due to the high availability of food and shelter in forest remnants than exotic landscapes. Thirty five bird species were recorded in both sites (urban adaptors) while 18 species (Urban avoiders) were restricted only to remnant forest patches and 5 species were urban exploiter only recorded in exotic landscapes. The species restricted to the remnant forest patches were native species which includes endemic and threatened species. In conclusion, even though rapidly urbanising Millennium drive comprises of a rich diversity of avifauna and it is clear that forest remnants support more native species diversity than new exotic landscapes. Therefore it is advisable to incorporate more native plants in future urban development

COLOMBO URBAN WATER CANAL SYSTEMS WATER QUALITY VARIATION DUE TO HUMAN ACTIVITIES IN SRI LANKA

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University of Colombo

Asitha NANDASEELA, University of Colombo

Urban water canal systems faces challenges of a growing and urbanizing population, a changing climate, an increase in the frequency of extreme weather events. Understanding these challengers in the physical environment and determining whether such changes are natural or a result of anthropogenic influences can be a difficult problem. The study was conducted in Colombo urban canal system in Sri Lanka to identify the variations of water quality and to identify the human health impact of water quality. Field study was conducted in canal systems identify the waste dumping sites, locations and also to study the physical conditions of the canal. Then a water quality survey was conducted to measure the water quality parameters, with special focus to E-Coli test, pH, Electrical conductivity, Salinity, Turbidity, Dissolved Oxygen, Ammonia levels, Nitrate levels, Phosphate levels, Chemical Oxygen Demand, Biological Oxygen Demand. Tertiary the questionnaire survey was conducted based on people who live adjacent to the canal to identify their health conditions. Main analytical tools of the study were statistical, Arc GIS 10.1 and ERDAS 2011. According to the study the main causal factor



for pollution is identified as waste generated by the human activities and poor sanitary facilities. Therefore the levels of e-coli are around 10 per milligram where the recommended level is zero E-coli in water and other chemical parameters also above the recommended levels. Based rainfall analysis revealed that the clear relationship between rainfall variations and water quality parameters; especially the salinity variation due to sea water intrusion to the canal system.

EFFECTS OF OCEAN ACIDIFICATION ON CORAL REEF COMMUNITIES

Laetitia Plaisance

Smithsonian Institution

Nancy KNOWLTON, Smithsonian Institution ; Katharina FABRICIUS, Australian Institute of Marine Science

Coral reefs are the most diverse marine ecosystems and among the most threatened. It is now widely accepted that increasing levels of carbon dioxide (CO₂) in the atmosphere pose an enormous threat to coral reefs and ocean acidification (OA) has recently come to the forefront as a major concern in the coming decades. OA will have numerous consequences for both calcifying and non-calcifying species and will potentially significantly modify reef communities. Field experiments at sites with naturally-elevated CO₂ conditions, such as CO₂ vents, are potentially useful for investigating the effects of future acidification on coral reef associated biodiversity at the ecosystem level. To this end, we characterized the cryptic microfauna associated with naturally acidified coral reefs in Milne Bay, Papua New Guinea. Two pH conditions representing present day pH (8.1) and the estimated global ocean pH by the end of the century (7.8) were investigated for two sites in Dobu and Normanby Islands. We used standardized sampling techniques (ARMS) and molecular species characterization (DNA barcoding and metabarcoding) to quantify the taxonomic composition of the sessile and motile reef-associated cryptofauna. We will assess changes in diversity and community structure and will interpret the results in the light of changes in water chemistry and associated loss of habitat complexity to provide insights into future reef-community structure in a high CO₂ world.

CASCADING EFFECT OF PREY ABUNDANCE ON CARNIVORE MORTALITY NEAR MOTORWAYS

Aimara Planillo

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Understanding effects of the human altered landscapes in wildlife is a priority to propose effective conservation measures.

Motorways are an interesting study case, as they not only create disturbance, but are also sources of extra mortality on many species. Some prey species have dense populations near these infrastructures which can attract predators to them. We analyzed changes in the predator-prey relationship in the proximity of motorways in comparison with control sites, with the prediction that prey populations beside the infrastructure will increase predator mortality. Our study model is a key prey species in Mediterranean area, the European rabbit (*Oryctolagus cuniculus*) and its carnivore predators - Red fox (*Vulpes vulpes*), Mustelids (several species, mainly *Martes foina*), and Cats (Feral and Wildcats, *Felis silvestris*), in a typical Mediterranean landscape of Central Spain. We conducted a survey of relative abundances and analyzed the effects of rabbit abundance and distance to motorway (motorway verges vs. control sites at more than 4 km away), on carnivore abundance. We also collected data on carnivore road mortality. We found that the carnivore abundance tend to increase with prey abundance, as expected. More interesting, we found that carnivore abundance was higher next to the motorway than in control sites, even for the same abundance of prey. As predicted, carnivore roadkills were related to the carnivore abundance in the verges. In the light of these results, we conclude that prey populations near risky anthropogenic areas, such as roads, can create a cascading effect that leads to increased carnivore mortality. These results will provide useful knowledge for future management actions, focused on reducing prey populations on road verges for carnivore conservation.

MULTI-SPECIES TRANSLOCATION STRATEGIES ARE HIGHLY INTERACTION-TYPE SPECIFIC

Michaela Plein

University of Melbourne

Michael BODE, University of Melbourne ; Melinda MOIR, The University of Western Australia ; Peter VESK, University of Melbourne

Translocating threatened species to prevent their extinction is commonplace. Although multiple species are being translocated to single locations such as fenced reserves or offshore islands, current translocation guidelines consider single species in isolation. This practice ignores important interspecific interactions and their influences on population dynamics, thereby risking translocation failure. To show if and how interspecific interactions influence translocation strategies, we modeled three two-species systems for consumer-resource, mutualism, and competition. We specifically focused on the influence of interaction types on the required founder population size, and the optimal order in which the species are moved (simultaneous or sequential) to achieve successful multi-species translocations. Further, we assessed the effect of increasing interaction strength in



simultaneous translocations, and increasing delay time in sequential translocations. Although we found few similarities between different interaction types, we identified a series of interaction-specific recommendations. Translocations of mutualists and competitors required a minimum founder population size, but consumer-resource translocations are more complex because they also exhibit a maximum founder population size. While simultaneous translocations improved the outcomes of mutualistic interaction partners, competitors and consumer-resource systems benefitted from sequential translocations. Interspecific interactions are important processes that shape population dynamics and should therefore be incorporated in the quantitative planning of each translocation, especially for multi-species translocations. Our findings not only apply to conservation translocations, but whenever interacting species are moved (e.g. biological control, restoration).

THE ROLE OF THE SEED BANK IN BUILDING UP A GENETIC EXTINCTION DEBT IN THE GRASSLAND PERENNIAL *CAMPANULA ROTUNDIFOLIA*

Jan Plue

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Fragmentation of natural habitats is a global threat to biodiversity. Still, many species survive in habitat fragments past the point where their minimal viable population size has been reached. Plant species may postpone their extinction, due to persistent life-cycle stages involving prolonged clonal growth or seed banks, resulting in a species extinction debt. A delay in the expected loss of population genetic variation may be one of the mechanisms behind a species extinction debt. We examined the role of the seed bank in building up a genetic extinction debt in the grassland perennial *Campanula rotundifolia*. We used microsatellite markers to analyze the genetic make-up of 15 above- and belowground populations in relation to historical and current landscape configuration. Aboveground genetic diversity and composition were related to historical patch size and historical patch connectivity, respectively, and not to the current patch characteristics, supporting a genetic extinction debt. When the entire gene pool was examined by including the genetically diverse seed bank, the genetic extinction debt pattern became even stronger. We conclude that the seed bank contributes to the genetic extinction debt build-up, by delaying genetic diversity losses in small populations. This renders *C. rotundifolia* a species able to postpone its extinction, yet the question rises whether the extinction debt concept currently underestimates species losses, as long as underlying mechanisms are not fully understood. The genetic extinction debt nevertheless buys

conservation management the time needed to restore habitat area and connectivity, preventing expected erosion of genetic diversity, averting future species losses.

EFFECTS OF SILVICULTURAL PRACTICES ON ECOSYSTEM SERVICES FROM BOREAL PRODUCTION FORESTS

Tähti Pohjanmies

University of Jyväskylä
Maria TRIVIÑO, *University of Jyväskylä*; Adriano MAZZIOTTA, *University of Jyväskylä*; Eric LE TORTOREC, *University of Jyväskylä*; Mikko MÖNKKÖNEN, *University of Jyväskylä*

Forests are widely recognized as major providers of ecosystem services, including timber, recreation, regulation of water, soil, and air quality, and climate change mitigation. Boreal countries harbor some of the world's most extensive forest areas and have long traditions of production forestry. Extensive tracts of boreal forest are actively managed for timber production, but actions aimed at increasing timber yields also affect other forest functions and thus ecosystem services. Our review of the environmental and social impacts of prevailing practices reveals that management may have positive or negative effects on multiple ecosystem services provided by boreal forests. Similarly, actions aimed at tackling future challenges (increased wood production, climate change, and biodiversity conservation) may lead to both gains and losses in ecosystem services. The direction and magnitude of most of the effects are highly dependent on the properties of the site, suggesting forest management for diverse benefits should be context-specific. While some effects occur at spatial scales that are relevant for forest management (i.e. stand or forest holding), some are generated at larger scales (i.e. landscape). This suggests coordination of activities among forest owners may be necessary to secure diverse forest services. Conflicts among different interests related to forests are likely, but the concept of ecosystem services may provide a useful framework for identifying and assessing the conflicts and for finding optimal solutions for them.

SIMULATIONS BASED ON MOLECULAR-GENETIC DATA IN DETECTION OF EXPANSION *SALMO TRUTTA* ALLOCHTHONOUS POPULATION IN THE NERETVA RIVER'S TRIBUTARIES

Naris Pojskic

INGEB, *University of Sarajevo*
Belma KALAMUJIC, *INGEB, University of Sarajevo*

In Bosnia and Herzegovina, brown trout resides in both river basins. The Danube (Da) evolutionary lineage is native in the Black Sea basin, while the Adriatic lineage (Ad) is autochthonous to the Neretva basin. The survival of the local



gene pool of wild brown trout is threatened due to habitat degradation, overexploitation, inadequate stocking and hybridization. Control region of mtDNA together with LDH gene were used to assign samples to evolutionary lineages, while 13 microsatellite markers were genotyped to assess population genetic diversity. Total of 335 specimens of brown trout from the main flow of the River Neretva and 11 of its tributaries were sampled. Sampling locations on tributaries were located in hardly accessible areas in order to maximally reduce the possibility of stocking. Besides the indigenous Adriatic haplotype, the Danube and the Atlantic mtDNA haplotypes were detected, which clearly indicates that populations of brown trout in the Neretva river basin have been subject to translocation activities and stocking with allochthonous gene pool. Simulation based on molecular-genetic data clearly proves hybridization events and expansion of population with allochthonous haplotypes. The trend of expansion of allochthonous gene pool of brown trout was also detected in the most remote tributaries of the river Neretva. MCMC analysis indicated that the first introgression phase was represented by intraspecific hybridization between the Danube and the Adriatic brown trout, imposed by the process of restocking. The second phase of introgression is ongoing; it represents intraspecific hybridization between the first-phase-introgression hybrids (as well as "pure" Adriatic trout) and the Atlantic brown trout that were introduced primarily through inadequate stocking activities. Other simulations show that only 11% of the initial population (indigenous specimens from the tributaries) has the characteristics of the simulated autochthonous population.

HUMAN LEOPARD CONFLICT IN CAPITAL CITY OF NEPAL

Monsoon Pokharel Khatiwada

Tribhuvan University

Khadga KHADGA, Tribhuvan University; Ambika Prasad KHATIWADA, National Trust for Nature Conservation; Kyran KUNKEL, University of Montana

Common leopard (*Panthera pardus*) is a widely distributed large cat included in near threatened category of IUCN. In Nepal, common leopards are found in variety of habitats including protected areas and human dominated landscape. Human leopard conflict (HLC) is a major issue in capital city of Nepal (Kathmandu valley) recently with death of leopards, injuries to human beings, and livestock losses. The objectives of this study were to collect historical human leopard conflict data and to identify cause of conflict with its appropriate mitigation measures. HLC data including leopard death/rescue and human injuries were collected from primary (interview survey, n=110) and secondary sources. Satellite imagery of 2003 and 2013 were analyzed to understand land use land cover change to identify the causes of HLC. Thirty-two human leopards

encounter cases were recorded in 2010-2013 with more than 50% (17) of leopards found dead and sixteen leopards were rescued and released back to natural habitat. During 2003 - 2013 an area of 4011 hectare was converted from forest to barren land in Kathmandu valley. Most of the HLC cases occurred in forest cover change area i.e., forest cover converted into settlements or agriculture or barren land and the area where change is occurring gradually. Forest cover change into settlements, limited prey species in forest and insufficient awareness level of local communities were the major causes of HLC in Kathmandu valley. It is a daunting challenge to ensure the peaceful coexistence of leopards among high densities of humans. During encounter with leopards, human provocations have often resulted in aggressive nature of leopards. Such cases of HLC often remain unaddressed. Local education campaigns, improved livestock management, and enhancement of wild prey populations hold much promise for reducing and better managing conflicts.

SPATIAL PATTERNS OF VULNERABILITY TO EXTINCTION IN TERRESTRIAL MAMMALS: SPECIES TRAITS VS. ANTHROPIZATION

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Doñana Biological Station

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Traditionally, prioritization schemes for global biodiversity conservation are based on the amount of (endemic) species that inhabit certain areas or, less frequently, on the coincidence of species richness and some proxy of human presence (e.g. population density). However, nowadays there is more information available, which may help not only to establish schemes but also to understand the potential causes that make some areas a priority. In the present work, we introduce the concept of vulnerability to extinction into the prioritization framework. We focus on terrestrial mammals to predict extinction risk at the species level based on two well-known aspects influencing vulnerability: life-history traits and overlap with different human activities. Using this approach we identify areas requiring different conservation actions. In particular we recognized four types of areas: 1) urgency areas: where both the characteristics of the species and the existing human activities pose a threat and thus, action is urgently needed; 2) species-based vulnerable areas: where species are naturally fragile and human presence is scarce, thus specific management plans for mammals that also maintain natural habitats would be particularly efficient; 3) highly-anthropized areas: where human pressure is high but species are not intrinsically vulnerable; monitoring checks would be highly advisable, making the most of closeness of human populations; and 4) remote areas: relatively pristine areas where there are not remarkable threats for terrestrial mammals. We find that



our urgency areas largely overlap with previously identified hotspots, whereas, the other three types have been generally grouped and given low priority in literature. Our study allows for a finer-grain differentiation of conservation priorities, revealing areas where preventive and less-resources-requiring actions could be effective in avoiding future urgencies.

OPTIMAL PLANNING FOR MITIGATING THE IMPACTS OF ROADS ON WILDLIFE: A MULTIPLE SPECIES APPROACH

Tal Polak

The University of Queensland
Emily NICOLSON, The University of Melbourne ; Clara GRILO, Universidade de Aveiro ; Joseph BENNETT, The University of Queensland ; Hugh POSSINGHAM, The University of Queensland

Roads have a major effect on wildlife worldwide through habitat loss, habitat fragmentation and direct road-kill mortality. Two of the ways to mitigate these impacts are erect wildlife crossings and/or build fences. However, these techniques are expensive, and have varying levels of success. Thus, deciding where and how to act in order achieve the greatest return on investment is crucial. Here, we use a decision theory framework driven by a metapopulation process model to determine the most cost-effective combination of actions to mitigate the effects of roads on wildlife for multiple species. We illustrate our approach using two sets of species (from Australia and Europe) that cover a range of taxonomic groups and life history traits. We test the cost-effectiveness of spatially explicit combinations of three management options: 1) no mitigation, 2) erect fences without wildlife crossings, and 3) erect fences combined with wildlife crossings. We explore the trade-off between each populations' mean time to extinction and total mitigation cost, first on a per-species basis and then considering all species. For most species there are "win-win" mitigation solutions with high benefits for a relatively low cost. Among the species' attributes, home range (relative to the modelled landscaped scale) and road edge effect have the greatest impact on the optimal strategy. We find that, while a single species approach was less cost-effective than a multi-species approach to management, some species can be used as indicators, allowing mitigation planning to be based on a smaller suite of species and further increasing cost-effectiveness. Our method is adaptable to any road mitigation problem and illustrates the need to consider the entire system when planning mitigation measures in order to spend mitigation funds wisely.

EFFICIENT EXPANSION OF GLOBAL PROTECTED AREAS REQUIRES SIMULTANEOUS PLANNING FOR SPECIES AND ECOSYSTEMS

Tal Polak

The University of Queensland
James WATSON, The University of Queensland ; Richard FULLER, The University of Queensland ; Liana JOSEPH, The University of Queensland ; Tara MARTIN, CSIRO ; Hugh POSSINGHAM, The University of Queensland ; Oscar VENTER, James Cook University ; Josie CARWARDINE, CSIRO

The expansion of protected area networks at national scales to conserve species and represent ecosystems is recognized as a core conservation priority in the Convention for Biological Diversity (CBD). The CBD's strategic plan advocates the use of environmental surrogates, such as ecosystems, as a basis for planning where new protected areas should be placed. However, the efficiency and effectiveness of this ecosystem-based planning approach to adequately capture threatened species in protected area networks is unknown. We examine the impact of ecosystem-based planning on the representation of threatened species using Australia as a case study, a continent where ecosystem-based targets form protected area acquisition policy. We test scenarios for protected area expansion using two targets: 1) 10% coverage of each of Australia's 85 bioregions and 2) species-specific targets based on spatial range of all of Australia's 1320 threatened species. We measured the total land area required to meet the ecosystem and species targets independently, sequentially or simultaneously. Seeking ecosystem coverage alone is poor at meeting targets for threatened species, with less than a quarter of species targets being met, representing only a slight (3.2%) improvement to the current network. Planning simultaneously for species and ecosystems targets delivered the most efficient outcomes, while planning first for ecosystems and then filling the gaps to meet species targets was the most inefficient conservation strategy. Our analysis highlights the pitfalls of pursuing goals for species and ecosystems non-cooperatively and has significant implications for nations aiming to meet their CBD mandated protected area obligations.

USING UNMANNED AERIAL VEHICLES TO SURVEY FOR THREATENED GRASSLANDS SPECIES

Lucy Poley

University of Calgary
Greg MCDERMID, University of Calgary

Remote-sensing technology provides researchers the ability to survey large areas quickly and efficiently, collecting data needed to model species distribution and habitat features in a spatially explicit manner. When surveys are repeated over time, models can indicate changes in range occupancy,



habitat selection, and other information critical for wildlife conservation and management. Unmanned aerial vehicles (UAVs) are emerging as exciting new platforms for conducting ecological surveys: they are small, safe and maneuverable, and can fly autonomous missions at low altitudes with minimal disturbance to wildlife. UAVs can gather high-resolution data on wildlife and habitat, while low operating costs means they are ideal for conducting repeat surveys. Native grassland is amongst the most endangered ecosystem on Earth. In Canada, the largest contiguous area of native grassland is in southern Alberta and Saskatchewan, where a number of threatened species reside, including the burrowing owl (*Athene cunicularia hypugaea*), now found in only 36% of its historical range. Burrowing owls live in holes made by small mammals such as Richardson's ground squirrels (*Spermophilus richardsonii*), which play an important role in maintaining healthy prairie ecosystems. However, to date no large-scale surveys have been conducted for these species, and their habitat selection is not well-understood. Using low-flying UAVs, we repeatedly surveyed study areas in southern Alberta and Saskatchewan to collect data on burrowing owls, ground squirrels, and vegetation communities. We have developed and applied an automated method for identifying active burrows and vegetation classes in UAV imagery, and are using the resulting data to model changes in species distribution, habitat selection, and other aspects of burrowing owl ecology important to conservation. Our study shows how UAVs allow researchers to gather ecological data at previously unattainable spatial and temporal scales.

PRESERVING PAST EVOLUTIONARY DIVERSITY INTO THE FUTURE

Laura Pollock
CNRS

Evolutionary history is often considered in biogeographic studies, but rarely in conservation planning. Many studies map diversity across the landscape, but hotspots of diversity should not necessarily become conservation priorities. We also need to consider the diversity that has already been lost, the diversity that is protected, and the cost of conservation actions among other factors. Here, we demonstrate a recently developed method of including phylogenetic diversity in spatial conservation prioritization with ~700 eucalypt species that dominate forest canopies across Australia. Currently, 17% of the total eucalypt PD is protected in reserves (which cover 15% of the land area), whereas 60% of the PD could be protected if the same land area was optimally located to preserve PD. Importantly, with a small expansion of the current protected areas by 2%, we could include 70% more PD. The largest intact 'candidate' area for protected area expansion coincides with

both a world biodiversity hotspot and an area of active mining exploration.

MANAGING A KEYSTONE RODENT AND DOMESTIC CATTLE TO RESTORE SEMI-ARID GRASSLANDS IN MEXICO.

Eduardo Ponce Guevara

Universidad Nacional Autónoma de México
Ana DAVIDSON, Institute for Wildlife Studies ; Rodrigo SIERRA CORONA, Universidad Nacional Autónoma de México ; Gerardo CEBALLOS, Universidad Nacional Autónoma de México

A major challenge facing grassland conservation in North America is determining how wildlife and cattle can co-exist in a way that maintains grasslands, while also supporting human needs. Around the world, keystone rodents such as prairie dogs (*Cynomys* spp) have been considered as pest and eliminated in most of their native geographic range. Eradication of native species has resulted in a cascading decline in both native wildlife and livestock production, and consequent grassland degradation. We established a long-term manipulative experiment to evaluate the individual and interactive effects of black-tailed prairie dog (*C. ludovicianus*) and cattle (*Bos taurus*) on shrub encroachment in arid grassland of northwestern Mexico. After six years, cattle and prairie dogs impacted shrub encroachment. Both reduced mesquite density, but prairie dogs had the greatest impacts. On sites where both species were removed, shrub density increased by 3-fold following their removal, increasing from 7 to 28 shrubs per hectare in six years. Cattle also impacted prairie dog abundance, whereas sites with no cattle maintained a lower prairie dog density of 14 ind/ha, on sites with cattle prairie dog density increased to 38 ind/ha. Our results provide new insights for grassland management by showing that cattle and prairie dogs may co-exist, and if they are properly managed, they may interact synergistically to control mesquite encroachment and increase habitat heterogeneity on arid grasslands.

SYMPOSIUM ID 141: DO NATIVE PLANT HEDGEROWS IN CONVENTIONAL FARMING SYSTEMS HELP TO CONSERVE POLLINATORS AND POLLINATION SERVICES?

Lauren Ponisio

University of California Berkeley
Claire KREMEN, University of California Berkeley

To slow the rate of global species loss, it is imperative to understand how to restore and maintain biodiversity in agricultural landscapes. Widespread evidence of pollinator declines has led to policies that support habitat restoration, yet, little is known about the effectiveness of these restoration techniques for conserving pollinators, especially in intensively-



managed agricultural landscapes. Using seven years of pollinator collection records from the Central Valley of California, we evaluate the effectiveness of on-farm habitat restoration, in the form of native plant “hedgerows”, for supporting pollinator populations. We find that hedgerow restoration enhances colonization and persistence of pollinators, leading to the assembly of phenotypically diverse communities. This in turn leads to increased spatial heterogeneity between communities. By helping to restore phenotypically diverse pollinator communities in intensively managed agriculture, even small-scale restoration interventions like hedgerows are a valuable measure for conserving biodiversity and promoting the provisioning of ecosystem services.

SYMPOSIUM ID 208-POTENTIAL OF DIGITAL TECHNOLOGIES TO ENHANCE OPENNESS IN LEARNING AND SCIENCE

Marisa Ponti

University of Gothenburg

The Internet, open licensing, open access journals, and open educational resources (OER) provide the foundation for redefining the experience of consumer relationship that most people have with science into one of active engagement. Specifically, OER and open access scholarly articles used as OER are critical to ensuring and expanding access to knowledge. In this respect, they can facilitate citizen science in terms of making scientific ideas and practices accessible to everyone. It has been noted that OER can support citizen science in three ways. First, the free circulation of results in open access scholarly publication allows citizens to become informed and educated, and, possibly, motivated to engage actively in scientific research. Second, open access can contribute to recruit and train potential citizen scientists. Third, funders increasingly require that grant funded science be returned and repaid to the taxpayers partially through open access to research results. Based on these three premises, it can be argued that OER can be tied into citizen science projects to build scientific communities outside of institutional settings and support peer-to-peer learning practices, in which participants work together with scientists to address relevant problems, explore scientific concepts and research solutions to problems and/or study phenomena of interest. During the oral talk, some examples of citizen science projects connecting learners and scientists in fieldwork will be presented. These projects show the possibility of using OER to involve learners in forms of inquiry-based learning, while developing their appreciation of science to their lives.

106-VISUALISING AND ANALYSING DATA TO SAVE LIVES: HUMAN AND CROCODILIAN

Simon Pooley

Imperial College London

As human populations grow and transform undeveloped lands and waterways, human-wildlife conflict inevitably increases. This is particularly problematic for large predators and the humans who live alongside them. Relatively little research has been conducted on alleviating adverse human encounters with one of the most significant and widespread predator species on the planet, the crocodiles. In this talk I argue that while long-term data on crocodile attacks will always be incomplete, and prediction of future attacks difficult, we can learn much from collecting and analysing attack data. We should focus on accumulating long-term data, entered in standardised form on a freely available database; disaggregate data on human victims by age, gender, location and activity at time of attack, to enable targeted mitigation; and analyse long-term ecological and social data for both humans and crocodiles. Continuously updated databases will enable the identification emerging trends and problem areas, and the online CrocBITE database developed by Adam Britton and Brandon Sideleau aims to achieve this on local and regional scales. In developing countries with a range of pressing social, health and other needs, crocodile attacks are unlikely to be sufficiently serious on a national scale to attract funds for mitigation. It is more feasible for local authorities to raise funds to create awareness or provide safe water access in specific locales with a history (or emerging pattern) of attacks – and link this with other social benefits such as safe drinking water. Using my data for South Africa, I am currently developing interactive visualisations of CrocBITE data to allow users to explore the data without requiring research skills to do so. We aim to motivate busy conservation managers and the public to collect, contribute, and use crocodile attack data. This knowledge can then be mobilised to save lives – human and crocodilian.

RECONCILING BIODIVERSITY CONSERVATION AND RENEWABLE AND UNCONVENTIONAL ENERGY DEVELOPMENT

Viorel Dan Popescu

Simon Fraser University

Robin MUNSHAW, Simon Fraser University; Federico MONTESINO-POUZOLS, University of Helsinki; Wendy PALEN, Simon Fraser University; Pascale GIBEAU, Simon Fraser University; Evgenia DUBMAN, Simon Fraser University; Matt



HORNE, Pembina Institute ; Atte MOILANEN, University of Helsinki

Balancing biodiversity protection with economic development is a central tenet of conservation science, but local, regional, and global conservation priorities often differ. Driven by efforts to lower greenhouse gas (GHG) emissions, renewable energy sources and low-carbon fossil fuels are being adopted worldwide, but their rapid development often outpaces our understanding of biodiversity impacts. We examined opportunities and conflicts for biodiversity protection and future electricity generation from renewable sources (wind, small hydro) and shale gas extraction and combustion in British Columbia (BC), Canada using two metrics: spatial overlap with conservation priorities, and greenhouse gas emissions. We identified conservation priorities at three levels of biological organization, species (terrestrial and aquatic vertebrates, $n=370$), communities ($n=40$), ecosystems ($n=16$) using spatial conservation planning, and quantified the spatial overlap between the footprint of each energy type and conservation priorities. We contrasted the spatial overlap against GHG emissions from electricity generation. Small hydro had the lowest GHG emissions (1.5 – 65 kt CO₂-eq/year for 5000 GWh/year), yet its infrastructure overlapped with high conservation-ranked areas for species and communities. Conversely, GHG emissions from shale gas extraction and combustion were up to 1000 times higher than small hydro. Shale development overlapped with low conservation priority areas for species and communities, but occurred in less disturbed regions. Wind energy had little overlap with conservation priorities, and low GHG (15 – 225 kt CO₂-eq/year for 5000 GWh/year), suggesting that wind could reconcile conservation and electricity production. In summary, future electricity development in BC that meets biodiversity conservation targets with minimal GHG emissions needs to focus on wind, and limited small hydropower (in areas of low conservation priority).

ID134 THE FUTURE OF MARXAN

Hugh Possingham

The University of Queensland
Matt WATTS, The University of Queensland ; Maria BEGER, The University of Queensland ; Jennifer MCGOWAN, The University of Queensland ; Hawthorne BEYER, The University of Queensland ; Yann DUJARDIN, The University of Queensland ; Viv TULLOCH, The University of Queensland

During this session researchers have discussed diverse and interesting applications of Marxan, some of which were not entirely intended by the creators of Marxan. This shows the power and flexibility of decision support software that is founded in proper mathematical problem formulation and rigorous solution methods. Having a well-defined mathematical problem is essential for credible and flexible

decision-support application. In this talk I will discuss some of the new features currently being added to Marxan, in particular the capacity to deal with more complex objective functions. This will mean that Marxan can deal with the optimisation of issues such as: species viability, species demographic objectives (e.g. minimising mortality of migrants), maximising connectivity, and ecosystem services, more flexibly than in the past. These new objectives also enable us to explore trade-off frontiers. Further, we are introducing some new solution methods (algorithmic options), including optimal solutions to the linear programming variant of the spatial planning problem. This enables us to calculate the shadow price of the target for a conservation feature (Kaim et al., this conference). Finally I note that Marxan with Zones enables us to specify multiple action packages in any cell, making Marxan useful for any sort of spatially explicit action planning, such as anti-poacher patrols, invasive species management, grazing management, indeed any regional or national land-use planning, not just reserve system design.

ID197 MARINE AND TERRESTRIAL PROTECTED AREA SYSTEM DESIGN IN AUSTRALIA: SUCCESSES AND FAILURES

Hugh Possingham

The University of Queensland
Alienor CHAUVENET, The University of Queensland ; Vanessa ADAMS, The University of Queensland ; Kerrie WILSON, The University of Queensland ; Jennifer MCGOWAN, The University of Queensland ; Lissa BARR, The University of Queensland ; Richard FULLER, The University of Queensland ; James WATSON, The University of Queensland ; Oscar VENTER, The University of Queensland

“The National Reserve System is underpinned by a scientific framework to ensure that Australia progressively extends protection to examples of all our ecosystems. The scientific framework has a clear objective: to develop a ‘comprehensive, adequate and representative’ system of protected areas - commonly referred to as the ‘CAR’ reserve system.” This represents a clear statement of intent by the Australian government for over a decade. But given that intent, how well has Australia done in efficiently constructing a ‘CAR’ reserve system. Our analysis suggests that a focus on representation has delivered clear dividends over the past decade on the land – although land-based acquisition has stalled through lack of funds. That said, management is inadequate and major gaps in the reserve system remain. Australia’s marine protected areas system designations represent some of the worst, and the very best global examples of protected area system design. The rezoning of the Great Barrier Reef is a shining example of efficient representation of conservation features, as is the South Australian state marine reserve system. However the rezoning



of many commonwealth regions is very poor, especially in the south-east and north, because of a failure to use, or properly use, systematic conservation planning tools. Sadly there is often a failure to openly acknowledge what has, and has not, worked. Our analyses uses a new metric - "protection equality" - to assess representation. We argue that this metric should be a new global standard that sits alongside total fraction protected as a measure of conservation success. Much can be learnt from Australia's successes and failures.

OPTIMAL CONSERVATION OUTCOMES REQUIRE BOTH RESTORATION AND PROTECTION

Hugh Possingham

The University of Queensland

Michael BODE, The University of Melbourne ; Carissa KLEIN, The University of Queensland

Conservation outcomes are principally achieved through the protection of intact habitat or the restoration of degraded habitat. Restoration is generally considered a lower priority action than protection because protection is thought to provide superior outcomes, at lower costs, without the time delay required for restoration. Yet while it is broadly accepted that protected intact habitat safeguards more biodiversity and generates greater ecosystem services per unit area than restored habitat, conservation lacks a theory that can coherently compare the relative outcomes of the two actions. We use a dynamic landscape model to integrate these two actions into a unified conservation theory of protection and restoration. Using nonlinear benefit functions, we show that both actions are crucial components of a conservation strategy that seeks to optimise either biodiversity conservation or ecosystem services provision. In contrast to conservation orthodoxy, in some circumstances, restoration should be strongly preferred to protection. The relative priority of protection and restoration depends on their costs and also on the different time lags that are inherent to both protection and restoration. We derive a simple and easy-to-interpret heuristic that integrates these factors into a single equation that applies equally to biodiversity conservation and ecosystem service objectives. We use two examples to illustrate the theory: bird conservation in tropical rainforests and coastal defence provided by mangrove forests.

ASSESSING AT-RISK STATUS OF ATHABASCA RIVER RAINBOW TROUT WITH LOTS OF POOR RESOLUTION CATCH DATA

John Robert Post

University of Calgary

Hillary WARD, University of Calgary ; Eric TAYLOR, University of British Columbia ; George STERLING, Alberta Environment and Sustainable Resource Development

In most systems, there is usually not sufficient information to develop accurate predictions for assessing the rate of population change for a species across a wide spatial scale. However, managers and policy makers must be able to estimate demographic statistics and understand how uncertainty in the data affects uncertainty in policy advice. We use a system (Athabasca River Rainbow Trout) as an example of how uncertainty in demographic rates of change can be better included in policy making, with a specific focus on the quantitative criteria used by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Athabasca river rainbow trout are one of the only native rainbow trout populations east of the continental divide and populations in this drainage are at reduced abundances due to natural low productivity, introgression with hatchery fish, competition with non-native species, habitat degradation from resource extraction and historical overfishing.

QUANTIFYING POPULATION RECOVERY AFTER FOREST FIRES: A MULTI-METHODOLOGICAL APPROACH

Dominique Potvin

University of Helsinki

Kirsten PARRIS, University of Melbourne ; Katie SMITH, Museum Victoria ; Jane MELVILLE, Museum Victoria

Sampling animals in the wild in order to make population-wide estimates is a task fraught with difficulty. Studies have shown that using multiple sampling methods can be beneficial, especially if such methods are complementary. This approach not only increases accuracy, for example when making calculations regarding population size, but can also provide additional information useful in population viability analyses, or estimations of population recovery. We demonstrate a case study where we used multiple sampling methods to quantify the recovery of frog metapopulations in the years following the devastating 2009 bushfires in South-eastern Australia. In particular, we demonstrate how using a combination of direct hand-capturing, acoustic sampling and genetic sampling can contribute to creating a more informed and useful assessment of species' recovery after a significant natural disaster.

BEHAVIOURAL CHANGES IN HIMALAYAN MARMOTS IN RELATION TO HUMAN ACTIVITIES ASSOCIATED WITH TRADITIONAL PASTORALISM

Buddi Poudel

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The Trans-Himalayas is among the world's largest pastoral ecosystems and has a long history of pastoralism. Climate change is predicted to enhance opportunities for high altitude rangeland grazing, however there is a paucity of information of potential conflict between human activities and local wildlife. We studied the behaviour of the Himalayan marmot, a common rodent that co-occurs in areas grazed by domestic livestock. In 2014, we used instantaneous scan and focal animal sampling methods to observe marmot behaviours at 30 sites located in the Upper Mustang region of Annapurna Conservation Area, Nepal. An index of pastoralism intensity, based on the presence of livestock, herders, guard dogs, distance from pastoralist camps, and density of major tracks was developed to compare marmot behaviour between high and low pastoralism sites. Using a linear mixed modeling approach, we found that the vigilance behaviour of marmots was significantly influenced by pastoralism. Marmots looked up more often and devoted more time in vigilance in areas of high pastoralism as compared to low pastoralism. Marmots also adjusted their diurnal patterns of activity (temporal niche adjustment), and the distances moved from their burrows, in relation to the timing of pastoralist activities. In general, marmots were less active and foraged near to the burrows during periods of high risk when livestock and their herders were in the vicinity, but compensated by increasing activity and foraging further away from their burrows when pastoralist activity was less. These results suggest marmot experience increased wariness and fearfulness when pastoralist are near, which in turn, may reduce their fitness in terms of decreased opportunities to forage and fatten for winter hibernation. These changes in marmot behaviour could have important ecological ramifications in relation to predicted expansion of pastoralism in the region and associated likely increases in human-wildlife conflict.

110 TREE CHIEFS OF NORTHERN GHANA: CAN LOCAL RESOURCE GOVERNANCE INSTITUTIONS HELP SOLVE GLOBAL ENVIRONMENTAL PROBLEMS?

Mahesh Poudyal
Bangor University

Agroforestry parklands are one of the main features of the landscape in West African savannas where mature trees of a few economic species occur scattered across the cultivated fields or fallows. These trees form a vital part of the socio-ecological systems providing not only material benefits to the local inhabitants, but also help in improving soil fertility, moisture retention and in reduction of erosion. Recent studies have suggested that these trees could be vital in the retention

of carbon in these parklands, a service that could be exploited for the benefits of the local population through mechanisms such as REDD+. The appropriation of economic and other benefits from these trees in the parklands, however, depends in large part on the institutional arrangements in place - such as various tenure regimes. In many parts of the rural West Africa, resources such as land and trees are still managed under the traditional institutional arrangements, often referred to as the customary laws. One of these traditional systems is the separability of land and tree tenures whereby rights over a parcel of land does not necessarily guarantee the rights over the trees on that land. Indeed tree tenure systems are often just as complex, a case highlighted by the special tenure arrangements for locust bean trees (*Parkia biglobosa*) - including chiefs for these trees among many ethnic groups. Field studies in Northern Ghana have shown that tree tenure arrangements could have significant impacts not just on how indigenous economic trees are exploited, but also how they are managed, ultimately impacting on the environmental conditions of the parklands. Using this unique case as an example, I discuss if and how local resource governance institutions can contribute to solving environmental problems - local and global.

SYMPOSIUM #90: INDIRECT EFFECTS OF MOSQUITO CONTROL ON THE NON-TARGET FAUNA IN THE CAMARGUE

Brigitte Poulin

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Bacillus thuringiensis var. *israelensis* (Bti) is the most commonly used agent to control mosquitoes worldwide. This soil-dwelling bacteria is considered non-toxic to most organisms, at the exception of non-biting-midges (chironomids), a major prey item in wetland food webs. Yet, few studies have addressed the indirect effects of Bti through trophic interactions. This topic was addressed within a control program encompassing 2500 of the 25,000 ha of mosquito larval biotopes in the Camargue. Since 2006, Bti spraying occurs whenever *Aedes* larvae appear in water bodies, totaling 30-60 aerial treatments annually. Various impact studies were implemented, being systematically based on the comparison of treated and untreated areas. A detailed investigation on breeding colonies of house martins revealed a shift in chick diet with less nematoceraans, spiders and dragonflies taken in treated areas, translating into a 33% decrease in breeding success and a 26% decrease in colony size at treated sites. Likewise, reed-dwelling invertebrates serving as food to passerines suffer a 34% decrease, while richness and abundance of Odonata is reduced by 50%. Comparison of



long term trends in water bird and passerine counts revealed a significant decline in 11 species amongst the most abundant, not observed at untreated sites. These multi-trophic impacts suggest a strong dependence of the non-target fauna on Bti-sensitive prey, while the observed persistence and proliferation of Bti spores in some marshes (up to 8 500 000 spores per gram of soil) suggests impacts on chironomids well extending the period of Bti spraying. Efficiency of alternative techniques to reduce mosquito nuisance adapted to the specific context of the Camargue (ie. small villages surrounded by wetlands covering large areas) are currently being tested. These include mosquito trapping in inhabited areas and increased awareness of wetland managers to reduce unintentional production of mosquitoes.

SEARCHING FOR HOTSPOTS WITHIN A HOTSPOT: STACKED SPECIES DISTRIBUTION MODELS PROVIDE NEW OPPORTUNITIES TO MAP SPECIES RICHNESS IN NEW CALEDONIA

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A critical prerequisite to implement efficient conservation actions in biodiversity hotspots is to understand how biodiversity varies in space. Stacked species distribution models (S-SDMs) provide new opportunities to describe patterns of species richness (α -diversity). In previous attempts to map richness through S-SDM, the accuracy of the method was assessed using global metrics. Here, we ask whether the reliability of S-SDMs varies along environmental gradients. We used an S-SDM to predict tree species richness in rainforests of New Caledonia (South-West Pacific Ocean). We built an individual MAXENT model for 743 species combining eight fine-scale environmental variables with c. 10,000 occurrence records derived from herbarium collections and plot inventories. For each species, a distribution map was produced at a 100 m-scale indicating the suitability of each site. All models were then summed up and we compared the resulting richness estimates with the number of species measured in independent one hectare inventories. Overall, we noticed that the S-SDM increasingly overestimated richness as elevation increased. We demonstrated that this pattern stems from two features related to mountain morphology that S-SDMs disregard: (1) the conical shape of mountains provides

a decreasing area at increasing elevation which influences the regional pool of species found in elevational bands; (2) the connectivity of mountain habitats ('sky islands') decreases at increasing elevation which affects the equilibrium between species and their environment, and exacerbates commission errors. Despite remaining difficulties to predict richness when accounting for the effect of mountain morphology, our findings represent a significant step forward towards improved S-SDM designing.

INTERSPECIFIC COMPETITION BETWEEN RESIDENT AND MIGRANT BIRDS IN JAMAICAN MANGROVE FORESTS: EVIDENCE FROM A REMOVAL EXPERIMENT

Luke Powell

Smithsonian Migratory Bird Center
Nathan COOPER, Smithsonian Migratory Bird Center ; Peter MARRA, Smithsonian Migratory Bird Center

Every autumn, billions of migratory songbirds depart North America for the Neotropics, where they spend ~7 months wintering alongside ecologically similar year-round residents. In the Caribbean, the winter influx of migrants coincides with low arthropod abundances, and food shortages limit wintering songbird populations. Despite recent progress, the question remains: how do so many ecologically similar migrants and residents coexist during the most resource-poor time of year? Here we test the hypothesis that interspecific competition exists between resident Yellow Warblers (*Setophaga petechia*; hereafter "yellows") and wintering American Redstarts (*Setophaga ruticilla*). We performed two experiments in Jamaican mangrove forests: 1) a removal experiment in which we 3D-mapped yellow territories (n = 14) and overlapping redstart territories (n = 24) before and after removal of yellows, and 2) a natural experiment in which we compared redstart presence with and without territorial yellows (n = 10 territories). In the removal experiment, male redstarts expanded their 3D space use into the core of the (vacated) yellows; female redstarts moved away from the core yellow territory—probably due to intraspecific competition from males. In the natural experiment, when the yellows were on the opposite sides of their territories from redstarts (i.e. absent) redstarts were 2.3 times more likely to be present than when yellows were present, indicating that yellows constantly but temporarily exclude redstarts from space. The relentless aggression of larger yellows towards smaller redstarts almost certainly denies redstarts access to otherwise obtainable resources: space and insect prey. Only by understanding interspecific competition between migrant and resident birds can we quantify the challenges that migrants face throughout the annual cycle.



DO PRIMARY FOREST PARKS IN CENTRAL AFRICA PROTECT RAINFOREST BIRD COMMUNITIES BETTER THAN UNPROTECTED SECONDARY FORESTS? AN EXPLORATION, EDUCATION AND ECOLOGY PROJECT FROM THE EQUATORIAL GUINEA BIRD INITIATIVE.

Luke Powell

Smithsonian Migratory Bird Center

Jared WOLFE, US Forest Service, Redwood Sciences Lab ; Jacob COOPER, University of Kansas

Equatorial Guinea is a small, poorly explored Central African nation along the Gulf of Guinea. With the highest GDP per capita in Africa, Equatorial Guinea is developing quickly, with major highways now crisscrossing primary forests. In December 2014, The Equatorial Guinea Bird Initiative conducted our second expedition with three primary objectives: 1) exploration: work towards completing a country list of bird species, 2) education: train local biologists to do ornithology and, 3) ecology: determine how primary and secondary forest bird communities differ. First, we documented the first country records of 8 bird species—all on the mainland. Second, we trained two government biological technicians and four university students on basic ornithological techniques, including the safe capture of birds using mist nets. Third, we spent eight days capturing and surveying birds in Altos de Nsork National Park with the goal of understanding differences in the avian community between primary and 15-20 year-old secondary forests. Primary forest communities were more diverse (Chao II estimate = 94 species) and had more specialized forest interior species. Secondary forests were less even and less diverse (Chao II estimate = 74 species), with captures dominated by the generalist species Western Olive Sunbird (*Cyanomitra obscura*) and Yellow-whiskered Greenbul (*Eurillas latirostris*). During audiovisual surveys, we detected 24 species in primary forest that we did not detect in secondary forest, highlighted by Lesser Bristlebill (*Bleda notatus*; n=10). The prevalence of this species and others in primary but not secondary forest suggests that they can be used as indicators of intact primary forest bird communities, thus giving local biologists a tool with which to quantify the quality of forest. Only by continuing a campaign of education, exploration and ecology can we hope to protect rainforest wildlife in this Central African nation during this critical period in its history.

DEVELOPMENT AND APPLICATION OF A SPATIAL IBM TO FORECAST GREATER PRAIRIE-CHICKEN POPULATION RESPONSES TO LAND USE IN THE FLINT HILLS REGION OF KANSAS

Breanna Powers

U.S. Environmental Protection Agency

Nathan SCHUMAKER, U.S. Environmental Protection Agency

Greater prairie-chicken (*Tympanachus cupido*) populations have been on the decline for decades. Recent efforts to reverse this trend are focusing on two specific disturbance regimes, cattle grazing and field burning, both prevalent in the Flint Hill region of Kansas -- an area of critical prairie-chicken habitat. Field burning and grazing are necessary for arresting the transition of prairies into shrublands and forests, but fire application (frequency and timing) is managed to optimize livestock production, and thus may not be ideal for prairie-chicken preservation. Not surprisingly, it is completely infeasible to perform real-world tests that might quantify the relationship between fire management and prairie-chicken population trends at large spatial scales. We addressed this constraint by developing a spatial IBM (individual-based model) capable of forecasting prairie chicken population trends and their responses to multiple interacting disturbance regimes. Here, we report on our initial results from this work, in which we have examined how sensitive prairie chicken population trends are to changes in landscape structure.

LOOKING FOR (THE ORIGIN OF) HEC IN THE OKAVANGO DELTA

Rocío Pozo

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In Botswana's Okavango Delta panhandle, fifteen thousand people share and compete for resources with a population of more than fifteen thousand African elephants (*Loxodonta africana*). Unsurprisingly, this area represents a real hotspot for human-elephant conflict (HEC), which manifests itself in the form of elephant crop-raiding (i.e. the destruction and damage to crops). Using historical data on human and elephant population size, as well as on allocation of agricultural land collected over the past 40 years, we first assess the likely drivers of human-elephant conflict in the eastern Okavango Panhandle. We then evaluate trends in the level of conflict over the last seven years when mitigation strategies were put in place by our project. We find that human and elephant population sizes have been growing exponentially and logistically, respectively, and that the land allocated to human activities across the study area has also been increasing steadily. In the absence of mitigation, we therefore predicted an increase in HEC in recent years. Surprisingly, however, we find that the level of HEC has been decreasing over the past seven years. We discuss these results in terms of recent



mitigation strategies, changes in elephant spatial behaviour and environmental factors.

UNDERSTANDING WILDLIFE-PEOPLE INTERACTIONS THROUGH MULTIDISCIPLINARY APPROACHES FOR APPROPRIATE PATHWAYS TO CONSERVATION IN THE DARJEELING HIMALAYAS, INDIA

Sunita Pradhan

ASHOKA TRUST FOR RESEARCH IN ECOLOGY AND THE ENVIRONMENT

Sarala KHALING, ASHOKA TRUST FOR RESEARCH IN ECOLOGY AND THE ENVIRONMENT; T GANESH, ASHOKA TRUST FOR RESEARCH IN ECOLOGY AND THE ENVIRONMENT; Sanjay NEPAL, UNIVERSITY OF WATERLOO; Vincent VON DOSKY, UNIVERSITY OF HEIDELBERG; Shekhar BHUJEL, ASHOKA TRUST FOR RESEARCH IN ECOLOGY AND THE ENVIRONMENT

Darjeeling Himalayas is a significant bio-geographic link between Nepal, Indian state of Sikkim and Bhutan extending into Assam and Arunachal Pradesh of North east India in the biodiversity hotspot of the Eastern Himalaya. Darjeeling, with an indicated forest cover of 40 percent of its geographical area (3149 sq km), has icon species such as the globally threatened Rufous-necked Hornbill (*Aceros nipalensis*) along with four other hornbill species, the critically endangered Chinese Pangolin (*Manis pentadactyla*), and the vulnerable Red panda (*Ailurus fulgens*), indicating the conservation significance of this region. Even though the region is a global biodiversity hotspot, the linkages and interactions among cultural, social and natural elements are poorly understood in context of biodiversity conservation. Hence Ashoka Trust for Research in Ecology and the Environment (ATREE) in an effort to fill this gap in knowledge, has taken up initiatives on Red panda conservation and tourism in the Subalpine Conifer forests, Chinese pangolin in the inadequately protected Areas Outside Protected Areas of Tea plantations in Darjeeling and dietary use of wild fruit resources by the local communities and the hornbills in the Subtropical lowland forests of Darjeeling Himalayas, to better understand wildlife-people interactions and linkages with the existing social elements. These initiatives are an attempt to understand and analyse aspects of nature-society relationships to seek pathways to conservation and sustainable use of forest resources in these regions, which supports 1.85 million people with recorded poverty rate of 56 percent - highest in the entire Indian Himalayas. Preliminary findings and appropriate interventions being taken up, from these initiatives are presented and discussed here.

PROTECTING THE FRAGMENTS - AN ANALYSIS OF MANDARIN ORANGE AND POLLINATOR DEPENDENCE ON FRAGMENTED FOREST PATCHES IN SIKKIM, EASTERN HIMALAYAS

Urbashi Pradhan

Ashoka Trust for Research in Ecology and the Environment(ATREE)

Soubadra DEVY M, Ashoka Trust for Research in Ecology and the Environment(ATREE)

In the Himalayan state of Sikkim 50% of total forest area is fragmented lying outside protected area network in dynamic human dominated landscape. We take an interdisciplinary approach in understanding the role of these fragments in provisioning pollination service and its impact on socioeconomic welfare of farmers in Sikkim. Detailed RS/GIS method was used to study landscape composition in orange belt of Sikkim. Result shows various landscape matrices determine the rate of pollinator visitation to mandarin oranges, the major cash crop of Sikkim. Manual pollination treatment shows increase in fruit set number by four times, highlighting importance of pollinators and pollination service to Sikkim mandarin oranges. Our vegetation sampling shows that forest patches in the vicinity act as resource reservoir for pollinators during non orange flowering season and help sustain pollinator population in the landscape. Therefore, pollination service has direct impact on the income of famers in Sikkim which surprisingly is less perceived by them. Open pollination resulted in fruit set similar to pollinator exclusion treatment which hints at a possible dearth of pollinators for mandarin oranges. This issue needs attention especially considering the decreasing number of pollinators worldwide. Pollinator composition shows drastic change with increase in elevation. Lower altitude orange belt is dominated by 80% of *Apis cerana* visitation but high altitude belt shows more Dipterans. As a policy intervention to increase yield of oranges, installation of domesticated honey bee boxes may be an option to compensate for lower pollinator visitation in the lower belt. But the only way to sustain viable Dipteran population in the upper belt is by conserving its habitat, which are fragmented forest patches along with the matrix in human dominated landscape. We discuss management measures that can be taken in a lived-in landscape like Sikkim Eastern Himalayan Biodiversity Hotspot.

3.09 MOLLUSKS ASSEMBLE DIVERSITY IN THREE LANDSCAPE UNITS OF DRY FOREST WITH DIFFERENT LEVELS OF TRANSFORMATION IN THE VALLE DEL MAGDALENA IN VICTORIA AND LA DORADA (CALDAS-COLOMBIA)

Angélica Prado-Ospina



Universidad del Valle

Alan GIRALDO, Universidad del Valle ; Wilmar BOLIVAR, Universidad del Valle ; Jaime CANTERA-KINTZ, Universidad del Valle

The dry forest in Colombia has lost its vegetation cover at an accelerated rate, being heavily transformed and fragmented. In the remnants, the flora, insects and some vertebrate groups have been intensively studied; however, the knowledge regarding mollusks inhabiting this ecosystem is scarce. The ecological attributes of the mollusks' assemblage, may be significantly affected by the transformation of the dry forest. This research describes the taxonomic composition of the mollusks' assemblage in three dry forests with different degrees of transformation located in the municipalities of La Victoria and La Dorada, Caldas: natural secondary forest succession (BSSN), intervened forest for silvopastures-livestock operations (BSSG), and forest intervened for mining activities (BSIM). Systematic sampling was conducted during the first rainy season and the second dry season of the year, taking records of temperature, relative humidity, soil humidity, luminosity, altitude and vegetation cover. 120 parcels were checked, at each parcel, two quadrats of 50 x 50cm were used to remove leaf litter and soil. 678 specimens belonging to 32 species were collected, of which 55% were associated to BSSN, 40% to BSSG and 5% to BSIM. The highest species richness (30 sp) was recorded in the BSSN, followed by the BSSG (8 sp) and the BSIM (4 sp). Despite the high temperature and low humidity conditions in the study area, the presence of tree cover in the BSSN provides suitable microhabitats for the presence of mollusks. According to the results, processes of transformation of dry forest involving a reduction in tree cover causes a significant reduction in the diversity of mollusks assemble in this ecosystem.

FOOD-WEB MODELLING: A POSSIBLE ECOSYSTEM MANAGEMENT TOOL FOR MEDITERRANEAN MPAS?

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Mediterranean coastal ecosystems support a great diversity of habitats, species and communities, being a major challenge for an ecosystem management approach. In particular, management of Marine Protected Areas should be informed about the possible effects of protection on often complex food-webs. The application of food-web modelling through the Ecopath with Ecosim software (EwE) may allow to unravel

such a complexity and could thus help to better pursue the conservation and management objectives of Mediterranean MPAs. Unfortunately, whilst widely applied at larger ecosystem scales where the presence of industrial fisheries allows for large data availability, EwE has not yet gained full attention as a possible tool for the management of smaller and highly diverse coastal areas. Main drawback is the difficulty of obtaining local biomass data for all functional groups in such areas. Here we propose a standardized and simplified model structure developed for Port-Cros MPA (France) and present its application in two case-studies that are well representative of Mediterranean data availability: the relatively well-studied Portofino MPA (Italy), where available local biomass data was used; the poorly studied Cap Roux fishery reserve (France), where biomass data was collected in the field. We show that using a standardized model strongly reduces the data requirement and the time spent for model building and allows for comparisons between ecosystems. We identify the possible management applications of such tool, focusing in particular on indices useful for the monitoring of ecosystem functioning and on the assessment of the ecosystem impacts of multiple and interacting fisheries. We conclude that this standardized approach could provide a well-defined framework for integrating available (but often dispersed) data on Mediterranean coastal ecosystems into a coherent picture of ecosystem functioning, allowing also to identify important monitoring gaps.

21-UBUNTU AND THE BALANCING OF DIVERSE ENVIRONMENTAL ETHICS AND VALUES TO ACHIEVE ENVIRONMENTAL JUSTICE IN THE MAASAI MARA, KENYA

Francisca Pretorius

Strathmore University
Jeffrey SU, Plains Conservation Center

Justice, as a moral and philosophical concept, is rooted in fairness. Depending on the desired goal, justice is meted out in four different ways: retributively (fairness in punishment), restoratively (fairness in correction), distributively (fairness in equal distribution), or procedurally (fairness in just process). Environmental justice, being the intersection between human rights, the environment, and the equitable access the resources people need to survive, constitutes a complex set of ethics and values. To fully explore environmental justice we must recognize the often competing environmental ethics and values of the constituents in an environmental conflict. These values can be broadly defined by the philosophies and work of John Muir (preservationist), Gifford Pinchot (conservationist) and Aldo Leopold (ecological). We contend that environmental justice can only be achieved by striking a balance between these concepts of justice and competing environmental values. We apply the uniquely African concept of justice, "Ubuntu",



to demonstrate the balancing of these complexities in the Maasai Mara, Kenya. We specifically examine the challenges of the competing needs of a thriving wildlife-tourism industry, the semi-nomadic pastoralist lifestyle of the Maasai tribe and the preservation of the increasingly fragile ecosystem of the Mara region. We demonstrate how these challenges can be successfully addressed through private conservancies that combine community-based agriculture, sustainable livestock enterprises and private land conservancy to effectively preserve wildlife (preservationist), the rich Maasai heritage (conservationist) as well as the ecosystem of the Mara region (ecological). We show the importance of understanding the diversity of environmental ethics and values, underpinned by the different concepts of justice, to find an equitable solution for competing needs and rights of interested parties, ensuring that justice is attained for all involved.

HOW FAST ARE THEY REALLY MOVING?

Sonja Preuss

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Species range shifts associated with environmental change or biological invasions are increasingly important study areas. However, quantifying range expansion rates may be heavily influenced by methodology and/or sampling bias. We compared expansion rate estimates of Roesel's bush-cricket (*Metrioptera roeselii*) a nonnative species currently expanding its range in southcentral Sweden, from range statistic models based on distance measures (mean, median, 95th gamma quantile, marginal mean, maximum, and conditional maximum) and an area-based method (grid occupancy). We used sampling simulations to determine the sensitivity of the different methods to incomplete sampling across the species' range. For periods when we had comprehensive survey data, range expansion estimates clustered into two groups: (1) those calculated from range margin statistics (gamma, marginal mean, maximum and conditional maximum: 3 km/year), and (2) those calculated from the central tendency (mean and median) and the area-based method of grid occupancy (1.5 km/year). Range statistic measures differed greatly in their sensitivity to sampling effort; the proportion of sampling required to achieve an estimate within 10% of the true value ranged from 0.17 to 0.9. Grid occupancy and median were most sensitive to sampling effort and the maximum and gamma quantile the least. If periods with incomplete sampling were included in the range expansion calculations, this generally lowered the estimates (range 16-72%). Care should be taken when interpreting rate expansion estimates from data sampled from only a fraction of the full distribution. Methods based on

the central tendency will give rates approximately half that of methods based on the range margin. The gamma quantile method appears to be the most robust to incomplete sampling bias and should be considered as the method of choice when sampling the entire distribution is not possible.

ENVIRONMENTAL CONCERN IS NOT MEDIATED BY UNIVERSITY EDUCATION

Anne-Caroline Prevot

Museum National d'Histoire Naturelle
*Susan CLAYTON, College of Wooster ; Raphael MATHEVET,
CEFE-CNRS*

In the current biodiversity crisis, increasing individual awareness of conservation issues becomes of prominent importance. Education is proposed as an important way to increase environmental concern by many authors and conservationists. In this study, we explored the relative roles of environmental education at university, personal experiences of nature and social identity on the level of individual environmental identity (EID), which is an important component of environmental concern. Environmental identity is a stable sense of oneself as connected to the natural world, and has been found to predict a wide range of environmental attitudes and behavior. To study its correlates, we proposed a questionnaire to more than 1200 students in different academic curriculum in France (ecology, other sciences and political sciences). We showed significant difference in levels of EID for students in ecology compared to others (students in political sciences having the lowest level), but also that EID was strongly influenced by personal experiences of nature and social context regarding conservation. Our results suggest therefore that academic curriculum is more a result than a cause for high environment identity. We discuss these results in terms of education and access to nature for children and young people

SYMP97-SHORT AND LONG TERM CONSEQUENCES OF URBAN CITIZEN-SCIENCE PROJECTS TO INDIVIDUAL CONNECTION TO NATURE

Anne-Caroline Prevot

Museum National d'Histoire Naturelle

Citizen science programs are first devoted to collect large amounts of data on large temporal and spatial scales, in order to survey biodiversity dynamics. The second objective of these participative observatories is however to encourage laypeople to interact with nature, in order to increase individual awareness on biodiversity and conservation issues. In this presentation, I present two studies that tested the consequences of participation on individual relation to nature. These studies were conducted in France, in the Vigie-Nature



program. First, we showed with a conservation psychology approach that 10-11 year old pupils which conducted a very short citizen-science program at school have a different way to represent ordinary nature than pupils that did not have this experience. Secondly, we showed with an anthropological approach that adult volunteers that surveyed butterflies in their garden during several years did change their relations and practices towards their garden. I discuss these results in terms of individual connection to nature.

THREATENED SPECIES CONSERVATION: CHALLENGES AND OPPORTUNITIES FOR FLAGSHIP TREES

Victoria Price

Fauna & Flora International/Global Trees Campaign
David GILL, Fauna & Flora International/Global Trees Campaign ; Georgina MAGIN, Fauna & Flora International/Global Trees Campaign

Halting the loss of threatened species is a major priority for the conservation community and was highlighted as an area for action under Aichi target 12. The challenge is of particular relevance to the world's tree species, of which more than 9,000 are threatened with extinction. This is despite the key ecological role played by many tree species and the goods, services and cultural values they provide. In addition to habitat loss, exploitation and climate change, increasing action for threatened trees faces a number of challenges. Firstly, there is a lack of information on tree species themselves. For example, 100% of the world's known bird species have been assessed on the IUCN Red List, but merely 12% of trees have been assessed under the same criteria. Secondly, there is insufficient awareness of the need for species specific tree conservation, and finally, so few organisations currently integrate tree conservation into habitat management strategies. This talk will explore whether the current pace of tree conservation is moving rapidly enough to keep up with the scale of the threats. There are opportunities to tackle these challenges, and upscale intervention efforts including; exploiting open source data to rapidly increase assessment effort, sharing skills through multi-disciplinary, regional networks and embedding threatened tree conservation into widely practised landscape approaches. Using case studies from our various field sites and activities across the globe, the Global Trees Campaign (GTC) will showcase examples of practical interventions to both address these challenges and exploit the identified opportunities. Recommendations will be made for embedding a species based approach to tree conservation into existing programmes and, into the wider conservation rationale.

THE IMPORTANCE OF CONSERVATION MANAGEMENT FOR LAKE OHRID TROUT

Viola Prifti

University of Korça
Arefi CAKE, University "A.Xhuvani",

In the past, trout and other fish introductions were made primarily by federal and state management agencies and less commonly through accidental releases and individual enterprises by anglers. Stocking can have a multitude of impacts on aquatic communities and it is conducted for the social and economic benefits provided to anglers and communities. The main purpose of this paper is to describe the importance of conservation management for Lake Ohrid trout. Lake Ohrid trout is an endemic species and very important in the context of cultural heritage for both states, Albania and Macedonia. For several years the increase of its conservation is associated with the social and economic benefits. What about the biological impact in the wild form of the Lake Ohrid trout? In recent years, stocking of trout have been left to persist with individual enterprises. We suggest that these activities should be well supervised by the government. In many cases not professional persons at the same pond made the farmed of similar species. And if the spawning period complies the natural hybridization is a random event. This is a very important point of our study because we think that the main reason of Lake Ohrid trout conservation should be the protection of this endemic specie.

A GENOME-WIDE ASSOCIATION STUDY (GWAS) OF AGE AT MATURITY IN ATLANTIC SALMON: IMPLICATIONS FOR CONSERVATION AND MANAGEMENT

Craig Primmer

University of Turku
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In wild Atlantic salmon (*Salmo salar*), there is variation in the age at maturity within and between populations, as individuals can spend anywhere between one and five years feeding at sea before returning, often to their natal river, to spawn. The larger, late-maturing 'multi-sea winter' (MSW) individuals are highly sought after by anglers. This life-history strategy has also been shown to be important from a biodiversity perspective, thus creating a management conflict. Knowledge of the genetic basis of age at maturity would provide a foundation for developing effective management strategies for conservation of this important life-history trait. The Atlantic salmon



population of the Teno River in northern Finland is arguably the most biodiverse salmon population in the world from a life history strategy perspective, with more than 100 different life history strategies (combinations of river years, years at sea and repeat spawning) being recorded. It also has immense socioeconomic importance, both due to fishing tourism (15,000 anglers visit this remote region annually) as well as local and indigenous fisheries, with up to 60,000 individuals (60% of the annual run of ascending salmon) caught annually. Alarming, the proportion of late-maturing MSW fish has been declining in recent decades. A long term scale archive combined with the availability of Atlantic salmon SNP arrays provides opportunities for conducting genome-wide association studies (GWAS) to identify genomic regions associated with age at maturity. By implementing genome-wide relatedness information to account for unexpected population structure, we identified several genomic regions harbouring loci significantly associated with age at maturity. The implications of the findings for conducting GWAS in wild populations, as well as for the practical management and conservation of exploited salmon populations will be presented.

165 FROM EVALUATING BIODIVERSITY CONSERVATION TO EVALUATING BIODIVERSITY CONSERVATION POLICY AND ECOSYSTEM SERVICE GOVERNANCE

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Biodiversity conservation policies are justified with arguments about the intrinsic value of nature and backed up with science. The outcomes are evaluated by tallying extinctions, endangered species as well as the conservation status of species and habitats. As outcomes of habitat and species conservation policies remain disappointing, attention is increasingly placed on broader arguments and broader science. The idea is that a systemic approach to ecosystems must save more ecosystem features and functions. How has this broadening of policy goals and scientific basis of conservation changed conservation policy itself? How have the institutions, processes and practices changed to make use of the new approach? In conserving biodiversity and securing ecosystem services, little empirical attention is paid to ways in which different types of decisions are made, to what arguments are effective in turning policy into practice and into conservation outcomes and, in general, to how ecosystem services are governed. The limited attention to ecosystem service governance is surprising, given the empirical evidence base that the conservation and management analysts have accumulated over the last 50 years. To close this gap, this paper identifies the different modes of governance and incorporates them in a conceptual model of ecosystem services

commonly utilised at present. The conceptual framework encompasses: 1) hierarchical governance; 2) scientific-technical governance; 3) adaptive collaborative governance; and, 4) governing strategic behaviour. This framework provides a structure for empirical analysis of ecosystem services governance, which takes into account the people and organizations making decisions, and the different arguments that are used when implementing policies. The framework will facilitate holistic ecosystem service analyses and support policies in generating conservation and sustainability impact.

ID #188: SALT WATER BARRIERS IN A TROPICAL ESTUARINE SYSTEM: IMPACTS ON BIODIVERSITY AND HUMAN LIFE

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Lying below mean sea level, tropical estuaries stand drastically impacted by global warming and salinity ingression. Salt water barriers and flood gates are built extensively throughout to prevent the increasing salt water ingression to agricultural fields on the estuarine flood plains. Vembanad estuary (Kerala, India), a Ramsar site, is the largest humid tropical wetland ecosystem in the south west coast of India. The estuary is fed by six rivers flowing towards west originating from the Western Ghats and forms the lifeline of the villages on its banks. Apart from providing feeding, spawning and rearing areas for a very large proportion of commercial fish and shellfish, this estuary is supporting a highly productive agricultural system also. A barrier was constructed at Thanneermukkam in 1976 to prevent saline water intrusion into paddy fields during the dry season, and thus to bolster paddy cultivation. But the closing of barrier stops the tidal effects, stagnates water movement and hinder the natural mechanism to flush out contaminants. It obstructs the migration of marine species to the upstream areas, the resultant salinity alteration has significantly impacted the breeding of fresh water prawns and clams. We have also noticed a significant spatial relationship between the barrier and the diversity of zooplanktons. Annual fish landing has been reduced to half after the construction of the barrier and has been causing conflicts between fishermen and farmers. This paper discusses the impacts of Thanneermukkam salt water barrier in Vembanad estuary on aquatic biodiversity and human life.

185. MANAGING INTERACTING SPECIES WITHIN FOOD WEBS THROUGH TIME

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The study of ecological food webs is useful for gaining insight into optimal management practice. Computational methods for finding optimal management strategies, however, face the challenge of overcoming computational bottlenecks inherent in evaluating all management options that are possible on large food webs that, themselves, may exist in a huge number of different states. To overcome this problem, we investigate the performance of several network metrics from the literature that are easily calculated on large food webs as tools to guide management by ranking species based on metric value. We view ecological food webs as directed acyclic graphs and use Markov decision processes to model management. Using dynamic programming we optimally solve the management of moderately sized food webs through time so as to maximise the expected number of species surviving. We use simulation to compare the performance of managing using several metrics with this optimal solution. For larger food webs, the size of the state and action spaces make dynamic programming computationally infeasible so, at this scale, we extrapolate our results from smaller food webs and investigate the performance of the network metrics for management. Our results show that network metrics which manage the simulated systems well, resulting in high numbers of species surviving, are generally those that highly rank the conservation of predator species. Our analysis illustrates computational techniques that allow management experiments to be performed on food webs of respectable size while using techniques that have been benchmarked against the exactly optimal solution on smaller food webs.

LAND SHARING FOR LAND SPARING: THE CASE OF SOWN BIODIVERSE PASTURES IN MEDITERRANEAN ECOSYSTEMS

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The concept of Sown Biodiverse Permanent Pastures Rich in Legumes (SBPPRL) was initiated in the 1960's as a response to the low productivity and feed quality obtained in semi-natural pastures (SNP) in Portugal. The poor performance of SNP derives from endogenous low fertility and historical land use practices causing soil nutrient mining and erosion but also plant community impoverishment. The SBPPRL system is based on sowing up to 20 species/varieties of legumes and grasses, correcting soil conditions by applying phosphorus and limestone, and adequate grazing management. Seed mixtures are tailored to each site to best cover the available environmental niches and enhance resilience to

environmental variation. Compared to SNP, SBPPRL provide higher quantity and quality of food for animals (without the need for nitrogen fertilizers or annual soil mobilization), permit increasing sustainable stocking rates, and promote soil carbon sequestration through soil organic matter (SOM) increases. Enhanced SOM contributes to control water runoff and soil erosion, and the increased stocking rates contribute to control fire risk. Sustainable intensification has been criticized for narrowing its view towards productivity. However, SBPPRL offer an alternative for sustainable intensification by combining higher pasture productivity, i.e. socio-economic benefits, with environmental benefits that emerge as positive externalities, namely soil carbon sequestration and soil restoration. Also, the use of phosphorus is more than compensated by the avoided impacts of nitrogen fertilizers (otherwise required either to produce concentrate feed or fertilize pastures), while potential leaching of phosphorus is mitigated by increased SOM. Hence, SBPPRL are a land sharing system that combines conservation (e.g. soil restoration) and production goals, and which may enable land sparing due to high productivity.

LANDSCAPE HETEROGENEITY IS CRUCIAL FOR SPECIALIST INTERIOR SPECIES IN ECOLOGICAL NETWORKS

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Landscape ecological networks (ENs) are an important mitigation measure in agriculturally transformed landscapes. Understanding the multitude of pressures influencing the presence/absence of species is important when planning effective ENs. Arthropods are effective bioindicators for measuring these pressures, as many are habitat sensitive. However, in sub-tropical grasslands caution is required, due to a high incidence of singletons (one individual recorded) in sampling regimes. Here we take a multi-taxon approach to determine how a variety of variables influence the spatially sensitive interior species of both EN corridors and adjacent reference sites in protected areas (PAs). At each of the 48 sites selected, nine stations were sampled for arthropods, with six stations in either wooded patch (i.e. plantation block or indigenous forest) or associated edge zone and three stations in EN corridor or PA interior. Eleven variables were measured and classed into environmental, design, and current and historical management variables. Data were split into: the overall data, recording all species found in the interior zones, and datasets containing only species that had more than 50% or 75% of their abundance sampled in the interior zone. These datasets were split into total species and singleton-removed datasets. Overall, species richness of the singleton-removed datasets and assemblage composition were most responsive to the natural background environmental variables,



while the design and management variables were the most important variables for datasets with the singletons included. When planning the ENs within future production landscapes, we first need to conserve the natural range of landscape heterogeneity, especially for the interior specialists. It is important that this spatial heterogeneity is incorporated into design and management planning to maintain the full range of biodiversity.

ROADLESS AREAS IN THE SERVICE OF THE EUROPEAN NATURA 2000 NETWORK

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Road Ecology has indicated transportation network as one of the most prevalent drivers of habitat fragmentation and biodiversity loss. In addition, Conservation Biology, through the establishment of protected areas, attempts to mitigate these detrimental impacts to the natural environment. Roadless Areas (RAs) have recently been identified as important sites to be protected due to their role in providing multiple ecosystem services, protecting biodiversity and offering economic profit. At political level it is of vital importance to investigate the potential complementarity of RAs and European N2K network with view to ensuring biodiversity conservation. Here, we present a Geographical Information System (GIS) methodological approach of broadening the surface of the existing European Natura 2000 network by overlapping RAs. Applying a buffer zone (1 km) around the road network of Europe and excluding these sites from the total surface of Europe, we resulted in RAs. We, then, superimposed Corine Land Cover 2000 database in order to remove any human induced area. The next step comprised the extraction of areas smaller than 100 km². Lastly we investigated the spatial overlap of RAs and Natura 2000 network, giving special attention to adjacent areas. We calculated the spatial intersection, as well as expansion, of adjacent areas of RAs and Natura 2000 network. RAs (18% of Europe) and Natura 2000 network overlapping divulged some interesting findings, showing that countries with the highest percentages of RAs coverage occupy the lowest percentages of roadless Natura 2000 sites. The potential expansion of Natura 2000 network, by appending intersected or tangent RAs, could lead up to a 63% increase of the European Natura 2000 network. Discovering new means of conserving biodiversity -like integrating RAs and Natura 2000 network- in a time-and-cost-effective way, could contribute to a more environment-friendly Europe under a socio-political and economic framework.

INVESTIGATION INTO THE ORIGIN AND IMPACTS OF THE CAUSATIVE AGENT OF WHITE NOSE DISEASE ON BATS

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White-Nose Disease (WND) is an infectious disease of hibernating bats that has killed millions of bats since it first emerged in eastern North America in 2006. The disease is caused by a pathogenic fungus, *Pseudogymnoascus destructans* that was suspected to be introduced to North America by human trade or travel. We applied eDNA analyses from bat hibernacula to demonstrate the widespread presence of the fungus across Europe and used genetic data from North American (suspected introduced) and European (suspected source) populations of the fungus to confirm the introduced origin of this invasive species in North America. This scenario explains the lack of associated mass mortality among European bats while the naive North American populations are collapsing. To investigate the consequences of the disease on bat populations, we assembled four decades of population counts from 1108 populations to compare the local abundances of bats in North America before and after the emergence of the disease to the situation in Europe, where the disease is endemic. We demonstrate a 10-fold decrease in the abundance of bats at hibernacula in North America, eliminating large differences in species abundance patterns that existed between Europe and North America prior to disease emergence. We also document extensive local extinction in many species in North America. As the fungus range is still expanding year after year in North America, we used a species distribution modelling technique – maximum entropy modelling – to predict its potential future distribution. Results indicated that the fungus is currently occupying only half of its potential distribution in North America, suggesting that the disease will soon threaten many more bat populations and species. Our results provide insights into the devastating outcome of alien species introductions, and highlight once more the critical need for the application of tighter control of international transfer and trade in biological material.

USING TECHNOLOGY TO IMPROVE COEXISTENCE BETWEEN HUMANS AND KANGAROOS

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Human-wildlife conflict is common where both parties compete for resources. The city of Bathurst in New South Wales is the oldest inland settlement in Australia and has witnessed stark changes in kangaroo abundance since. The last remnant population close to the city persists on Mount Panorama, also home to a car racetrack, shooting ranges, permanent residents, agriculturalists, and a historic goldfields site. This small kangaroo population is largely closed to migration due to the inhospitable nature of the surrounding land. Attempts to reconcile conflicting use of space have been largely implemented through culling and fencing, which resulted in international criticism and tainted the image of the Bathurst 1000 car race on which the local economy relies. To provide new insight into sharing space on the Mountain, we chose to implement a compassionate conservation approach to encourage coexistence with kangaroos. Compassionate conservation promotes the inclusion of individual welfare in conservation practice and thereby reframes how conservation targets are established and envisioned. We installed a range of monitoring technologies to collect information on kangaroo numbers, movement and demography that simultaneously provided the Bathurst community with a means of connecting to individual animals and the population as a whole. We actively involved the community in our research and provided regular online and media reports. Despite entrenched perceptions of conflict and negative attitudes towards kangaroos permeating the Bathurst community, we found broad acceptance for the use of technology to assist with demystifying science and a thirst for overcoming traditionally combative interactions with kangaroos. By collecting cheap, reliable and transparent data we were able to create accurate maps of kangaroo space use to identify the principal areas of human-wildlife conflict. This in turn may be used to establish sustainable and compassionate management strategies.

MULTI-SCALE DISTRIBUTION MODELS FOR CONSERVING WIDESPREAD SPECIES: THE CASE OF SLOTH BEAR IN INDIA

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Information on patterns and determinants of spatial distributions remains poorly available for many widespread

species of conservation importance. The sloth bear *Melursus ursinus*, in the Indian subcontinent exemplifies this requirement. We aimed at assessing (1) distribution patterns of sloth bears at two spatial scales, (2) ecological and anthropogenic factors that determine bear occupancy. We estimated sloth bear habitat occupancy at a countrywide scale across India and at the landscape scale in the Western Ghats of Karnataka, India. We used a grid-based occupancy approach to determine sloth bear distribution patterns. At the countrywide scale, we used data from questionnaire-surveys of field experts. At the landscape scale, we conducted field surveys of bear signs. Detection/non-detection data from both surveys were analysed using occupancy-modelling methods that account for imperfect detection. Countrywide, sloth bears occupied an estimated 67% of plausible bear habitat in contrast to 46% derived from methods that disregard detectability. Bear distribution was positively influenced by deciduous forests, scrub and barren areas, regions with high human densities and cultural tolerance. At the landscape scale, bears occupied 61% of the area versus 54% estimated from methods ignoring detectability. Occupancy probabilities increased with forest cover and topographic heterogeneity, whereas annual precipitation and human disturbance showed negative effects. Our study underlines the need to integrate human-modified areas with existing conservation landscapes. Given its widespread nature, functional role, conservation status and relatively benign interactions with humans, we propose recognizing sloth bear as an umbrella species for securing unprotected habitats in India. Protection of widespread species like the sloth bear in other landscapes may complement current conservation strategies for large mammalian communities.

REVERSING THE DECLINE OF SHARK POPULATIONS IN RAJA AMPAT, EASTERN INDONESIA

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The high marine biodiversity and natural beauty of Raja Ampat, Indonesia attracts not only dive tourism, but also outside fishers, who often engage in destructive and illegal fishing, including the targeting of sharks for their economically valuable fins. This is driven by international markets. Indonesia is the number one exporter of sharks and shark products in the world. The local government made several efforts to improve shark conservation in Raja Ampat, including: campaigning about the importance of shark for ecosystem function and economic



benefits through ecotourism; consistently enforcing no-take-zones in the MPA network; implementing an integrated routine surveillance system that includes monitoring shark fishermen activities; and supporting efforts by the Raja Ampat local government to develop regulations that prohibit shark fishing throughout the area's waters. The declaration of 46,108 km² marine areas as a Raja Ampat shark sanctuary in December 2012 was the first of its kind for Indonesia and for the Coral Triangle. Since the declaration of the shark sanctuary, the Indonesian government has been supporting the enforcement of the shark finning ban, with several illegal fishers being caught and prosecuted. Shark populations have been surveyed approximately annually from 2009 to 2014 as part of routine reef fish monitoring. Preliminary results indicate shark populations are already recovering in MPAs since implementation of the shark sanctuary. This is further reinforced by anecdotal evidence from local patrol team observations on the reappearance of juvenile shark populations in several areas. Amidst an overall trend of shark population decline in Indonesia, this shark sanctuary is showing a promising outlook for the recovery of shark populations in Raja Ampat, providing a model for other regions in the Coral Triangle and beyond.

RHINOS IN THE PARKS: OCCURRENCE AND ABUNDANCE INDICES OF THE LAST WILD POPULATIONS OF SUMATRAN RHINOCEROSSES

Wulan Pusparini

WCS

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In the 200 years since the Sumatran rhinoceros was first scientifically described (Fisher 1814), the range of the species has contracted from a broad region in Southeast Asia to three areas on the island of Sumatra, Indonesia. Little information on the factors influencing the distribution of rhinos on Sumatra has been gathered since the study of van Strien's 1986 in the Mamas Valley of the Leuser Landscape. Using a hierarchical modeling approach, we estimated proportion of area occupied (PAO) and indices of abundance (IA) for Sumatran rhinos at the only sites in the world where they are known to occur: Leuser Landscape [2007: PAO = 2.8%, IA = 26 (CI = 12-61)], Way Kambas National Park [2008: PAO = 33.6%, IA = 27 (CI = 14-50)], and Bukit Barisan Selatan National Park [2010: PAO = 36.4%, IA = 31 (CI = 19-66)]. In the Leuser Landscape, rhino PAO was positively associated with primary dry land forest, and rivers, while IA was influenced by deforestation (-), landscape roughness (+), and vegetation indices (+). In Way Kambas, PAO was related to the amount of deforestation (+) and IA was associated with the presence of major roads (-), brush (+), and

savanna (-). In Bukit Barisan Selatan, PAO and IA were both influenced by presence of secondary dryland forest (+), regular roads (+), and deforestation (-). Using the above predictors of PAO and IA, we developed spatially explicit maps that can be used to outline intensive protection zones for in-situ conservation efforts. In addition, reducing deforestation and maintenance of dry land forests in sensitive areas are needed to protect last remaining habitats of Sumatran rhinos.

IMPROVING THE EVIDENCE BASE OF CONSERVATION INTERVENTIONS: WHAT ROLE SHOULD RANDOMISED CONTROL TRIALS HAVE?

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Robust evidence of the effectiveness of socio-ecological conservation interventions (such as agroforestry projects or Payments for Ecosystem Services schemes) is widely considered necessary for improved land management. Randomised Control Trials (RCTs), in which experimental units are randomly allocated to intervention or control groups, are increasingly promoted as a tool for evaluating an intervention's impact. They have received notable recent support from governments and there are number of high-profile examples currently underway, but they are currently not widely used in conservation. Here we use lessons from RCTs' implementation in other fields to examine their potential for more widespread use in conservation. RCTs have a number of advantages as a method of impact evaluation. They offer a straightforward, intuitive means of calculating the average treatment effect of an intervention through establishing a reliable counterfactual, avoid many pitfalls of the commonly used quasi-experimental approach (particularly poor matching between intervention and comparison groups), and the method's clarity is likely to appeal to those aiming to translate evidence into policy. However, there are a number of issues to be considered when designing an RCT which may not be immediately obvious to researchers and practitioners. Randomisation may not always be practical for large-scale interventions, and outcomes may spill over between experimental and control groups. Interventions seeking to change human behaviour may be affected by psychological effects arising from participants knowing they are in an experiment, and often additionally raise ethical dilemmas. The question of the extent to which knowledge obtained from an RCT is relevant to other contexts must also be considered. RCTs must therefore be designed carefully, incorporating knowledge from other fields where their use is established. If this is done they have a key role in evaluating conservation interventions.



MAPPING BUNDLES OF ECOSYSTEM SERVICES REVEALS DISTINCT TYPES OF MULTIFUNCTIONALITY WITHIN A SWEDISH LANDSCAPE

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Ecosystem services can be a valuable tool to be used in the planning and management of social-ecological landscapes. However, the understanding of the determinant factors affecting the interaction between services in the form of synergies or trade-offs is still limited. We assessed the production of 16 ecosystem services across 62 municipalities in the Norrström drainage basin, Sweden. We combined GIS data with publically available information for quantifying and mapping the distribution of services. Additionally, we calculated the diversity of ecosystem services for each municipality and used correlations and k means clustering analyses to assess the existence bundles of ecosystem services. We found five distinct types of bundles of ecosystem services spatially agglomerated in the landscape that could be explained by regional social and ecological gradients. Human dominated landscapes were highly multifunctional in our study area and urban densely populated areas were hotspots of cultural services.

GLACIER RETREAT EFFECT ON PEAT LAND POOL METACOMMUNITIES IN THE HIGH BOLIVIAN ANDES

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High altitude Bolivian peat lands concentrate many services such as high biodiversity and support of endangered wildlife, support of livestock production especially during the dry season, regulation of organic matter decomposition influencing regional carbon cycle, and filtering and regulation of water for hundreds of thousands of people. These peat lands are also one of the most threatened ecosystems of the world as they are extremely sensitive to climate change, due to change

in water provision from melting glaciers and the impact of temperature rise on biodiversity, and human disturbance, due to land transformation, burning, mining activity and drainage. As peat land habitats can be viewed as green islands in the arid environment of the Bolivian Cordilleras, several studies have shown that their biodiversity is tightly related to their size and habitat heterogeneity, which depends on the provision of melt water from surrounding glaciers. Here we investigated the relationship between glacier influence, peat land area and environmental heterogeneity on the organization of aquatic metacommunities living in pool networks characteristic of Bolivian peat lands. We select 200 pools of 20 peat lands in the Cordillera Real (above 4500 m. asl) where we analyzed the metacommunity structure of zooplankton, macrophytes, algae and macroinvertebrates at different levels of spatial scale (α , β and γ diversity). We found that the aquatic environmental heterogeneity of peat lands was positively correlated with the percent of glacier cover in the catchment and positively affected β and γ diversity. Local diversity in each pool was best explained by the percentage of macrophytes cover and water conductivity. The turbidity levels of the peat lands were positively correlated to the percent of glacier cover in the catchment.

124 THE CHALLENGE OF ACHIEVING NO NET LOSS IN THE FORESTS OF CENTRAL AFRICA

Fabien Quétier

Biotope

Pauwel DE WACHTER, WWF ; Hélène DESSARD, CIRAD ; Laurène FEINTRENIE, CIRAD ; Claude GARCIA, CIRAD [INSTITUTE] ETH

The Tri-National Dja - Odzala - Minkebe Forest landscape (TRIDOM) covers 178000 km² across the borders of Cameroon, Gabon and the Republic of Congo. Almost 97% is covered by sparsely populated lowland tropical rainforest and is globally important for the conservation of large mammals (elephants, gorillas, chimpanzees). It is also an emerging iron ore province with several deposits currently being explored and two mining projects ready for exploitation. Encouraging investment while respecting the legal and customary rights of local populations and conserving biodiversity represents a major challenge. Conservationists fear that the needed infrastructure (railroads, roads, transmission lines, hydropower dams) and the associated impacts (especially from the influx of population) will lead to the fragmentation of TRIDOM. It risks being reduced to a mosaic of vulnerable, isolated protected areas, no longer fit to conserve its mega-fauna or maintain large scale ecosystem processes, but developing mining projects with a no-net loss (NNL) or even a net gain (NG) biodiversity objective as a condition for access to finance raises considerable technical and institutional challenges. A landscape-level approach is needed to take into account and mitigate indirect and cumulative impacts. Land-use rights are granted through



sector-specific concessions that have varying requirements in terms of biodiversity and rural livelihoods. Elaborating long-term arrangements for implementing and financing biodiversity offsets will thus require close collaboration between financial institutions, mining companies, conservation NGOs and government bodies from different sectors. We investigate the opportunities and obstacles for achieving NNL/NG objectives in the TRIDOM and draw lessons for other biodiversity-rich landscapes faced with the perspective of large-scale environmental and socio-economic changes.

CAVE DISTURBANCES AND ITS EFFECTS TO CAVE-DWELLING BATS IN A SMALL ISLAND IN SOUTHERN PHILIPPINES

Ma Nina Regina Quibod

Adamson University

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Caves are among the habitats and/or resources that are critically important to the ecology of a number of species, especially cave-dependent species like bats. These habitats are utilized by bats as sites for roosting, courtship and mating, maternity, and hibernation. More than 2,000 caves have been documented in the Philippines, yet cave research is very poor. To address and fill the gaps of knowledge on caves and cave bats in the country, a baseline study on the ecology of cave-dwelling bats in a highly disturbed small island in the southern region was conducted. Thirty caves with different diversity, architecture, microclimate, and disturbances were surveyed, wherein the types and degree of disturbances were correlated to the species richness and abundance of cave-dwelling bats. A total of 16 anthropogenic disturbances were identified outside and inside the caves surveyed, including proofs of bat hunting activities. The survey showed that most caves in the island are moderately to highly disturbed. Important disturbances to consider are visitation/tourism, guano harvesting, and proofs of bat hunting such as bamboo poles, remains of bonfires, torches, and nets. A positive and significant relationship was determined with species richness, abundance, and degree of disturbance in this study. Statistical results showed that disturbed caves have high species richness and abundance. However, the architecture of the cave plays an important role on the presence of high species richness and abundance in disturbed caves. These findings also pose alarm as it reveals that disturbances are concentrated in species rich and abundant caves. Hence, conflicts between cave use (especially tourism) and cave conservation are perceived, as caves with high species richness and abundances (often large caves) are also the most prized tourist destinations.

MODELLING HYBRIDIZATION WITH DENSITY-DEPENDENT RANGE EXPANSION AND ITS IMPLICATIONS FOR CONSERVATION

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The dynamics of range expansion need to be taken into account when studying the genetic consequences of an invasive species spreading and interbreeding with native populations. This is also critical when interbreeding results from shifts in the natural distribution of species due to climate change. Among the species interactions that take place during range expansions, hybridization is of growing concern in conservation biology. Models aimed at studying the genetic consequences of species range expansion have been recently developed but usually assume dispersal to be independent from local population densities. However, organisms may disperse because they are attracted by conspecifics, or to the contrary because they prefer depopulated areas. These behaviours are referred to as positive or negative migratory responses toward conspecifics. Here, through spatially explicit simulations, we assess the effects of various forms of density-dependent dispersal during range expansion on the genetic introgression between two interacting species. We show that massive introgression of neutral genes in the invasive species occurs in all the density-dependent dispersal models (positive and negative), even when hybridization is relatively low. For a given hybridization rate the levels of introgression are lower when dispersal is negatively related to local densities and higher under positive density-dependent dispersal. Our results suggest that organisms that tend to disperse due to conspecific attraction are more affected by genetic introgression. As a consequence they are more threatened by hybridization, which in turn is enhanced by anthropogenic factors and global climate change. We applied our theoretical framework on a real case of hybridization between European wildcat and domestic cat in Switzerland. We highlight that considering density-dependent dispersal in the models has the potential to improve their predictive power and has evident species management implications.

CONSERVATION OF ENDANGERED MARINE SPECIES AND TRADITIONAL ECOLOGICAL KNOWLEDGE: CASE STUDY OF HIPPOCAMPUS INGENS "PACIFIC SEAHORSE" IN PERU.

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In order to implement and develop a program to protect endangered marine species, gathering information about these species is a priority. Additionally, traditional ecological knowledge (TEK) represents an extremely useful tool when the distributional area of the species is largest and the economic means limited. This is the case of the assessment of *Hippocampus ingens* in Peru. The study presented here took place in the Northern shore of Peru, between 3° 30' and 6° 30' LS. Six field works were made and 15 fishermen communities were visited. A total of 88 individuals (fishermen principally) were interviewed. Information related to distribution, size, reproductive biology, species association, extraction, commercialization and population shift was collected. This data was crossed with that obtained through ecological assessment. Both data collection were performed in parallel. Fishermen TEK allowed principally: (1) To identify key points of marine extraction and marketing, then allowing the design of the commercial circuit. (2) To show the accuracy of the information related to the spatial distribution and size of specimens in these areas. (3) To determine modes of marine extraction and which of them has the highest impact on populations of *H. ingens*, in this case the bycatch (4) To chronologically know about the shift situation (such as population density and distribution) of *H. ingens* and some other traded species associated with it. Throughout the three years that lasted this assessment, TEK of fishermen, constituted an invaluable tool in the development of the field study and the way to establish links with fishermen, facilitating the process of sensitization pro-conservation, in this case, of *H. ingens*. In conclusion, this study highlights the importance of involving the fishery communities to enrich conservational studies.

SCENARIO PLANNING FOR COUPLED HUMAN-NATURAL SYSTEMS IN A RAPIDLY URBANIZING ANTHROME

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Anthromes link human and natural systems by characterizing terrestrial ecological patterns in terms of human populations and how these populations use the land. Thus biogeographical descriptions of regions like the eastern United States shift from temperate deciduous forest to a heterogeneous mix of semi-natural woodlands and dense settlements. One area of rapid change is the Piedmont ecoregion of the eastern U.S. where an expected >100% increase in urbanization will likely drive continued loss of forest cover, resulting in a regional transition to a homogenous anthrome of dense settlement.

This simplification of the coupled human-natural system necessitates integration of data and perspectives to effectively prepare for future change. Here we present the results of an interdisciplinary effort to link local and regional data to design and test, with the program InVEST, future scenarios of land use change in anthromes. Ecological and economic input data sets were collected at multiple spatial scales. Scenarios prioritized bird conservation, retention of agriculture, timber harvest, carbon regulation, and storm water control. Importantly, while conservation scenarios are sometimes based on conservation ideals and ignore economic constraints, these scenarios reflect measured values of willingness to pay. Specifically, we consider the amount and spatial arrangement of land that could be retained as forest in semi-natural and used anthromes. Evaluation of scenarios suggests that optimizing multiple services at the local scale is challenging, for example the difficulty of maximizing both bird richness and carbon sequestration, but regional coordination, within economic constraints, can improve the future flow of services. Ultimately, by connecting ecological value to economically viable scenarios, we can better assess where biodiversity conservation and ecosystem services retention would successfully occur in shifting anthromes.

THE EFFECT OF ENLISTING SPECIES ON THEIR CONSERVATION STATUS: A MEXICAN CASE STUDY

Esther Quintero

Conabio

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Mexico is one of the few megadiverse countries of the world, however, not all of its biodiversity is well known, documented, and protected. For instance, there is a good level of knowledge for some groups such as mammals and birds, but other such as fishes, invertebrates and even plants are poorly known. For instance, there is not a comprehensive taxonomic treatment for the Mexican Flora. Aichi Biodiversity Target 12, derived from the Convention on Biological Diversity establish that "By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained", whereas target 17 requires that "by 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan." It then follows that basic species knowledge and assessment are the first steps towards conservation actions. We thus analyze the gaps in generating a comprehensive assessment of the Mexican biota, and then assess how effective the National Red List has been as policy instrument to achieve the Aichi Targets. In so doing, we analyze a number of case studies from animals and plants in the List for which their risk status have granted them a positive impact



towards their conservation, or on the contrary those that although enlisted have not receive any effective protection.

MANAGEMENT PLANS FOR THE CONSERVATION OF FIVE INDIGENOUS PROTECTED AREAS OF THE ETHNICITY NONAN IN THE PACIFIC COAST OF COLOMBIA

Andrés Quintero Angel

Pontificia Universidad Javeriana

Miyela RIASCOS, ACIVA-RP Association of Indigenous councils ; Luis TANDIOY CHASOY, ACIVA-RP Association of Indigenous councils ; Carolina GAITÁN-NARANJO, ACIVA-RP Association of Indigenous councils

The Chocó biogeographic is recognized as one of the most biodiversity areas in the world; however anthropogenic pressures on these habitats represent major threats to this region. In this sense as a response to this problem two indigenous communities of the ethnicity Nonan located on the banks of the river San Juan and on the River Calima in the municipality of Buenaventura in the pacific coast of Colombia, stated autonomously in 2008 five areas of environmental interest (indigenous protected areas), with the aim of conserving natural and cultural resources, closely related to their customs and their stay in these ancestral territories. In 2013 using the methodology of research - action and Participation we gather the biological information and the Traditional knowledge associated to the five indigenous protected areas. The natural resources used and recognized by the community of these territories a long list of species that are related to different levels of community life, a relationship that leads to an ancestral knowledge of use and customs. Also identifying key issues such as: Conservation Actors, Co-management of Natural Resources and Agricultural Production in the region. As a result we establish eight biological and cultural conservation objectives for each area in the management plans for conservation, which were subsequently validated and agreed with communities in the two Indian Reservations. Although it is not yet possible to assess the impact of these management plans for conservation is important to emphasize that it is the first experience that involves biological and cultural values objects for conservation in the country and that the five "indigenous protected areas" area about 1850 hectares of continues forest.

COMMUNITY-BASED APPROACHES FOR THE CONSERVATION OF INDIGENOUS PROTECTED AREAS IN THE CHOCHO REGION OF COLOMBIA

Andrés Quintero Angel

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The loss of cultural identity, poverty, lack of environmental education, the population growth and the low level of development of indigenous communities are among the causes of environmental problems plaguing the Chocó biogeographical region. In response to this problem, we used a community based approaches to design and implement an educational tool that incorporate the traditional knowledge for the conservation of indigenous protected areas defined by two communities of the ethnicity Nonan located on the banks of the river San Juan and on the River Calima in the municipality of Buenaventura in the pacific coast of Colombia. With the aim to develop in the communities environmental competencies and recovery of the Traditional knowledge that help in the conservation of natural resources in the ancestral territories, we made an participant observation exercise and knowledge dialogue to identify the species of fauna and Flora related to different levels of the community life. Resulting in the recovery of traditional knowledge of 266 species of fauna-flora and 40 cultural elements associated with indigenous protected areas. This knowledge was incorporated into the education material that recognized equality of scientific and traditional knowledge. The material was presented in mother language (Mach meu), Spanish and Latin (scientific names). Additionally, it was accepted and agreed with each Indian reservation communities improving their design and facilitating its implementation. Being widely appealing to all community members, fulfilling some of the pedagogical principles that make relative to the stimulus in learning so we recommend for future conservation initiatives in indigenous territories recovering knowledge and use of educational tool as a means of interaction between members of the indigenous communities; facilitate the transmission of traditional knowledge related to biodiversity and improving attitudes of responsibility and respect for nature.

ASSESING THE CULTURAL AND SOCIO-ECONOMIC IMPORTANCE OF THE HAIRY ARMADILLO (CHAETOPHRACTUS NATIONI) IN ORURO, BOLIVIA

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University of Kent

Douglas MCMILLAN, Durrell Institute of Conservation and Ecology

The high Andes hairy armadillo (*Chaetophractus nationi*) has been traditionally used in Bolivia to manufacture charms, souvenirs and musical instruments such as the charango, a small traditional guitar, and especially a music box named "matraca" used during Carnaval processions. The species is



vulnerable to extinction according to IUCN and over-harvesting seems to be one of the main threats. Although the trade of the hairy armadillo is illegal according to national laws and local bylaws in some Bolivian towns, and on the fact that the species is listed in CITES Appendix II, the trade of the animal is open across the country, mostly on the west side, with additional evidence that dead individuals are also taken inside and outside the country without export permits. In the first stage of the research, we interviewed dancers and artisans, as well as visited local markets to assess the use of the species during Carnival celebration, particularly in Oruro, where the biggest procession is held. At least 160 animals are harvested every year only for the festivity, despite the availability of alternative non-animal products with a lower price in the market, so we believe that the reason for dancers to still prefer buying and using the real animal goes beyond the economic drivers and has a deep socio-cultural root, as interviewees stated they love the animal and feel identify by this particular species. Therefore, to have deeper knowledge about the value of the species in Oruro, further information was gathered using a mixed method approach, and was then processed using qualitative and quantitative analysis. The results of this research will help not only to generate knowledge about people's perceptions on this matter, but also to pursue cultural-friendly conservation solutions for the hairy armadillo, suitable with the needs and beliefs of the actors involved in the trade chain

SMALL SCALE SEAGRASS FISHERIES IN THE PHILIPPINES, A CASE STUDY OF TWO COASTAL BARANGAYS

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In developing countries, seagrass fisheries provide essential resources for coastal communities. While there is a bias towards management and conservation of coral reef fisheries, seagrass fisheries are important to rural communities, especially when there are declining artisanal fisheries catches. Between March 2013 and February 2014, we conducted semi-structured interviews of fishers, quantitative household surveys, observed fishing practices, and measured fish catch in landing sites in two coastal villages in the Philippines: one in a rural province and the other near a metropolitan area. In one site, seagrass fishers made up 85% of nearshore fishers, while coral reef fishers made up 15%. Compared to coral reef fishers, seagrass fishers had easier access to fishing grounds and only 85% used boats. The majority either gleaned at night or used boats and seine nets. The second most popular gear was crab and eel traps, and fish corrals. The majority of the

catch was juvenile fish, dominated by the Families Siganidae, Labridae, Muraenidae, Gerreidae and adult invertebrates in the Families Holothuroidea, Strombidae and Portunidae. Local food preferences aligned with the most abundant catches in both barangays. Household interviews assessed overall income and reliance on seagrass resources for income and protein. In the rural province, seagrass fisheries provided essential protein for daily consumption to the majority of households, while in the province near a metropolitan area which had access to non-fishing jobs, seagrass fisheries provided supplemental protein to a portion of the households. Regardless, proper management of seagrass resources under both scenarios is critical.

CONSERVATION OF THE FRAGMENTED FOREST SURROUNDING RANOMAFANA NATIONAL PARK, MADAGASCAR USING PARTICIPATORY ECOLOGICAL MONITORING AND GIS AS A TOOL FOR BIODIVERSITY AND ITS HABITAT MONITORING

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Local people are not considered as stakeholders of their environment, biodiversity, and its forest habitat worldwide. Many countries use Participatory Ecological Monitoring to involve local people to be responsible of their environment. This project aim to engage local people surrounding Ranomafana National Park, Madagascar in conservation and management of their natural resources. 10 villages surrounding the Park will be targeted to monitor the fauna and flora biodiversity, and the pressures in the forest. Three transects will be used for observations using the existing trails in the forest. Observations will be conducted once a month for four days for each village. Villagers will be trained on survey methods, data collection, use of GPS and camera for the observation. All the forest transects of each village will be mapped using Mapsource and Arcgis 10.2.2 software. Data recorded from biodiversity and pressures observations will be analysed based on indicators for biodiversity and pressures. Baseline information from the sites will be taken including delimitation of the villagers' forest habitat characteristics, the forest fragments around Ranomafana National Park with the observation trails, number of encountered species of animals and targeted plants during observations, and potential disturbances (e.g., slash and burn agriculture, gold mining, etc.). I expect the local community to be responsible in site and trained in GPS, confident in conducting transect observations. Analyzed data from the surveys will be used as management tools and at the end as a standardized biological monitoring that will be elaborated for future use in other regions in Madagascar. In conclusion, this project can motivate locale



population to be responsible for conserving locale biodiversity and extending the protected areas with these new monitored sites.

MUSHROOMS AND MACAQUES: USING ANTHROPOLOGY FOR CONSERVATION IN NORTH MOROCCO

Lucy Radford

Barbary Macaque Awareness and Conservation
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Around the oak forest of Bouhachem, north Morocco, Endangered Barbary macaques and people coexist in close proximity. With Barbary macaque populations in decline across their range due to human activity, using sociocultural and anthropological methods to approach their conservation is vital. Many agropastoralists from villages around Bouhachem collect wild mushrooms from the forest to sell as an additional source of income. We conducted research on mushroom collectors' perceptions of Barbary macaques. We used semi-structured interviews, allowing for open discussion of all the wild and domestic species the collectors encounter in the forest, and avoiding bias towards discussion of the macaques. We discovered that some mushroom collectors find the macaques helpful because they uncover mushrooms in the leaf litter as they forage. The species the macaques eat are different from the species people collect to sell, so there is no competition. With a history of macaques being persecuted by other forest users, the mushroom collectors' perceptions are an important facet to our understanding of the greater picture of macaque-human relationships in the area. Predation by dogs is another major threat to macaque populations in Bouhachem, and some mushroom collectors take dogs with them to the forest which harass the macaques. By ascertaining that mushroom collectors who go without dogs - and are therefore able to follow macaques - have greater success, we are able to tacitly communicate the message that it is better for people to keep dogs out of the forest unless they are being used for livestock guarding. We conclude that encouraging open discourse with forest users about the species they encounter can be a valuable conservation tool for Barbary macaques, as it allows us to gain deeper understanding which aids the design of our initiatives and our communications with local people.

HOW OXFAM AND SCARES DOLLARS CREATED TNC AND WCS

Stéphane Radureau

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While the ultimate aim of conservation non-government organizations (NGOs) is the preservation of biodiversity, two divergent strategies are used to achieve these aims. The first strategy is to implement projects that focus solely on biodiversity. The second strategy emphasizes the social benefits derived from biodiversity so as to enhance community engagement with biodiversity protection (an ecosystem services strategy). The last decade has seen an increased and contentious focus on the second of these strategies by some NGOs. The reason for this shift is not clear. One explanation is that it is the outcome of competition among NGOs for fund-raising from a limited donor pool. To test this we construct a game theoretical model of strategic interaction within the NGO sector. We demonstrate that competition for donations and the availability of funds for ecosystem services could explain recent changes in the structure of the conservation NGO sector, and that such changes could undermine biodiversity conservation outcomes. Within our model fund-raising competition leads to both NGO's converging on an ES orientated strategy. However, the presence of a human development NGO and the possibility of NGO's attaining funds from non-donor sources changes the game - now the NGO receiving non-donor funds focuses solely on biodiversity protection while the other focuses on providing ecosystem services. Knowing how such games play out allows insight into why conservation NGOs may have shifted focus in recent times but also provides understanding that could help funding bodies and governments influence conservation NGO strategies through targeted project funding. However, caution must be taken, even in our relatively simple model we find counterintuitive results suggesting that such interventions could not be the most efficient in terms of investment in biodiversity protection.

FINDING ALTERNATIVES TO SWIDDEN AGRICULTURE: DOES AGROFORESTRY PROVIDE SUPERIOR LIVELIHOOD OPTIONS AND REDUCE PRESSURE ON EXISTING FOREST?

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Swidden cultivation causes deforestation and land degradation, which result in a number of serious environmental problems. This paper examines the financial and social potential of agroforestry systems and their barriers of widespread adoption, as a land use alternative to swidden cultivation, which may potentially help protecting local forest. The Gunung Salak valley in West Java, Indonesia is presented as a case study. Empirical data collected from the study site found that, agroforestry systems have higher net present value (NPV) and benefit-cost ratio (B/C) than swidden cultivation. Tree ownership creates more permanent right on farm land and is prestigious in the community. Agroforestry products have high monetary value and help strengthen social cohesion when shared (fruits, vegetables, etc) with neighbors. Yet farmers are reluctant to implement agroforestry. Stated reasons are both cultural and capacity oriented. Agroforestry farmers are less involved in forest clearing and forest products collection than swidden farmers indicating that it may better preserve local forests. Support is needed to overcome capacity constraints and facilitate agroforestry adoption in the study site if conversion to agroforestry is wanted.

DO ROADS INFLUENCE PREDATOR ACTIVITY IN INTACT LANDSCAPES?

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University of Western Australia

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Extensive developments such as mining, and oil and gas extraction in relatively intact landscapes have numerous ecological impacts that affect ecosystems beyond their immediate footprints. Many of these impacts are poorly understood, particularly for linear infrastructure. We quantified linear infrastructure development in Western Australia's Great Western Woodlands, a region with significant mineral values supporting extensive and diverse woodlands and shrublands. Linear infrastructure in this region represents a large source of direct physical alteration that is likely to have an array of other consequences, such as hydrological change and altered connectivity for fauna. We then surveyed predator activity in woodland and shrubland habitats for evidence of changed native and introduced predator activity associated with unsealed roads. We established motion sensor cameras and searched for spoor (scats, prints and other evidence of predator activity) along 16, 3-kilometer transects situated perpendicular to roads. We discovered a strong association between predator activity and roads, although the effect of

the road did not extend far into the surrounding vegetation matrix, and trends varied between species. In particular, dingo preferences for tracks were stronger than cat preferences, and this may indicate some spatial interactions between the apex and mesopredators. These results have implications for the consideration of ecological impacts of developments in impact evaluations and land-use plans, and can inform predator control strategies.

THE RESPONSE OF NAIVE BUMBLEBEE (B. TERRESTRIS) FORAGERS TO CONSPECIFIC AND HETEROSPECIFIC SOCIAL CUES

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Across the animal kingdom, animals rely on social information to make adaptive decisions. Recent work has highlighted that animals respond not only to cues provided by their conspecifics, but also to those provided by other species that share the same habitat. Yet, we know little about whether selection might specifically have favoured responding to heterospecific cues, or whether animals simply learn through experience that heterospecifics provide useful information. Here, we test the responses of naïve bumblebee (*Bombus terrestris*) foragers to the presence of conspecifics, heterospecific *Bombus* species, and the honeybee *Apis mellifera* at forage sites. We find that foragers respond only to their conspecifics and to a heterospecific species displaying most similar tongue length, niche overlap and close relatedness. We also compare the responses of naïve bumblebees to nestmate and non-nestmate cues. Our results suggest that bees show naïve responses to conspecific and not heterospecific cues, with the exception of *B. hypnorum*, and that these responses are unlikely to simply be the by-product of an attraction to the scent of nestmates.

INTERVIEW SURVEYS VS. MONITORING PROGRAMMES: EVALUATING ALTERNATIVE METHODS OF MONITORING MARINE MAMMAL POPULATIONS IN DEVELOPING COUNTRIES, A CASE STUDY FROM MALAYSIA

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The interview survey is a cost-effective method to learn of the distribution, crude abundance, and threats of marine mammals, especially in data-deficient developing countries. These surveys can also provide information on conservation issues and community perceptions regarding these mammals. Monitoring programmes are interview surveys conducted at regular intervals to obtain a temporal evaluation of trends



in population status, seasonal occurrence and movement patterns. Interview surveys and monitoring programmes were conducted at two locations namely, Sabah (dugong) and Penang (cetaceans) in Malaysia, in 2002 and 2013, respectively. This paper aims to evaluate and compare interview surveys and monitoring programmes used in these two study sites. The topics discussed will include: questionnaire design and the importance of pilot studies, biases involved in conducting these surveys, the measures recommended to decrease them in terms of validation of interview answers, repeat sightings, and respondent daily routine. The feasibility of using interview surveys as a onetime survey, or continuing with a monitoring programme, which could be short term (e.g. one year) or long term (e.g. several years) will also be discussed. The importance of developing a relationship with the local community, interviewer skills and experience, and recommendations on how to approach community will be highlighted.

LOCAL WELFARE IMPACTS OF FOREST CONSERVATION: EXAMINING THE RELIABILITY AND VALIDITY OF ESTIMATES USING THE CHOICE EXPERIMENT METHOD

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Neal HOCKLEY, Bangor University

Understanding the impacts of conservation on local people's welfare remains very difficult in least-developed countries where markets for land and labour are weak and analysts often lack good understanding of people's livelihoods. This study tests whether choice experiment surveys can provide reliable and valid estimates. I used choice experiments to investigate trade-offs between swidden agriculture and attributes such as cash payments and agricultural support. I surveyed matched households in an open and closed forest frontier where people have different experiences of restrictions. I also conducted qualitative debriefing interviews with a sub-sample of respondents to explore respondents' motivations and strategies. Past experiences of restrictions significantly affect how people answer choice experiment surveys. Where restrictions have been enforced for a relatively longer period (closed frontier), swidden agriculture is almost incommensurable. Whereas in the open forest frontier, respondents are willing to make trade-offs although important discrepancies exist between migrants and indigenes. Findings also show that respondents anchored their responses in a variety of ways which are rooted in their perceptions and beliefs. These results call into question the reliability and validity of choice experiments conducted prior to conservation actions or other policy interventions. My research has implications for how we design choice experiment (and other) surveys. I identify circumstances when we can expect them to provide reliable and valid estimates of welfare

impacts. Findings also suggest that conservationists may need to rethink their approaches and inform the design of more effective compensation measures since forest dwellers have the greatest impact on resources.

EFFECTS OF FRAGMENTATION AND DEGRADATION ON THE DISPERSAL ABILITY OF THE WOODY PLANT COMMUNITIES IN THE ATTAPPADY HILLS, WESTERN GHATS (INDIA): IMPLICATIONS FOR FOREST LANDSCAPE RESTORATION

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Seed dispersal plays a key role in structuring the plant communities across a range of spatial scales resulting in different patterns of species diversity across landscapes. Spatial patterns occur due to the movement of seeds based on different dispersal vectors (whether abiotic or biotic), which operates at various spatial scales and consequently determine the community structure. When forest landscapes are altered due to fragmentation and habitat loss, the mechanisms of various dispersal vectors are affected and subsequently hinder species dispersal resulting in altered community structure. Although it is the only factor that accounts for the movement of species among fragmented habitats, local processes such as disturbance and biotic interactions may determine their persistence within the habitat. Therefore, studying the distribution of woody plants (based on seed dispersal) among the habitat fragments provides insights into how vegetation communities were shaped by factors related to environmental disturbances. In the Attappady hills, Western Ghats, efforts to restore several hundred hectares of degraded forests have been organized under an eco-restoration project. We studied the spatial distribution of the woody plant communities based on the seed dispersal modes to understand the mechanisms of recolonization of the woody plants into the fragmented habitats, and thereby help restorationists to adopt better restoration management. We found that the larger habitat fragments positively affected the diversity of passive and animal dispersed species. Secondly, passively dispersed species that are short-distance dispersal mechanisms were more dispersal-limited than species with adaptations for long-distance dispersal such as animal and wind dispersed species. This indicated that dispersal indeed constrains species' recolonization into degraded fragments, and facilitating natural regeneration may not be sufficient in restoring these fragmented forests.



IDENTIFYING CRYPTIC LINEAGES WITHIN AN ENDEMIC FROG GENUS (INDIRANA) IN THE WESTERN GHATS

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A large number of extant species in the tropics are awaiting discovery, many due to their crypticity ie. lack of morphological difference. We tested for crypticity in a frog genus, *Indirana*, endemic to the Western Ghats of peninsular India. We updated a published phylogeny using increased taxon and spatial sampling, and by examining the relationship between genetic and morphological divergence among close relatives. Initially, we delimited potential lineages using a 16S rRNA haplotype tree and then, a multigene tree using multiple criteria including haplotype clusters, genetic distances and geographical range separation. Our results suggest that there are 19 – 21 potential lineages in *Indirana*, which is an increase of between 70 – 90 % from earlier estimates. Pairs of potential lineages that differed in their levels of genetic divergence were examined in multivariate morphological space. Several lineages within *Indirana* were cryptic and could not be distinguished on the basis of morphology, and the potential lineages identified await formal description as species.

TRACKING THE MOVEMENTS OF A SMALL AND THREATENED NEW ZEALAND NATIVE FROG

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New Zealand native frogs belong to the genus *Leiopelma* and are classified as threatened, both internationally and nationally. All four extant species have suffered major range reductions and are now restricted to a few islands in the Marlborough Sounds and parts of the North Island mainland. The study of amphibian movement is a critical component of their ecology, relating to interaction between species and their environment. Small-scale movements are important as they enable identification of habitat features essential for species persistence, which relates to conservation management. Despite this, little is known about small-scale movements in *Leiopelma* species. Their small size and cryptic nature presents a challenge, and therefore commonly used techniques (e.g. radio-tracking) are not adequate. This study aims to investigate small-scale movements of a nocturnal terrestrial species, *Leiopelma pakeka*, in its natural environment. Non-toxic fluorescent powders were applied to randomly selected frogs

during their putative breeding and non-breeding seasons to track their movements throughout the night. Irrespective of season, males and females moved similar distances during the night. Females grow larger than males, but there was no correlation between movement behaviour and size (SVL) of frogs. However, there was a marked variation in movement behaviour between individuals. Total distance moved was significantly higher during the breeding season, independent of sex. Microhabitat selection differed between seasons, reflecting different substrate preferences during movement. The use of fluorescent powders proved effective for short-term tracking of this species. This research improves our understanding of *L. pakeka* habitat requirements, and should allow more effective conservation management, such as translocation and captive husbandry.

WHERE TO GO NEXT? PREDICTING HABITAT SUITABILITY OF AN EXPANDING MESOCARNIVORE - THE GOLDEN JACKAL (CANIS AUREUS) IN EUROPE

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The golden jackal's *Canis aureus* range in Europe is expanding rapidly. Historically restricted to the Mediterranean and Black sea coastal regions, golden jackals are now reproducing in most of Southeastern European and some Central European countries. In addition, vagrant animals have been detected further to the north and west (Estonia, Germany, Switzerland). The presence of this new carnivore could have impact on existing animal communities and is already receiving high interest among wildlife managers. There is thus an urgent need to forecast species colonization at the European scale. In this analysis, we used species distribution models (SDMs) to map the species habitat suitability across the continent. SDMs were calibrated within the core range of the species using data of territorial jackal groups (>1000 locations, mostly from howling surveys) as presence. By contrast, absences



were drawn from hunting-statistics and refined with both expert-based distribution models and opportunistic jackal records. We used environmental variables relevant to the species ecology: altitude, snow cover, land-cover and grey wolf *Canis lupus* presence. We controlled for sampling selection bias by manipulating presence weights and absence spatial selection. We calibrated 10 different algorithms; all internally and externally validated. The final model projection was achieved through an ensemble procedure and we investigated the robustness of our predictions to extrapolation using a multivariate environmental surface analysis. Our analysis indicates that mountain areas characterized by unfragmented forest cover, high snow prevalence and wolf presence are particularly unsuitable. Besides these areas, large parts of Western and Central Europe appear suitable, so we can expect further expansion of this species in the future. These results provide managers with the opportunity to prepare for the future colonization by the jackals in areas, where expansion is most likely.

DEAD WOOD CREATION TO COMPENSATE FOR HABITAT LOSS FROM INTENSIVE FORESTRY

Thomas Ranius

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Negative consequences of human activities for biodiversity may be mitigated by compensation measures. Although the interest in applying compensation measures is generally increasing, such measures have rarely been applied in forestry. Many boreal forests are managed by clear felling and used for timber and pulp production. There is an increasing interest in intensifying forestry by also harvesting slash and stumps for biofuel at felling. We evaluated the efficiency of combining intensified forestry production with compensation measures, by estimating the net revenue from slash and stump harvest, the cost of high stump creation, and simulating habitat amount for 680 bark- and wood-living species (fungi, beetles, lichens, and bryophytes) in Norway spruce forests in Sweden under different scenarios of biofuel harvest and compensation. We show that the harvest of slash and stumps has a clear negative effect on the habitat amount available for many species, especially for many fungi and beetles. Combining slash harvesting with the creation of high stumps results in an economic surplus and at the same time provides significantly more habitat in comparison with no slash harvesting and no high stump creation. When undertaking stump harvesting it is currently impossible to achieve such positive effects. Thus, our analyses show that compensation can sometimes be a useful tool when both economic and biodiversity goals must be

achieved in forestry, but in other cases it is a better alternative to avoid the activity that causes the negative effects.

TO SET ASIDE YOUNG FORESTS MAY BE A COST-EFFICIENT STRATEGY FOR CONSERVING DEAD WOOD-DEPENDENT SPECIES

Thomas Ranius

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In managed forest landscapes, a common practice to mitigate negative consequences on biodiversity is to set aside old forest stands. However, alternatives to this have been suggested: young stands can be set aside and the rotation period can be extended in forests managed by clearfelling. Using simulation models, we have analysed the consequences of applying these strategies in a managed boreal forest landscape in Sweden. Then we applied a constant conservation budget and predicted forest development and harvesting over the following 250 years and the colonisation-extinction dynamics of a redlisted beetle species dependent on dead wood. In the short term, setting aside young stands leads to a higher extinction risk, as it takes longer time before the amount of dead wood increases. However, since young forests are cheaper, the total area set aside becomes much larger with that strategy, which in the long term generates a lower extinction risk and a decreased volume harvested in the forest. Prolonging the rotation period was not a cost-efficient strategy, given a 3% interest rate, which is commonly assumed. In our case, the most cost-efficient strategy to preserve the beetle species in the study landscape over 250 years was to spend about half of the budget on young set-asides and spend the other half on old set-asides, which is significantly different in comparison to the current strategy that almost only involves old set-asides. However, to set aside young stands instead of old means that both the cost (decreased harvest) and benefit (decreased extinction risk) is delayed, and it is a question of values whether this is desirable or not.

ROB PETER TO ROB PAUL. TRIAGE OR THE LIMITS OF CONSERVATION APPROACHES THAT IGNORE STRATEGY

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IDDR-Sciences Po
Raphaël BILLÉ, Associate researcher at IDDR-Sciences Po

In recent years, "triage" has received a growing interest in the conservation community. It is increasingly present in the



scientific literature, in expert discussions and even echoes in the general media. Following its advocates, triage is the undesirable but necessary path through which conservation has to go through in order to stay “realistic” in a context where the resources allocated to conservation seem scarce in regard to its needs. What seems at stake is the capacity of the conservation community to remain credible in the eyes of decision-makers and to have transparent, scientifically-informed debates as to “what to let go”. This approach has spurred many debates, that for the most part focus on its moral implications and feasibility. However, we argue that triage must at first be critically assessed through strategic analysis. Indeed, current debates remain in an intellectual space where the premisses underlying triage and its supposed fit to real world constraints are very seldomly discussed. Yet, the efficacy of any given strategy strongly depends on first making an accurate framing of the issue it is supposed to tackle. Here, we will first propose an overview of the triage rationale and the debates surrounding its morality and implementability. Then, we will show that most hypotheses behind the triage rationale are actually highly disputable on strategic grounds. We will particularly address three misconceptions that are at the core of the triage rationale: (i) The lack of pertinence of its displayed tactical dimension; (ii) How it underestimates the complexity of conservation action contexts; and (iii) The numerous uncertainties pertaining the actual resources allocated to conservation and their pathways. Based on these elements, we will argue that instead of helping conservationists better achieve their goals by moving away from the zero extinction goal, triage might unnecessarily weaken their position in real world negotiations.

RESPONSE COMPOSITION OF EPIPHYTIC LICHENS DIFFERS AMONG TREE TAXA

Åsa Ranlund

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Organisms vary in their responses to environmental change. Characterizing these response differences is important in order to understand how anthropogenic changes to the environment affect communities and how adverse effects might be mitigated. We propose the term “response composition” to capture variation in the distribution of responses by the species in a community. As an example we used lichens in Sweden to compare the response composition among epiphytic communities, in relation to the forest disturbance of clearcutting. We found a distinction between lichen species that were mainly associated with the late successional Norway spruce and the early successional European aspen, birches, and Scots pine. The spruce-associated species had on average a

negative response to the exposure of logging, while the species associated with early successional tree taxa had on average a positive response to exposure. Consequently, epiphytic lichens response to exposure correlates with the conditions of where their host tree taxa have commonly occurred in the landscape. Our results are in line with theory on how historic environmental conditions have affected species pools. We introduce the term “response composition”, which has the potential to complement studies on response diversity by adding dimensions such as response direction, magnitude, and variation over time. Such additions can help define community-specific conservation actions.

MONITORING SUITABLE HABITATS FOR FOREST BIRDS IN MADAGASCAR USING TIME-EXPLICIT SPECIES DISTRIBUTION MODELS AND TIME-SERIES OF SATELLITE DATA

Andrianarivelosoa Solohery Rasamison

Université d'Antananarivo

Madagascar is home five endemic bird families and 37 endemic bird genera, more than any other country in the African region. Among 286 bird species that can be found in the island, many species are threatened by habitat loss. In this study I used GBIF and other sources of spatial-temporal records of birds, time-series of environmental variables derived from satellite data at moderate spatial resolution, and species distribution models to estimate trends in the extent of suitable habitat for birds in Madagascar from 1990-2010. This method allows area of habitat for bird species, a proxy for population size, to be monitored retrospectively and into the future. It complements the studies of population trends at a very limited number of sites.

THE DEVELOPING WORLD BIAS IN STUDIES OF HUMAN DIMENSIONS OF INVASIVE SPECIES: RESULTS OF A SYSTEMATIC REVIEW

Archi Rastogi

University of Waterloo
Brendon LARSON, *University of Waterloo*

The focus of invasion biology are invasive species, which are often defined in terms of their non-native origin, their tendency to spread, and their social-ecological impacts. To date invasion biology has largely been developed from an ecological perspective. It is critical to understand human dimensions of invasive species, since this knowledge can help conservationists to determine when to intervene and how to design effective interventions. We conducted a systematic review of social scientific research on the human dimensions of invasive species. Adapting the method from prior studies, we aimed to explore how humans relate to invasive species



by characterizing the current state of the literature, and identifying lacunae for future research. Our review revealed that the funding agencies, lead authors, and respondents were primarily based in the developed countries for the majority of studies. As a result, there is dearth of relevant knowledge from developing country contexts. This disparity in scientific knowledge can create serious challenges for global policy discussions on invasion biology. Further, we found that the majority of studies tended to subscribe to the philosophical viewpoint of “stewardship” or “participation with nature”, which relate to management challenges created by invasive species, and the loss of ecological integrity. We found a small minority of studies allying with the viewpoint on “mastery over nature”, discernible by their emphasis on the monetary functions of nature. Since invasion biology is a relatively new discipline, this review provides the opportunity to assess the direction of the discipline and take corrective measures. In this paper, we outline other trajectories of the literature on human dimensions of invasive species and identify implications for conservation and management.

WHO KILLED THE TIGER? UNDERSTANDING THE SOCIAL DIMENSIONS OF TIGER CONSERVATION IN INDIA.

Archi Rastogi

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Gordon HICKEY, McGill University ; Sneha THAPLIYAL, Indian Institute of Management Bangalore ; Ruchi BADOLA, Wildlife Institute of India ; Syed Ainul HUSSAIN, Wildlife Institute of India ; Anupam ANAND, University of Maryland

Tiger conservation represents some of the most intense challenges facing Protected Areas management. It involves the protection of a potentially-dangerous predator in some of the world’s most densely populated landscapes shared by the animal with human populations. This is known to create a serious dilemma: successful tiger conservation requires the establishment of ‘exclusively-managed’ Protected Areas, which can antagonize local communities and render tiger conservation unsuccessful. What, then, are the lessons to be learnt from successful governance of tiger conservation? We present the results of a five-year research project that considered the case of tiger conservation in India. The research utilized diverse academic approaches to understand the social dimensions and governance of Protected Areas in India at several levels of governance (policy, national, Protected Area, community and village-level). We utilized diverse methods ranging from psychometrics to institutional analysis, and economics to analysis of geographic information system (GIS). This research was designed to fulfil an important gap by using science to devise pragmatic and practical inputs for conservation. The key outcomes of the research include: a) outlining ‘the dilemma of tiger conservation’, b) understanding

the psychological make-up that affects policy networks, c) examining the processes through which local-level politics can affect and undermine Protected Area management, d) identifying local-level social capital as a potential resource, rather than a challenge, for Protected Areas, e) exploring the implications of tourism for institutions and ecology of Protected Areas, and f) analysis of popular media on tiger conservation. Overall, the research makes pragmatic inputs for tiger conservation, with implications for Protected Areas globally. The pragmatic results inform long-term and short-term policy and management of Protected Areas worldwide.

COMMUNITY-BASED INTEGRATED MONITORING FOR LONG TERM BIODIVERSITY CONSERVATION IN SOUTHERN MADAGASCAR

Joelisoa Ratsirarson

University of Antananarivo

Jeannin RANAIVONASY, University of Antananarivo ; Alison F. RICHARD, University of Yale

For nearly 30 years, a monitoring and conservation program in partnership with local community is implemented at the Bezà Mahafaly Reserve (southern Madagascar). The study documents the vulnerability and resilience of local ecology, landscapes and communities and combines ecological and socioeconomic data at Bezà Mahafaly. Land cover changes show fragmentation of vegetation cover, mainly outside the protected Reserve. The role of the protection of the Reserve is very important as the study demonstrated the stability of some indicator vertebrate species populations of habitat health). The impact of local climate variability has been noted on phenology of flora as well as reproductive success of lemurs. Thus, years of good rain are associated with available vital resources for lemurs and thus higher fertility and a higher survival rate of newborn lemurs. Community livelihoods and food security, which are based on agriculture and forests products, are strongly influenced by climate variability and its ecological implications. The integrated community-based monitoring system has an important role as an early warning system, and has helped to make relevant decisions for adaptive sustainable management of the Reserve, including protected area extension and protection, ecological restoration and promotion of local development. Local partnership at Bezà Mahafaly, with by mutual trust between stakeholders can be considered as a unique model for sustainable conservation.

ECOLOGY AND CONSERVATION OF BIRDS AND CARNIVORE SPECIES OF RANOMAFANA NATIONAL PARK RAINFOREST: MONITORING ENVIRONMENTAL AND CLIMATIC CHANGE THROUGH CAMERA TRAPPING

A. Jean Claude R. Razafimahaimodison



Centre ValBio Ranomafana

Ranomafana national park has been well known worldwide for its high level of biodiversity endemism and diversity, following the 1986 discovery of the golden bamboo lemur. Birds and carnivores represent among the most unique and diverse species of the rainforest biodiversity. Within the 416001ha protected area, bird diversity of Ranomafana represents a relatively low number of species, but a high number of endemics. 115 bird species are found and more than 60% of them are endemics. The three endemic civet-like carnivore species and two out of the five endemic mongoose species are also well represented in Ranomafana national park. However, environmental deterioration, through human pressures, such as intrusion, illegal mining, forest exploitation; and natural catastrophic damage, like cyclone, erosion, and land slide lead to the vulnerability of these species. Little is known on the impact of environmental and climatic changes on the distribution of bird and carnivore species within the forest area. Ecology and conservation of these species are also poorly understood. From 2010 to 2014, large-scale camera trap monitoring of terrestrial vertebrates within the protected rainforest has revealed that bird and carnivore species distribution has impacted greatly by human induced habitat and environmental climatic changes. Rare and cryptic species are the most vulnerable, as they tend to skip human induced habitat disturbance by moving towards the more pristine habitats. The degree of human frequentation, the presence of invasive species, and the variation of temperature are the most determinant for their distribution and movement within the area. However, no decrease in diversity or abundance of these species was recorded at Ranomafana national park. Conservation management policy of this world heritage rainforest can be greatly influenced by the outcomes from the camera trapping research, especially from studies on the most threatened endemic cryptic species.

USING MULTISCALE PRIORITIZATION CRITERIA TO OPTIMIZE ELECTROCUTION MITIGATION: AN EXAMPLE FOR THE ENDANGERED BONELLI'S EAGLE *AQUILA FASCIATA*

Joan Real

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Antonio HERNANDEZ-MATIAS, UNIVERSITAT DE BARCELONA ; Rafel BOSCH, UNIVERSITAT DE BARCELONA ; Alex ROLLAN, UNIVERSITAT DE BARCELONA ; Albert TINTO, UNIVERSITAT DE BARCELONA

Electrocution on power lines is a serious threat to a wide range of birds, including several endangered species. Currently, the main factors that increase the risk of electrocution are known. However, power lines are ubiquitous and approaches

useful to optimize mitigation actions are urgently required. In this regard, we developed a procedure based on multiscale prioritization criteria. It follows four main steps to identify: (i) sink populations over large areas; (ii) sink territories within target populations; (iii) intensively used areas by individuals within target territories; and (iv) dangerous pylons within used areas. We applied this procedure in the endangered Bonelli's Eagle (*Aquila fasciata*) populations in western Europe, where electrocution is a major cause of mortality. We used demographic models to identify sink populations. Then, we focused in the local population of NE Iberia, which acts as a sink, and identified those territories acting as sinks within this population. After that, we delimited the home range of 12 territorial pairs in this area, most of them acting as sinks, which allowed us to identify the power lines candidate to be corrected. In three of these territories, we assessed the dangerousness of all power line pylons. In collaboration with electric companies, we proceed to correct the dangerous pylons. We also monitored the main vital rates of these three territories, both before and after mitigation measures were carried out. Our results suggest that the risk of electrocution would be reduced by 65% by correcting 2.5% of pylons in the 12 territories analyzed. Accordingly, we found a significant increase of survival in those territories where corrections were done, meaning that population viability would be guaranteed. Overall, our study establishes a framework for performing electrocution mitigation actions in a concerted and rigorous fashion and for optimizing resources to address this conservation concern.

LISTENING IN AND NOT LOOKING OUT: CONSIDERING THE DIFFERENCES IN THE ACOUSTICAL ECOLOGY OF BALEEN WHALES TO IMPROVE OPTIMAL MONITORING USING PASSIVE ACOUSTICS.

Angela Paola Recalde Salas

Curtin University

Chandra Patricia SALGADO KENT, Curtin University ; Christine ERBE, Curtin University ; Robert D. MCCAULEY, Curtin University ; Hugh P. POSSINGHAM, The University of Queensland

Passive acoustics monitoring is one of the most common techniques for assessing the effects of underwater noise on baleen whale populations. However, for it to be successfully implemented some basic gaps in acoustical ecology of baleen whale species need to be understood. Blue and humpback whales are two of the most commonly studied species in Western Australia (WA) waters, an area under pressure from coastal development and industrial activities. Here, we compare acoustical detection rates of blue and humpback whales using a combination of acoustic and land based surveys. Surveys were conducted between November-



December of 2010-2014 in Geographe Bay, WA. Land based observations were run using theodolite tracking methods from a 50m hill. An acoustic logger was placed on the seabed at 2.5km from the land station in 30m of water. The recording schedule was either 800 or 1300 seconds every 900 seconds, depending upon the unit deployed. Data presented here only includes the daylight hours between 7am and 6pm. Transmission loss methods were used to identify vocalising groups. A total of 1228 humpback and 87 blue whale groups were visually tracked. Of those less than 30% were vocalising. Differences in the dominant vocalisations were also observed. While humpback whales produced song and non-song sounds with no apparent preference, blue whales mostly produced non-song sounds and only sang in a few occasions. For both species, mother and calf, or mother, calf and escort groups did not sing and were less vocal in terms of non-song sounds. Groups with two individuals and lone singers were the most vocal for blue and humpback whales, respectively. While song is the most widely used vocalisation for monitoring, our results suggest that song may not be the best option for all species at all locations. We suggest the inclusion of non-song sounds to increase the likelihood of species detection and increase the scope of monitoring to other groups such as females with calves.

COEXISTENCE WITH AQUATIC PREDATORS IN THE PERUVIAN AMAZON

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Mathew ANDERSON, Institute of Conservation Research, San Diego Zoo Global ; Phyllis C. LEE, University of Stirling

Human-wildlife interactions are increasing as human populations expand, and some wildlife species cause damage or losses to humans. In Amazonian Peru, communities are principally riparian, and fish provide an important source of protein. We interviewed community members close to the Pucacuro National Reserve (PNR), to see if large aquatic predators are considered problematic. Between September and December 2014, we interviewed men and women in three communities in the PNR buffer zone to determine opinions, attitudes and perceptions towards wildlife. For 58 interviewees, the main activities listed were farming (n=41), hunting (n=35) and fishing (n=20). Despite the dominance of farming and hunting, when asked to rank the top 3 most damaging species from 22 photos of terrestrial (n=8), arboreal (n=7) and aquatic (n=7) animals, the most listed were giant otters (37.9%), pink dolphins (37.9%) and black caiman (36.2%). When asked to choose the worst fishing net damager from 7 aquatic predators: the most commonly ranked first were giant otter (34%), pink dolphin (33%), black caiman (16%), and Neotropical otter (10%). Retaliatory actions occurred against some species. Of 30 respondents, 43% interviewees said they had previously

hunted giant otter (23% because of damage to nets, 20% to sell the skin), although 93% knew that hunting giant otters is currently illegal. 87% thought that there were more otters than 10 years ago, 70% of people agreed that there are enough fish for people and giant otters (n=21) and 73% of interviewees agreed that not all animals that break nets should be killed. However, 73% of people did not like to live close to the otters, 27% felt scared of otters, and 57% of people thought that it would be better if the giant otters disappeared from the area. In Pucacuro, negative attitudes to aquatic predators exist, due to concerns of damage to nets. This may be causing hostility and retaliation towards giant otters in particular, despite legal protection.

RETHINKING THE USE OF PPGIS IN EXPLORING PERCEPTION OF ECOSYSTEM SERVICES - HOW TO ASSURE DATA VALIDITY?

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Although the concept of ecosystem services (ES) has become influential in environmental sciences, relatively less effort is put on improving the ways public perception of ES is investigated. In case of irreplaceable ES, the ES concept has any explanatory power only with the assumption of sustainable use of the services, otherwise – attempts of their valuation would always end up with acquiring infinite figures. Since social perception of ES is crucial for assuring sustainability, we find proper methodology for gathering the data a critical issue. ES without their spatial references would remain abstract constructs, thus examining patterns of their perception should also reflect their geographical attributes. However, despite variety of available PPGIS methods, their limitations seem to be even exacerbated in aforementioned research context. Within the presentation we discuss applicability of both Internet-based and workshop mapping for collecting data on perceived ES distribution. We analyzed the use of both points and polygon as basic units of spatial representation of responses. We comment the issue of perceptual inconsistency of ES categories in the light of its consequences for methods' validity. We review and comment examples of ES operationalization in PPGIS studies



i.e. from Australia, USA and rare examples from Europe. We also provide reflections from empirical studies led in Poland where the basemap with pre-demarcated polygons was used for ES mapping. We describe criteria for establishing the polygons and the role of bottom-up knowledge in defining their borders. Finally, we confront applicability of using regular-grid and habitat-based basemap layer in similar studies. We believe that our recommendations will help to deal with utmost uncertainty: are some ES (e.g. regulating ones) actually poorly recognized by the public or are these only imperfect operationalization techniques, which hinder the process and bias validity of results?

(SYMPOSIUM ID: 33) UNDERSTANDING HUMAN BEHAVIOR AND NATURE TO UNCOVER NEW CONSERVATION STRATEGIES

Sheila Reddy

The Nature Conservancy

Jensen MONTAMBAULT, The Nature Conservancy; Yuta MASUDA, The Nature Conservancy; Jon FISHER, The Nature Conservancy

Human behavior influences virtually all aspects of nature conservation. Yet, to date, conservation science has rarely studied human behavior. The dominant theory of change in conservation about human behavior assumes that there is a deficit of information on environmental conditions or ecosystem services and that decision makers are rational. This theory of change has seldom incorporated other models of or influences on human behavior, such as those that consider psychological, social, or institutional processes. We examine five classes of decision-makers that have a large impact on nature conservation by reviewing the literature to identify models of human behavior that best explain these decisions. Using case examples, we show how human behavior interacts with the ecological, economic, psychological, social, and institutional conditions and constraints in each case and how the strength of the interactions depend on the model of human behavior. Our analysis shows that interactions between humans and nature are often more multi-faceted and less driven by information and rational decision-making than is currently understood by mainstream conservation science and practice. We then identify new conservation strategies that could be used in each case to create systemic change in human's relationship with nature. We discuss how the strategies would complement or contrast with current conservation strategies. The results of this research should provide a new way of thinking about human behavior and nature, as well as specific hypotheses to be tried out and tested.

#165 TOO BUSY SAVING THE WORLD TO BE ACCOUNTABLE

Kent Redford

Archipelago Consulting

Andrew KNIGHT, Imperial College; Matthew KEANE, Environmental Protection Agency

Conservation is a value-based enterprise that was founded as a crisis discipline. Despite its base in science, much of the practice of conservation has been driven by values, funding availability and donor requirements. As such, learning, and the evaluation that is part of it, has received little attention. Though acknowledged as important there are a variety of reasons for this that we will explore in this talk. This lack of work has hampered the ability of conservation practitioners to be accountable, which may be limiting our success.

106-CONSERVATION CONFLICTS: APPROACHES, OPPORTUNITIES AND CHALLENGES

Steve Redpath

Institute of Biological and Environmental Sciences

Conservation conflicts are widespread and typically damaging to biodiversity and human livelihoods. They arise from situations where conservation objectives clash with other objectives, such as those of farmers, or foresters or hunters or business. There is an urgent need to understand how we can most effectively deal with these difficult problems. In this talk I will first reflect on how we frame and understand conservation conflicts and why this is important in developing effective management strategies. I will then move on to consider some of the opportunities and challenges in this field, focusing on i) the role of models in helping us understand conflict, ii) why and how we might link science and stakeholder knowledge, and iii) how we evaluate the effectiveness of alternative conflict resolution strategies. Throughout I will draw on a range of conflict case studies to illustrate the approaches, opportunities and challenges.

BIODIVERSITY SURVEYS GUIDE URBAN DEVELOPMENT STRATEGIES TO CONSERVE NATURE IN THE CITY

Sarah Reed

Wildlife Conservation Society[INSTITUTE]Colorado State University

Jessica SUSHINSKY, Wildlife Conservation Society; Lindsay EX, City of Fort Collins; Liba PEJCHAR, Colorado State University; Kate RENTSCHLAR, City of Fort Collins

More than half of the world's population now lives in urban areas, and preserving natural areas in urban ecosystems is



critical for conserving biodiversity, maintaining ecosystem function, and sustaining human well-being. The population of Fort Collins, Colorado (USA) is projected to grow from 155,000 today to 240,000 by 2045. The Nature in the City initiative aims to minimize negative effects of increasing urbanization by creating a connected open space network that provides a variety of experiences for people and functional habitat for plant and animal species. To support this goal, we formed an interdisciplinary team to assess the current status of biodiversity throughout the City and guide future development patterns. We selected 166 points stratified among nine land uses ranging from formal City Parks and Natural Areas to informal neighborhood open spaces and urban farms across the City's 201 km² growth management area. We conducted repeat point-count and Pollard-walk surveys from May-August 2014, detecting 88 species of birds and 33 species of butterflies. Land use had the greatest influence on species richness and community composition. The greatest numbers of bird species and proportions of urban avoiders were detected in public and private lands managed specifically for their natural resource values, whereas the greatest numbers of butterfly species and proportions of native species were detected in parks and urban farms. Representation of some bird guilds (e.g., grassland specialists, ground nesters, urban avoiders) was positively correlated with site area ($r=0.34-0.47$) and proportion of remnant natural area ($r=0.55-0.60$). Together with concurrent social and economic assessments, occupancy analyses and connectivity models resulting from our study are being used to guide implementation of a strategic plan, which includes design guidelines, policies, and actions to ensure that high-quality natural areas are preserved in a rapidly growing urban environment.

SPATIAL DISTRIBUTION ESTIMATES OF ASSAMESE MACAQUE (*MACACA ASSAMENSIS*) IN SOUTH AND SOUTH-EAST ASIA BASED ON A FIRST OPEN ACCESS ENSEMBLE MODEL-PREDICTION

Ganga Ram Regmi

Global Primate Network-Nepal
Falk HUETTMANN, -EWHALE lab-, University of Alaska Fairbanks (UAF); Madan Krishna SUWAL, Global Primate Network-Nepal; Vincent NIJMAN, Oxford Brookes University; K. A. I. NEKARIS, Oxford Brookes University; Kamal KANDEL, Global Primate Network-Nepal; Narayan SHARMA, National Institute of Advanced Studies, IISC Campus; Camille COUDRAT, Oxford Brookes University

We developed the first quantitative and climatically potential niche distribution models for the Assamese macaque (*Macaca assamensis*) for 12 countries in South and South-east Asia. We used species occurrence records from our own field work as well as extracted species occurrence records from published

sources. We applied Random Forests, Classification and Regression Trees, TreeNet, MaxEnt and Multivariate Adaptive Regression Splines machine learning algorithms in concert. Then we averaged all of these model outputs as an ensemble model prediction. Elevation and 19 environmental layers related to precipitation and temperature from WorldClim were utilized to develop these models. The predicted distribution of Assamese macaque was strongly associated with Precipitation of Warmest Quarter, Temperature Annual Range and Temperature Seasonality. The predicted map shows that there is a continuous and potential niche of Assamese macaque from east of the Kaligandaki river in Nepal up to the Brahmaputra river in northeast India. Other predicted areas seem to be either fragmented or confined to small pockets except in Lao PDR where some continuous potential habitat can be seen in the predicted map. Here we provide the first robust rules and resource selection functions for such predictions using partial dependence plots. Our predictions also confirm that there are no ecologically suitable areas for this species in Pakistan, Afghanistan and Cambodia. Our most significant contribution is the identification of the areas with a high probability of the presence of Assamese macaque, which is the information that can be applied to identify new populations of this species and for planning future surveys in previously un-surveyed areas of the large geographical extent. The model outputs obtained here are also helpful for understanding biogeography and historical ecological niche evolution of the species, as well as for taxonomy, genetics and conservation management.

193 REWILDING AS A LAND-USE OPTION FOR BIODIVERSITY CONSERVATION IN A CONTEXT OF LAND ABANDONMENT AND FIRE DISTURBANCES: WINNERS AND LOSERS

Adrián Regos

Forestry Science Center of Catalonia
Jesús DOMÍNGUEZ, University of Santiago de Compostela; Asunción GIL-TENA, Forestry Science Center of Catalonia; Manuela D'AMÉN, University of Lausanne; Antoine GUIBAN, University of Lausanne; Lluís BROTONS, Forestry Science Center of Catalonia

Land-use change is a large component of global change and the effects on biodiversity and ecosystem services currently represent a major challenge for ecologists and conservationists. Rewilding has been proposed as a potential alternative approach to conservation in abandoned landscapes where rural communities have been depleted because the low-intensity farming that supported them is no longer economically viable. Fire is a major disturbance in Mediterranean ecosystems. For millennia, fire has been a key self-regulating process influenced by natural factors such as climate and vegetation characteristics. Nevertheless,



the ongoing trend towards landscape homogenization that has taken place over recent decades has led to an increase in fire impact. Despite all of this, knowledge about positive and negative effects of rewilding as a land-use option on biodiversity in fire-prone, abandoned landscapes and how fire management policies could alter these causal relationships is astonishingly poor. Here we present one of the first assessments of rewilding as an opportunity for biodiversity conservation in a context of land abandonment and fire disturbance in Spain. Two fire-prone, abandoned landscapes and their past and potential future pathways were evaluated combining medium-term data on avifauna distribution with information on temporal changes in land-use/land-cover from remote sensing data and landscape dynamic simulations. Our results showed that rewilding in these landscapes provides habitat for high-priority, shrub-forest-dwelling bird species at the cost of modest reductions in numbers of open-habitat birds. In addition, fire suppression strategies based on 'letting fires burn' could counterbalance the negative effects of land abandonment on fire risk and biodiversity conservation. We conclude that biodiversity conservation via rewilding could be a cost-effective land-use option in abandoned landscapes wherein fire management programs should be also integrated.

ADVANCING PUBLIC LANDS MANAGEMENT: A MODEL FOR FILLING THE IMPLEMENTATION VOID

Evan Reimondo

Western Sense

Spencer PLUMB, University of Idaho

Two US federal agencies, the US Forest Service and the Bureau of Land Management, are jointly responsible for managing approximately 1,781,000 km² of public lands. Managers are facing threats to public resources of unprecedented scale and severity with dwindling budgets and fewer personnel, and their ability to innovate is often constrained by policies and institutional barriers. Worsening budget shortfalls are resulting from national funding cutbacks and emergency internal borrowing to respond to natural disasters like catastrophic wildfires. This has created an "implementation void" due to the loss of technicians who perform on-the-ground implementation of policies, plans, and rules related to conservation and restoration. We propose a model of integrating a nonprofit internship program with existing federal volunteer programs to leverage funds and human power to fill this void. Nonprofits can leverage diverse funding sources over multiple years, bypassing current shortfalls of agency budget cycles, and are mission-driven to achieve these objectives. The existing federal volunteer programs are an affordable way to put "boots on the ground," but are traditionally limited to those who are willing and able to volunteer, and be without compensation, for extended periods. Our model would select interns through a competitive process

and award recipients with a supplemental stipend. The intern would function as full-time agency staff, but be required to devote a percentage of their time to a pre-determined conservation or restoration project. These projects, defined in consultation with regional community leaders, NGOs, and agency staff, would have high potential value and otherwise lack the necessary funding or staff. The local or regional focus of these projects allows communities to have a meaningful impact in protecting and restoring their public lands through tax-deductible donations to support the internship program's project.

SEMINATURAL FORESTRY CAN SUSTAIN LAND SNAIL ASSEMBLAGES: A CASE STUDY ACROSS FOREST TYPES IN ESTONIA

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Snails are an integral part of many forest ecosystems. Their sensitivity to timber harvesting seems to depend on multiple and sometimes counteractive factors. Some snail species have been proposed to indicate natural forest conditions, and old-growth forests with abundant dead wood have been reported to be most species rich. Other studies, in contrast, have demonstrated richer snail fauna in young managed forests, and clearcutting has been hypothesized to be less detrimental on wet soils. We examined forest management impacts in 100 stands, which represented a balanced design of five site types and four management types (old and mature forests, retention cuts and clearcuts, harvested 5-11 years ago). We collected ca. 20,000 individuals of 70 species and found that snail assemblages differ between site types. Dry pine forests with sparse vegetation and little woody debris were most distinct having only scant snail assemblages. Stand scale analyses showed that snail assemblages are tolerant of seminatural timber harvesting in all studied site types. We found neither strongly negative nor positive responses to timber harvesting for any species, no influence of the amount of woody debris or any species preferring old growth. In fact, several species that have been claimed to indicate natural forest tolerated timber harvesting well, and they were rather more abundant on clearcuts than in closed stands. The single retention trees on cut sites did not have remarkable impact on snail assemblages. Thus, seminatural forestry in such humid temperate climate and on calcium poor to moderately rich sites seems to sustain comparatively intact snail assemblages. The tolerance might be explained by lack of soil scarification on clearcuts and allowing natural regeneration instead of planting pure coniferous stands. However, snail assemblages are prone to combined effects of various intensive techniques, as can be demonstrated for cutting activities in artificially drained swamps.



WHAT HAPPENS WHEN 100 KM² OF SAND DUNES ARE SPRAYED WITH PESTICIDES?

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Swarms of locusts (*Locusta migratoria*) invaded the western Negev sand dunes in Israel during March 2013. Four weeks later, tens of millions of locust larvae hatched and marched across the dunes. In order to reduce swarm numbers, pesticides were sprayed by the Israel Ministry of Agriculture over the course of six weeks, covering more than 100 km². Arthropod-specific pesticides were used and no secondary poisoning was detected. Arthropods constitute the majority of fauna in most terrestrial habitats, forming a significant functional component due to their diverse feeding habits and lifestyles. Changes to the arthropod community may significantly impact the ecological functions of the habitat and lead to a cascade of negative processes. This study examined the impact of the intensive pesticide application on the terrestrial arthropod community. Arthropod sampling was undertaken in the spring of 2013, 50 days after the first spraying event, and in the following spring of 2014. Eight sprayed and eight control plots were sampled. Arthropods were collected from each plot via 25 pitfall traps, left open for 48 hours in each of the two years. A total of 4,736 specimens were collected from 400 pitfall traps. No significant differences in the arthropod community between the sprayed and unsprayed plots were found in spring 2013. However, in 2014 uni- and multivariate analyses revealed a significant decrease in diversity indices in the sprayed plots. The arthropod community in the sprayed area was highly dominated by ants, mainly *Cataglyphis savignyi*, a large scavenger that accounted for 66% of all individuals. A significant decrease in functional diversity index was found in the sprayed plots also when omitting the ants from the analysis. Ongoing monitoring of the area in 2015 (to be presented) will provide a better understanding of the system's response to the severe spraying event and its consequent impact on biodiversity.

FROM BEHAVIORAL PATTERNS TO POPULATION GENETICS: THE REINTRODUCED ASIATIC WILD ASS IN THE NEGEV DESERT

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Long-term viability of populations is highly dependent on genetic diversity. One factor that can strongly influence genetic diversity of small populations is the social structure, affecting both gene flow and genetic drift. Therefore, in threatened species, studying the social behavior and its effect on population genetics is of high importance. The endangered Asiatic wild ass (*Equus hemionus*) was reintroduced to the Negev Desert, Israel, and population's activity centers were naturally established around water sources. This species lives in a resource-defense polygyny in which dominant territorial males obtain most of the mating opportunities. We hypothesized that if territorial males constitute only a small portion of all males and their dominance tenure is relatively long, the strong site fidelity of these genetically important males may result in limited gene flow among activity centers, accelerating the development of population structuring. We combined behavioral observations, non-invasive genetic study and simulation modeling to examine the level of polygyny and male dominance stability of the wild ass, and to evaluate the spatial genetic structure of the Negev population. From five years of behavioral observations, we found that only a quarter of all males were dominant and that males remained dominant for several years. This was supported by a simulation model, based on genetic data, revealing a strongly polygynous mating system in which less than 25% of all males participate in the mating process. Additionally, a population genetic structure among activity centers was detected. This structure could be a result of limited gene flow, possibly due to strong site fidelity of dominant males, coupled with potential founder effects during the population's establishment. The information gained in this study can be applied for assessing the Asiatic wild ass long term viability and as a basis for conservation and management regimes.

1.01 INTEGRATING GENETIC AND STABLE ISOTOPE ANALYSES TO INFER THE POPULATION STRUCTURE OF THE SNOWFINCH (*MONTIFRINGILLA NIVALIS*) IN WESTERN EUROPE

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Alpine ecosystems count among the most threatened by climate change. Species occurring in high mountains now face high risk of habitat loss, range contractions and local extinction. The Snowfinch (*Montifringilla nivalis*) is a characteristic passerine of alpine habitats in Europe. Despite its breeding nuclei are relatively well-defined, we still know little about the connectivity between breeding and wintering grounds. Based on a 10 year banding program conducted in the Eastern Pyrenees during winter, we know there is connectivity between breeding grounds in the Alps and overwintering areas in the Pyrenees. Return rates of banded birds are however too low to address how often such movements occur. By analysing intrinsic biomarkers (i.e. sequences of the mitochondrial gene *cyt b* and stable isotopes $\delta^2\text{H}$), here we assess to which extent breeding populations of Snowfinches in the Cantabrian Mountains, Pyrenees and Alps and the wintering population in the Eastern Pyrenees function as a metapopulation. Two out of three main haplotypes (A and B) characterized for *cyt b* were present in all breeding populations, but haplotype C is only found in the Cantabrian Mountains and predominant there. Most wintering individuals either have A or B but none show C. Two more haplotypes (D and E) are present in a few wintering individuals. Thus initial genetic analyses suggest connectivity between all breeding populations, although the one at the Cantabrian Mountains seem to be more isolated. Wintering individuals in the Eastern Pyrenees may have their breeding grounds either in the Pyrenees or the Alps but less likely in the Cantabrian Mountains. No differences in $\delta^2\text{H}$ from the most inner primary were found between breeding populations so we could not assign the breeding grounds of wintering individuals by isotopic analysis. Further analyses are required for a better understanding of the species' population structure in Western Europe.

LIVE CAPTURE AND OWNERSHIP OF LEMURS IN MADAGASCAR: EXTENT AND CONSERVATION IMPLICATIONS

Kim Reuter

Temple University

Haley Gilles, Temple University; Abigail Wills, Mpingo Conservation & Development Initiative; Brent Sewall, Temple University

Overexploitation represents a severe threat to biodiversity, with live capture affecting millions of animals yearly. The

impacts of live capture could be extensive as 4 million living birds, 640,000 reptiles, and 40,000 primates are captured and traded globally each year; the live capture of animals could be widespread and increasing. Little is known about the live capture of Madagascar's mammals, 97% of which are endemic. This is especially true for Madagascar's lemurs, which are the world's most threatened group of large vertebrates. Therefore, this study aimed to increase an understanding of the captive ownership of lemurs. Our objectives were to provide the first quantitative estimates of (1) the prevalence, spatial extent, correlates, and timing of lemur ownership; and (2) procurement methods, within-country movements, and numbers and durations of ownership. Using semi-structured interviews of 1093 households and 61 transporters across 17 towns, we found that lemur ownership was common, widespread, and affected a variety of taxa. Lemur ownership is ongoing, impacting an estimated 28,253 animals since 2010. Most lemurs were caught by owners, and kept for short (≤ 1 week) or long (≥ 3 years) periods. The live capture of lemurs within Madagascar is not highly organized, but may threaten several already-endangered species. Our work is an important first step towards quantifying the live capture of lemurs, informing efforts to conserve lemur populations, and clarifying means to effectively regulate lemur ownership. These findings illustrate how common and widespread lemur ownership is, and further indicate that a large number of threatened or otherwise susceptible taxa may be affected. In addition, these findings underscore the importance of quantifying ownership of endemic primates in other tropical countries, especially where they are facing additional anthropogenic threats like hunting and habitat change.

THE CONSUMPTION OF WILD MEAT IN MADAGASCAR: FOOD SECURITY, DRIVERS OF CONSUMPTION, AND POPULARITY AS A FOOD ITEM

Kim Reuter

Temple University

Brent SEWALL, Temple University

The role of wild meat consumption in developing countries is debated; some communities rely heavily on wild meat, yet others treat it as a luxury good. We investigated the role of wild meat in food security in Madagascar, a country with high levels of malnutrition, but where wild meat consumption is poorly understood in urban areas and at regional scales. Specifically, we aimed to: 1) quantify the amount and purpose of; 2) understand the macro-level drivers behind; and, 3) examine recent changes in wild meat consumption in Madagascar. Using semi-structured interviews with 1339 heads-of-household in 12 urban and nine rural towns, we found that few respondents preferred wild meat ($8 \pm 3\%$) but most had eaten it at least once ($78 \pm 7\%$), and consumption occurred across ethnic groups and in urban and rural settings. More food



insecure areas reported higher rates of recent consumption of wild meat. However, patterns of wild meat consumption were best explained by individual preferences and taboos. Despite reports of increasing wild meat consumption in Madagascar, few respondents ($<1 \pm <1\%$) had increased rates of wild meat consumption during their lifetimes, and wild meat prices showed no change from 2005-2013. Most consumption involved wild pigs, or small-bodied animals such as bats and tenrecs, though these animal groups and lemurs were consumed less in recent years. Given the low preference for wild meat, the focus of wild meat consumption on mostly small-bodied animals, and evidence that ongoing hunting is unsustainable, wild meat is unlikely to enhance food security for most Malagasy people in urban and well-connected rural areas.

SYMPOSIUM ID 88: POTENTIAL LIMITING FACTORS OF REINTRODUCTION SUCCESS ACROSS MULTIPLE SPATIAL SCALES: AN EXAMPLE WITH THE IBERIAN LYNX

Eloy Revilla

Estacion Biologica de Doñana CSIC

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Apart from a poor design and implementation and the wrong environmental conditions, many things can lead a reintroduction to failure. In many cases failures associate with non-evident combinations of environmental conditions precluding the long term establishment of new populations. Here we investigate thresholds in combinations of demographic scenarios that may allow for the successful reintroduction of Iberian lynx (*Lynx pardinus*), from local populations to the distribution range of the species. Isolated areas should have a carrying capacity of at least 20 female territories with a normal breeding rate and high resident's survival rates (equivalent to good quality habitat in protected areas). The spatial distribution of breeding habitat should be continuous as fragmentation seriously limits success (the threshold in carrying capacity goes up to 30 when distributed in two patches). In order to be sure that the number of animals released is non-limiting, we should release above 4 animals of each sex per year during 5 years. These recommendations can be relaxed with larger spatially structured populations connected by dispersers. Using a set of areas preselected by informed managers, we determined that for many scenarios we can have a few isolated areas (including the existing Doñana population) and a large system in central Spain, including Sierra Morena-Montes de Toledo historical range in which the current Andújar population has a central location (in general areas more than 50 km apart will be isolated). The good news is that the large central population (Andújar plus 6 reintroduced

small local populations) can have a low long term extinction risk even with moderately high mortality rates. The bad news is that a normal breeding rate is required. The outbreak of a new disease affecting lynx prey (European rabbits) precludes normal breeding, as already happened during the collapse of lynx populations due to the appearance of rabbit hemorrhagic disease.

95 LINEAR INFRASTRUCTURE PLANNING AT LANDSCAPE SCALES: IMPACTS, COSTS AND COLLABORATION

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Linear infrastructure such as roads, railway lines, and pipe lines present significant threats to biodiversity through both direct and indirect impacts. Linear infrastructure commonly has strong local impacts on biodiversity, but cumulative impacts across infrastructure networks can also lead to substantial impacts on biodiversity at broader scales. Dealing with these cumulative impacts requires an assessment of environmental impacts at the scale of whole landscapes, rather than only at the site scale. Using landscape scale models it can be shown that the impact of linear infrastructure networks depends on the spatial patterns of linear infrastructure and particularly in relation to the spatial pattern of biodiversity. However, the choice of linear infrastructure placement also drives the economic costs of construction and maintenance; a critical factor driving the feasibility of alternative locations. We therefore extended the assessment of landscape scale linear infrastructure impacts to also consider the trade-offs between costs and biodiversity impacts. We show that the trade-off between construction costs and biodiversity impacts depends critically on the distribution of biodiversity in the landscape. However, we also show that costs can be reduced substantially through collaboration among infrastructure providers, although the economic benefits of collaboration can be highly asymmetric. This provides general insights into the economic feasibility of minimising linear infrastructure impacts on biodiversity and has important implications for how we design linear infrastructure networks that are biodiversity friendly.

PREDICTING ANURAN VULNERABILITY IN A BIODIVERSITY HOTSPOT: AN INTEGRATED TRAIT-BASED ANALYSIS

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Determining species extinction risk and its drivers is one of the major goals of conservation biology. Species traits are often associated with extinction risk and perceived as determinant for species resiliency to disturbances. Trait-based analyses may identify potentially vulnerable species, even when data are scarce (e.g. Data Deficient species). Standing as Brazil's agricultural frontier, the Cerrado is one of the world's most imperiled biomes. Despite its high endemism, the Cerrado herpetofauna remains largely disregarded and generally perceived as resilient to disturbances. We provide a predictive spatially explicit assessment of anuran vulnerability in the Cerrado, based on intrinsic species traits and extrinsic environmental variables for 195 species extant in the biome. We applied machine-learning techniques to built decision-tree models using IUCN population trend and expert-perceived vulnerability as proxies for anuran vulnerability. About 23% of Least Concern species are sensitive and 13% are decreasing. Furthermore, 65% of Data Deficient species are predicted as sensitive, 11% as decreasing and 17% as sensitive and decreasing. Breeding site, clutch size, range size and body size are important predictors of anuran vulnerability to habitat alteration. Family is the main predictor of decreasing population trends, although stream-associated breeding habits are also important, especially if in synergy with forest/rupestrian habitats. The center of the Cerrado is the main hotspot for sensitive/decreasing anuran species, but effective protection is very low in this region because protected areas are scarce, small and disconnected, while crops and pastures are ubiquitous. This study is the first to predict and represent anuran vulnerability using several intrinsic traits and extrinsic variables to direct conservation practice in the Cerrado, while also identifying important patterns for anuran conservation worldwide.

REAPING THE LAST HARVEST: POST-DEPLETION TIMBER VALUE OF AMAZONIAN FOREST STANDS

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Slow-renewal biological resource populations have been predictably overexploited over the course of human history, often to economic extinction. Industrial scale logging in old-growth tropical forests occurs along variable-aged logging frontiers. Initially highly selective operations target slow-growing, shade-tolerant hardwood species, but subsequent harvests may shift towards fast-growing light-wooded pioneer trees. Brazil accounts for 85% of the roundlog production in the Latin America/Caribbean region, Pará state for almost 50% of all offtakes from Brazilian Amazonia. Yet the degree to

which subsequent timber harvests can be financially profitable or demographically sustainable remains poorly understood. We report data on the legally planned logging of ~9.6 million m³ of timber across 314 species extracted from 446 private and community-based logging concessions between 2009 and 2012. Using data from government-approved logging concession management plans, we document patterns of timber offtake by volume, species and value along aging logging frontiers of eastern Amazonia, which are then explained on the basis of historical and environmental variables. Generalized linear models indicate that logging operations farthest from heavy-traffic roads can afford to be most selective, concentrating their gross timber revenues on fewer high-value species. We find no evidence that the post-depletion timber species composition and total value of forest stands recovers, suggesting that high value timber species become predictably rare or economically extinct in old logging frontiers. Predicting the sustained financial yields of selectively-logged forests is crucial for the long-term integrity of both forest biodiversity and the financial viability of local extractive industries. The history of logging in primary forests in Pará likely mirrors broad patterns of sequential timber exploitation over time elsewhere in Brazil, and arguably throughout the humid tropics.

208 THE CITIZEN SCIENCE STRATEGY 2020 FOR GERMANY

Anett Richter

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Lisa PETTIBONE, Museum für Naturkunde

Citizen science at an international level is currently experiencing an increasing attention among scientists, politicians, members of the society and policymakers. Germany is no exception to this trend, which has increased the need to develop a strategy to promote and support citizen science in Germany. "Citizens create knowledge" (in German, "Bürger schaffen WISSEN" or GEWISS) is a capacity-building program and online platform for citizen science in Germany, led by a consortium of 10 scientific institutions and partners. GEWISS aims to develop citizen science in Germany in several ways: networking and exchange for engaged or interested actors; analysis of current citizen science activities and needs; development of a citizen science toolkit for practitioners; and the development of the Citizen Science Strategy 2020 for Germany through a moderated consultation process. Here, we focus on development of a citizen science strategy 2020 for Germany. Specifically, we report on the initial results of the consultation process, and discuss the possibilities and challenges of using online consultations as a practical tool to allow equitable participation of all actors in the diverse citizen science community. We discuss the two-stage online



consultation conducted in parallel to a series of dialogue events in 2015. The GEWISS consultation was based on a draft strategy document developed during a think tank event and kick-off conference in 2014. We discuss the challenges surrounding the consultation process and link them to concepts of e-Democracy and Government 2.0.

CHANGING OCEANS - CHANGING FISH CONSUMPTION. A PSYCHOLOGICAL APPROACH TOWARDS SUSTAINABLE FISH CONSUMPTION AS A WAY OF COMBATTING OVERFISHING

Isabel Richter

NTNU

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The thoughtless mass-consumption of seafood drives the oceans to complete exploitation. Besides changes on industrial and governmental levels, it is also the consumer's responsibility to shift consumption patterns. This presentation shows how seafood consumption can be shifted into a sustainable direction by merging the knowledge of marine biology with theories and methods of environmental psychology. A challenge in addressing seafood consumption is the fuzziness of its concepts. Therefore, a definition for sustainable fish consumption (SFC) from a consumer perspective is introduced. Subsequently, potential predictors of SFC are selected and analyzed, including variables covering the three subcategories proposed in Thøgersen's (1995) Motivation-Opportunity-Ability Model. The opportunity part comprises socioeconomic characteristics, living conditions and product qualities like availability, visibility, price and labelling that hinder or facilitate the behavioral performance of SFC. The motivational part includes common psychological variables like intentions, attitudes and norms and the availability part finally incorporates habits and knowledge about the target behavior. The predictive value of each variable is discussed and inter-variable relationships are suggested in orientation to widely applied models from environmental and social psychology. The best variable fit is verified with Structural Equation Modelling ending up in a comprehensive model for SFC. The psychological analysis of SFC as the target behavior provides an ideal starting point for effective intervention design because interventions can be individually adapted to target groups (i.e. from different countries) in consideration to the pattern the predicting variables show. The SFC model will be used to create and later evaluate effective interventions for a national campaign fostering SFC together with the World Wildlife Fund Norway.

IMPROVING COMPLEMENTARITY WITHIN A PORTFOLIO OF CONSERVATION FENCES

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Invasive predators are a major cause of wildlife decline globally. In Australia, 30 % of native mammals are at risk of extinction, primarily as a result of predation by introduced feral cats and foxes. Feral predators have contributed to the extinction of at least 20 species of Australian mammals and are listed nationally as a major threatening process for further 58. Translocations within predator exclusion fences are the more favourable option over baited areas because for many of these species only fences can provide sufficient predator protection.. A gap analysis of Australia's fenced conservation areas (30 in total), targeted the 58 threatened mammal species that would most benefit from predator exclusion fences. Only one third of the species were represented within fenced areas, but many of the species that were protected were represented many times, often disproportionately to their extinction risk. It appears that fence conservation areas in Australia are emerging from largely from ad hoc decision making. Without a systematic approach to determining suitable fence locations, cost inefficiency and compromised conservation of important threatened species is likely. We developed a decision support tool for systematically identifying and assessing priority sites for future fencing projects, to create more representative fence network. The method considers biogeographic and population viability factors to measure the complementary benefits offered by a new fence at any point in a landscape. A greedy algorithm chooses the optimal combination of new fenced sites that lead to the greatest reduction in risk of extinction for threatened species included in the study. Although we analyzed fencing options in the state of New South Wales; the generality of our approach means that it can be applied to any spatially localised management action that benefits a suite of species, such as the location of a baiting program, or the choice of islands for translocations.

EFFECT OF LANDSCAPE FRAGMENTATION ON GENETIC DIVERSITY OF A GENERALIST SPECIES IN CHIAPAS, MEXICO

Tamara Rioja-Paradela

Oikos: Conservacion y Desarrollo Sustentable A.C.

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One of the main consequences of landscape fragmentation is the reduction of species diversity in the remaining landscape patches. Fragmentation are also reflected at the genetic level,



particularly in the genetic diversity of populations isolated by landscape degradation. However, certain generalists species characterized by high population density and short dispersion ranges seem to thrive in fragmented landscapes. This study aimed to estimate the effect of landscape fragmentation on a generalist species, *Peromyscus mexicanus*, in tropical forest sites with varying degrees of fragmentation, in Chiapas, Mexico. During 2012, five sampling sites were established in a highly fragmented area, and five in an area with average-low fragmentation rates. Each site was established with a minimum distance of 500 meters between each other. At each site were captured 5-8 individuals, which were measured and weighed. In addition, a tissue sample was taken. All individuals were eventually released on the same site of capture. Nine landscape fragmentation variables for each of the capture sites was measured. Genetic diversity was calculated for each site. Finally, F_{st} values were contrasted against landscape variables by GESTE, and confirmed by the method implemented by Passage. Results showed that the degree of fragmentation had no significant effect on the genetic diversity despite the landscape fragmentation level. Prevalence of these generalist species despite high fragmentation level becomes relevant because the fragmentation not only adversely affects certain species, but also can benefit to potentially harmful species, which can displace species of restricted distribution. Also, can become a public health risk to humans, since they can be reservoirs of diseases.

SECONDARY HABITATS: A VALUABLE OPPORTUNITY FOR THE CONSERVATION OF VERTEBRATES IN THE CENTRAL MEXICAN PLATEAU

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CUCBA-University of Guadalajara

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During the last 100 years, human activities have modified natural landscapes at considerable scale and speed, generating, in many cases, complex secondary landscapes. Some of these retain some characteristics of the original landscapes, in which more or less random assemblages of native plants and animals survive successfully. In the central part of Mexico's Central Plateau, agriculture and animal husbandry have caused a drastic transformation of the original landscape, and the area is now covered mostly by secondary habitat patches. The ecological consequences of this transformation have not been recorded, but are likely to include negative impacts to many species of the native flora and fauna. However, the establishment of natural protected areas in the area to alleviate these impacts is highly unlikely, due to the scale of landscape transformation. Hence, biological conservation must rest on the tapestry of man-modified, or created, habitats. For the past decade we have studied some of the ecological characteristics

of the communities of terrestrial vertebrates in different secondary habitats. Our findings indicate that just three of the most emblematic secondary habitats in the Llanos de Ojuelos (grasslands, nopal orchards, water reservoirs) support at least about 40% of all potential bird species and 80% of rodent species of the area, in addition to many amphibians and reptiles, including 17 or more species of conservation concern. Our data provide evidence that secondary habitats can indeed be the basis for a regional biodiversity conservation program. However, in addition to management decisions to benefit certain species and promote other ecosystem services, to be effective, it is imperative that such conservation projects be compatible with resource appropriation by humans, especially those many farmers that survive under precarious conditions.

DOES THE MATRIX TYPE MODIFY THE RODENT COMMUNITY COMPOSITION IN PRICKLY PEAR ORCHARDS IN THE CENTRAL HIGH PLATEAU OF MEXICO?

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Some perennial agroecosystems retain a considerable number of wildlife species. In the Central high Plateau of Mexico fruit-oriented prickly pear orchards, based on 30 different varieties, offer suitable conditions for native rodent species that occupy natural habitats that are currently highly modified and/or fragmented. The orchards are patches distributed in different matrix types, and it was not known whether the matrix affected the composition of their rodent assemblages. To assess this, during each of the three climatic regional seasons we performed a rodent survey in 12 orchards in three different matrix types: secondary shrubland, grassland and rain-fed annual agriculture. Species richness, diversity value (Shannon exponential index), and same-matrix inter-orchards similarity were not different between orchards in different matrix type. The orchards were as diverse and as rich as the adjacent shrubland matrix (16 out of 25 potential species for the region), and significantly richer than the grassland and rain-fed agriculture habitats. The rodent assemblages in orchards in shrubland matrix were significantly more similar to those of the matrix ($40 \pm 8\%$), than the ones in grassland ($3\% \pm 1$) or in rain-fed agriculture ($8 \pm 4\%$) were to their matrix. The orchards have a similar habitat structure to some of the secondary shrublands in the region. In all the orchards studied we captured rodent species commonly present in both, the region's shrublands and grasslands. Based on the data we concluded that: 1) prickly pear orchards retain 64% of the known native rodent species



regardless of the surrounding matrix, (2) they can contribute importantly to biodiversity conservation in the region, and (3) their structural attributes can be managed (without negatively affect fruit production) to reach specific conservation objectives.

LAND USE AND DEFORESTATION IN THE PERUVIAN AMAZON: IMPACTS OF DIFFERENT LAND USE STRATEGIES OVER CLIMATE CHANGE

Sandra Rios

Instituto del Bien Comun

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Amazonia has recently received wide attention for its role in climate change regulation. Substantial efforts have been placed to measure the role of forests and land use change over the carbon cycle, especially greenhouse gas emissions from deforestation. However, the relationship between different land management regimes and their impacts over land use change processes and how this can impact climate change have not been analyzed thoroughly. We present a comprehensive analysis of the impact of different land use types over carbon stocks and its potential impacts over climate change processes using Peru as a case study. We especially review different land cover configurations depending on tenure arrangements, the management regime and management potential to impact the role of forests in climate change processes. Forests managed as commons will be compared with other land cover types like public and private management, as well as open access, for climate change implications. Close to 20% of the land in the Peruvian Amazon is titled as indigenous communities and an even larger percentage is under their management and control. Also, riverine people control another similar percentage of land but without any official land tenure recognition. Recent studies of deforestation have highlighted the reduced rates in indigenous community lands in comparison with the national average, suggesting an important role of indigenous peoples in managing their territories as commons. As we have been compiling additional geographical information on other land cover type and management regimes such as protected areas and forest concessions we will expand the analysis to include the range of land cover management regimes existing in the Amazon. Analysis will focus on how deforestation varies between different tenure regimes, land management regimes and competing land use.

AGRI-ENVIRONMENT SCHEMES IN AGRICULTURAL LANDSCAPES: THE IMPORTANCE OF AREA, QUALITY AND CONNECTIVITY FOR BIRD AND BUTTERFLY BIODIVERSITY

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European farmland biodiversity is facing serious declines due to agricultural intensification since the second half of the 20th century. Since decades European governments subsidize agri-environment schemes (AES), aiming to counteract the loss of biodiversity. Thereby, semi-natural habitats, such as extensively managed meadows, wildflower-strips, hedgerows or traditional orchards, are managed as wildlife-friendly areas in agricultural landscapes. However, evaluation studies showed that their effects on biodiversity are only modest and that we still observe a persisting decline in biodiversity. Missing connectivity between AES or too poor quality of individual AES, are often used as arguments to explain the lack of effectiveness of these schemes. In our project we studied the influence of AES on bird and butterfly species richness and abundance in over 40 agricultural landscapes (1 km²) in Switzerland. We found a positive effect of total AES area (% of utilized agricultural area) on overall bird species richness and a particularly strong effect on farmland species abundance and richness. However, there was no evidence that connectivity (distance between AES) has an effect on bird species richness or abundance (when total AES area was taken into account). Butterfly data are currently analysed. There is an urgent need to define and implement effective conservation measures if we want to stop the loss of biodiversity in agricultural landscapes. The results of our study will help decision makers to allocate AES financial resources in the most effective way, by defining if they should be invested in increasing the total amount of area under AES, the connectivity or the quality of them.

FLYING OFF RAILS: HABITAT LOSS DUE TO CLIMATE CHANGE MAY ENDANGER MARSH-DWELLING BIRDS

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Species distribution models have been applied across a wide range of spatial scales to generate information for conservation planning. However, the generality of these models has rarely been tested. Understanding how well models transfer through space and time is important to promote effective species-habitat conservation. When transferability of models is evaluated it is typically done using occurrence data. Here we assess model transferability in coastal tidal marshes of the Southeastern United States using point counts of a widespread marsh bird: the clapper rail (*Rallus crepitans*). We first derived the top species-habitat models at a state-level in both South Carolina and Georgia, and then assessed how well top models from each state predicted abundances across the region. Internally (locally) validated models performed well



with reasonable fit, and high significance; however, during the independent model validation process (between states) both models performed poorly. Even if model transfer across regions poorly predicts absolute abundance, it is possible that transferred models still have utility for identifying the best relative habitat. To address this possibility, we applied the South Carolina- and Georgia-derived parameters to habitat features in South Carolina and then identified the top 25% of tidal marsh habitat each model predicted within the state. Our results address the predictive power and uncertainties that arise from using habitat associations and climate models to predict species distributions or abundances through space. We discuss potential reasons model transferability was not successful and address the need for better regional datasets and further studies addressing issues associated with transferability.

RELATIVE CONTRIBUTIONS OF SET-ASIDES AND TREE RETENTION TO THE LONG-TERM AVAILABILITY OF KEY FOREST BIODIVERSITY STRUCTURES AT THE LANDSCAPE SCALE

Jean-Michel Roberge

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During recent decades new environmental measures have been implemented in forestry. In Fennoscandia, forest management practices were modified to set aside conservation areas and to retain trees at final felling. In this study we simulated the long-term effects of set-aside establishment and tree retention practices on the future availability of large trees and dead wood, two forest structures of documented importance to biodiversity conservation. Using the Heureka forest decision support system, we projected the amounts of these structures over two centuries in two managed boreal landscapes, under management scenarios with and without set-asides and tree retention. In line with common best practice, we simulated set-asides covering 5% of the productive area with priority to older stands, as well as ~5% green-tree retention (solitary trees and forest patches) including high-stump creation at final felling. We found that only tree retention contributed to sizeable increases in the future density of large (DBH ≥ 35 cm) deciduous trees, while both measures made substantial contributions to the availability of large conifers. It took more than half a century to observe stronger increases in the densities of large deciduous trees as an effect of tree retention. The mean landscape-scale volumes of hard dead

wood fluctuated widely, but the conservation measures yielded values which were, on average over the entire simulation period, about 2.5 times as high as for scenarios without these measures. While the density of large conifers increased with time in the landscape initially dominated by younger forest, best practice conservation measures did not avert a long-term decrease in large conifer availability in the landscape initially containing more old forest. Our results highlight the needs to adopt a long temporal perspective and to consider initial landscape conditions when evaluating the large-scale effects of current conservation measures on forest biodiversity.

76-AN EVALUATION OF THE CONTRIBUTION OF CITES TO THE CONSERVATION OF INTERNATIONALLY TRADED SPECIES

Rachel L. Roberts

IUCN

Daniel CHALLENGER, IUCN; Stuart BUTCHART, BirdLife International; Michael Hoffmann, IUCN

Illegal, international trade in wildlife products is a major threat to biodiversity conservation and a surge in this trade in recent years has led to unprecedented levels of poaching affecting many species. This trade occurs despite near universal political commitment to regulate international wildlife trade through CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which entered into force in 1975, and seeks to ensure international trade in c.35, 000 species is sustainable as well as legal and traceable. However, there has been little evaluation of the effectiveness of CITES beyond single species, taxonomic groups and the impact of trade controls generally, and in particular quantitative assessment of the impact of CITES on the status of listed-species. This is partly due to the complexity of causally attributing interventions within the Convention to species' status. Here, we present analyses on how well CITES reflects species currently known to be threatened by international trade, whether CITES listings have impacted on species listed as threatened by international trade, and whether there are differences between species subject to different levels of regulation within CITES, in order to quantitatively evaluate the contribution of CITES to the conservation of trade-threatened species.

141 - WHEN INTEGRATION FAILS: WISHES VERSUS REALITY IN THE EU AGRICULTURAL POLICY AND BIODIVERSITY

Trees Robijns

Stichting BirdLife Europe

Guy PE'ER, Helmholtz Centre for Environmental Research

The facts are plain and simple: Farmland biodiversity in Europe is in decline, and compared to birds in all other



ecosystems, farmland birds are suffering the most. The causes are well-known, and include agricultural intensification; growing monocultures; ongoing loss of natural and semi-natural landscape features; land abandonment; and, in the EU's new Member States, an increase in agrochemical use. The EU's Common Agricultural Policy (CAP) supports farmers by ~50 billion Euros/ year. Originally, the CAP aimed to boost production and sustain farmers' income. However, the public increasingly criticized the subsidies for harming the environment while failing to stop the decline in farmers' employment. Reflecting on this criticism, new "greening measures" were introduced into the CAP in its recent reform. However, pressures in favour of increasing agricultural production, seemingly to address concerns about food security, resulted in the watering down of the green components of the CAP. This failure should serve as a warning signal, questioning the entire integrative approach which seeks to bring environmental criteria into existing policies whose main aims inherently contrasts with environmental protection. Alternative approaches are urgently needed. For instance, one may wish to "rethink integration", and instead develop an opposite approach where environmentally-friendly policies and practices are designed for their own purpose and judged on their own merit. Alternatively, or additionally, one may ask how policies could support the common wellbeing of farmers and nature. Thereby, we could potentially achieve greater success in addressing the two parallel, but related, processes: the loss of traditional, often small-scale, agricultural practices and traditions (and employment) – and the loss of biodiversity, ecosystem functions and services. We offer the audience to judge on these two approaches, and come up with own ideas.

117. ENGAGEMENTS BETWEEN CONSERVATION NGOS AND CORPORATIONS: LESSONS FROM THE FRONT LINES

John Robinson

Wildlife Conservation Society

The conservation community increasingly is engaging with corporations so as (1) to mitigate the negative effects of corporate activities, (2) to encourage corporations to generate positive effects on biodiversity conservation, and (3) to benefit from financial support for conservation programs. The interests and goals of conservationists and corporations can sometimes be aligned but they are not identical, and they can be in conflict. For conservationists, therefore, there are ethical and reputational risks and vulnerabilities of these engagements. These risks depend especially on the financial and contractual nature of the specific relationship. I consider a variety of relationships between conservation organizations and corporations: philanthropic support; sponsorship/ marketing engagements: conservation-driven business

collaborations; and operational/business collaborations to mitigate environmental impacts. Drawing on the portfolio of engagements that the Wildlife Conservation Society (WCS) has with corporations, I outline how WCS has sought to mitigate those risks and promote the conservation outcomes.

208 TEN PRINCIPLES OF CITIZEN SCIENCE: SHARING BEST PRACTICE AMONGST THE CITIZEN SCIENCE COMMUNITY

Lucy Danielle Robinson

Natural History Museum London

Jade Lauren CAWTHRAY, Natural History Museum London

The European Citizen Science Association (ECSA) is a network of scientists, researchers, informal education practitioners and others who are working together to encourage the growth of the citizen science movement in Europe. Key goals of the Association are to identify, develop and promote best practice and excellence in citizen science, and to share knowledge and skills on citizen science approaches across Europe and globally. In such a diverse and rapidly expanding field as citizen science, developing a shared understanding of what characteristics and principles underpin good quality citizen science is key. Sharing knowledge, experiences and expertise gathered through running or participating in citizen science projects is a vital part of advancing the field and ensuring that new projects are as engaging, exciting, valuable and impactful as possible. The European Citizen Science Association, through its working group on 'sharing best practice and building capacity in citizen science' has developed a document setting out Ten Principles of Citizen Science. The Principles represent a shared understanding of the core attributes and attitudes that are common to successful citizen science programmes. The Principles have been developed collaboratively within ECSA with input from many of its members. Here we present the Ten Principles, and discuss their relevance and application in the field of citizen science. We also present a range of other materials that support citizen science practitioners to develop or enhance their own projects, including guidelines for ensuring citizen science is the right approach to meet the research aims, setting up new projects, running BioBlitz events, and evaluating the outcomes and impacts of a citizen science programme.

THE MICROVERSE CITIZEN SCIENCE PROJECT: COLLABORATIVE MICROBIOLOGY RESEARCH WITH UK SECONDARY SCHOOLS

Lucy Danielle Robinson

Natural History Museum London



Jade Lauren CAWTHRAY, Natural History Museum London ; Anne JUNGBLUT, Natural History Museum London ; John C TWEDDLE, Natural History Museum London

The Microverse is a UK-based citizen science project that actively involves school students and community groups in microbial research using cutting edge DNA sequencing technologies. The Natural History Museum in London is collaborating with over 150 schools on this research, engaging over 1000 students aged 16-18 from across the country. By collecting samples of microorganisms from buildings and other man-made structures across the UK and using next generation DNA sequencing techniques, this research will reveal new insights into the microbial communities present and the role they are playing in the urban ecosystem. Students collect samples of microorganisms from a building local to them, submit them to the Natural History Museum for DNA sequencing, analyse the data, write blog posts to share their experiences, and suggest future directions for the research. Samples collected by the students are stored indefinitely within the Museum's Molecular Collections Facility, creating a lasting legacy for the project and an ongoing resource for researchers both at the Museum and internationally. This poster will introduce The Microverse project, share initial research findings, and analyse the challenges, benefits and impacts of involving school students in citizen science projects.

ECOGEOMORPHOLOGICAL ASSESSMENT OF AGRICULTURAL ABANDONMENT IN SEMIARID MEDITERRANEAN AREAS: A BASIS FOR NATURAL RECONSTRUCTION

Francisco Robledano

University of Murcia

Asunción ROMERO-DÍAZ, University of Murcia ; Francisco BELMONTE, University of Murcia ; Víctor Manuel ZAPATA, University of Murcia ; Carlos MARTÍNEZ-HERNÁNDEZ, University of Murcia ; Vicente MARTÍNEZ-LÓPEZ, University of Murcia

Agricultural policies and socioeconomic drivers, reinforced by climate change, promote the spontaneous abandonment of large areas critical for soil, water and biodiversity conservation. Natural reconstruction can be a cost-effective management option, alternative to reforestation policies. We present a framework for assessing the potential for ecosystem recovery in semiarid agricultural areas of the Mediterranean, based on the results of SENECA Research Foundation's Project 15233/PI/10, focused at the evaluation of ecogeomorphological responses to land abandonment in Southeastern Spain. To delimit the feasibility of applying passive restoration methods, we have made an integrated assessment of biodiversity and physical conservation indicators, with substrate lithology as key factor controlling physical vulnerability, and colonization dynamics (sources, agents and filters) as main driver of recovery. The

assessment has been applied at different scales covering lithological-climatic gradients and space-for-time substitution scenarios of post-agricultural succession. Compositional, structural and functional indicators were built on field surveys of woody flora, vegetation and animal communities, including multispecies indexes of conservation value and functional contribution to recovery. Physical and biological indicators often followed divergent or contrasting trajectories, particularly in less coherent substrates where soil degradation and erosion processes concur with high biodiversity value. Abandonment per se is not widely applicable but in many instances can naturally improve soil and vegetation conditions. Although not generalizable, the results can help decisions about management measures and the scale and intensity of their application. The assessment of new areas, the search for ecogeographical patterns, and the reformulation of the rewilding paradigm within traditional agricultural landscapes, are the next steps forward.

LIFE+ RIPISILVANATURA: AN ECOLOGICAL ENGINEERING, ADAPTIVE APPROACH TO THE RECOVERY OF SOUTHERN MEDITERRANEAN RIPARIAN HABITATS OF EUROPEAN COMMUNITY IMPORTANCE THROUGH THE CONTROL OF EXOTIC INVASIVE SPECIES

Francisco Robledano

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Josefa VELASCO, University of Murcia ; Daniel BRUNO, University of Murcia ; Víctor Manuel ZAPATA, University of Murcia ; José Francisco CALVO, University of Murcia ; Andrés MILLÁN, University of Murcia

In Southeastern Spain, the control of Exotic Invasive Species (EIS) invading riparian habitats is based mostly on short-lived, intensive eradication campaigns. Project LIFE 13 BIO/ES/001407 RIPISILVANATURA (2014-2019), co-funded by the European Commission, adopts a new approach which combines low-intensity restoration and ecological engineering techniques, taking advantage of the native species' capacity to recover and outcompete EIS. Its main objective is to recover the riparian forest along 57 km of the Segura River, through the protection of key habitats and the control of EIS. The Project Leader is the Basin Authority, Confederación Hidrográfica del Segura (CHS), and partners two municipalities, the Autonomous Government of Murcia Region, a NGO, and the University of Murcia, responsible for preparatory habitat assessments and ecological monitoring. Target formations are priority habitats 92A0 and 92D0 (Directive 92/43 EEC). Drafting restoration projects requires selecting sections with higher expectations of success, on the basis of: a) closeness to natural habitats; b) presence of native remnants, and c) vegetation dynamics capable of reinforcing repeated controls of EIS (mostly Giant



Reed *Arundo donax*). Coordinated work involving project drafters and researchers, seeks to optimize the choice of protection and restoration units, and the type and intensity of actions. Methodological steps are: 1) Database and literature search on native and exotic biodiversity, and ecological quality indexes; 2) Surveys to complete species inventories, habitat maps and quality assessments; 3) Definition of reference, good quality riparian stretches; 4) Selection of nearby sections of intermediate quality, on which to focus actions; 5) Selection of methods for the control of EIS, depending on their dominance and the presence of native vegetation remnants; and 6) Definition of riparian structural design (trees and shrubs) and accompanying species to be used in restorations.

RAT ERADICATION AND ECOSYSTEM RECOVERY IN SEYCHELLES

Gerard Rocamora

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André LABICHE, Island Conservation Society; Elvina HENRIETTE, University of Seychelles; Gaëtan GALMAN, Island Conservation Society

The outcome of rat eradications on ecosystems is poorly documented, especially in the tropics. Between 1996 and 2010, invasive rats were eradicated in the Seychelles from 12 islands of up to 219 ha. Monitoring comprised 13 formal protocols combined with empirical wildlife observations. A minimum of 24 native vertebrates and several large invertebrates (snails, millipedes, crabs) benefited from these operations. Reptiles and landbirds normally showed increasing or stable trends, although some strongly declined first but later recovered beyond initial abundances. Seabirds already present increased in numbers, and 4 species established a total of 8 new breeding populations across 6 islands. Post-eradication invertebrate abundance appears unpredictable and difficult to interpret within complex ecosystem interactions such as trophic webs, habitat modifications, and species reintroductions. In high islands, overall invertebrate abundance and diversity decreased, contrary to flat islands where it increased on the ground. Invertebrate groups declining were possibly preferentially preyed upon by increasing lizards, birds, and/or large invertebrates. Vegetation changes include the increase of endemic palm seedlings and the rapid development of native *Pisonia grandis* trees. On coralline islands, the spread of several invasive grasses was inconclusive. Negative effects included the spread of two invasive animals on one island. Seven island translocations of 5 globally threatened endemic birds and one reptile were conducted on 3 islands, contributing to IUCN status downgrading for 4 of them. Pre-eradication baseline surveys were often absent or insufficient and long-term monitoring protocols not regularly implemented. Documenting ecosystem recovery should be given higher

priority in future. Overall rat eradication consistently benefited island ecosystems in all cases.

SPATIO-TEMPORAL DYNAMICS OF THE IMPACTS OF FOREST FRAGMENTATION ON NEOTROPICAL BAT ASSEMBLAGES

Ricardo Rocha

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The consequences of forest fragmentation for tropical vertebrate assemblages have garnered much attention over the last few years. However, many fragmentation studies conducted to date are hampered by the fact that they typically only provide a brief snapshot in time as most research is carried out in the form of short-term projects. This study aimed to investigate the temporal variation in tropical bat responses to forest fragmentation within the experimentally fragmented landscape of the Biological Dynamics of Forest Fragments Project, Manaus, Brazil, specifically focusing on how changes in matrix quality and composition over time mediate species responses to landscape modification. We surveyed bat assemblages in 6 forest fragments (3 of 1-ha and 3 of 10-ha) and in 6 sites in continuous forest in 1996-99 and resurveyed the same sites in 2011-13, using the same methodology. Although there were no pronounced differences in terms of species richness between sampling periods, we



found high between-period species turnover, especially in the smaller fragments. Moreover, between-period differences in species composition were more pronounced for the fragment assemblages indicating that when compared with continuous habitat, fragment assemblages tend to be hyperdynamic. Several species that were commonly captured in 1996-99 were not captured during our resurvey or are now uncommon in the fragments. Conversely, certain forest-dependent species are now among those commonly captured in fragments. These findings demonstrate the mitigating effects of the relatively tall secondary forest vegetation that nowadays dominates the matrix surrounding the fragments. Our study also highlights that responses of bats to habitat fragmentation are strongly influenced by temporal changes in the composition of the landscape matrix surrounding forest fragments.

151 - ON THE THEORETICAL GENERALITY OF DILUTION EFFECT

Benjamin Roche
IRD

Zoonotic pathogens exist within a complex environment that involves many host species. The diversity of host species with low competence for transmitting a given pathogen can reduce the intensity of pathogen transmission, leading to a prophylactic "dilution effect". However, the generality of this effect in wildlife disease systems is unclear. Here, we use a theoretical framework to examine the expected generality of the dilution effect for vector-borne zoonoses by removing all the assumptions generally involved in dilution effect theory. We found that either a dilution effect or an amplification effect was each found in about 50% of simulations; however, the magnitude of the decrease in reservoir species richness was not associated with either effect. We then explore the condition for observing a dilution effect and we compare these conditions with the current knowledge about a large range of vector-borne diseases. We found that dilution is significantly more likely to occur than an amplification, opening the way to use conservation biology as a potential public health tool.

PLASTIC IN MY SEAFOOD!: PLASTIC IN FISH AND BIVALVES SOLD FOR HUMAN CONSUMPTION

Chelsea Rochman
UC Davis

Akbar TAHIR, University of Hasanuddin ; Dolores BAXA, UC Davis ; Rosalyn LAM, UC Davis ; Jeffrey MILLER, UC Davis ; Foo-Ching TEH, UC Davis ; Shinta WERORILANGI, University of Hasanuddin ; Swee TEH, UC Davis

Plastic debris is now recognized globally as one of the several persistent contaminants that have become ubiquitous on our planet. Its presence has been discovered across multiple

habitats worldwide, but most strikingly is its occurrence in wildlife. Plastic debris has been recovered from the gut content of hundreds of species, including several that are part of the human food chain. As such, people have begun to raise concern regarding marine plastic debris and its effects on human health. To help address these concerns, and as part of a collaborative study between the University of California, Davis, USA and the University of Hasanuddin, Makassar, Indonesia, we looked for the presence of plastic debris in seafood sold at local fish markets. From the local fish market in Makassar, Indonesia, we purchased 5-10 fish from across 10 species, encompassing 76 samples in total. From local fisherman and fish markets in Half Moon Bay and Princeton, CA we purchased whole fish/shellfish or collected the gut of 1-12 fish from across 11 species, encompassing 76 samples in total. Overall, our work shows that plastic debris is ingested by marine animals sold for human consumption, including some that we consume whole (i.e., including the gut—anchovies, bivalves). Results to date show plastic debris in a total of 21 fish across 5 species in Indonesia and in a total of 22 fish and 6 oysters across 10 species in California. This presentation will provide details of results including patterns among species and location, the type and size of the debris found and how the waste management strategies in each location relate to our findings. Because our past research has shown that plastic debris can act as a vector for organic pollutants to bioaccumulate in fish tissue, this work warrants further research to examine if our seafood is contaminated with harmful chemicals associated with ingested plastic.

73-MULTI-DISCIPLINARY APPROACHES TO THE STUDY OF MARINE CONNECTIVITY: RECENT EXPERIENCES IN THE WESTERN MEDITERRANEAN BASIN

Delphine Rocklin

University of Murcia

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- CEFREM ; Matteo MURENU, University of Cagliari ; Jose Antonio GARCÍA CHARTON, University of Murcia

Increasing population connectivity knowledge is essential for proposing a coherent management of the resources. In the Mediterranean Sea, marine connectivity studies are still scarce. Here, we present the results of a large-scale study combining various approaches, gathering genetic, modelling and otoliths techniques, for studying the striped red mullet *Mullus surmuletus* and the red mullet *Mullus barbatus* populations connectivity. These species are highly targeted by Mediterranean fisheries, being among the most important demersal fishing resources of the Western Mediterranean Sea. First, we performed genetic analyses using microsatellites markers on adults and juveniles collected in numerous areas spread in the Western Mediterranean basin. Second, since larval dispersal, during the early life-history of many fish species, is a major process influencing populations connectivity, the dispersal patterns of *M. surmuletus* and *M. barbatus* larvae were assessed using a Lagrangian tool coupled with a general oceanic circulation model, to underline the spatio-temporal dynamic and variability of this crucial stage. Finally, to highlight the population structure of these species and to discriminate among possible different stocks, we evaluated the differences in otolith shape. This multi-disciplinary approach was helpful for understanding and assessing the connectivity patterns of *Mullus* sp. in the Western Mediterranean Sea and to shed new light on the resource management of these highly targeted species.

POPULATION SIZE AND HABITAT PREFERENCES OF THE BAWEAN WARTY PIG *SUS BLOUCHI*, ONE OF THE RAREST PIG SPECIES IN THE WORLD, AND APPLICATIONS FOR CONSERVATION

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Mark A. RADEMAKER, University Van Hall Larenstein ; Gono SEMIADI, Indonesian Institute of Sciences

The Bawean warty pig (*Sus blouchi*) was believed to be extinct, but got rediscovered on Bawean island, located in the Java Sea near East Java, Indonesia, in 2013. No study has been done on this species and its conservation status is not yet assessed. The legally unprotected pig is heavily hunted by local people to protect crops. In November 2014, we started the first ecological study on Bawean warty pigs with the aim to assess the total population size, habitat preferences, and behaviour. This information is crucial for species conservation planning and future Red-Listing of the taxa. We installed camera traps at 105 random points in the island's five isolated protected areas (46 km²), the only forested areas on the island. We calculated pig density using the Random Encounter Model (REM) that does not require the recognition of individuals.

Furthermore, we used a Generalised Linear Model to assess the influence of habitat parameters on the trapping rate at the trapping locations. Finally, we assessed the pigs' behaviour on the videos, such as activity profile and social group patterns. We collected 92 independent videos showing in total 162 individuals, including 67 adult females, 35 adult males and 30 immatures. The REM revealed that a total of 292 to 598 pigs live on the island. Based on the number of mature animals between 225 and 460 and an area of occurrence below 100km², the Bawean warty pig should be assessed as Critically Endangered. Mean group size was 2.18 animals. Animals are active mainly during the night, at dusk and dawn. Trapping rates were significantly higher in community forest as compared to natural mature forest, nearer to the forest boarder and in areas with higher tree density. Habitat preference for community forest stresses the problem of human-wildlife conflict, which should be addressed in future conservation projects.

POPULATION GENETIC STRUCTURE OF ACACIA TORTILIS TREES IN ISRAEL AND IMPLICATIONS FOR THEIR CONSERVATION

Yael Rodger

Ben-Gurion University of the Negev

Gidon WINTERS, The Dead Sea and Arava Science Center ; Shirli BAR-DAVID, Ben-Gurion University of the Negev

Genetic diversity and population structure are of great importance for potential adaptation to environmental changes, and consequently for the long-term survival of species. Therefore, species conservation should account for the potential negative effects of climate change and anthropogenic disturbance on its genetic diversity. *Acacia tortilis* is a thermophilic desert tree that has a range of distribution along the hyper-arid Arava valley in Israel. Acacias are a keystone species in this ecosystem, under threat from water depletion due to agriculture, road-building and changing climate. The aim of this study is to evaluate the genetic diversity, structure, and connectivity in the *Acacia tortilis* population and to correlate these findings to natural and anthropogenic factors occurring across their range. Using eight polymorphic microsatellite loci to conduct the population genetic study, we sampled and analyzed eight subpopulations of *A. tortilis* along their distribution in Israel. High levels of expected heterozygosity were found, with an average of 0.77 ± 0.01 across the population. An AMOVA test showed that a significant amount of variation occurs between subpopulations ($F_{st}=0.04$; $p<0.01$) and Pairwise F_{st} calculations showed high genetic differentiation between all subpopulations, particularly between the extreme northern (Ein Gedi) and southern (Shlomo) subpopulations ($F_{st}(L)=0.071$; $p<0.001$). A Mantel test indicated that some of the genetic differentiation between subpopulations could be explained by geographic distance ($R^2=0.13$; $p<0.01$). A "gap" in distribution of the trees occurring



along an elevated region with lower temperatures could act as a barrier to gene flow. These results suggest that the *A. tortilis* population is genetically structured and significant differentiation between subpopulations exists, which should be taken into account in the development of management strategies aimed at maintaining the genetic diversity of this keystone species.

LOCAL KNOWLEDGE AND ADAPTATIVE MANAGEMENT IN BRAZIL NUTS HARVEST IN WESTERN AMAZON

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The approaches of socio-ecological systems, resilience, and adaptive management suggest new forest governance arrangements that include the participation of marginalized rural people in territorial management. These approaches require efforts of scientists and managers to deal with these people local knowledge and social institutions that govern resources access and use. Moreover, Non-timber Forest Products are recognized as one of the most important products for rural communities livelihood. This research characterizes the Brazil nut *Bertholletia excelsa* (Humb. & Bonpl.) harvest based on harvest practices and local knowledge in Brazilian Western Amazon protected areas and their surroundings. Then, these practices and knowledge are discussed based on human ecology and adaptative management approaches. For this, qualitative and ethnographic methods were applied (i.e. semi-structured and open-ended questionnaires, participant observation). The obtained information was classified in: Brazil Nuts stands zoning, technical and social organization for the work, pre-harvest management and management practices, and the local knowledge about biological and ecological aspects of the species. The results suggest that the existing local knowledge in the region is extensive and constantly driven by environmental feedbacks. This knowledge therefore should be considered for adaptive co-management. This research reiterates local people's capacities to work toward effective resource management if they are given the opportunity.

PROPERTY RIGHTS COMPLEXITY OF BRAZIL-NUT HARVEST AND THEIR IMPLICATIONS FOR AMAZON FOREST CONSERVATION

Raquel Rodrigues Dos Santos

Núcleo de Apoio a População Ribeirinha da Amazônia
Danilo MUNIZ DA SILVA, Universidade Federal de São Carlos

Non-timber Forest Products are among the most important livelihoods for rural communities. The study of Non-timber Forest Products based on the property rights approach can

explain community's equity, livelihoods and sustainable forestry management. Here, we examine Brazil nuts harvest *Bertholletia excelsa* (Humb. & Bonpl.) in Brazilian Western Amazon protected areas and their surroundings. We searched for property rights arrangements in Brazil nuts stands and management practices. Then we tested relationship between property rights and management practices, and their implications for tropical forests conservation, particularly for the managed species. At first, a socioeconomic household survey was conducted, followed by ethnographic and participant observation interviews. Finally, the Brazil nuts stands were cooperatively mapped by the authors and the harvesters. A three-digit code system categorization was used to describe the property rights arrangements. Our findings show that (i) Brazil Nuts harvest operates in a complexity of tenure situations where *de jure* (legitimated by law) and *de facto* (legitimated by practice) rights are not in perfect alignment; (ii) secure rights are related to conservation and effective management; (iii) secure rights to resources and conservation can occur within different property rights or combinations, except for open access regimes. This study reinforces that local people are capable of working toward effective resource management even under complex property rights, if they are given the opportunity.

GPS TRACKING FOR MAPPING SEABIRD MORTALITY INDUCED BY LIGHT POLLUTION

Airam Rodriguez

Phillip Island Nature Parks

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Light pollution and their consequences on ecosystems are increasing worldwide. Knowledge on the threshold levels of light pollution at which significant ecological impacts emerge and the size of dark refuges to maintain natural nocturnal processes is crucial to mitigate its negative consequences. In seabirds, fledglings are attracted by artificial lights when they leave their nests at night, causing high mortality. We used GPS data-loggers to track the flights of Cory's shearwater *Calonectris diomedea* fledglings from their nest-burrows to grounding lit locations, and to evaluate the light pollution levels overflow using nocturnal high resolution satellite imagery. Birds were grounded at locations closer than 16 km from colonies, 50% of individuals being rescued in a 4-km radius from the nest-site, and rescue locations showed radiance values greater than 18nW/sr*cm². Breeding habitat alteration by light pollution is more severe for inland colonies, and point to its extinction if artificial lights continue with current regulation. Furthermore, we provide scientific-based information to create dark corridors facilitating that fledglings from inland colonies reach the sea successfully. Given the



similarities in seabird attraction to lights elsewhere, our results could help in the management of other critically threatened or rare species grounded by light pollution across the world.

A NOVEL AND LOW COST METHOD TO CALCULATE POPULATION SURVIVAL USING INVERSE MODELLING

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Estimating survival is paramount population ecology and conservation, since they are at the core of population models and population viability analyses. However state-of-the-art methods to estimate survival, such as capture-recapture analysis, are highly costly since they are based in long-term monitoring and require large number of individuals captured. In this sense, developing new approaches that provides accurate, but affordable, estimates of survival is a priority in population ecology. In the present work, we present a novel method to estimate population survival starting from short-term census data. Our method merges two well-known approaches in the ecological and modeling literature (matrix population models and inverse modelling), however we advocate that their joint potential has not been explored and exploited for parameter estimation. Specifically, we search for those survival parameters that best reproduce the observed age structure of the population according to a likelihood function. This method also allows to test for changes in the survival through time (i.e. due a perturbation). Our method was evaluated against a long-term monitored population (10 years) of the tortoise *Testudo graeca* that experienced a fire during the monitoring period. Our estimates of survival were very similar both in their mean values and their error measures when compared to estimates obtained using capture-recapture methods. In addition, in agreement with capture-recapture results, our approach indicated that fire strongly impacted survival the years after the fire and that this parameter recovered pre-perturbation values few years after the event. Survival estimates with our method were consistent with a sample size as low as 50 individuals sampled in one single year. Our results should encourage of alternative methods, such as those based in inverse modelling, as one more of the possible standard tools for estimating demographic parameters in ecology and conservation.

ID38: UNDERSTANDING THE COMPLEX RELATIONSHIP BETWEEN POVERTY AND WILDLIFE CRIME

Dilys Roe

International Institute for Environment and Development (IIED)

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There is a common assumption in the conservation literature that wildlife poaching is driven by poverty. The evidence base for this assumption is, however, patchy. Duffy and St John (2013) highlight that "poaching and trafficking of ivory and rhino horn are ultimately driven by wealth and not by poverty per se" but concede that poverty is an important factor. The relationship between poverty and wildlife crime is complex - and indeed there is no one relationship. It is clear that in some cases poverty is a major motivation for engaging in wildlife crime. But equally wildlife crime can exacerbate poverty by depleting the natural resource base on which many poor people depend - and which in many cases makes a significant contribution to the GDP of poor countries. In addition, responses to wildlife crime can affect poor people negatively. Recent calls to address wildlife crime have emphasised the need to increase law enforcement. However this can be a blunt instrument which can result in disproportionate persecution of minor actors and alienation of poor people from critical livelihood resources. This paper explores these different relationships assessing the state of the evidence base for each. Uganda is used as a case study country to illustrate some of the complexity involved.

ARE ALTERNATIVE LIVELIHOODS PROJECTS EFFECTIVE AT DELIVERING CONSERVATION RESULTS?

Dilys Roe

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Alternative livelihood projects are used by a variety of organisations as a tool for achieving conservation results. Yet these interventions, including their objectives, vary a great deal, and there is no single accepted definition of what constitutes an alternative livelihood project. In addition, very little is known about what impacts, if any, alternative livelihoods projects have had on biodiversity conservation, as well as what determines the success or failure of these interventions. Reflecting this concern, a resolution was passed at the IUCN World Conservation Congress in 2012 calling for a critical review of the benefits to biodiversity of alternative



livelihood projects and we report here on a systematic review undertaken for that purpose. We define alternative livelihoods projects as interventions that seek to alleviate a human threat to biodiversity through providing, or encouraging the use of an alternative resource; an alternative occupation; or an alternative method (lower impact) of exploitation. Our review identified approximately 100 studies of alternative livelihood interventions of which 50 include detailed assessments of their effectiveness. We explore the types of interventions that have been deployed, the nature and scale of their impacts and the types of contexts in which they have been found to be effective or not.

MULTIPLE EVIDENCE FOR THE PHYLOPATRIC BEHAVIOR OF THE CRITICALLY ENDANGERED HOODED GREBE: IMPLICATIONS FOR ITS CONSERVATION

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The Hooded Grebe (*Podiceps gallardoi*) belongs to one of the most endangered groups of birds, the Podicipediformes. It was discovered in 1974 at Santa Cruz province, Argentina. Its numbers have dropped over 80% in less than 25 years, with a current population of less than 400 pairs. It inhabits highland basaltic plateaus, spotted in an area of 120.000 km² through out arid Patagonia. In 2009, census program was started in 400 lakes at 7 plateaus monitored regularly. Numbers across seasons in each single plateau did not change ($\chi^2 < 0,001$). Additionally, we collected tissue samples to assess its population structure. We sequenced a 353 bp fragment of mtDNA control region for 51 individuals obtained at Buenos Aires (n=31) and Siberia (n=20) plateaus. We analyzed population structure between plateaus with AMOVA, for testing the fidelity to breeding sites. The genetic variability between them explained 11% of the variation, and the haplotype frequency distribution was significantly different between plateaus ($F_{ST} = 0.1$, $p = 0.009$). Finally, we tagged 20 individuals from two plateaus (wing tags n=8; color bands n=12). A juvenile banded at Buenos Aires plateau was detected nesting on the same lake one year after. These results showed that the distribution between breeding sites is not random, which suggests this species shows a phylopatric behavior. Although the series of surveys showed similar numbers in every plateau each year, the observed variation among lakes suggest that grebes have fidelity at the scale of plateau, instead of to specific lakes. From a conservation perspective this information is fundamental to understand the population

dynamic of Hooded Grebe and the importance of each plateau as reproductive habitat. This represents primary information to conduct specific management plans, considering the population structure of Hooded Grebe and the geographic complexity of this region.

MODELLING EXTINCTION RISK OF GLOBAL REPTILES

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The IUCN's Red List of threatened species has grown in scope and importance for the prioritizing, planning and management of biodiversity, yet most global biodiversity remains unassessed. To-date only 4256 reptile species (45%) have been assessed by the IUCN. Here we make use of a unique and comprehensive database on traits and ranges of all living reptiles in order to explore patterns in their extinction risk. Initially we highlight geographic and taxonomic biases in assessed versus unassessed species and link threat category to various morphological, ecological, physiological and life-history traits of the species, as well as attributes derived from their geographic ranges. We use machine learning models to assign tentative threat categories, based on the range size of each species (criterion B) and the various attributes that were found to correlate with the different threat categories of assessed species. Our results indicate that assessed species are on average larger and have a larger range size than unassessed species. Furthermore, many more Nearctic and Madagascar reptiles have been assessed, and only few in the Australian, Afrotropic, Neotropic and oriental realms. Restricted range size species are on average more threatened as are iguanas, and Madagascan species. Geckos are less threatened, as are Afrotropic species and species living at higher elevations. Modelling threat categories to unassessed species highlights more than a thousand species that receive a provisional threat status. It also enables us to identify potentially miss-classified species and reveals general inconsistencies between classifiers and classifications. Our work highlights lacunas in the reptile assessment and identifies attributes most important for threat status prediction. We also give provisional threat categories to all unassessed reptile species, and provide a robust 'shortcut' mechanism for the classification of species from lesser known groups, yet to be assessed.

TEMPORAL AND SPATIAL DYNAMICS OF REEF FISH SPAWNING AGGREGATIONS IN NEW CALEDONIA

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Reef fish spawning aggregations reflect the diversity of reproductive strategies of coral reef organisms. Groups of conspecific fishes are gathered for the purpose of spawning. These aggregations occur at a specific times and locations and are often the target of intensive fisheries. To protect and manage spawning aggregations, it is desirable to locate sites, identify the species that form aggregations and the periodicity with which species form them. We focused our study on a multi-species aggregation site that experiences low levels of exploitation, the Kouare channel, located in the New Caledonia's south lagoon. Conventional underwater visual census methods and diver operated stereo-video transects (Stereo DOV) were combined with four remote underwater video systems to provide very high replicated observations in low light conditions, up to 40m depth and strong current. Globally, 33 species of coral reef fishes have been identified forming spawning aggregations, including commercially important and emblematic species in New Caledonia (*P.leopardus*, *L.nebulosus*, *C.undulatus*). Seasonal and daily patterns in spawning activity and aggregations were analyzed with regard to topographic complexity, coral cover and temperature. Significant spatial differences between species were detected plotting the aggregations on a bathymetric 3D map. For example, *E.cyanopodus* only spawned on the outer slope between 25 and 40m deep whereas *S.globiceps* only spawned on promontories between 5 and 8m deep. Differences between temporal patterns were defined by the frequency with which the spawning aggregation occurs and the length of time the aggregation persists. The time of day varied between species from dawn to dusk. Among the species observed during the survey, 6 species were identified as priority species for conservation. Data collected during the survey will be used in a population dynamics model (ISIS Fish) that is designed to assess different management scenarios.

SYMPOSIUM 91. ISSUES FOR IMPACT EVALUATION DESIGN OF FSC CERTIFICATION OF NATURAL FOREST MANAGEMENT

Claudia Romero

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FSC natural forest management certification has been implemented for >20 years. FSC's goal is to provide a system through which responsible forest management is recognized by consumers and others. Our team works on the design of an empirical theory-based impact evaluation (IE) of the biophysical, social, economic, and policy impacts of this

intervention in Brazil, Peru and Indonesia. The range of expected outcomes, and the scales at which impacts ensue, forced us to use inter and trans-disciplinary approaches to define the IE scope and goals. While this research is still ongoing, our goal is to share lessons learned in tackling the complexity of the social-ecological systems where the FSC intervention occurs. We present ideas that see evaluation as a knowledge-generating process as well as a goal in itself. Thus, we introduce the rationale for a multi-stakeholder platform to assure the IE design would be built upon discussions with a range of social actors on the value of this knowledge-generation research to improve their conservation practice. We introduce a conceptual framework that lays out the foundation for the IE work, tightly linked to relevant concepts for conservation biologists such as adaptive management and systems thinking. We discuss results of preparatory studies that provide information used as a backbone for the IE design and that attempts, from the different angles where conservation trade-offs occur, to provide a roadmap for the IE. Studies include a descriptive analysis of auditing and accreditation activities aimed at providing transparency and accountability to the audit component behind certification. We developed country-based studies of political economy factors that underlie historical issues regarding forested lands use and analyze these issues across countries. We ground on these quantitative and qualitative studies hypotheses on how forest management decisions in general and FSC certification in particular, have occurred

INCORPORATING THE EFFECTS OF MULTIPLE FUTURE THREATS ON DECLINING MAMMALSTO IDENTIFY SPATIAL PRIORITIES FOR PRIVATE LAND CONSERVATION INCENTIVES

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Climate change is predicted to alter the distributions of many species as their environments become unsuitable under future climatic conditions. Uncertainty in expected future climate scenarios plus the likely effects of additional threats complicate efforts to plan for the conservation of threatened species. It is therefore important to incorporate multiple threats when planning for species conservation under climate change to avoid costly errors in prioritising limited conservation funding. We explore future scenarios of climatic conditions, and incorporate the threat of urbanisation, to plan for the persistence of species of conservation interest in a case study located in south-western Australia, a global biodiversity hotspot. We use species distribution modelling to understand how climate change might affect the geographical ranges of



a suite of endemic mammals. We develop a 'threat map' that describes the relative threat of urbanisation and associated clearing, and use cost-effectiveness analysis to identify spatial priorities for conservation on private land that supplement existing conservation strategies of public protected areas. Our approach targets areas of low cost, high threat and high likelihood of containing the present and future distribution of each species. The results suggest the species selected will move towards the coast. Although the percentage of species' range inside statutory protected areas is predicted to increase, the total range will contract and shift closer to urban areas. The cost-effectiveness analysis indicates the best areas to target for future conservation action on private land for these species would be those on the edge of protected areas in the south and west of the region. Our analysis demonstrates how predictive modeling, threat mapping and cost-effectiveness analysis can be used by conservation planners and decision-makers for anticipatory policy adaptation and implementation in the face of future threats.

DESIGNING A NETWORK OF WILDLIFE CORRIDORS ACROSS HETEROGENEOUS MOUNTAIN LANDSCAPE - THE CARPATHIANS CASE STUDY

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The Carpathian Mountains forming an arc roughly 1.500 km across seven states provide the habitat for some of the largest European populations of brown bears, grey wolves and Eurasian lynx, with the highest concentration in Romania. However, Ukrainian, Romanian and even Slovakian parts of Carpathians suffer from the lack of the functional nature protection and the effective landscape management. Several protected areas including the large number of NATURA 2000 sites have been declared, but their spatial design recalls rather patchwork instead of coherent network. Populations of large carnivores with enormous spatial requirements and extensive dispersal and migratory needs are widely endangered by rapid development of roads and motorways creating long impermeable barriers across the Carpathians. As new traffic projects are planned on supra-national level, the same scale is needed for designing an extensive system of wildlife corridors. Habitat suitability models for brown bear, grey wolf and Eurasian lynx were used to delineate core habitat areas and stepping stones important for dispersal. The Circuit Theory was applied for assessment of landscape connectivity and finally a coherent network of wildlife corridors was designed. Proposal of such green infrastructure was presented to regional authorities and stakeholders, to provide them with relevant information for negotiations with road and motorways planners.

DECLINE OF EUROPEAN LARGE MAMMALS UNDER GLOBAL CHANGE SCENARIOS

Carlo Rondinini

Sapienza University of Rome
Piero VISCONTI, Microsoft Research

The distributions and populations of large mammals are declining globally, leading to an increase in their extinction risk. We forecast the distribution of extant European large mammals (17 carnivores and 10 ungulates) based on two Rio+20 scenarios of socio-economic development: business as usual and reduced impact by consumption change. These are linked to scenarios of land use change and climate change through the spatial allocation of land claim until 2050. We used a hierarchical framework to forecast mammal suitable habitat, based on their habitat preferences recorded in the IUCN Red List database, within their suitable climatic space, fitted to their current geographic range. We analyzed the geographic and taxonomic variation of habitat loss for large mammals, and the potential effect of the reduced impact policy on loss mitigation. Averaging across scenarios, European large mammals would lose 10% of their habitat by 2050 (25% in the worst-case scenario). The loss would be much higher for species in northwestern Europe, where habitat is expected to be lost due to climate and land use change. Change in human consumption patterns would mark a substantial improvement in the conservation of habitat for European large mammals, but this would still be insufficient if they are not capable to adapt locally or disperse.

130 - CHALLENGES FOR COMBINING INDICATORS, MODELS AND SCENARIOS OF HUMAN PRESSURE AND BIODIVERSITY RESPONSE INTO A COHERENT STORY

Carlo Rondinini

Sapienza University of Rome

A variety of indicators, models and scenarios have been developed in the last decades to represent, quantify, monitor, and forecast human pressure on natural systems and the resulting response of biodiversity. These indicators, models and scenarios usually tell a broadly coherent story of biodiversity loss, but are often discordant when the story is developed in further detail. This discordance translates into high uncertainty on the relationships between pressures and responses, which hampers decisions on actions to halt biodiversity loss. To reduce this uncertainty we need to understand the sources of the observed differences. While part of the uncertainty derives from random sampling of a statistical population, other relevant components lie in the behaviour of indicators, in the assumptions of the models and scenarios, and in the pathways



chosen to combine them all. Building on the frameworks of the IPBES report "Policy support tools and methodologies for scenario analysis and modelling of biodiversity and ecosystem services" and of the EU COST action Harmonizing Biodiversity Modelling, I discuss: 1. how similar biodiversity indicators respond to different processes or different stages of the same process; 2. how choices on combining models and scenarios produce outputs with different interpretations; 3. how, when and why models of pressure and response should or should not be harmonized.

RESTORATION ECOLOGY, REWILDING, PASTORALISM AND FOOD SECURITY: RENEWING OLD CONNECTIONS IN CENTRAL CHILE

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Restoration of the semi-arid Chilean silvopastoral system called "espinal" is a longstanding challenge. Here we present and discuss the prospects for a restoration approach inspired by rewilding. We suggest an alternative model of rewilding with the potential to contribute to food production and food security. We argue that the reconciliation of rewilding and food security approaches is appropriate to the central Chilean context. Pastoral systems are adaptations to environmental heterogeneity and variability, and may involve both domestic and semi-wild species. With sedentarization, the capacity for dynamic responses to the environment is lost, and with factory farming may be decoupled from local variability while strongly coupled to regional or inter-regional fodder production. Extensive pastoral systems have a large water footprint, which has been used as an argument against extensive meat production as a component of food security. However, the water input (precipitation) to pastoral systems produces a large number of supporting, provisioning and cultural ecosystem services, which intensive meat and vegetable production do not. Furthermore, the grazing of large herbivores can contribute to landscape management for ecosystem services. The rewilding movement has provided lessons on passive and dynamic approaches to megaherbivores as management tools. We discuss this model of rewilding with reference to our experiments on the potential to reintroduce semi-wild guanacos (*Lama guanicoe*), the "missing herbivore" in the espinal habitat, as a restoration tool. We provide preliminary evidence from our ongoing experiment and GIS analysis that the ecological restoration of a dynamic rewilding-inspired silvo-pastoral system can broadly contribute to food security as well as biodiversity and sustainability in central Chile.

GENETIC CHARACTERIZATION OF THE RELICT POPULATION OF THE EUROPEAN STURGEON, ACIPENSER STURIO: INSIGHTS INTO BREEDING AND CONSERVATION PROGRAMS

Séverine Roques

IRSTEA

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Genetic evaluations in breeding programs of critically endangered species are essential not only to characterize and maintain genetic diversity, but also to improve both effectiveness and monitoring of repopulation. The European sturgeon was the most widespread sturgeon species all over Europe, but its abundance has been drastically reduced to be now on the brink of extinction. Only a single population is surviving in the Gironde-Garonne-Dordogne watersheds (France) where the last known natural spawning occurred in 1994. In the years that followed, a sturgeon restoration program has been launched to build up a broodstock and repopulate this watershed. In the present study, a microsatellite multiplex assay was developed to characterize genetically the relict population actually reduced to 70 captive-wild spawners and the seven generations (2007-2014) issued from the breeding program. Our genetic assay proved highly reliable and powerful in relatedness analysis and assignment approaches, and is thus promising to help the conservation-restoration actions of the species. Mains aims include assessing the genetic variability of broodstocks and F1 juveniles, estimating relatedness and effective population size within captive individuals, providing molecular tags for released individuals, and assisting in the evaluation of survival of stocked individuals according to the parents used and the stocking practice. Here, we will present the obtained data and their usefulness for discussing suitable strategies for the genetic management and conservation of this almost extinct species.

RECREATING THE SOUNDSCAPE: DISENTANGLING EFFECTS OF OIL WELL NOISE FROM INFRASTRUCTURE ON GRASSLAND SONGBIRDS

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As anthropogenic noise becomes more prevalent across habitats, its impacts on wildlife remain difficult to assess. Noise from oil well development may contribute to grassland bird population declines, in western Canada. Thus far, noise playback studies have failed to accurately reproduce



anthropogenic sound sources, resulting in a limited understanding of its impact. To disentangle effects of noise from confounding factors of oil development (i.e. infrastructure presence, associated roads, traffic, human activities), we used a solar-powered broadcasting system that reproduces sound with a high degree of source fidelity, surveyed bird abundance on transects, and monitored nesting success at pumpjack playback sites, silent playback sites, and control sites without playback infrastructure. We found positive effects of noise for certain species (i.e. chestnut-collared longspurs and horned larks), but for other species, noise reduced abundance (i.e. vesper sparrows). Differences in noise sensitivity were also observed. Baird's sparrows were negatively impacted by the loudest sound stimulus and not the quieter on. The presence of infrastructure and not of the noise itself also had varying effects by species; for example, increased perch availability attracted Western meadowlarks and deterred Sprague's pipits. Decreased nesting success in Savannah sparrows was primarily driven by the presence of infrastructure. Thus, in our system, oil well noise does not have an overall negative or positive costs for residing songbird species. The management implications are not straightforward: simply reducing amplitude of noise without minimizing the footprint of above-ground infrastructure may not aid in conservation of grassland songbirds as a whole; species-specific mitigation must be considered.

COST-EFFECTIVE CONSERVATION OF AN ENDANGERED FROG UNDER UNCERTAINTY

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How should managers and policy-makers choose between conservation actions when resources are scarce and there is uncertainty regarding the effectiveness of actions? Well-developed tools exist for prioritising areas for one-off and binary actions (e.g. reserve/don't-reserve), but methods for prioritising incremental or ongoing types of actions (e.g. habitat creation and maintenance) remain uncommon. We present an approach that combines population viability — a proximate measure of species benefit — with cost-effectiveness analysis to evaluate and identify alternative actions that are efficient and robust to uncertainty. We demonstrate our approach with a case study of the endangered growling grass frog, *Litoria raniformis*, which is threatened by urban development. We extended and customised a Bayesian metapopulation model to predict viability under ten urbanisation and management scenarios involving combinations of habitat removal, installation of stormwater management wetlands, and frog wetland

creation, enhancement and maintenance. The full probability distribution of possible outcomes produced for each scenario was incorporated in the cost-effectiveness analysis. This helped elucidate extinction risks and discriminate cost-effective alternatives robust to uncertainty from those with a high risk of failure. Extinction was predicted following urbanisation if the only conservation action was reservation of core habitat. Creation and maintenance of wetlands dedicated to *L. raniformis* was the only cost-effective action likely to result in sufficiently low risk of extinction. To our knowledge this is the first study to utilise a Bayesian population viability analysis to explicitly incorporate uncertainty in cost-effectiveness analysis of conservation actions. The approach offers guidance to decision-makers aiming to achieve cost-effective conservation under uncertainty.

CHANGES IN TWO DECADES IN THE BIRD AND PLANT COMMUNITIES IN TWO HIGHLAND ANDEAN LOCALITIES POTENTIALLY THREATENED BY CLIMATE CHANGE

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Tropical highland ecosystems have been identified as among the most threatened due to climate change. However, few studies exist with specific data assessing the effect on organisms, particularly in the Andes and in Colombia, a highly biodiverse country. Such data are needed to evaluate the theoretical models that are currently dominant in this field. We have detailed data from 23 years ago on the bird community and the phenology of fruits and flowers of two high Andean areas in a National Park in the Eastern Andes of Colombia, an Endemic Bird Area: paramo and highland tropical forest. Through bird, flower and fruit censuses, we are evaluating again these communities in order to document changes that could be related to climate change. We are also evaluating vegetation cover changes in the area through a multi-temporal analysis using satellite images to permit evaluation of changes in the bird community related to changes in vegetation. So far, we have found one hundred and two bird species, several of which are endemic and threatened or have restricted ranges. We tentatively have detected both increases and decreases in bird species, the former being more common. The species that are decreasing belong to different feeding guilds (insectivores, nectarivores), include migrants and do not belong to closely related taxonomic groups. Increasing species are mostly from lower elevations and also are diverse, including a guan, hummingbirds, and understory insectivores. With this ongoing study in its early stages, we expect to detect the number and type of species for which changes have occurred in their presence and abundance and relate these changes



to their ecology with predictive and conservation purposes. These data will contribute to the management of the park and the conservation of Colombian biodiversity as well as the corroboration of predictive theoretical models.

49-RESPONSES OF INSECT HERBIVORES AND HERBIVORY TO HABITAT FRAGMENTATION: A META-ANALYSIS

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Habitat fragmentation is one of the main causes of species loss with consequences for ecological interactions and ecosystem functioning. Among ecosystem processes, insect herbivory has been widely studied because of its impact on plant growth and reproduction, affecting plant community structure and diversity. Evidence shows contrasting patterns of herbivory in fragmented habitats. On the one hand, reduction of herbivore populations and herbivory levels in small fragments may be due to direct loss of herbivore species and individuals, or through reduced number of plant species and their associated herbivore species. On the other hand, more herbivores and herbivory levels in small fragments may be a result of decreased density of herbivore natural enemies, which are often more vulnerable to fragmentation than herbivores, releasing them from potential biocontrol. Here we test in a meta-analysis, a powerful tool to combine results across studies, the effects of fragment area, isolation and fragmentation per se on herbivore abundance, species richness and herbivory levels. We performed subgroup analysis with fragmentation type (anthropogenic / experimental / natural), herbivore type (endophagous / ectophagous) and herbivore study level (community / species) as moderators. We identified 70 suitable studies evaluating habitat fragmentation effects. The overall habitat fragmentation effect across all studies was negative, but only significant for species richness and the abundance of endophagous insects, which were stronger affected than ectophagous herbivores. Habitat fragmentation effects seem to involve mainly direct loss of herbivore species with reduction of habitat area and these effects would be moderated by fragmentation and herbivore type.

DENSITY, DIET, AND PREY SELECTION OF THE INDOCHINESE LEOPARD IN EASTERN CAMBODIA

Susana Rostro-García

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Leopards *Panthera pardus*, the most persecuted large cat in the world, have been eradicated from >50% of their range in Asia. The Monduliri Protected Forest (MPF) in eastern Cambodia contains one of the last viable populations of Indochinese leopards *P. p. delacouri* in the region, as well as a high diversity of potential prey, including several threatened species. Recent increases in illegal logging and poaching are believed to be impacting the faunal community, however little information has been gathered on this unique predator-prey community. Thus, the aims of this study were to determine the: 1) current density, and 2) diet and prey selection of leopards in MPF. In 2014, we conducted a camera-trapping study for leopards in MPF, and obtained density estimates using spatially explicit capture-recapture, calculated in program DENSITY. The resulting density estimate of 1.1 leopard/100 km² was 70% lower than that obtained in 2009 on the same site using the same methods. Analyses of scats (n = 83) revealed that leopards consumed at least 14 prey, ranging in size from insects and rodents to banteng *Bos javanicus*. Compared to availability, leopards selectively preyed most on muntjak *Muntiacus muntjak* followed by wild pig *Sus scrofa*, and these two species were the most important prey in terms of biomass consumed. We conclude that leopards are important apex predators in this unique ecosystem of eastern Cambodia. However, this high-priority population of Indochinese leopards is declining at an alarming rate, and will soon be eradicated unless effective protection is provided.

BIRD COMMUNITY RESPONSES TO WOODY BIOENERGY CROPS IN ARGENTINA AND THE U.S.

Amber Roth

Michigan Technological University
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As part of an interdisciplinary study of the effects of bioenergy development, we examined how changes in land use and management of forested landscapes influence bird communities in Wisconsin, USA and Entre Rios, Argentina. In Wisconsin, naturally occurring coppiced aspen trees (*Populus* spp.) are used as feedstock for a nearby biomass energy plant. Here, aspen is clearcut, though newer management includes hardwood and conifer legacy tree retention. In contrast, Argentina is manufacturing biomass pellets from non-native *Eucalyptus* spp. plantations, which are replacing annual crops and ranchlands, the dominant land use in the region for over a century. We compared bird communities in alternative



probable land uses in each country, censusing birds in 27 sites (9 replicates of clearcut, hardwood and conifer legacy tree retentions) in Wisconsin from 2007-10 and 12 sites in Argentina (4 replicates of large-scale eucalyptus, small-scale eucalyptus, and pastures/annual crops) in 2014. Breeding bird species richness in the Wisconsin averaged 25.2 species while conifer and hardwood retention sites contained an average of 27.6 and 30.9 species, respectively. In Argentina, eucalyptus stands greater than 100 ha contained on average 6.8 breeding bird species, compared with 23.2 species in smaller eucalyptus stands and 20.8 species in annual crops and ranchlands. In both countries, distinct bird communities were detected with little species overlap among treatments. Should bioenergy continue to increase in Wisconsin, the likely effect would be shorter rotation of aspen, resulting in more young and less structurally complex habitats that are more similar to large-scale eucalyptus monocultures that support fewer breeding bird species. Our results document consequences of current and potential future expansion of tree monocultures and shortening of stand rotation times in contrast with management for wood products using techniques that support greater bird species richness.

(117) ABORIGINAL ENGAGEMENTS WITH MARKET-BASED CONSERVATION

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Aboriginal and marginalized communities who have long resisted old 'fortress' style conservation are frequently finding that the new market-based trajectory offers a viable option for their territories. Critical analysis might assert that these communities have been duped by neoliberal capitalism but such critics fail to recognize 1) the agency of aboriginal people, 2) the history of their relationship to other conservation actors and 3) their constrained options for asserting their own conservation regimes in their territories. More favorable analysis might celebrate the benefits aboriginal communities can receive but express concern over the conservation outcomes of increased market-based actors in conservation. This paper starts to tease out the complexities and contradictions of Aboriginal engagements with Market-Based Conservation by drawing on case studies in Asia and North America.

DETECTING POPULATION TRENDS WITH LOCALLY-BASED TRANSECT DATA: CASE STUDY ON THREATENED PRIMATES IN THE UDZUNGWA MOUNTAINS OF TANZANIA

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Increasing threats to primates in the tropics make robust and long-term population assessments increasingly important for conservation. Concomitantly, monitoring becomes particularly relevant in countries with primate habitat. Yet monitoring schemes in these countries often suffer from logistic constraints and/or poor rigor in data collection, and a lack of consideration of sources of bias in analysis. We addressed the need for feasible monitoring schemes and flexible analytical tools by analyzing data collected by local technicians on abundance of three species of arboreal monkey in the Udzungwa Mountains of Tanzania (two *Colobus* species and one *Cercopithecus*), an area of international importance for biodiversity conservation. We counted primate social groups along eight line transects in two forests in the area, one protected and one unprotected, over a span of 11 years. We applied a recently proposed open metapopulation model to estimate abundance trends while controlling for confounding effects of observer, site, and season. Primate populations were stable in the protected forest, while the colobines, including the endemic Udzungwa red colobus, declined severely in the unprotected forest. Targeted hunting pressure at this second site is the most plausible explanation for the trend observed. The unexplained variability in detection probability among transects was greater than the variability due to observers, indicating consistency in data collection among observers. There were no significant differences in both primate abundance and detectability between wet and dry seasons, supporting the choice of sampling during the dry season only based on minimizing practical constraints. Simple monitoring routines implemented by trained local technicians can effectively detect changes in primate populations. The Bayesian model formulation provides a flexible tool to determine temporal trends with full account for data constraints and imperfect detection.

ENLACE VERDE: A COMMUNITY MANAGED TRAIL SYSTEM IN THE BELLBIRD BIOLOGICAL CORRIDOR, COSTA RICA

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In the 1980's Costa Rica had the highest rate of deforestation in the world, turning Costa Rica's Pacific Slope into a landscape of isolated forest fragments in a matrix of cattle pasture. The government has recognized the conservation value of this area by integrating it into the national system of biological corridors. However, the Bellbird Biological Corridor (BBC) is still not a protected area and lacks the on-the-ground influence to ensure sustained protection. One community in



the BBC, San Luis de Monteverde, has proposed an innovative approach to landscape connectivity: a network of community managed protected areas linked by a hiking trail stretching from the mountainous continental divide to the Pacific coast. This dispersed management structure would extend the economic and conservation benefits of lower-impact tourism along the the critically important Bellbird Biological Corridor. Our project supports San Luis de Monteverde's Community Development Association (ADISL) in establishing the first such co-management system. ADISL is in the process of negotiating a cooperative agreement with a conservation NGO to maintain trails within part of a 20,000ha forest, and would like to use this as the basis for negotiations with other communities and landowners to complete the trail. Using San Luis de Monteverde as a case study, we explore this framework for co-management and use participant observation and unstructured interviews to identify key community features that support such an initiative. Our findings and this program will serve as a pilot for a novel framework of co-management of protected areas, based on low-impact tourism that will support conservation priorities, promote rural tourism in the region, and protect the Bellbird Biological Corridor.

208 CELEBRATING 50 YEARS OF THE BIOLOGICAL RECORDS CENTRE

Helen Roy

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Michael POCOCK, Centre for Ecology & Hydrology ; David ROY, Centre for Ecology & Hydrology

The contribution of volunteers to our understanding of ecology is inspiring. Indeed people have been recording wildlife for centuries and the resulting datasets have underpinned important scientific research. The Biological Records Centre (BRC), established in 1964, is a national focus for terrestrial and freshwater species recording in the United Kingdom (UK). Together with more than 80 volunteer-led recording schemes and societies, BRC provides essential information which informs research, policy and the conservation of our heritage of wildlife. Biological recording is perhaps one of the oldest examples of citizen science with records spanning centuries. It represents a diverse range of activities, involving an estimated 70 000 people annually in the UK, from expert volunteers undertaking systematic monitoring to mass participation recording. Biological recording represents an invaluable monitoring tool because the datasets are long-term, large-scale and taxonomically diverse. There are many published outputs from biological including atlases showing national distributions (12,127 species from over 40 taxonomic groups), quantified trends (1,636 species) and peer-reviewed publications (more than 200 in the last ten years). BRC pioneers the use of technology for data capture (online portals and smartphone apps) and verification (including automated

verification) through customisable, inter-operable database systems to facilitate efficient data flow. Here we provide an overview of the activities of the BRC, highlighting lessons learnt with broad applicability to citizen science.

CAN THE NATURA 2000 NETWORK ADEQUATELY CONSERVE CROP WILD RELATIVES?

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Crop wild relatives (CWRs) are wild plant species that share a common ancestor with domesticated plants. In the context of the new challenges facing agriculture over the coming years, the conservation of these species and their genetic diversity is a matter of general interest as they may possess desirable characteristics that can be used to obtain new varieties adapted to climate change. To avoid the wasteful resource expenditure on establishing a parallel protected area system, the Natura 2000 network has been proposed as an available resource for the in situ conservation of these genetic resources, as it covers today almost a fifth of Europe's land area. As a part of the European project PGR Secure, the suitability of this approach has been evaluated in Spain. First, the coverage level offered by the Nature 2000 network to 508 species in the Spanish National Inventory of CWRs was calculated using gap analysis techniques. In 18 cases all known populations were inside the boundaries of a site of community importance (SCI), while 38 species were not represented in any protected area. The overall picture is that $42 \pm 24\%$ (mean \pm standard deviation) of the populations of the priority CWR species are located in SCIs. Next, an ecogeographical representativeness analysis for each species was performed to estimate the genetic diversity that would be preserved under this scenario. For 70 species, the ecogeographical representativeness in protected areas was maximum, as all environments in which the species is present would be represented by the populations inside SCIs. Finally, a complementarity analysis allowed to identify the SCIs that maximise the number of CWRs conserved by the Natura 2000 network and, more important, the genetic diversity of species. Advantages and limitations of this approach to conserve the Spanish CWRs are also discussed.

Implications of model and data uncertainty for conservation decision-making under the IUCN Red List."

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Threat rankings for endangered species often rely on assessments of extinction risk and population declines. The International Union for Conservation of Nature (IUCN) Red List Categories and Criteria has emerged as the global gold standard for quantitative assessment of extinction risk. Since data for many parameters used in IUCN Red List assessments are inherently uncertain, and in many cases absent, consideration of its reliability is fundamental in guiding priorities for conservation investment among species and populations. The adoption of population models has been recommended to minimize the uncertainty associated with subjective judgment in estimates of extinction risk or population decline but uncertainty remains in the choice of model that best represents population dynamics and in the parameters on which the model is based. In this study we investigate the effects of model choice, variability, measurement error and time series length on the reliability of risk classification decisions made with model outputs under the decision Rule A.3 of the IUCN Red List. We used an age-structured population model to simulate population trajectories subject to different controlled levels of variability and uncertainty and under a range of growth rates. We parameterize scalar and matrix models with these simulated time series to predict percent declines. These were then used to assess IUCN threat status and whether the estimated models' output accurately captured the underlying "true" threat status. We found that high levels of variability decrease model accuracy and high levels of measurement error generated biased risk assessments for both models. However, scalar models generate more reliable risk assessments than matrix models, which tended to be precautionary. Our study provides evidence that short time series and scalar models can be more useful than matrix models in conservation decision-making under particular conditions.

UNDERSTANDING THE ENVIRONMENTAL DRIVERS OF RECORDING BIAS IN CITIZEN SCIENCE DATA ACROSS SWEDEN

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The collation of citizen science data in open-access biodiversity databases makes temporally and spatially extensive species' observation data available to a wide range of users. Such data are an invaluable resource but contain inherent limitations, such as sampling bias in favour of recorder distribution, lack of survey effort assessment, and lack of coverage of the distribution of all organisms. Any technical assessment,

monitoring program or scientific research applying citizen science data should therefore include an evaluation of the uncertainty of its results. We consider that the open-access databases themselves can – and should – provide information about the quality of the data, and as such we present 'ignorance' scores using data accessed via the Swedish LifeWatch (SLW) biodiversity analysis portal. Ignorance scores are spatially explicit indices of the bias and lack of sampling effort across a study region, and are a feature soon to be implemented in the SLW portal. We analysed spatial patterns of ignorance scores for 13 reference taxonomic groups to further understand observer behaviour. The data is mainly based on voluntary observations between 2000 and 2014. Our aim was to compare the effect of six geographical variables (elevation, steepness, population density, log population density, road density and footpath density) on the ignorance scores among the reference taxonomic groups. We will show how the effect of geographic variables differs among taxonomic groups, and discuss how this information can be applied by the database users, allowing them to take account of the biases present in the citizen science data.

IS HYBRIDIZATION THREAT FOR CONSERVATION? CASE OF PRINCE RUSPOLI'S TURACO, ETHIOPIA

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Hybridization due to habitat loss is a concern due to genetic loss of material. This concern is more acute in species that are vulnerable and endemics. The Ethiopian highlands have two endemic species of turacos, the widespread White-cheeked Turaco (*Tauraco leucotis*) and the globally-threatened Ruspoli's Turaco (*Tauraco ruspolii*). The two turacos co-occur only in a small region of southern Ethiopia, where *T. leucotis* mainly lives in forest and *T. ruspolii* mainly in more open woodland vegetation. Natural hybrids of the two species were reported in 2002, which might pose a new threat to the survival of *T. ruspolii*. Field work was done between November 2007 and June 2011 to evaluate the abundance and distribution of the turaco hybrids as well as understand the impact of human-caused habitat change on Prince Ruspoli's turaco. The survey was conducted using the point count method within 200 m radius. Each locality was visited to record turacos and their hybrid in different habitats in the morning when the detectability is maximum (6:00-10:30) and playback method was used to detect the turacos. A total of 46 transects, which consisted 548 census points were surveyed. During the census 333 *T. ruspolii*, 251 *T. leucotis*, and nine hybrid individuals were recorded. Hybrids were observed in the overlap zone



between the ranges of the two parent species, suggesting that they are widespread in the region. Turaco hybrids are difficult to recognize and can only be safely distinguished from pure individuals if seen at close distance, therefore we believe that the abundance of hybrids might have been underestimated. All the hybrids were observed in anthropized habitats, suggesting that habitat change might be one of the causes of the hybridization. The distribution of the two turacos showed differences across habitat types and these differences were statistically significant at 1%.

DRIVERS AND MOTIVATIONS FOR COMMUNITY-BASED CONSERVATION: INSIGHTS FROM LATIN AMERICA

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Indigenous and rural communities have worldwide developed strategies aimed at supporting their livelihoods and protecting biodiversity. Factors underlying these local conservation strategies, however, are still a largely neglected topic. We aim to enrich the conceptualization of community-based conservation by exploring trigger events and local people's motivations that result in functional institutional arrangements for successful natural resource management and biodiversity conservation. Examining the history and development of three community conservation initiatives in Brazil, Mexico and Bolivia, we illustrate and discuss two main ways of understanding community-based conservation from the interaction between external drivers and individuals' motivations. First, incentive-based conservation policies can stimulate people's economic motivations and mobilize individual and collective behavior toward the formalization of conservation-oriented actions. Second, environmental justice concerns, such as international and national movements for the recognition of indigenous peoples' rights, can support local people's sense of autonomy and result in their increased control over their territory and resources, and a renewed conservation commitment. The results are crucial from a policy perspective since they provide insight into the governance of conservation development by bridging the gap between communities' culturally-based motivations for conservation that are still embedded in customary institutions and broader political and socio-economic contexts.

DECISION TOOLS FROM EVIDENCE SYNTHESIS: SUPPORTING WOODLAND EUCALYPT RESTORATION

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The restoration of native vegetation and habitat is an inherently difficult and uncertain task. Calls to provide accessible evidence-based information to aid management decisions are well justified. Research syntheses can provide much needed information on the outcomes of interventions, the gaps in knowledge and future research needs. Yet more is needed; predictions of the outcomes of management, the relative effects of different actions and the uncertainties associated with these are needed so that managers can ask 'what-if' questions. Further, it is desirable that these can be updated with appropriate empirical data. Bayesian Networks can serve the role of a process model for an adaptive management approach. In this paper we present a process model that synthesizes knowledge from the scientific literature into a modelling framework that can be updated as new information emerges. Despite much research dedicated to determining the major factors that most influence tree recruitment, continued declines in the extent of woodland habitat challenge biodiversity conservation in Australia. Through development of a process model focused on eucalypt seedling establishment in woodlands in south-eastern Australia, this research aims to provide a crucial link between the scientific literature and management. We describe the development of the model, its evaluation, updating with new data, then demonstrate how the model can be used to determine the management options that maximise the probability of restoration success, given a set budget, under scenarios where land-use history or climatic conditions may vary.

27 PATTERNS AND PROCESSES OF BIODIVERSITY DEFINING CONSERVATION PRIORITIES IN MEDITERRANEAN-TYPE ECOSYSTEMS OF THE WORLD

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Mediterranean-type ecosystems (MTEs) have been recognized as global hotspots of biodiversity since the "hotspot" concept was introduced (Myers 2003). Covering 2% of global land surface, the five MTEs are home to 16% of vascular plant species. All five regions show high species richness, diversification of many taxa, small population sizes, and comparatively high levels of endemism; both the species and their environments have proven to be appealing to human populations. Though the five regions share many climatic



characteristics, their floristic and faunal diversity have been generated and maintained by contrasting processes. The Cape Floristic Region and the Southwest Floristic Region of Western Australia are ancient landscapes, characterized by nutrient poor soils, long-term climatic stability (absence of glaciation), and accumulations of species over time from very old genetic lineages; these regions may have heightened vulnerability to human-associated extinction processes. The geologically and climatically more recent MTEs (central Chile, California Floristic Region, and the Mediterranean Basin) are heterogeneous landscapes with comparatively younger, more nutrient-rich soils, and a greater diversity of microhabitats; habitat diversity may explain more of the biodiversity in these regions. The distinctive attributes of each MTE region - including current biological and physical characteristics, past and present ecological and evolutionary processes, and the cultural norms of their human populations - must shape effective approaches to conservation of these resources.

SECURING MIGRATORY BIRDS IN PROTECTED AREAS

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Migratory birds present the ultimate future challenge for conservation, as their protection relies heavily on international policy and cross-border collaboration. Over half of the world's migratory birds are declining and it is clear that key science-policy gaps remain despite a proliferation of international conservation agreements targeting their conservation over the past three decades. We discover that 91% of the world's migratory bird species are inadequately covered by protected areas across their whole annual migration cycle, compared to 55% of non-migratory birds. Moreover, we show that protection is highly inequitable among countries, so birds that are well protected in one nation might be exposed to threats as they traverse other nations. This first global assessment of migratory species conservation has sobering consequences, given the recently renewed efforts towards increasing both the size and representation of the global protected area estate since the development of the Convention on Biological Diversity Strategic Plan in 2010. Our results demonstrate that this expansion must specifically consider migratory species, and will require better-targeted investment and enhanced coordination among countries. The current 2020 CBD targets will drive the greatest expansion of protected areas in history and represent a key opportunity to conserve migrants into the future in a coordinated and equitable way.

COSTS AND OPPORTUNITIES FOR PRESERVING COASTAL WETLANDS UNDER SEA LEVEL RISE

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Innovative strategies are needed to adapt to future impacts of climate change, such as sea level rise. Rises in sea level can alter the distribution of coastal wetlands, which may migrate landward or be lost as tolerance of inundation is exceeded. Coastal ecosystems are vital habitat for many species, such as migratory birds, and also provide essential ecosystem services. Whilst much attention has been given to the costs of human displacement and damage to property or infrastructure, the cost of preserving wetlands as their distribution changes under increasing rates of sea level rise has not previously been quantified. We illustrate that coastal land value increases with elevation and explore the implications of this for adapting the coastal reserve network to sea level rise using a local planning case study in Moreton Bay, Australia - a fast-growing urban region. Here we combined best practice in conservation planning with fine scale simulations of wetland change, revealing that the opportunity cost of preserving wetlands increases substantially with higher sea level rise projections. We quantified the value of carbon sequestration and nursery habitat for commercially important species and found that the additional costs could be attenuated by payments for ecosystem services, but only if these markets and payment mechanisms mature quickly. Until these markets mature, implementing climate change adaptation policy will require a greater investment in the conservation of coastal wetland communities.

USING CONTACT NETWORKS TO PREDICT INFECTIOUS DISEASE RISK IN SOCIAL MAMMALS

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Disease prevention is a top conservation concern for many wildlife species. Traditional disease modeling approaches assume individual contact rates are constant within a population; however, this is not the case for many wildlife species, where individuals vary in frequency and duration of contact with conspecifics. Social interactions can be formalized



as contact networks, which have great potential to better interpret the spread of infectious disease within susceptible wildlife populations. Here we present case studies on how these networks can be used to predict pathogen transmission in two social wildlife species. In South Africa, we used proximity-logging collars to quantify contact rates in a herd of wild African buffalo, which are naturally exposed to pathogens that cause diseases like tuberculosis and foot-and-mouth disease. We found that pregnant buffalo had the highest contact rates, and may therefore act as “superspreaders” of outbreaks within the herd. By collecting biological samples during bi-monthly captures, we are currently examining how buffalo contact patterns scale with individual immunity and real-time pathogen transmission. In a separate study system, we evaluated the efficacy of targeted wildlife vaccinations. Endangered great apes live in large communities and have experienced major population declines from directly transmitted infectious diseases like measles and Ebola. We simulated pathogen transmission and control strategies on social networks informed by nine months of behavioral contact data from a wild chimpanzee community in Uganda. Our simulations indicate that targeting the most connected chimpanzees can prevent large outbreaks with up to 35% fewer vaccines than random vaccination. Together, these studies demonstrate the use and versatility of contact network models in wildlife epidemiology and underscore the value of incorporating behavioral data into wildlife disease control efforts, particularly for endangered species.

MARGINALIZATION OF AGRICULTURE AND CONSERVATION OF SEMI-NATURAL GRASSLAND HABITATS IN LATVIA

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The important part of agrobiodiversity is semi-natural habitats. In Latvia, semi-natural grassland habitats cover approx. 47 500 ha (0.7 % of the total area of the country). Only 40 % of this area is located inside Natura 2000 sites. Overall conservation status of semi-natural grassland habitats was bad with the tendency to deteriorate according to the report on Article 17 of the Habitats Directive for 2007-2012 despite of ten year long support of management under agri-environment schemes of Rural Development Programme. One possible reason for this is marginalization of agriculture which leads to land abandonment and decline of biodiversity in agricultural landscapes. Our research aimed to evaluate the conservation status of grassland habitats in regions with different intensity of agriculture marginalization. We analyzed the area of grasslands and the number of households participating in the

agri-environment schemes. Analysis of grassland botanical quality was based on the results of Natura 2000 site monitoring (2007-2012), and inventory carried out in 2013 and 2014. In total, 4.5 % of the total area of semi-natural grasslands under agri-environment schemes were inventoried. The area and diversity of semi-natural habitats were not lower in marginal areas compared to non-marginal areas. Extent of abandonment of semi-natural grasslands was similar both in marginal areas with almost no agricultural activities, and in areas with the most intensive agriculture in Latvia. Biodiversity deterioration of abandoned grasslands was faster in areas with intensive agriculture. Semi-natural grasslands are located in river valleys in these regions, and flooding with nutrient-rich river water enhances eutrophication. The research was supported by the Latvian Council of Science (project No. 514/2012) and European Fund for Agriculture.

HOUSEHOLD LEVEL INFLUENCES ON FRAGMENTATION IN AN AFRICAN PARK LANDSCAPE

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The process of landscape fragmentation outside park borders occurs through the actions of people living in the landscape. In the larger protected area landscape of Kibale National Park in western Uganda, human-landscape relationships are typified by small-scale subsistence agriculture, in which households rely on resources provided in forests and wetlands, whose use is in turn shaped by perceptions of resource availability. To understand and manage for fragmentation of resource pools, identifying the proximate drivers - perceived limitations, and thus enacted resource extraction and utilization - is of fundamental importance. We combine landscape analysis at the household scale, using remotely sensed data, with household surveys, to understand the potential human drivers of local scale landscape change. We found strong evidence for a local household zone (LHZ) effect on fragmentation patterns, with geographical and socioecological heterogeneities in LHZ impact. Differences were influenced by wealth, and in some cases, tribal identity. The perception of crop raiders - primarily baboons and small monkeys, but also elephants and other animals - may have largely shaped human-environment interactions, and were associated with fragmentation. Ninety-two percent of the best fit models included the attitude that the park should stay, but associated with increased fragmentation, suggesting that the uncharacteristic non-hostile attitude about Kibale does not directly translate into conservation-friendly local human-environment interactions. Thus, this study provides insight into park-neighbor



interactions, the influence of the LHZ on protected area landscapes, and points to important points in the system for collaborative opportunities to engage communities and conservation managers.

WHOLE GENOME SEQUENCING OF CALIFORNIA CONDORS IS NOW UTILIZED FOR GUIDING GENETIC MANAGEMENT

Oliver Ryder

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A surviving species from North American Pleistocene biodiversity, the California condor is a critically endangered avian species that, in 1982, was reduced to a population of 22 birds in 1982, became extinct in the wild, and has survived persevered through a captive breeding program. It is now back in multiple populations within its former range, through reintroduction efforts. As of October, 2014, 425 California condors, including 219 flying in the wild constituted the extant population. Concern regarding preservation of genetic diversity and other small population impacts such as inbreeding, have led to intensive population management supported by molecular genetics research. Following a 1993 study, estimation of kinship among founder birds was based on multi-locus probe DNA fingerprinting. More recently, genomic methodologies have been applied to better understand the evolutionary and population genetics of California condors. A genetic map has been produced, DNA microsatellites developed and utilized for parentage verification, and whole genome sequencing of 36 California condors has described the entire genomic variation of the species. This has allowed reassessment of kinship among the founder birds, which is now being applied to selecting breeding pairs for the ongoing captive propagation effort. The captive breeding program for the California condor has become the first to base genetic management recommendations on complete genomes of the founders. A genetic disease, chondrodystrophy, is inherited consistent with an autosomal recessive mode of transmission in condors. Utilizing whole genome sequencing of affected chicks and their carrier parents, a series of linked markers localized in a 1 Mb region of the condor genome have been employed to detect carrier condors heterozygous for the lethal mutation. This information can be incorporated into population

management and reduce risk of reproductive failure as reintroduced populations begin to expand.

GENETIC DIVERSITY OF GAZELLES (GAZELLA MARICA AND GAZELLA GAZELLA) IN SOUTHEAST TURKEY

Dilan Saatoglu

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The present study was conducted to clarify and support the newly established taxonomic status of gazelles in Turkey and also to detect genetic differences between individuals (total n=77) based on 17 microsatellite loci, partial mtDNA cyt B sequence and restriction profiles for two restriction enzymes (Hinfl, HaeIII), and one Y-chromosome microsatellite locus (INRA126). We also investigated the variation between and within gazelle populations (n=3). First, we analyzed the effective population sizes and the recent past events which gazelles went through in the border of Turkey based on microsatellite data. Then, their taxonomic status was evaluated and confirmed by using mtDNA cyt B partial sequences and restriction enzyme profiles including the data from the literature. The results revealed no within population differentiation. However, observations on the basis of two restriction enzymes suggested that there is an easy and less time consuming method to differentiate the three gazelle species (*Gazella marica*, *Gazella gazella*, *Gazella subgutturosa*). Finally, the sequence of the INRA126 locus on the Y-chromosome differentiated between *Gazella marica* and *Gazella gazella* species. This preliminary Y-chromosome data may serve as a reference point for further studies on Y-chromosome diversity within and among gazelle species. The project was carried out in the name of Turkish Ministry of Forestry and Water Affairs and was supported by the Scientific and Technological Research Council of Turkey (TUBİTAK, project no: KAMAG 109G016).

THE CHANGING TRENDS IN BUSHMEAT EXPLOITATION IN GHANA

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The high level of exploitation of wild animals as food has contributed to biodiversity loss and the depletion of several species of conservation concern. This study examined the dynamics of bushmeat exploitation and trade in the Mankessim area in the Central Region of Ghana, and implications for resource sustainability and wild animal species conservation. Direct observations and structured interviews were used to collect biological data on traded species and socio-economic data from key actors in the bushmeat exploitation and trade from January, 2013 to February, 2014. A total of 3,743 individuals of 19 species of wild animals were recorded at the Mankessim market; with rodents dominating (74%), and the grasscutter (*Thryonomys swinderianus*) accounting for 54.5% of the total number of carcasses recorded. Bushmeat was delivered to the market from a large catchment area including 129 towns and villages. A comparison of the results with surveys carried out in 1975 showed that there has been a change in the composition and relative abundance of bushmeat species delivered to the Mankessim market, with significant decreases in the average weight of the carcasses of two species (*GrasscutterThryonomys swinderianus*, $t=13.368$, $df=3465$, $P<0.05$; and Royal antelope *Neotragus pygmaeus*, $t=6.089$, $df=194$, $P<0.05$). Bushmeat, including protected species, was available on the market all-year-round. The level of exploitation was not sustainable and the level of wildlife protection in Ghana is inadequate for regulating bushmeat exploitation. There is an urgent need to increase wildlife law enforcement efforts and proactively engage the key actors in the bushmeat trade in the regulation of bushmeat exploitation, not only to support species protection, but also to ensure the sustainability of their livelihood sources.

MAPPING FRESHWATER SERVICES FOR ASSESSING CONSERVATION METRICS IN CAMBODIA UNDER CONDITIONS OF SPARSE DATA

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Natalia ACERO, Conservation International

Mainstreaming ecosystem services into sustainable development policies is dependent on the scientifically sound demonstration of the role that ecosystems play in ensuring progress. This is of particular relevance to Cambodia, which is implementing the National strategic plan on green growth 2013 – 2030. Bearing in mind the importance of

freshwater systems to the country, assessing the role of conservation responses at safeguarding key provisioning and regulating services in Cambodia is likely to be essential for implementation of the strategy. This paper will provide context to current freshwater ecosystem mapping methods, will identify knowledge gaps in quantifying actual freshwater services and will propose and test a methodological framework to provide performance metrics for assessing the role that conservation has had in Cambodia in maintaining freshwater services. Many existing freshwater ecosystem mapping methods spatially represent the level of available services but very few use ecological production functions to elucidate the role that ecosystems play in delivering “actual” services. Moreover, many studies focus on quantifying the state of services but a knowledge gap still remains in integrating services to response dimensions such as conservation for appraising overall environmental sustainability. Here, we pilot the integration of an ecosystem services cascade framework with a pressure state response framework in order to create performance metrics of the role of conservation in ensuring provisioning and regulating freshwater services under conditions of sparse data. We demonstrate the method using the Tonle Sap Lake as a downstream reservoir of natural capital in Cambodia where a substantial amount of upstream provisioning and regulating freshwater services are realized.

AN ASSESSMENT OF ACADEMIC APPROACH ON A HOTSPOT REGION, TURKEY FOR BIRDS

Necmiye Sahin Arslan

Hitit University

Gönül ARSLAN, NEVSEHIR HACI BEKTAS VELI UNIVERSITY SCIENCE AND LETTERS FACULTY DEPARTMENT OF BIOLOGY

Turkey is a country that lies between Europe, Asia and Africa and has a total land area of more than 750.000 km². Millions of migratory birds passages across Turkey. A total of 464 species can be seen and there exist 16 globally endangered bird species in this region. There are 178 Important Bird Area with an area of 11,492,455 ha and four of them are in danger. Academic studies on birds are very important for conservation programs. We aimed to present the trend of the interest of birds in Turkish universities. The master and doctoral thesis which were done in Turkey on birds were searched between 1995 and 2014 years using the database of the Council of Higher Education and the thesis were grouped according to the topics and the study areas. Eventually, it was seen that 122 master and 27 doctoral thesis were issued throughout these 20 years. The thesis were related to avifauna (62), bio-ecology of one species (15), migration (12), breeding biology (8), bio-ecology of more than one species (6), anatomy (6), genetics (3), ecotoxicology, habitat, parasites, climatic changes, behavior, evolutionary biology, community ecology and conservation subtopics, respectively. These studies were carried out in



Biology, Zoology, Forestry and Forest Engineering, Veterinary Medicine, Genetics and Environmental Engineering departments. In conclusion, it was seen that the numbers of studies on birds have increased statistically significantly within years. Since Turkey is a critically important for birds, studies are still not enough. The awareness on the necessity of academic studies should be raised and the importance and necessity of studies in collaboration with different countries must be recognized in this important bird area where there are numerous endangered bird species.

POSTER: CO-INVASION BY ANTS: INHERENT BEHAVIOR FOR DISTINCT IMPACTS

Noémie Saint Germes

IRD

Eric VIDAL, IRD ; Hervé JOURDAN, IRD

With increased globalization, tourism and trade, more and more species are moved outside their native range. Some become invasives and then contribute to create multi-invaded ecosystems, but with unknown biotic interactions and other biotic consequences on communities (additive effects, facilitation, inhibition...). Among invasives, ants are considered prominently among the worst ones, according to their range of ecological and economic impacts. This kind of patterns are highly represented on islands, such as New Caledonia, in south West Pacific. New-Caledonia is recognized as a unique biodiversity hot spot with current high pressure from ants invasion, with at least 32 exotic ant species recorded. Two species are particularly of concern, classified among the world's 100 worst invasive species listed by the IUCN: *Anoplolepis gracilipes* (Smith) 1857 and *Wasmannia auropunctata* (Roger) 1863. In Northern New-Caledonia, on Tiébaghi mountain, *A. gracilipes* and *W. auropunctata* coexist together and with a highly endemic lizard community. This co-existence is unusual and not expected as many previous studies considered the co-existence impossible according to their respective high behavioural dominance over community. Many questions arise from this situation : how and why cohabitation is possible? Can cohabitation last? What impacts of invaders on biodiversity? Our study deal with impacts of this multi-invasion at various trophic levels (litter and ground dwelling arthropods to reptile predators) and give us an exceptional and unique insight of a multi-invasion on ecosystem functioning. First results reveal a clear differential impact on two distinct compartments of the ecosystem: When *A. gracilipes* interfere with endangered species of skinks, *W. auropunctata*, impact on native ant community. In order to better assess processes involved in the co invasion maintenance, a longer study is required.

21-BIOCULTURAL RIGHTS OF INDIGENOUS PEOPLES AND LOCAL COMMUNITIES: WHEN RIGHTS EMBRACE RESPONSABILITIES

Giulia Sajevo

Università degli Studi di Palermo

According to K. Bavikatte and Robinson, new 'basket' of group rights is emerging from the interpretation of multilateral environmental agreements, domestic law and case law, and from shifts in the development discourse and the struggles of communities. This new set of rights, 'biocultural rights' encompass all the rights of indigenous peoples and local communities required to secure their stewardship role over their lands and waters. Biocultural rights build on two founding interests: the self-determination and cultural diversity of indigenous peoples and local communities, and the conservation of the environment. This presentation suggests that the second foundation, the conservation of the environment, is what makes biocultural rights potentially more appealing than other human rights but that it is also the reason for their sui generis façade. Unlike human rights generally, biocultural rights seem to be aimed at protecting not only the interests of their right-holders, indigenous peoples and local communities, but also seem to protect a general interest of humankind in the conservation of the environment through the impositions of stewardship duties on rights-holders. Therefore, it is suggested that while biocultural rights provide a promising instrument for the promotion and protection of the interests of indigenous peoples and local communities, they also require such peoples and communities to be conscious of the fact that they, as biocultural rights-holders, take on a duty towards environmental sustainability that limits their self-determination interests. The presentation will explore some of the conceptual tensions emerging from this possibility.

129 TAKING THE OPEN STANDARDS TO SCALE: OUR PATH FOR THE COMING DECADE

Nick Salafsky

Foundations of Success

Amielle DEWAN, IFAW

Over the past decade, the Open Standards for the Practice of Conservation have become one of the world's leading systems for helping conservation practitioners to design, manage, monitor, adapt and learn from their site-based project work. In the coming decade, our challenge is to now take this work to scale. We need to work with conservation practitioners to (1) move beyond a focus on planning to implementation and full-cycle adaptive management and (2) expand our focus from site-based projects to large-scale programs. We need to work with thought leaders and system designers to (3) develop simple tools that enable practitioners to use key



Open Standards concepts without being overwhelmed by the entirety of the process, and (4) incorporate other key tools such as decision support methodologies and spatial analyses into our work. We need to enlist senior organizational leaders and funders to (5) demand that projects and programs have clear theories of change and systematically report on performance, (6) promote open sharing of both success and failures that is the basis of true learning, and (7) provide the necessary institutional support to take on this work. We need to engage with the academic community to (8) systematically vet and test key questions and assumptions and (9) provide training to the next generation of conservation practitioners and researchers. And we need to reach out to our colleagues in the rest of the environmental sector (e.g. climate change, sustainable agriculture, pollution management) and in other fields (e.g. poverty alleviation, public health) to (10) share what we have learned and benefit from their experiences. In the last ten years we have created the foundation of an applied evidence-based science of conservation – in the coming decade, we can now hopefully use this science to improve the effectiveness of our conservation actions at all scales.

ELEPHANT UTILIZATION AND IMPACTS ON THE FUNCTIONAL DIVERSITY OF THE DIOECIOUS PALM TREE BORASSUS AETHIOPUM MART. IN THE PENDJARI NATIONAL PARK, BENIN

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An in-depth understanding of plant-animal interactions is crucial to guide conservation decision especially in protected areas (PAs). Using 60 plots of 0.25-ha in a West African PA, the Pendjari National Park, we investigate the interactions of elephants with natural populations of *Borassus aethiopum*, a dioecious palm tree that provides important nutritional resources for elephants. Specifically, we documented all types of elephant-driven damages to the palm. We then measured the intensity of the damages (number of damaged tree per hectare) and assessed whether the life stage of the palm trees predispose them to intense elephant damages. Finally, we assessed how elephant pressure (low versus high) might affect the structure of the palm populations. We documented four types of damages to the palm tree, and these damages affect mostly sapling and adult palms. All palm populations follow a reversed J structure, irrespective of elephant pressure,

indicating the dominance of seedlings; but very few juveniles were found. As opposed to our expectation, we found no significant effects of elephant-driven damages on sex ratio within the populations of palm trees. However, there was a clear effect of elephants on density, height, dbh, and survival ratios. In particular, the density of saplings, the palm height and the seedling-to-sapling survival ratio track the intensity of elephant pressure (they are high where elephant pressure is high) whilst the density of juvenile and adult trees, the dbh and sapling-to-juvenile ratio followed an opposite trend. Our study therefore indicates that elephant impacts on the palm trees are contingent upon life stages, promoting recruitment of seedlings but preventing their transition to trees. Our findings suggest that elephants limit the functional diversity of *B. aethiopum* in natural ecosystems. **Keywords:** *Loxodonta africana*; *Borassus aethiopum*; herbivory; impacts; population structure.

LANDSCAPE CONNECTIVITY FOR WHOM, WHAT AND WHERE-TO-WHERE: ENGAGING EXPERTS IN CONNECTIVITY MODELING IN HALIFAX, NOVA SCOTIA, CANADA

Saloni Salaria

Dalhousie University

Karen BEAZLEY, Dalhousie University ; Peter BUSH, Dalhousie University

Landscape connectivity is complex to model, given the many species, ecosystems, ecological processes, spatio-temporal scales, landscape measurements and methodologies involved. In this study, we explore these elements by engaging experts (biologists, ecologists, planners and managers) and conducting preliminary analyses of connectivity in Halifax Regional Municipality (HRM) of Nova Scotia, Canada. Our multi-track approach included literature review, focal elements selection, habitat modeling, integration of expert knowledge, and application of GIS-based Circuitscape modeling. Expert engagement in determining who, what and how to connect formed a substantive component of the study. Habitat suitability and connectivity models were created for five focal elements – American Moose, Great Blue Heron, Red Spruce, River Otter and Wood Turtle. For a selected subset of these, alternative models were created using varied parameters of model inputs. As a case example, alternative series of connectivity maps for American Moose were generated for connectivity between habitat patches with (1) ≥ 75 habitat suitability index (HSI), (2) ≥ 80 HSI values, and (3) protected areas. The variations in results obtained highlight the importance of engaging experts and experimenting with model parameters before finalizing model rules and/or a specific connectivity plan. Such practices serve to lend greater credibility and buy-in to the analyses undertaken. The process and its results also speak to the importance of establishing



a clear vision, goals and objectives, delineating priorities around focal elements and target patches, and developing a transparent and defensible analytical framework for landscape connectivity and its application in landscape planning and management.

PREDICTING FUTURE EMERALD ASH BORER *AGRILUS PLANIPENNIS* (COLEOPTERA) INVASION INTO TEXAS USING DISPERSAL RATES AND DISTRIBUTION OF *FRAXINUS TEXENSIS*

Katalina Salas

St. Edwards University

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First reported in North America in 2002, the emerald ash borer (EAB, *Agrilus planipennis*) has been spreading rapidly from its point of invasion in Michigan. This spread has resulted in ash tree mortality in massive amounts on the scale of millions of individual trees. EAB appears to spread at a relatively constant dispersal rate, as over the past 13 years it has moved from southeast Michigan to states that are nearby Texas, including Colorado in 2013, Arkansas in 2014, Georgia and Kansas in 2015. In this study we examined previous models used to estimate EAB invasion from a study conducted at the University of Illinois Urbana and extended them to predict EAB invasion of Texas, allowing us to identify likely entry points for this invasive species. We also determined likely dispersal pathways within the state using known distribution of ash trees that would allow EAB to move from Arkansas to Wild Basin Wilderness Preserve in Austin, Texas using ArcGIS. We then examined the likely impacts of EAB at a local level by measuring the distribution and abundance of ash trees within and surrounding Wild Basin using plots for saplings, complete counts for adults with Wild Basin, and iNaturalist for adults outside of Wild Basin. Texas recently suffered a major drought that killed approximately 102.3 million trees in central Texas alone, so adding pressure from EAB invasion to these extreme climatic events resulting from climate change is highly problematic for Hill Country ecosystems. By estimating arrival times and dispersal pathways, our study provides critical information that can be used to stop the invasion before it occurs.

COMPLEX RESEARCH ON BIODIVERSITY (FLORA, BUMBLEBEE AND COMMON BIRD FAUNA) OF WOOD PASTURES IN THE NORTH HUNGARIAN MOUNTAINS

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Wood pastures are important remnants of traditional land use and preserve high biodiversity. Moreover, they are one of the most endangered woody, semi-natural habitats which are threatened by abandonment due to more intensive livestock production. In this way, nature conservation has major act in the maintenance of these habitats. The six selected wood pastures – located in the North Hungarian Mountains – are typical examples of this habitat in the geographical region and to the different states of use and abandonment. We have classified the main habitat types as treeless, wood pasture, shrubland and woodland parts. To compare the sites and habitats – as within each site as between the sites – we have collected coenological data on vegetation, zoological data by trapping and individual observations in the case of bumblebees and by point counting in the case of common birds. The diversity and distribution relations of the recorded approximately 290 plant species, 6 bumblebee and more than 50 bird species from the researched wood pastures highlight the differences and parallelisms between the habitats and different sites with regard to their various management history. Based on the composition of plant species, the treeless and wood pasture habitats are clearly segregated from the shrubland or woodland parts, moreover their diversity is also higher than the afterward mentioned. The low number of bumblebee species and individuals points to the signs of the pollination crisis, while the distribution of birds shows the importance of complex habitats.

CORAL REEF FISH POPULATIONS CAN PERSIST WITHOUT IMMIGRATION

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Determining the conditions under which populations may persist through time necessitates the use of demographic models, based on reliable estimates of input (recruitment, immigration) and output (mortality, emigration) parameters. Developing such models is especially challenging for marine populations for which recruitment may come from the natal population (self-recruitment) or other sources (larval



connectivity), which are rarely distinguished. The degree to which future population persistence depends on one or both of these inputs is unknown. Here, we evaluate population persistence and turnover for an entire population of the clownfish *Amphiprion percula* at Kimbe Island (Papua New Guinea) by genetic sequencing of all individuals on a bi-annual intervals over 8 years. These data enabled accurate measurement of self-recruitment, larval immigration and mortality through time, and an evaluation of their roles for the persistence of this open population. We found that more than ~50% of the recruits come from local recruitment and that this level of recruitment is stable over five sampling periods. Our demographic model indicates that the Kimbe Island clownfish population can persist without larval connectivity, as can 3 of its 7 small sub-populations. The sub-populations that persist without immigration either have high self-recruitment or low mortality rates. Fundamental approaches are necessary to understand how population can persist, evaluate parameters forcing the dynamics and to be able to develop appropriately targeted and scaled actions. In our own point of view areas that can self-sustain may be among the most important of sites to protect in priority than marginal areas in an era of increasing disturbance frequencies.

CRYOPRESERVATION FOR LONG-TERM CONSERVATION OF DATE PALM (PHOENIX DACTYLIFERA L.) DIVERSITY

Mohammad Salma

IRD (Institut de recherche pour le développement)
Florent ENGELMANN, IRD (Institut de recherche pour le développement)

Date palm (*Phoenix dactylifera*, L.) has a great ecological and socio-economical importance in arid and semi-arid areas of the globe. Date palm displays a large diversity, with over 2,000 varieties identified. However, this diversity is threatened by various diseases and by large-scale dissemination and intensive cultivation of elite varieties. These factors may result in the loss of many local varieties, which have a low productivity but which display interesting characteristics such as disease tolerance. The conservation of date palm diversity is thus a major challenge for date palm cultivation at the global level. Date palm is usually propagated using offshoots sampled on mother-plants. However, the number of offshoots produced per mother-plant is low and highly dependent on the variety. Therefore, *in vitro* propagation protocols have been developed, which allow the rapid and large-scale production of high quality materials. However, large-scale *in vitro* propagation bears the risk of off-type production caused by the occurrence of somaclonal variation. Cryopreservation, i.e. the storage of biological material at ultra-low temperature (liquid nitrogen, -196°C) is currently the only technique available to achieve long-term conservation of local and elite varieties of date palm

and to overcome the risk of somaclonal variation. In this work, we tested the efficiency of two techniques, droplet-vitrification (DV) and dehydration (D) cryo-plate for cryopreservation of proembryogenic masses (PEMs) of two varieties of date palm. With cryopreserved PEMs of variety Sokary, the highest regrowth achieved was 90.9-98.6% with DV and 92.0-97.9% with D cryo-plate. With variety Sultany, DV led to a maximum of 85.6-88.0% regrowth, while D cryo-plate led to a maximum of 67.0-74.6% regrowth. Our results will contribute to the long-term conservation and safeguarding of date palm biodiversity.

INTEGRATING BIODIVERSITY KNOWLEDGE IN VOLUNTARY CONSERVATION PRACTICE

Anna Salomaa

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While there are calls for scientific evidence based conservation, it is acknowledged that translating science into decision-making and policy implementation is not a linear process and the role of science has to be understood in relation to other forms of knowledge. Including research-based knowledge in decision-making should increase the effectiveness of conservation. Voluntary conservation is based on the premise of increased acceptance, but acceptance does not directly increase the effectiveness of conservation results. In Finland, voluntary conservation has been particularly emphasized in the Forest Biodiversity Programme METSO. METSO aims to halt the ongoing loss of biodiversity in southern Finland by involving landowners in conservation. Forest owners offer sites that are evaluated against ecological criteria and if accepted, the owners receive financial compensation for conserving the sites or for managing them if negotiated in contract. We study empirically the research-implementation gap in voluntary conservation. Data were collected via nine focus group discussions involving forest conservation stakeholders including administration, forest advisers, scientists and forest owners. The groups discussed the bottlenecks in implementation and solutions related to specific conservation issues such as landscape-level planning, old growth forests and the new Forest Act. Based on our findings, different types of knowledge mingle with each other. Discussions reflect that social knowledge is versatile and challenges ecological criteria. Understanding qualities of science, including ecological and other relevant types of knowledge when defining policy instrument, educating forest advisers, informing forest owners, increasing collaboration, creating chances to learn and build trust, carrying out management actions and monitoring effects can increase the flow of information from research to practice and increase effectiveness of conservation.



88 POST-RELEASE BEHAVIORAL MODIFICATIONS IN REINTRODUCED ANIMALS AND THEIR IMPORTANCE FOR CONSERVATION

David Saltz

Ben Gurion University
Oded BERGER-TAL, UCLA

The movement patterns of animals should result from decision-making processes based on the interaction between past experiences (knowledge), the animal's internal state, external conditions, and navigation capacity. Theoretical work supports the notion that organisms should initially invest more in learning when in an unknown environment and, over time, should shift to an exploitation strategy. Reintroductions offer a unique opportunity to study this fundamental theory, as reintroduced animals are completely ignorant of the new landscape they are confronted with and must modify the time allocated to exploration and exploitation as they gain knowledge of their environment. i.e., as an animal is becoming more familiar with its new environment, its knowledge gain should be followed by subsequent changes to its movement behavior. Such post-release behavioral modifications (PRBM) make movement behavior an excellent indicator of reintroduction progress. In this talk we will conceptually describe a logical process that enables the inclusion of behavior (in particular, movement behavior) in management decision-making post-reintroductions, and to do so, we will provide four basic components that a manager should look for in the behaviors of released animals. The suggested components are release-site fidelity, recurring locations, proximity to other individuals, and individual variation in movement behavior. These components are by no means the only possible ones available to a manager, but they provide an efficient tool to understanding reintroduced animals' decision-making based on ecological theory.

PUSHING THE BOUNDARIES ON ISLAND RODENT ERADICATIONS IN THE TROPICS: SHIP RAT ERADICATION ON CAYO CENTRO, BANCO CHINCHORRO, MÉXICO

Araceli Samaniego-Herrera

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The conservation of tropical islands is key for global biodiversity and central to the growing field of island restoration is the removal of invasive rodents. There are 25 biodiversity hotspots at the global scale; 16 of these are in the tropics and nine are mainly or completely made up of islands,

including most tropical islands. The 500+ rodent eradications on islands worldwide reflect the high relevance given by the conservation community to this tool as an effective approach to restore island ecosystems. However, the limited achievements in tropical regions mean that fewer efforts have been done to restore some of the most biodiverse portions of the planet. Furthermore, the lower eradication success rate has raised concern, as it is recognized that rat eradications on tropical islands face inherent challenges not well understood. This is particularly true for evergreen, tropical ecosystems, especially mangrove habitat. The Mexican islands are among the richest insular territories, as Mexico is a megadiverse country with an important tropical area. Unfortunately, invasive mammals have caused at least 17 extinctions of vertebrates on these islands and remain the main threat for many more. The challenging ship rat (*Rattus rattus*) eradication on Cayo Centro (Banco Chinchorro, Mexican Caribbean), scheduled for March 2015, will set a benchmark for rodent eradications on tropical islands worldwide. The closest comparable successful rodent operation is Palmyra, in the tropical Pacific, which at 235 ha is less than half the size of Cayo Centro (539 ha). The associated risks (flooded terrain in mangrove areas, tropical rainforest, land crabs and human settlements), science-based eradication strategy, and results of the operation (the 15th in Mexico) will be discussed. This experience will facilitate future projects in Mexico and elsewhere.

COMMUNITY ENGAGEMENT FOR SEA TURTLES PROTECTION IN LPMSUR, NORTH-WESTERN LIBERIA

Gordon Sambola

Farmers Associated to conserve the environment

The focal project species are the Leather back and Green sea turtles which IUCN Red list considered as endangered. Poachers often kill these turtles for their meat and eggs on the beaches of the project area (Lake Piso Multiple Sustainable Use Reserve, LPMSUR) which are important sea turtle breeding sites. Major beach threats here are sand mining and waste disposal. The project purpose is to stop the killing of sea turtles and harvesting of their eggs on the beaches of LPMSUR. Also the focused turtle species can serve as marine flagship species and their protection can support sustainable beach management and conservation of other important coastal biodiversity habitats/species in the area. The main project methods include (a) Organizing and training sea turtle protection groups in biodiversity conservation (b) Monitoring sea turtles (c) Conducting sea turtle campaign through village forum, nature clubs, drama, song and radio program and (d) Providing alternative livelihood for the sea turtle protection groups as motivational strategy. The expected output includes (1) three functional community sea turtles protection groups established (2) alternative livelihood provided for the group



and (3) a sea turtle data base established. The expected output will reduce threats to sea turtles in the project area

FLORISTIC HOMOGENIZATION CAUSED BY OVEREXPLOITATION OF THE ENDANGERED TROPICAL PALM TREE *EUTERPE EDULIS* MART.

Talita Ariela Sampaio E Silva

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Raquel Negrão BALDONI, Universidade Federal de São Carlos ;

Dalva Maria Silva Matos, Universidade Federal de São Carlos

The impacts of extraction of non-timber forest products on ecological processes have been underestimated. The tropical palm tree *Euterpe edulis* (Mart.) has high ecological and economical importance, but is subject to intense illegal harvest, which led species to extinction in some remnants of the Atlantic Forest. Our aim was to determine whether the density of palm trees influences the regeneration of plant communities by assessing the forest regeneration in the presence and absence of palm heart harvesting and two densities of palm trees in the tree layer. Our results showed that dominance patterns in the regeneration layer are affected by palm tree density. The diversity of seedlings was higher at intermediate densities of palm trees. Our results indicate that palm heart harvesting caused changes in community structure leading to floristic homogenization. Therefore, we suggest that the conservation of this species should consider the study on sustainable harvest of its resources, as well as improving the surveillance activities in order to conserve their populations and the entire communities.

SHOULD WE BE WORRYING ABOUT ECOLOGICAL TRAPS?: THE CASE OF FOREST BIRDS IN SHADE COFFEE.

Lina Maria Sanchez Clavijo

University of Central Florida

Tropical agroforestry systems retain important elements of native forest biodiversity. However, these intermediately-modified habitats may be functioning as ecological or perceptual traps, making species persistence uncertain in the face of further landscape change. We used birds in shade coffee plantations to evaluate if habitat selection is acting in an adaptive, maladaptive or neutral manner. We assessed habitat preference and quality at different scales by carrying out capture-recapture, capture-resight and visual surveys between 2009 and 2014, in a location known to be a hotspot for endemism and diversity (Sierra Nevada de Santa Marta, Colombia). We analyzed the resulting dataset of 4,539 captures and 2,655 observations for 12 resident focal species using general linear regression models. Conclusions varied depending on how preference was assessed, and

there were differences between the scales and variables that each species responded to. Species were assigned to three groups according to whether they prefer forest, shade coffee or are true generalists. Using size-corrected body mass as an indicator of habitat quality showed that after accounting for the effect of species and breeding condition, only three species showed differences between habitats, and all three exhibited adaptive selection (i.e. preferred the habitat where condition was higher in general or during breeding). Lack of support in any direction for the other species may be evidence for soft perceptual traps but this trend needs to be analyzed in light of varying densities and sampling efforts by habitat. Our work aims to improve the quality of the ecological information used to evaluate and develop conservation tools for birds in shade coffee, specifically, and for mobile animals in heterogeneous landscapes in general.

A SPATIALLY-EXPLICIT MODEL OF ECOLOGICAL TRAPS IN HETEROGENEOUS LANDSCAPES.

Lina Maria Sanchez-Clavijo

University of Central Florida

Jessica HEARNS, University of Central Florida ; Pedro F.

QUINTANA-ASCENCIO, University of Central Florida

Novel habitats in heterogeneous landscapes can become ecological traps for mobile animals if individuals consistently select habitats with detrimental fitness consequences over favourable ones. This phenomenon is hard to detect, which hampers our understanding of the factors that make species and regions vulnerable to it. Most analyses have focussed on animals selecting habitat type as a categorical variable but ecological traps only arise when the original and new habitats share selection cues. We created a spatially-explicit and individually-based simulation model to evaluate effects of landscape structure on population dynamics under different types of habitat selection. The model was parameterized with literature and field data from birds in tropical mountain forests and shade coffee. We ran simulations for 108 scenarios that varied in landscape configuration and composition, individual search distance, and algorithms for habitat choice. The strongest determinant of population size and overall fitness was the proportion of forest in the landscape. With discrete habitat selection (forest vs. coffee) there was a significant interaction between composition and the adaptiveness of selection (adaptive, neutral or maladaptive). Landscape configuration had a minor role, and search distance did not have strong effects. When birds used canopy cover as their preference criteria, the result was a heterogeneous selection surface with fuzzy emergent patterns and outcomes intermediate between neutral and adaptive selection. This result helps explain why habitat preference is so difficult to quantify and ecological traps so hard to detect. Our findings suggest that the negative impacts of ecological traps can be



buffered by managing both habitat structure and landscape characteristics. We hope to combine these outcomes with fieldwork to aid with the creation, evaluation and improvement of conservation tools aimed for forest species in agricultural landscapes.

DOES THE EUROPEAN UNION BIRDS DIRECTIVE CONTINUE TO BENEFIT BIRDS IN A NEW, LARGER EU? TESTING THE EFFECTIVENESS OF AN INTERNATIONAL POLICY INTERVENTION

Fiona Sanderson

RSPB

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Whilst considerable time, money and effort are invested in international conservation policy, the effectiveness of such policy and the conservation interventions implemented under it in improving the conservation status of targeted species is rarely evaluated. In one of the first studies of its kind, Donald et al. (Science, 2007) demonstrated that breeding bird species protected under Annex I of the European Union Birds Directive had more positive population trends following the Directive's implementation and more positive population trends in countries where they were protected than those where they were not, up to the year 2000. In this presentation, we consider whether protection under the Birds Directive continues to correlate with more positive population trends of listed species in an enlarged European Union up to 2012, using data on the population trends of all breeding bird species in all EU countries, and whether species which have been protected for longer benefit more. We also examine the impact of conservation interventions implemented under the Birds Directive, including the proportion of a species' range and habitat under protected area designation and the targeting of EU LIFE funding towards conservation action for particular species, to identify mechanisms by which protection under the Birds Directive might drive population trends, how these vary between countries, and how the targeting of such interventions might be improved in the future.

BONDING THROUGH HUNTING: THE ROLE OF ILLEGAL HUNTING AS A SOCIAL ACTIVITY IN THE BATUMI BOTTLENECK, GEORGIA

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Every autumn more than one million birds of prey funnel between the eastern coast of the Black Sea and the foothills of the Lesser Caucasus, in the Republic of Georgia. This

spectacle attracts not only bird watchers and ornithologists from all around the world, but also local people with shotguns. The tradition of autumn hunting of raptors has long been a widespread practice in the region: migration is a part of village customs, and the families' annual rhythm. In these sometimes very remote and infrastructurally underdeveloped poor villages, where unemployment rates are high, people mostly work around their houses, sometimes without going to the nearest town for weeks. For them, the autumn migration period is a red letter day in the calendar that signifies entertainment and free food. Despite its prevalence, there have been few studies on the scale, impacts and drivers of the shooting, and our understanding of its role as a social activity is still limited. According to previous studies, the range of the estimated casualties is very wide (up to 18,000 individuals per year), however, an increase of the number of shots recorded at the migration count stations indicates an increase in hunting pressure. Though Georgia is party to international agreements that protect migratory raptors, the current national legislation contains several loopholes, and its enforcement is close to non-existent. In addition, regional and national governmental institutions are largely ignorant or misinformed about this issue. Local and international NGOs monitoring the migration and hunting activities have recently become increasingly present in the region, which forecasts a potential conflict between conservationists and local people. This paper has a twofold aim: to present conservation questions arising from the illegal hunting of protected species, and to unpack the complexity of the social factors contributing to this.

PINE HEATH FORESTS IN THE HIGH COAST IN NORTHERN SWEDEN

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Pine heath forests in the High Coast area in eastern Sweden are old-growth forests with very little human impact. These forests are situated at hill tops and are characterized by nutrient poor and sun-exposed conditions and exposed rock is a common feature. The main tree species is slow-growing and persistent scots pine (*Pinus sylvestris*) and dead wood are abundant. In 2007 a rare beetle was discovered, *Chalcophora mariana*, a species previously thought to be extinct in Sweden. The beetle is entirely dependent on large dead pine wood in warm and sun-exposed environments. In addition a number of other rare species dependent on similar conditions are present in these forest stands, e.g. *Hymenophorus doubleri*, *Cryptophagus lysholmi*, *Dicerca moesta* and *Nothorina punctata*. Pine heath forests in the High Coast have not yet been studied and described. The aim of this study is to describe the structure, dynamics and history of these forests to better understand the environmental demands of several rare dead wood dependent



species. During the summer of 2014 we conducted field surveys using line transects quantifying key features important for the rare species. Tree diameter, age, growth rates, dead wood abundance as well as human influence and signs of fire was examined in seven forests. The result indicates that there has been some human impact since stumps were found in few locations, most likely only for fire-wood use because these forests have never experienced large-scale production. Signs of fire were rare, only a few fire-scarred trees were found, suggesting that perhaps fire has not been frequent, likely due to the low tree density and large areas of exposed rocks which restricts the spread of crown fires and ground fires. To better understand the structure, dynamics and history is of great importance for management of these forests so that the conditions for the threatened species that inhabits pine heath forests in the High Coast can be optimized.

AGRO-FORESTS COMPLIMENT BIODIVERSITY CONSERVATION IN THE WESTERN GHATS OF INDIA

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Krithi KARANATH, Centre for Wildlife Studies ; Paul ROBBINS, University of Wisconsin-Madison ; Ashwini CHHATRE, Indian School of Business ; Shashank DALVI, Centre for Wildlife Studies

The pervasive global forest decline has highlighted the importance of secondary habitats like production landscapes in harboring biodiversity. These landscapes are of particular significance in India, where protected areas are small and isolated. The Western Ghats region of India is amongst the hottest of the global biodiversity hotspots. However, with over 50 million people and rapid economic growth, only 9% of the region is protected as wildlife reserves. Studies suggest that matrices of cultivated agroforestry landscapes support wildlife, providing new opportunities for conservation. Our study focused on understanding the ecological and anthropogenic drivers of avian and amphibian community structures across agro-plantations of Western Ghats. We surveyed arecanut, coffee and rubber plantations, the three dominant crop types in the region. A total of 187 plantations were selected from districts with highest annual crop production in Karnataka State. Point counts were conducted in each plantation during the dry season to estimate bird species richness and densities. A subset of the same estates was resurveyed during the monsoons to examine patterns of amphibian occupancy. Coffee plantations ranked highest for their ability to support greater diversity and abundance of all guilds of birds and amphibians. Areca and rubber plantations favored different taxonomic groups. Of the three crop types, rubber hosts second highest species richness and density of birds. On the contrary, we detected more species of amphibians in areca plantations. The difference in management practices in these three crop-types likely influence the community structure of

vertebrates. Since vegetation within coffee plantations is more heterogeneous, its inherent capacity to sustain biodiversity is higher than mono-cropped plantations of rubber and areca. Our findings demonstrate the immense potential of agro-forests in sustaining biodiversity and compliment protected area based conservation.

OBSEA MULTI-SENSORS VIDEO-OBSERVATORY HIGHLIGHTS COASTAL COMMUNITIES' TEMPORAL DYNAMISM

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Multi-sensors observatories are developed nowadays in order to have a survey of marine communities at all depths of the continental margin. The multiparametric Western Mediterranean Expandable SEAfloor OBServatory (www.OBSEA.es) is a video platform used as EMSO testing site, and controlled by SARTI-UPC and ICM-CSIC. That platform is located 4 km off Vilanova i la Geltrú (Catalonia, Spain) at 20 m depth within the Colls i Miralpeix consortium. Using video camera, digital images of the environment have been taken at 360° in the past 3 years, during night and day, at 30 min frequency. Environmental variables (i.e. atmospheric for the surface buoy and oceanographic from the benthic platform; i.e. water temperature, pressure, salinity, chlorophyll, turbidity, air temperature, irradiation, rain, wind speed, sun elevation, and photophase duration) are sampled at corresponding timing. The number of counted fishes is estimated in images, as considered a proxy of overall activity levels within populations. Temporal variability in abundances is described for 2012. Time-frequency decomposition methods on abundances time series are used in order to detect temporal rhythmicity of fish abundances. A strong 24-h periodicity is highlighted. However, the amplitude coefficients of such periodicity vary over time. For all frequencies, 3 distinct periods are described. The first one, from the end of February to mid-April, has low amplitude coefficients for all frequencies. The second one from mid-April to, at least, mid-July is an intermediate period with low coefficients for all frequencies. The third period has the higher



coefficients for all frequencies, with strong 24-h periodicity. This lasted from mid-September to the end of December, as well as in the very beginning of 2012, before mid-February. In order to explain and understand this variability of species count rhythms, we sought for a cause-effect linkage with environmental variables.

HARVESTING RENEWABLE ENERGY WHILE PROTECTING BIODIVERSITY

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Reliance on fossil fuels is causing unprecedented climate change and is accelerating environmental degradation and global loss of biodiversity. Together, climate change and biodiversity loss, if not averted urgently, may inflict severe impacts on ecosystem processes, functions and services that support the welfare of modern societies. Increasing renewable energy deployment and expanding the current protected area network represent key solutions to these challenges, but conflicts may arise over the use of limited land for energy production as opposed to biodiversity conservation. Here we compare recently identified core areas for the expansion of the global protected area network with the energy potential available from renewable energy sources such as solar photovoltaic, wind and bioenergy. We show, for the first time at the global extent, that these energy sources have very different biodiversity impacts and net energy contribution. Using just 1% of land evenly spread over all viable areas for energy production, we identify a major opportunity for filling most of the global energy demand with solar power without compromising areas of high priority for global biodiversity protection. On the other hand, we find potentially catastrophic impacts on biodiversity from the expansion of bioenergy production, which furthermore can only provide a negligible contribution towards global energy consumption. The evidence provided here helps guide sustainable development of renewable energy and contributes to the targeting of global efforts in climate mitigation and biodiversity conservation.

HARVEST OF PINE TREES AT VARYING RETENTION LEVELS: ECONOMIC RETURN AND EFFECTS ON AMOUNT AND DIVERSITY OF DEAD WOOD

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Line DJUPSTRÖM, Skogforsk ; Thomas RANIUS, SLU ; Jörgen RUDOLPHI, SLU ; Olof WIDENFALK, Greensway ; Jan-Olov WESLIEN, Skogforsk

In managed forests, retention of both living and dead trees is fundamental to conserve biodiversity. In Sweden, the current practice is to retain a few percent of the trees on each clear-cut and set aside a few percent of the forest stands. Since retention decreases the revenues from forest harvesting, it is important to understand the consequences of different retention levels for both forestry economy and biodiversity conservation. In this study we compared different levels of retention in stands of Scots pine. The retention consisted of both leaving alive trees and creation of dead and dying trees. The level of retention was ranging from a few percent to all (100%) of the initial tree volume. We estimated the opportunity cost and, as a proxy for nature conservation values, dead wood amount and diversity. This was done in 15 harvested stands in a 140 ha large study area in central Sweden. As expected, we found an increase in opportunity cost with increasing retention level, mainly due to lower harvested volumes but also higher harvesting costs. Since a big part of the retention was killed trees, the amount of dead wood increased with increased retention level. To some extent it also increased because downed dead wood are destroyed to a lower extent in the areas where green trees are retained. The amount of coarse dead wood increased linearly with the retention levels, but it was not the same for the fine dead wood, since it was homogeneously distributed on the whole forest surface. The dead wood diversity increased linearly by increasing the retention up to 35-50%, before leveling off. We conclude that increasing the retention level could be beneficial for the biodiversity and could be an alternative to leave some stands with total retention.

TEMPERATURE-DEPENDENT SEX DETERMINATION CONFERS RESILIENCE TO HIGH TEMPERATURES IN SEA TURTLES BUT EFFECTIVENESS IS OVERRUN BY CLIMATE CHANGE

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Prevailing evolutionary theory is that environmental sex determination (ESD) is beneficial over genotypic sex determination (GSD) when there is differential fitness between the sexes. Temperature-dependent sex determination (TSD) is the predominant mechanism of sex determination in reptiles but its adaptive significance has not been assessed in most groups. In sea turtles, high temperatures produce female offspring and cool temperatures produce male offspring



(TSD type Ia). High temperatures also increase mortality of eggs and hatchlings. We simulated the effects of increasing temperatures on the viability of a population of leatherback turtles (*Dermochelys coriacea*). Then, we compared the results to those of a virtual population with similar characteristics but with fixed sex ratios, as if it had GSD. TSD populations were more resilient to increased nest temperatures than simulated GSD populations. Temperature in the TSD populations increased production of female offspring and future fecundity and compensated for the increased mortality of early stages, buffering the negative effect of high temperature on the population growth rate (λ_s). However, TSD was an effective mechanism only over a range of temperatures. Current climate change models included in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) project increases in temperature between +1°C and +3.7°C by the end of the 21st century. The leatherback population will decline under all contemplated scenarios of climate change and may become extirpated in ~50 years under the high gas concentration scenario.

MODELING SPREAD RATE IN TERRESTRIAL MAMMALS AND THE ABILITY TO TRACK A SHIFTING CLIMATE: A TRAIT SPACE APPROACH

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Sapienza Università di Roma

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Population spread rate is an important indication of species' ability to respond to new conditions and is receiving increasing interest in climate change biology. Understanding species' abilities to expand their range is key to assess species vulnerability to climate change, yet empirical data on range shifts are rare, and disentangling the effect of biological traits and local interacting effects has proved challenging. In this study we present a novel approach that allows us to explore species potential spread rate and their ability to track climate change. We generate a multivariate parameter space that follows the trait covariation observed in real terrestrial mammal species, we estimate the relative contribution of individual life history traits to the spread process and the potential spread rate given different combinations traits. Finally, we assess the ability of the terrestrial mammal community to track shifting climate across Earth biomes. Spread rate yields a positive relationship with dispersal distance, litter size and annual survival while a negative relationship with inter-birth interval and sexual maturity age. Almost 30% of species' spreading rate fall below the global predicted climate change velocity,

but the proportion varies across biomes ranging from 7.6% in tropical and subtropical coniferous forests to 44.6% in flooded grasslands and savannas. Our results allow to improve the predictions of species vulnerability to climate change by reducing the uncertainty due to the adoption of extreme and unrealistic dispersal scenarios. Given the lack of knowledge for most species, and the increasing threats to biodiversity and ecological processes, it is important to develop methods that rely on the knowledge of species traits and their covariation, and can be generalized at the species level in order to provide guidelines for management in applied conservation science.

CONNECTIVITY OF THE GLOBAL NETWORK OF PROTECTED AREAS

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Millennia of human activity have drastically shaped the Earth's surface confining wildlife in ever more rare and sparse habitat fragments. Within the strategic Plan for Biodiversity 2011-2020, Aichi target 11 aims at the expansion of the current protected area (PA) system and the maintenance and improvement of its connectivity. The present study aims at providing the first overview of the functionality of the PA networks across the six continents at different spatial scales as perceived by terrestrial mammals. We used a graph theory approach to compare the PA networks of different continents across a wide range of dispersal distances. We assessed networks at the country level, both as isolated networks within countries and as part of the continental network, in order to assess their potential role at a larger scale and identify transboundary areas along which connectivity should be improved.

National and continental networks are characterized by very different spatial arrangements which translate into different levels of connectivity, ranging from networks where the reachable habitat is mostly determined by habitat structural connectivity within reserves to networks where connectivity mostly depends on animal dispersal among reserves. These contrasting arrangements may be equivalent for long-dispersing species but result in different connectivity levels for less vagile species. Continental networks tend to perform worse than national networks; transboundary connectivity is often weak and should be improved, especially for countries that play an important role for upholding continental connectivity. The ability of species to move among PAs is heavily dependent on PA size and total coverage, while being less affected by species dispersal abilities whose effect size depends on the number of PAs. This suggests that increasing PA coverage and investing in PA size represents a good strategy for improving multi-species connectivity.



MANAGED LANDSCAPES AS SPATIALLY STRUCTURED ENVIRONMENTS FAVOURING COEXISTENCE: SPATIO-TEMPORAL NICHE PARTITIONING AMONG MEDITERRANEAN MESOCARNIVORES

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Successful conservation and management efforts require the understanding of mechanisms underlying species coexistence and assemblage organisation. In the biodiverse agroforestry cork oak landscapes of Iberia (Montado), management practices promoted landscape mosaicism and created intricate habitat and resource availability patterns, shaping the volume of available ecological spaces. Previous studies have assessed the association between these landscapes structure and patterns of carnivore diversity, but the mechanisms through which anthropogenic derived heterogeneity influences carnivore guilds organisation remain unclear. It rests uncertain whether human influence in managed landscapes stimulates differential selective behaviours and promotes niche segregation or increases inter-specific niche overlap due to the reduction of suitable habitats. We used camera-trap surveys to investigate niche relationships across a spatiotemporal axis among five mesocarnivore species (red fox *Vulpes vulpes*, Eurasian badger *Meles meles*, Egyptian mongoose *Herpestes ichneumon*, common genet *Genetta genetta*, and feral cat *Felis sp.*) in a managed Montado landscape in central Portugal. Interspecific differences in patterns of habitat use and activity supported a hypothesis of spatio-temporal niche partitioning. Results suggest indirect effects of human activity may greatly influence niche relationships. The anthropogenic-induced contrast between Montado patches preserving dense shrubby understory and semi-disturbed mosaics of sparse shrubs mediated spatial segregation patterns between the most abundant mesocarnivore species. We argue human-derived environmental heterogeneity in agro-silvo-pastoral landscapes creates new ecological spaces, acting as additional sources of niche differentiation to promote coexistence of generalist mesocarnivore species. Our findings can support informed management decisions reconciling exploitation of natural resources with conservation principles.

ATLANTIC FOREST: REMOTE SENSING DATABASE TO INVESTIGATE ECOLOGICAL PROCESSES

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Remote sensing and GIS are important tools to evaluate ecological processes. Remote sensing data enables to observe ecological processes in large and small scales and making consistent observations across time of these process. Here, our object was to structure a database from available remote sensing data for a part of Atlantic Forest Biome and estimate the habitat amount available for different groups of species in this Biome and provide this database for ecological studies. Our first step was to define from literature data the habitat requirements and matrix permeability informations for different group of terrestrial mammals. Our second step was explore all remote sensing data available of different periods of the time and adjust this data in the same size, spatial resolution and number of land use classes to 30 landscapes of 20 by 20 kilometres. Last, the mammals were classified in groups of size: small, medium and large and by habitat preferences and we estimated the habitat amount for each group including matrices as habitat areas preferences and also were calculated the percentage of each class by landscape. Our results showed the low conservation of the Atlantic Forest landscapes with high rates of the agricultural areas, where generalist species are more abundant and has more habitat amount available, due to these species use the matrices areas as resource. Remote sensing data are important tools for monitoring ecological processes and provide data for ecological analyses.

OCCUPANCY PROBABILITY OF ENDEMIC BIRDS IN GALLERY FOREST FRAGMENTS IN A TROPICAL SAVANNA

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Little is known about effects of habitat loss and fragmentation on birds' occupancy patterns in the Cerrado. This biome is one of the largest tropical savannas in the world composed of a mosaic of vegetation physiognomies including forests. Its landscape structure may affect both richness and occupancy probability of forest birds. Here we used a single-season occupancy model to estimate the occupancy and detection probability of five endemic forest bird species. We evaluated hypotheses related to forest cover (NDVI - Normalized Difference Vegetation Index, and NDVI Standard Deviation) and to the landscape composition (amount of forest, native and non-native surrounding vegetation). We conducted 589 point counts surveys at a total of 310 points in 59 sites within gallery forests during September to December from 2011 to 2013. Model-averaged occupancy estimates ($\hat{\psi}$) ranged



from 0.33 to 0.75, and detection probability (p) was less than one (0.29-0.71) for all species. Forest cover (NDVI in a 100-m buffer) was an important predictor variable and occupancy probability increased with NDVI values for three bird species. Landscape composition variables had a weak effect on occupancy probabilities. NDVI is an indirect measure of primary production and sites with higher NDVI values might have more resources available to birds. Considering this, in a local scale, the effect of habitat quality on birds' occupancy may be more important than the amount of available habitat. Thus, conservation efforts should be focused in activities that directly affect habitat quality, like selective logging and cattle presence into gallery the forests in the Cerrado.

RECONSTRUCTING CALIFORNIA CONSERVATION HISTORY: WHERE, WHEN, WHAT, HOW AND WHY

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In an era when biodiversity is highly threatened by changes in climate and land use, it is unclear whether our past conservation efforts will remain effective, and we do not know whether they have been effective so far. Reconstructing conservation history aims to digitally record and understand the development of conservation actions over time. We applied this framework to California to reconstruct where and when Open Space land was acquired, what these areas were acquired to conserve, how the process of acquisition was conducted, which governance levels and actors were involved, and which policies and other drivers explain their acquisition. Today, about ¼ of California is Open Space. Fewer and larger areas acquired at the beginning of the 20th century; and this conservation network was complemented with a larger number of small sized properties. The process of land acquisition was uneven, mostly due to the large efforts in the 1900s, followed by 1930s and 1940s. Forest ecosystems were the ones to be first protected, followed by coastal ranges and ocean-front landscapes, and deserts lands were mostly acquired in the 21st century. This process was a result of a comprehensive set of legislation that evolved through time, and resulted from the competing needs for development and conservation. Several actors were involved in the process of land acquisition, but polycentric governance does not seem to have an effect on conservation land purchases both in number and area. Governance levels, however, showed complementarity in their goals in that different government levels focused on acquisitions of different land-cover types. The framework we present here can, and should, be applied to other geographies and conservation strategies. Future conservation decisions are

not independent of the history of the conservation practice, as conservation in any decade is influenced by what has already been accomplished.

INTEGRATIVE APPROACH TO ASSESS GENOTOXIC RISKS AND ECOLOGICAL RISKS OF RIVER CONTAMINATION FOR WILD FISH POPULATIONS

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Water pollution is considered as one of the main threat to explain fish declines observed worldwide. Because of human activities, a large array of hazardous substances impairing aquatic organisms and leading to population disturbances are discharged into surface waters. Genotoxic compounds including pesticides, polycyclic aromatic hydrocarbons or heavy metals have been considered as hazardous substances inducing deleterious effects to exposed organisms, as well as progeny developmental defects. The first objective of the present study was to investigate a large panel of biomarkers including a genotoxicity biomarker to assess biological impacts of contamination on wild sticklebacks (*Gasterosteus aculeatus*). As a second objective, the relationship between the level of primary DNA damage in sperm from fish sampled in polluted rivers and their progeny survival was investigated. Finally, an approach integrating i) chemical analysis, ii) biomarker responses as early warning signals of contamination impacting individuals and iii) the Fish Based Index as an indicator of fish communities "health status" in French rivers was developed to assess ecological risks for fish populations. Biomarker responses showed some correlations between genotoxicity, biotransformation and oxidative stress biomarkers thus discriminating impacted sites under urban pressures. A significant lower probability of progeny survival was highlighted between the reference and contaminated sites. A trend for a correlation between the level of paternal DNA damage in sperm and progeny survival has also to be noted. Finally, the integrative approach underlined the complementary role of biomarkers, of chemical and of ecological indexes to point out biological disturbances at low levels of biological organization before affecting the community level.



CHARACTERIZATION OF A GENOTOXICITY BIOMARKER IN THREE-SPINED STICKLEBACK AND IMPLICATIONS FOR ENVIRONMENTAL MONITORING

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Water pollution is considered as one of the main threat to explain aquatic species decline observed worldwide. In order to assess exposure, fate and effects of chemical contaminants, aquatic ecotoxicologists have developed a large array of early-warning biomarkers proving that toxicants have entered organisms and have triggered toxic effects. In this context, investigating a large panel of biomarkers is relevant to assess the "health status" of aquatic organisms. For an optimal use of biomarkers in environmental monitoring, in-depth knowledge of the kinetics of response and of the natural variability of biomarker responses are required. As genotoxic environmental pollutants induce deleterious effects to aquatic species, this work aims to define as a first step of a validation process, the kinetic response of a genotoxicity biomarker recently developed in the three-spined stickleback (*Gasterosteus aculeatus*) through a 32 days laboratory experiment. Then, natural confounding influences of biotic factors (age, gender and reproductive status) on the biomarker response were investigated in a reference site before integrating the biomarker in a battery of 9 biomarkers to study fish populations from 5 rivers. The kinetic response of the biomarker underlined a fast induction and a slow recovery considering this biomarker as an integrative biomarker "ideal" for environmental monitoring. Gender, age and reproductive status did not influence the biomarker response in fish from the reference site. Finally, the genotoxic biomarker was among the four most discriminating biomarkers investigated discriminating fish from sites under urban pressure. The present work highlights in-depth knowledge necessary to avoid misinterpretation leading to false diagnostic of pollution impacts on aquatic organisms and demonstrated that integration of a biomarker of genotoxicity in a multi-parametric approach is relevant to assess ecotoxicological risk in freshwater aquatic organisms.

116. CONSERVATION FOR PEOPLE AND NATURE, A MAJOR EVOLUTIONARY TRANSITION?

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The debate about "old" and "new" conservation, or conservation for nature, for people or for both is mostly based on cultural, economic, or historic arguments concerning humans and ecological ones concerning non-humans. However we often miss an evolutionary point of view, despite conservation might induce major changes in micro and macro evolutionary trajectories of both human and non-humans. Indeed analysing conservation strategies in the framework of human and non-human evolution would not only allow us considering the evolutionary consequences of our actions on non-humans but also identifying the depth of the challenges that these strategies may constitute. Indeed conservation for people or for nature, e.g. through the definition of instrumental or intrinsic values of biodiversity, is all but neutral for the evolutionary dynamics of humans and non-humans. Conservation to sustain the basic needs of present and future generations and/or maximise their well-being puts a clear focus on the biodiversity required to maintain human fitness on the one hand, and human phenotypic comfort on the other hand. This appears to be a direct heritage of selective pressures and cultural evolution on human individuals and groups. It involves the reduction of predation, competition, parasitism and the enhancement of mutualism or symbiosis as well as the domestication of plants and animals to secure resources. On the contrary, the conservation of nature for itself, the acceptance of spontaneous dynamics and evolutionary trajectories, the maintenance of wildness beyond human needs constitute a fully new strategy at the scale of evolution. Thus, "old" conservation is paradoxically far evolutionary "newer" than the so called "new" one and this may explain the resistance to its implementation. We will explore evolutionary scenarios associated with conservation strategies, particularly for people and nature, and the possibilities of such evolutionary transition in the Anthropocene era.

DROSOPHILID ASSEMBLAGE STUDY AS A TOOL FOR BIODIVERSITY ASSESSMENT, CONSERVATION AND SUSTAINABLE DEVELOPMENT

Manisha Sarswat

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Saurabh DEWAN, HNB GARHWAL UNIVERSITY ; Rajendra Singh FARTYAL, HNB GARHWAL UNIVERSITY

Very few studies to date have exploited *Drosophilids* as potential bio-indicators of biodiversity or ecological integrity. Here we investigate the *Drosophila* assemblage as a bio-indication system especially for the management of areas



with high rates of habitat destruction and biodiversity loss especially aftermath Uttarakhand disaster. Several sampling surveys were carried out for about a year at several disaster hit stations in the Uttarakhand region to provide information about the composition of the Drosophilid community. Various diversity indices, constancy method and cluster analysis were used to analyse species occurrence. We analysed and compared this drosophilid assemblage data with our past years data record. Drosophilid community structure was found to be adversely affected for all disaster hit regions. Further, the ecological indexes also showed a possible positive association between species abundance and environmental heterogeneity of the studied areas. Mandal (1600m) being a transition area between sub-tropical and temperate zones, with a high degree of integrity as well as heterogeneity in climate & vegetation, proved to be most diverse of all stations studied. Thus, analysing drosophilid assemblage composition could help us better understand biodiversity of the region at different scales, and can help in identification of more accurate and resourceful biodiversity reserves. It can be also useful in recognizing the pattern and practices related to biodiversity loss and also the effect of anthropogenic activities, allowing the design of efficient conservation policies, and improved in-time future presumptions.

NICHE DEVELOPMENT FOR CERTIFICATION OF FOREST ECOSYSTEM SERVICES - ARE WE THERE YET?

Sini Savilaakso

Center for International Forestry Research
Manuel R. GUARIGUATA, Center for International Forestry Research

The rise of the concept ecosystem services has meant changes in the way forests are seen but so far the implications to their management have been limited. Despite the minimal market demand so far, certification standards have foreseen a potential market niche and have moved into certification of ecosystem services. Forest Stewardship Council is one of the standards developing its certification system to cover forest ecosystem services (FES) more explicitly. It is currently testing its strategy in a pilot project covering Nepal, Vietnam, Indonesia, and Chile. In this presentation we discuss the development of FSC's FES certification using multi-scalar multi-level perspective framework. We focus on niche internal dynamics as modifications of the system under development are possible based on the lessons learned. We look at three key processes of strategic niche management: expectations and visions, social networks, and learning processes. In addition to niche internal processes we identify macro-level processes that can influence niche development for FES certification. Our results suggest that developing a niche for FES certification is still at its infancy. Although the concepts "ecosystem services" and "certification" are well known among practitioners, they

remain rather abstract at implementation level. This has meant weak participation in creation of the vision that guides the development of FES certification. When we look at the social networks, we can see emphasis on different aspects at local and global level. Whereas at local level the focus has been on building a constituency, at global level the focus has been on further development of the system. Among the macro-level processes that can influence niche development for FES certification are market developments, other standard systems and governance instruments as well as the global efforts to improve effectiveness of governance interventions.

HEATED DEBATE BUT LITTLE EVIDENCE: USING SYSTEMATIC REVIEWS TO BUILD BRIDGES BETWEEN STAKEHOLDERS

Sini Savilaakso

Center for International Forestry Research
Manuel R. GUARIGUATA, Center for International Forestry Research ; Gillian PETROKOFKY, Biodiversity Institute, Department of Zoology, University of Oxford

The media is full of stories about the damage done to the environment by oil palm plantations and it is equally full of stories of the huge success of palm oil production for countries trying to raise their economic standards. Green business for the future will mean having economic success without damaging the environment. But just how much damage is being done by palm oil production? What does the science tell us? A systematic review is the best method for assessing this type of question where there is plenty of disagreement and not much robust analysis. Systematic reviews are transparent and replicable and seek to avoid the potential biases found in most literature reviews. They were developed in medicine to provide policymakers and practitioners with robust evidence that is as free from vested interests as possible. They are increasingly used for the same purpose in the area of natural resource management. In this presentation we discuss the opportunities systematic reviews offer to build bridges between different stakeholders. We use our own systematic review as an example. Our systematic review addressed the biodiversity impacts of oil palm cultivation and whether those impacts differ between industrial plantations and smallholder plantations per volume of fuel produced. We also want to share perspectives from our experience on conducting a systematic review in order to lift the veil to the world of systematic reviews and encourage more people to partake them to fully realize their potential in decision-making relevant to environmental management.



EFFECTIVENESS OF TRADITIONAL STRATEGIES IN REGULATING THE FISHERIES RESOURCES OF A SMALL COASTAL LAGOON IN GHANA

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Many Africa cultures have practices that regulate the exploitation of fisheries and other wildlife resources. The Sakumo Lagoon is a small coastal lagoon situated between Accra and Tema and within the Sakumo Ramsar site. The traditional owners of the land regard the lagoon as a god and use a strategy of closed and open season enshrined in religious beliefs to regulate the lagoon fisheries. We tested the effectiveness of this traditional strategy by measuring the fishing intensity, catch per unit effort as well as length-weight relationship, condition factor and reproductive status of the common fish species during the closed and open seasons of 2014-2015. Five fish species were recorded in fishermen's catches: *Sarotherodon melanotheron* and *Oreochromis niloticus* together accounted for 98% of the catch, *Alestes baremoze*, *Heterobranchus bidorsalis* and *Mugil cephalus* constituted the remaining 2%. The number of fishermen recorded on the lagoon in the daytime was much lower during the closed season, however the catch per unit effort was higher. Analysis of the weight-length relationships showed that for both *O. niloticus* and *S. melanotheron* individuals caught in the closed season were significantly heavier and longer (*O. niloticus*, mean weight (gm) closed season 19.4 ± 1.56 ; open season 11.98 ± 0.88 , $t=4.14$, $df=217$, $p < 0.0001$; *S. melanotheron*, closed season 19.4 ± 1.56 ; open season 7.11 ± 0.27 , $t=3.61$, $df=64$, $p < 0.001$). The condition factor (*k*) computed on the monthly samples ranged from 1.37 to 5.36 and 2.14-2.91 for *O. niloticus* and *S. melanotheron* respectively, indicating that the fish were in healthy condition in both seasons. While the traditional strategy was disregarded by several of the fishermen, it had a significant impact in reducing the pressure on the fisheries and allowing the fishes to grow bigger.

CURRENT STATUS OF STRIPPED HYENA IN SOUTHEASTERN TURKEY: PRELIMINARY FINDINGS OF THE RECENT CONSERVATION EFFORTS

Ali Onur Sayar

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Alper ERTURK, Kastamonu University, Game and Wildlife Programme ; Hasan EMIR, Republic of Turkey, Ministry of Forest & Water Affairs , General Directorate of Nature Conservation

and National Parks ; Taner HATIPOGLU, Republic of Turkey, Ministry of Forest & Water Affairs , General Directorate of Nature Conservation and National Parks ; Evren KOBAN, TUBITAK, Marmara Research Center, Genetic Engineering and Biotechnology Institute

As one of the Turkey's cryptic mammals, striped hyena is still remains its mystery in Turkish wildlife due to the lack of information on its behavior and ecology. However, thanks to the increasing number of studies in last ten years, the fundamental knowledge about the Anatolian populations of the species has been raised. Although the ancient records suggest that the species has once distributed through the Mediterranean and southeastern region of Turkey, current studies points out that western Mediterranean populations may have been extirpated, but southeastern populations are still viable. From this point of view, Central Hunting Commission has declared striped hyena as protected species in 2004 and Turkey's first wildlife reserve where the striped hyena is the target species has been designated in Antioch at 2013. To understand the current status and the major threats of the species in southeastern Turkey, camera trap studies, den site observations and the mortality data analysis has been performed in four different study sites between 2013 and 2014. According to the current data, species is highly nocturnal in Turkey unlike the Middle Eastern populations. Also the current data shows that the individuals closely dependent to the den sites especially those are surprisingly very close to the rural settlements and highest mortality on individuals are caused by highway collisions and poaching. Consequently, we believe that the findings of this ongoing study will contribute to the conservation and management of the striped hyena in the middle-eastern turkey

USING SOCIAL MARKETING CAMPAIGN AS EDUCATIONAL TOOL ON TIGER CONSERVATION

Santi Saypanya

Cornell University

The social marketing campaign designed to stimulate human behavior change in order to promote biodiversity conservation in developing countries. Lao People's Democratic Republic (Lao PDR) fits into the criterion. Specifically, Nam Et Phou Louey (NEPL) National Protected Area (NPA) that is considered to be among the best tiger habitats in South-East Asia. Significantly, it supports a tiger population of international importance. However, direct killing of tigers for trade and hunting tiger prey for trade lead to a high potential of losing key species forever. Therefore, the social marketing campaign was used as an educational tool to address the threats. The campaign used proven social marketing activities "theory of change" and "flagship species".The theory of change is key



component to address human behavior by addressing multiple educational materials at following stages knowledge, attitude, interpersonal communication, barrier removal and behavior change. Simultaneously, the flagship species represented the campaign as mascot. The presence of mascot is found every material in order to capture the prompt of the audiences on the campaign. At the end, the theory of change was measured by using a set of standard questionnaires developed by Rare. The results yielded significant increase in every stage of theory of change in campaign site as compared to the control site where there was no significant increase. At the end, the theory of change was measured by using a set of standard questionnaires developed by Rare. The results yielded significant increase in every stage of theory of change in campaign site as compared to the control site where there was no significant increase. In addition, in summer 2013 an additional research on understanding the relations between attitudes and behaviors on ungulate hunting will be conducted at the site and the finding will be added to this presentation.

SYMPOSIUM 34: SATELLITE REMOTE SENSING, FRONTAL ZONES AND THE IDENTIFICATION OF PRIORITY CONSERVATION AREAS IN THE OCEANS

Kylie Scales

NOAA Southwest Fisheries Science Center
Peter MILLER, Plymouth Marine Laboratory ; Elliott HAZEN, NOAA Southwest Fisheries Science Center ; Steven BOGRAD, NOAA Southwest Fisheries Science Center

Identifying priority areas for biodiversity conservation in the vast and dynamic oceans is a major challenge in marine management. Oceanographic features such as upwelling regions, major currents, fronts (physical interfaces at the transitions between water masses) and eddies (circular currents with warm or cold water cores) can create conditions suitable for the development of biophysical hotspots in pelagic systems. Predictable mesoscale (10s to 100s km) regions of persistent frontal activity, 'frontal zones', appear to be particularly important. A taxonomically diverse range of marine predators such as seabirds, sharks, turtles, pinnipeds and large teleost fish are known to associate with these habitats for foraging and migration, making them important candidate sites for conservation. Frontal zones can also be hotspots of overlap between critical habitat and spatially explicit anthropogenic threats, such as the concentration of fisheries activity. As such, they represent tractable conservation units, in which to target measures for threat mitigation. Satellite front mapping facilitates identification, monitoring and management of these hotspots of vulnerability. Seasonal or climatological products can locate biophysical hotspots, while near-real-time front mapping augments the suite of tools supporting spatially dynamic ocean management. These insights are informative for marine spatial planning and marine biodiversity

conservation, both within Exclusive Economic Zones and in the open oceans.

SYMPOSIUM #133 SACRAMENTAL MOTIVATION FOR RESTORING AND CONSERVING PRAIRIES, WOODLANDS, AND LAKES IN MIDWESTERN USA

Jame Schaefer

Marquette University

Partnering with environmental, civic, and community groups and aided by conservation biologists, the Sisters of the Order of St. Benedict have been restoring prairies and woodlands and protecting a 10,000 year old glacial lake in the middle of the State of Wisconsin of the United States of America for all people to enjoy and native species to flourish. They hope that all who experience the 138 acres that constitute Holy Wisdom Monastery will respect and nurture the harmonious functioning of the diverse animals, vegetation, land, water, and air. To advance this goal, they offer volunteer restoration opportunities, nature walks, tours of seasonal changes, educational programs, and spiritual retreats. Motivating their efforts is their reverence for God's creation through which the faithful can experience the presence of God. Conceptualized as the "sacramentality of creation," the Sisters' reverence for Earth (the "Book of Nature") has a long theological tradition that is explored in this presentation and paralleled with other religious faiths that variously express a "sense of the sacred" in the world. This spiritual perception can inspire the faithful to collaborate constructively and meaningfully with scientists in restoring, conserving, and preserving ecological systems and the biosphere.

THREE DECADES OF HABITAT USE REVEALS FOOD LIMITATION OF NEWFOUNDLAND CARIBOU

James Schaefer

Trent University
Shane MAHONEY, Conservation Visions ; Jackie WEIR, Newfoundland & Labrador Department of Environment & Conservation ; Glenn LUTHER, Newfoundland & Labrador Department of Environment & Conservation ; Colleen SOULLIERE, Newfoundland & Labrador Department of Environment & Conservation

The identification of limiting factors is paramount in population ecology and conservation, but often demands sustained observations in the case of long-lived species. Indeed, numerical changes of migratory caribou typically unfold over decades; few studies have examined habitat use at similar timeframes. We analyzed three decades of habitat use by caribou in Newfoundland, Canada – based on radio-tracking of almost 500 adult females, and analysis of diet and age-



specific tooth wear from harvested animals – coincident with the numeric growth ($r \approx 0.064$ in 1980s, 1990s) and decline ($r \approx -0.099$ in 2000s) of this population. Based on landcover composition in the vicinity of each radio-location, females in the 2000s generally displayed diminished use of open and closed coniferous forests, especially during fall and winter, and increased use of barrens, a habitat with greater vascular plant resources, although patterns were not wholly consistent among herds. Based on histological analysis of rumen and faecal samples, diet in the 2000s was increasingly composed of moss and other low-quality forages at the expense of lichens. Teeth of prime age and older caribou exhibited premature wear, likely indicative of depletion of high quality forages and cropping of foods close to the ground. These patterns mirror other responses – declines in calf weight, female body size, number of male antler points, herd affinities, and time spent on the summer grounds. We surmise that they are consistent with density-dependent forage limitation of this island population.

33: THREATENING MESSAGES IN ENVIRONMENTAL COMMUNICATION: A DREADFUL IDEA?

Tim Scharks

University of Washington

People concerned about an issue may attempt to use fear or threats of negative outcomes to persuade others to care about that issue and modify their behavior accordingly. But this tactic rarely works, and may even backfire by polarizing opposition instead of persuading. Threatening messages may cause psychological reactance, defined as anger and counterarguments, increasing resistance to the desired behavior change. This talk presents results from an experimental test of threatening climate change messages on donation behavior. Participants were randomly assigned to a variety of advertisements and could then choose to donate part of their compensation either to environmental nonprofits or to conservative organizations working against climate policy.

INTEGRATED SPATIAL CONSERVATION PRIORITIZATION

Laura Scherer

ETH Zurich

Michael CURRAN, ETH Zurich ; Miguel ALVAREZ, University of Bonn

Biodiversity is declining worldwide at an alarming rate. There is an urgent need to expand conservation efforts to save as many species as possible. To assist this effort, we mapped conservation priorities in Kenya based on maximising complementary richness of plant communities while minimizing economic costs. Complementary richness accounts for both alpha and beta diversity, represented by

species richness and community uniqueness, respectively. We predicted such patterns spatially by relating biological data to environmental variables based on a dataset of 1936 plots and 1432 vascular plant species. To do this, we used generalised additive models and generalised dissimilarity models. We applied nonmetric multidimensional scaling to community dissimilarity to delimit floristic management units. We used these data, as well as existing protected area (PA) coverage, habitat condition, agricultural opportunity costs and conservation management costs to conduct a conservation prioritization using the software Zonation. Zonation iteratively removes the least valuable cells of a landscape based on a pre-defined “biodiversity benefit function” while accounting for land use competition and cost-effectiveness. Our results indicate that Kenya’s current 10% PA coverage does not represent all 37 delineated floristic management units. Expanding the PA network should focus on the Coast and North-Eastern provinces. Meeting the Convention on Biological Diversity (CBD) target of 17% terrestrial coverage by 2020 would increase representation of plant complementary richness by 69%. However, this would require up to USD 400 million per year in management costs, 20 times more than Kenya has received thus far from the Global Environment Facility. Additional opportunity costs could amount to up to USD 68 million per year. This implies serious practical challenges for meeting the CBD targets. Regardless, our models can still be useful to guide existing funding more effectively.

126 - CONSERVATION AND DEVELOPMENT IN A VUCA WORLD: THE NEED FOR A SYSTEMIC, RISK-ROBUST AND ECOSYSTEM-BASED APPROACH

Axel Schick

Eberswalde University for Sustainable Development
Pierre L. IBISCH, Eberswalde University for Sustainable Development

Overcoming traditional approaches biodiversity conservation is becoming an integral part of an ecosystem-based sustainable development targeting the maintenance of functional ecosystems that provide the significant basis for human well-being. The framework conditions that challenge sustainable development are shaped by increasing Volatility, Uncertainty, Complexity and Ambiguity (VUCA concept). Drivers of system dynamics such as climate change, rapid interacting socioeconomic, technological and political changes are often unmanageable on a local scale and require a new approach to planning and action. We analyzed 12 conservation areas (covering 9 protected areas and 5 administrative areas) on 3 different continents with the MARISCO method (adaptive Management of vulnerability and RISks at COnservation sites). This method follows an ecosystem-based approach to natural resource management that systematically encourages managers to include uncertainties and risks into the



process of decision-making and sensitizes for the frequently underestimated complexity that easily leads to strategic failure. Guided by a set of standardized steps, the method provides a systemic reflection of complex conservation situations elaborating a conceptual model. The participatory analyses illustrate that human wellbeing depends to a high proportion on the functionality of ecosystems, which face a high diversity of stresses and threats of varying criticality. Worldwide, local stakeholders and experts rated impacts of global climate change on ecosystems as the most critical problems. Institutional and governance-related weaknesses imply a relatively high vulnerability of management. To achieve an ecosystem-based sustainable development most management teams strive for more risk-robust and adaptive strategies, envisioning an active risk management. A general trend is the need for cooperative management of smaller conservation sites in order to jointly face bigger challenges.

CATTLE FOR CONSERVATION? CATTLE-WILDLIFE COEXISTENCE ON SHARED RANGELANDS IN EAST AFRICA

Jennifer Schieltz

Princeton University

Daniel RUBENSTEIN, Princeton University

Forty percent of earth's land surface is used for grazing domestic animals. These lands also support many wild large mammals and are vital to their continued existence. Consequently, conservation efforts are increasingly aimed at managing land for wildlife-livestock coexistence. In East Africa, many ranches and conservancies have now adopted policies of wildlife-livestock integration, combining cattle production and wildlife tourism. However, there are still many unanswered questions about how species will respond in these systems. This work aimed to quantify the response of a range of wild grazers to cattle grazing in central Kenya and provide data directly to land managers to further conservation goals. One explanation for why so many grazing species coexist in African savannas is that they divide up food resources. I investigated how body size and digestion affect responses of five focal species, three ruminants (Thomson's gazelle, hartebeest, buffalo) and two non-ruminants (warthog, plains zebra) spanning a range of body sizes, to cattle grazing. Detailed spatial data on cattle use intensity was obtained using GPS collars on cattle herds. I then examined the impact of cattle on vegetation, and in turn on wild grazers. Results show that cattle change both the quantity and quality of grass, and may improve vegetation for several species. Small species preferred low biomass areas grazed more by cattle, while buffalo were found mostly in high biomass areas away from cattle. When grass is not limiting, zebra are also drawn to areas of high cattle use after rain. Non-ruminant species were more evenly distributed and utilized more of the available habitats than

their similar-sized ruminant counterparts. Understanding the effect of cattle on different species will allow ranchers to adjust management plans to promote coexistence. We are examining how adaptive cattle management can even be used as a tool to manage rangelands for wildlife.

GLOBAL DATA, SCIENCE, AND CONSERVATION: ARE WE TALKING TO EACH OTHER?

Dmitry Schigel

Global Biodiversity Information Facility

Tim HIRSCH, Global Biodiversity Information Facility ; Siro

MASINDE, Global Biodiversity Information Facility

Explorative and experimental scientists have been mostly collecting, analysing and interpreting their own data. The nature of questions faced by conservation biology calls for use of aggregated data at various temporal, spatial and taxonomic scales. Development of biodiversity and environmental data standards improved the compatibility and the trust in the aggregated data. The relatively new phenomenon of digital availability of massive and heterogeneous biodiversity data has not yet fully permeated the culture and traditions of biological research and conservation management. The Global Biodiversity Information Facility (GBIF) is an international open data infrastructure, funded by governments, allowing free and open access to biodiversity data collected and stored anywhere on Earth. GBIF provides a single point of access to more than 500 million records of nearly 1.5 million species, shared freely by hundreds of institutions worldwide (www.gbif.org). The records, some backed by multimedia files, vary from geo-referenced and time-stamped observations, provided both by researchers and citizen scientists. GBIF collaborates with major organisations active in biodiversity conservation and data, including IUCN, Biodiversity Heritage Library, Encyclopedia of Life, International Barcode of Life Consortium, Catalogue of Life, UNEP-WCMC, and the Intergovernmental Oceanographic Commission, and is recognised as a complementary partner of the Convention on Biological Diversity (CBD) and Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) for data mobilization, integration and access. There is strong potential for substantial global benefits to improve the quality, completeness and accessibility of biodiversity data and information in closer collaboration between institutions and expert communities, data aggregators and research infrastructures, conservation biology and other biodiversity sciences, conservation management and decision making.

MAPPING A SUSTAINABLE FUTURE FOR GABON'S FRESHWATER RESOURCES

Steven Schill

The Nature Conservancy



The Gabon Freshwater Conservation Atlas is a multi-stakeholder effort to balance government commitments to freshwater habitat conservation with ongoing planned economic development. As a decision support system, the Atlas was created by combining available data, literature, and expert knowledge within a framework designed to evaluate conservation and development scenarios-- guiding decisions about habitat protection, natural resource development, and mitigation. We provide a comprehensive aquatic ecosystem classification for the entire country as well as measures of disturbance or cumulative impacts, and an analysis of conservation priorities based on the representation of biodiversity elements, connectivity, and ecological condition of these resources. A unique aspect of the Atlas is that it uses the model RIOS to incorporate ecosystem services such as erosion control, nutrient retention, and groundwater recharge into conservation planning scenarios in order to evaluate tradeoffs between natural resources development and protection of habitat and ecosystem services. The compilation of these data and models have been a benefit to a variety of stakeholders since they have provided a way to locate high value servicesheds, while systematically identifying data gaps and prioritizing areas where additional field surveys are needed. Areas identified in the model as conservation priorities are not intended to be prescriptive or static, but to provide a dynamic user-friendly and accessible platform that permits users engaged in development, conservation and management activities (e.g. hydropower, mining, forestry, palm oil, etc.) to have the best available spatial information on freshwater resources and better understand their options for avoidance, offsetting, and mitigating potential impacts of their economic activities for promoting sustainable economic growth into the future.

MOSS INVASION EFFECTS ON COASTAL DUNE ARTHROPODS

Jens Schirmel

University of Koblenz-Landau

Invasive plants can have significant ecological impacts. One of the most invasive moss species worldwide is *Campylopus introflexus*, which is known to affect the native vegetation in dune and heathland ecosystems. This project aims to investigate its potential impact on the structure and function of multiple arthropod taxa in grey dunes on the island of Hiddensee, Germany. In particular, the effect of the moss invasion was analyzed on (i) the community structure and diversity of ground-dwelling arthropods with a special focus on carabids and spiders, (ii) soil biological activity as a main ecosystem function, and (iii) the oviposition behavior of grasshoppers. As main results, the moss influenced the

community structure of arthropods and reduced the soil biological activity compared to native lichen-rich grey dunes. It decreased alpha diversity of carabids and spiders and changed the functional trait composition with more herbivore and smaller carabids and more web-building spiders occurring in native sites. Grasshoppers preferred to oviposit in *Campylopus* moss patches compared to native lichen-rich patches. The shifts in arthropod community structure were taxon-specific and can be explained by changes in vegetation structure, microclimate and soil moisture associated with the moss invasion. The reduced soil moisture was identified as the main driver for the decreased soil biology in moss invaded sites. The reduced habitat complexity associated with the moss invasion can explain the displacement of single carabid and spider species and shifts in functional trait composition. In contrast, the reduced habitat complexity might facilitate the oviposition of grasshoppers into the moss patches. The results demonstrate the various and taxon-specific effects of the invasive moss *C. introflexus* on arthropods and highlights the importance of approaches which consider multiple taxa and ecosystem functions for a better understanding of plant invasion impacts.

76-EVALUATING IMPACTS OF CONSERVATION INITIATIVES ON DEFORESTATION AND FOREST DEGRADATION IN THE PERUVIAN AMAZON AND FACTORS INFLUENCING THEIR SUCCESS

Judith Schleicher

University of Cambridge

In light of the persisting conservation pressures despite considerable conservation efforts, there have been increasing calls for interdisciplinary approaches to rigorously evaluate conservation impacts to ensure that conservation efforts are effective and have their intended impacts. However, such evaluations of conservation efforts are still relatively rare. In addition, the establishment of state-controlled protected areas (PAs) has dominated conservation strategies globally, although an extensive literature has highlighted that no single governance regime is a silver bullet solution to sustainable resource use. As a result one emerging strategy, which has so far not received much research attention, has been to draw on the contribution of non-state actors to protect conservation areas. To contribute towards addressing these research gaps we therefore evaluated conservation impacts of Conservation Concessions (CCs), a novel conservation tool promoted in a number of Latin American countries. These concessions comprise public land given to non-state actors, whether individuals or collectives, for conservation purposes. We integrated quantitative and qualitative data derived from remote sensing, GIS datasets, a questionnaire survey and semi-structured interviews to better understand: 1) whether CCs



have helped to reduce deforestation and forest degradation in the Peruvian Amazon compared to non-protected lands and state-controlled PAs, using a counterfactual approach; and 2) the factors influencing these conservation impacts. The study highlights the contributions that CCs have made to conservation in the Peruvian Amazon in terms of reducing the likelihood of deforestation and forest degradation. However, several institutional, social and economic challenges have constrained their conservation impacts and should therefore be strengthened to improve conservation impacts.

SUSTAINABLE USE OF ECOSYSTEM SERVICES IN JORDAN: EXPERIENCES FROM THE FIRST MONTHS OF A MULTILAYER PROJECT

Oliver Schlein

Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) GmbH

Jordan, with its very limited natural resources, is seriously affected by desertification, urbanization and a rapidly growing population. Obvious effects of climate change like erosion and land degradation, as well as unsustainable practices like overgrazing, illegal logging and environmental pollution, cause all dramatic pressures on the highly vulnerable ecosystems and threaten their numerous services provided to the people. Ecosystem services are still rarely evaluated and neither considered in the political decisions of the Jordanian government, nor recognized by the Jordanian society. On behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) strengthens different Jordanian relevant stakeholders with the project "Sustainable Use of Ecosystem Services in Jordan" from 2014 to 2019. The Jordanian Ministry of Environment is supported in the development of a national biodiversity policy with guidelines for the evaluation of ecosystem services. Field case studies are implemented in selected communities in the Jordan Rift Valley to demonstrate best practice examples for rangeland and grazing management, combined with strategies to enhance ecotourism. Results of these case studies are shared with the Jordanian public and related stakeholders, to feed it into political decision making. The establishment of a national information system about ecosystem services, based on professional evaluation, monetary calculation and related aspects of biodiversity conservation, is another main objective of the project. Preliminary results of the start up of the project are presented, with a focus on the involved field case studies, the evaluated ecosystems, the main ecosystem services used by the local population, as well as the positive impact of sustainable practices on the conservation of natural resources and biodiversity of Jordan.

CAN WE INFORM EBVS WITH THE CURRENTLY AVAILABLE DATA ?

Dirk Schmeller

Helmholtz-Center for Environmental Research

The main source of information on biodiversity originates from biodiversity monitoring under an enormous effort. Biodiversity data is however scattered and difficult to assemble, access and analyze. Despite efforts deployed in the global mobilization and the standardization of (digital) biodiversity data, progresses are still insufficient to integrate all information, making access to unbiased biodiversity status and trends difficult on a global level. Despite such difficulties, data from biodiversity monitoring remains central to document change and therewith evaluate the conservation status of species or to assess biological responses to environmental changes (such as climate change, and to conservation policies. In that regard, it is important to know, if we can really inform important biodiversity changes and the relevant Essential Biodiversity Variables. I will elucidate on the currently available biodiversity information with a look backward in time.

151-MICROSCOPIC AQUATIC PREDATORS DICTATE INFECTION DYNAMICS OF A GLOBALLY EMERGED PATHOGEN

Dirk Schmeller

Helmholtz-Center for Environmental Research

Adeline LOYAU, Ecolab Laboratoire écologie fonctionnelle et environnement ; Mark BLOOI, University of Ghent ; An MARTEL, University of Ghent ; Frank PASMANS, University of Ghent

Research on emerging infectious wildlife diseases has placed particular emphasis on host-derived barriers to infection and disease. This focus neglects important extrinsic determinants of the host/pathogen dynamic, where all barriers to infection should be considered when ascertaining the determinants of infectivity and pathogenicity of wildlife pathogens. Those pathogens with free-living stages, such as fungi causing catastrophic wildlife declines on a global scale, must confront lengthy exposure to environmental barriers before contact with an uninfected host. Hostile environmental conditions therefore have the ability to decrease the density of infectious particles, reducing the force of infection and ameliorating the impact as well as the probability of establishing an infection. Here we show that, in nature, the risk of infection and infectious burden of amphibians infected by the chytrid fungus *Batrachochytrium dendrobatidis* (Bd) have a significant, site-specific component, and that these correlate with the microfauna present at a site. Experimental infections show that aquatic microfauna can rapidly lower the abundance and density of infectious stages by consuming Bd zoospores, resulting in a significantly reduced probability of infection in anuran tadpoles. Our findings offer new perspectives for explaining the divergent impacts of Bd



infection in amphibian assemblages and contribute to our understanding of ecosystem resilience to colonization by novel pathogens.

CAPACITY BUILDING IN BIODIVERSITY MONITORING

Dirk Schmeller

Helmholtz-Center for Environmental Research
Working Group 2 GEO BON, GEO BON

It is incontestable that human-driven global change is causing ongoing declines in biodiversity worldwide. The assessment of status and trend of biodiversity is heavily constrained by incomplete and uneven spatial, temporal and taxonomic coverage. For instance, data from developed regions, such as Europe and North America, are currently used overwhelmingly in biodiversity assessments due to lack of suitable data from other regions, and despite developing countries having in general the highest biodiversity on Earth and the strongest negative pressures. There is an urgent need to fill the existing gaps in global biodiversity monitoring. Without a global perspective that encompasses the terrestrial, freshwater and marine realms, decision-makers, scientists and the wider public are left misinformed and with a highly skewed image of the status and trends of biodiversity. We give examples of how new technologies and remotely sensed imagery can be used to improve our knowledge on the status and trend of biodiversity globally and particularly in remote areas. This review describes a range of opportunities and requirements to build capacities for biodiversity monitoring. The literature examined showed that each situation, with its specific socio-ecological background, may demand strategies for capacity building to be adjusted. Monitoring networks may also function most efficiently via key individuals or institutions, which are inter-linked with each other, and which can act as regional hubs to interact with many individuals/institutions at a more local level. That approach maximizes the interplay between expert input and standardization and adaptation of prevailing methods to unique socio-economic backdrops at a local or regional scale, as well as flow of information, information exchange and training.

142 ASSESSING THE POLICY INTEGRATION POTENTIAL OF THE EU GREEN INFRASTRUCTURE STRATEGY ON THE EXAMPLE OF THE EU COMMON AGRICULTURAL POLICY (CAP)

Jenny Schmidt

Helmholtz-Centre for Environmental Research - UFZ
Jennifer HAUCK, Helmholtz-Centre for Environmental Research - UFZ

Environmental Policy Integration (EPI) aims at incorporating environmental issues into decision-making and policy formulating processes of different sectoral policies. The Green

Infrastructure (GI) strategy of the EU aims at integrating GI protection and enhancement into different policies like climate adaptation, nature conservation, regional and agricultural policy, and spatial planning which is of particular concern to ensure connectivity between important biodiversity areas. Based on the analytical concept of EPI we assessed the integration potential of the GI strategy and the greening measures (ecological focus areas, grassland protection, and crop diversification) of the recent CAP reform. We analysed official documents concerning the EPI dimensions 'output' and 'process' using the categories objectives, instruments and addressees. The GI strategy formulates the objectives much more detailed, while the goals of the CAP greening measures remain rather vague concerning environmental aspects with fragmentation and connectivity being not addressed at all despite the fact that the measures are meant to enhance biodiversity protection in intensively used agrarian landscapes. Regarding the addresses of the policies, the CAP mainly focuses on farmers while the GI strategy is targeting a wider audience, including for example civil society, private businesses and conservation practitioners, agricultural stakeholders, rural and urban spatial planners, or potential investors. The analysis of the process revealed that the two policies differ in their participatory approaches. While the CAP greening is rather top-down, the GI strategy encourages bottom-up approaches based on stakeholder participation which could help to make measures more effective and applicable at the same time. Including local and regional stakeholders' views on implementation options could help to understand obstacles and chances of GI integration through the CAP greening measures.

EFFECTS OF DENSITY-DEPENDENT DISPERSAL BEHAVIOUR AND LANDSCAPE STRUCTURE ON DISPERSAL DISTANCES

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Dispersal is a key process for understanding and predicting species' viability in fragmented landscapes, and their performance under land-use- and climate-change. Many decision-support tools and models in conservation describe the dispersal potential of a species by its "typical dispersal distance", as derived from empirical observations. Yet, under which circumstances is this approach really valid? Namely, to what extent can one expect dispersal distances observed in a specific study site to resemble distances occurring in other landscape contexts or at different population densities? Answering these questions requires accounting for the three phases of dispersal (emigration, transfer and immigration),



embedded in the demographic processes occurring in the landscape. We used a simulation study with hypothetical terrestrial animals over virtual landscapes, to investigate the impacts of dispersal behaviour (density-dependent emigration, movement rules and density-dependent settlement), landscape structure and population density on the frequency distribution of dispersal distances (dispersal kernel). We analysed how these factors affect the shape of the dispersal kernel, their relative importance in different scenarios, and the overall dispersal success. We demonstrate that the same species can show a markedly different dispersal kernel, depending on the spatial and population dynamical context. By exploring this sensitivity, we hope to improve the ability to interpret empirical observations on dispersal events and contribute to a refined, process-based representation of functional connectivity in tools and models for conservation.

CONSERVATION AS HYBRID KNOWLEDGE: THE CASE OF THE CALAKMUL BIOSPHERE IN SOUTHERN MEXICO

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ECOSUR

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We describe conservation built on local expertise such that it constitutes a hybrid form of traditional and bureaucratic knowledge. Researchers regularly ask how local knowledge might be applied to programs linked to protected areas. By examining the production of conservation knowledge in southern Mexico, we assert local expertise is already central to conservation. However, bureaucratic norms and social identity differences between lay experts and conservation practitioners prevent the public valuing of traditional knowledge. We make this point by contrasting two examples. The first is a master's thesis survey of local experts regarding the biology of the King Vulture (*Sarcoramphus papa*) in which data collection took place in communities adjacent to the Calakmul Biosphere Reserve. The second is a workshop sponsored by the same reserve that instructed farmers on how to monitor endangered species, including the King Vulture. In both examples, conservation knowledge would not have existed without traditional knowledge. In both examples, this traditional knowledge is absent from scientific reporting. On the basis of these findings, we suggest conservation outcomes may be improved by recognizing the knowledge contributions local experts already make to conservation programming.

RANGE SHIFT OF EUROPEAN BUTTERFLY: INCREASING COLONIZATION-EXTINCTION RATIO AT THE MARGIN

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Butterflies are an ideal focus to understand global drivers of biodiversity change. Their short generation times, high fecundity and sensitivity to temperature make them particularly good indicators to assess species response to climate change. While distribution shifts have been documented from atlas data, such large-scale analyses have never been computed with standardized long-term monitoring data. Here we use dynamic occupancy models with count data extracted from six national Butterfly Monitoring Schemes (BMS) to examine how variation in colonization and extinction affect species occupancy over time and space. In our model, we explicitly account for imperfect detection related to sampling effort and species life-history and allow demographic parameters to vary between regions and over time. First results show that the ratio between colonization and extinction vary substantially with range position. Most interestingly, a large proportion of species shows increasing trends in colonization/extinction at the cold margin of their distribution, but no change at the core nor at the warm margin. We expect these patterns in demographic response to be strongly related to species temperature preference and their mobility. By combining the strengths of dynamic occupancy models and extensive monitoring programs supported by thousand of skilled volunteers across Europe, our study provides new insight into butterfly response to climate change and how local and regional demographic processes can affect distribution patterns at the continental scale.

#156 GLOBAL SCALE EXPLORATION OF THE POTENTIAL OF TERRESTRIAL BLOOD-FEEDING LEECHES AS A VERTEBRATE MONITORING TOOL

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Estimating abundances and distributions of vertebrate species is one of the fundamental challenges to appropriately guide conservation efforts. Thus, any methodological 'breakthroughs' in species monitoring that lower the impact on the target species, and/or reduce the financial and physical costs, are extremely valuable. An emerging discipline is 'iDNA', where genetic material ingested by invertebrates is used to characterise the biodiversity of the species that served as hosts. These methods are promising as they enable collection of "blood/tissue samples" that are usually difficult to obtain, especially from vertebrate species that are difficult to monitor because they are e.g. shy, nocturnal, dangerous or live in inaccessible habitats. Although promising, using leech-derived iDNA as a source of vertebrate DNA is still in its infancy and thus, to verify the potential of this method, we examined haematophagousterrestrialleeches collected over almost their full geographical range (thus, where this method might apply). Specifically, this included leeches representing both morphologically distinct groups of terrestrial leeches, the duognathous (two-jawed) and trignathous (three jawed) leeches, collected in South-East Asia, Madagascar, and Australia; areas that are known for their extensive tropical or subtropical rainforests, rich biodiversity, and high number of endemic or threatened vertebrate species. Host DNA extracted from the examined leeches were assigned to approximately 40 vertebrate families from four different vertebrate classes including mammals, birds, reptiles, and amphibians; demonstrating that blood ingested by many different species of haematophagous leeches is a viable source of vertebrate DNA and is a tool applicable to numerous geographic locations.

SYMPOSIUM 156: TARGETED DETECTION OF MAMMALIAN SPECIES USING CARRION FLY - DERIVED DNA

Grit Schubert

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DNA analysis from carrion flies (iDNA analysis) has recently been promoted as a powerful tool for cost and time efficient monitoring of wildlife. While originally applied to identify any mammalian species present in an area, it should also allow for targeted detection of species and individuals. Using carrion flies captured in the Taï National Park, Côte d'Ivoire, we

assessed this possibility by i) screening carrion fly DNA extracts with non-specific and species-specific PCR systems respectively targeting mitochondrial DNA (mtDNA) fragments of any mammal or of Jentink's duiker (*Cephalophus jentinki*), three colobine monkeys (subfamily Colobinae) and sooty mangabey (*Cercocebus atys*) and ii) genotyping carrion fly extracts containing sooty mangabey mtDNA. In comparison with the non-specific PCR assay, the use of specific PCRs increased the frequency of detection of target species up to three fold. Detection rates partially reflected relative abundances of target species in the area. Amplification of seven microsatellite loci from carrion flies positive for sooty mangabey mtDNA yielded an average PCR success of 46 %, showing that the identification of individuals is, to some extent, possible. Regression analysis of microsatellite PCR success and mtDNA concentration revealed that, among all carrion flies analysed for this study, 1 % contained amounts of mammal mtDNA sufficient to attempt genotyping with potentially high success. We conclude that carrion fly-derived DNA analysis represents a promising tool for targeted monitoring of mammals in their natural habitat.

EXAMINING THE RELATIONSHIP BETWEEN STAKEHOLDERS AND U.S. NATIONAL PARKS: THE CASE OF EVERGLADES NATIONAL PARK

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Over the last few decades, diverse groups of stakeholders have become increasingly involved with parks and protected areas that are impacted by impending development, population shift and other natural processes. A collaborative approach to landscape conservation is necessary to cultivate natural resource stewardship but challenging given the diverse backgrounds of external partners. In keeping with the theme of the 2015 ICCB-ECCB conference, this study examines the relationships between stakeholders and one of the most biologically diverse national parks in the United States National Park System, Everglades National Park (EVER). Located in the southeastern U.S., this park was added to the World Heritage List in 1979. At 1.5 million acres, EVER is home to over 20 rare, endangered/threatened species and provides habitat for over 400 species of birds. However, EVER is also on the World Heritage Danger list threatened by poaching, disruption in water flow, pollution, and development. This poster presentation will report on interviews with 51 stakeholder groups representing government, businesses, conservation organizations, local residents, and adjacent national parks. Study participants were asked about meanings of the park, change over time, involvement with the park, relationships, and the future. Results showed several key themes emerging from the interviews: environment, community participation, culture/



history, education and partnerships. Theoretically, the findings will provide a better understanding of diverse stakeholders' and their relationships with national parks. For park managers, the results will facilitate more effective strategies to guide conservation in and beyond park boundaries.

CHIPMUNK IN THE CITY: EFFECTS OF URBANIZATION ON INDIVIDUAL BEHAVIOR AND ECOLOGY OF EASTERN CHIPMUNKS

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Laurentian University

Jeremy LYONS, Laurentian University ; Darryl EDWARDS, Laurentian University ; Gabriela MASTROMONACO, Toronto Zoo

Human-altered landscapes provide ecological and evolutionary challenges for all organisms, and urban environments are such an example. Cities offer habitats, stressors and resources that are significantly different from natural habitats. For example, the presence of people, roads, cars, and domestic pets may elicit different behavioral and stress responses. We examined differences in behavior, cortisol and body condition (size-corrected mass) of eastern chipmunks (*Tamias striatus*) that were captured from urban and natural populations. The eastern chipmunk is a small diurnal, solitary rodent that occupies forests and parkland. We predicted that chipmunks captured in urban areas would be (i) more vigilant and exhibit more locomotory behaviour, (ii) have higher cortisol levels, and (iii) be in poorer body condition, than chipmunks captured in natural habitats. Chipmunks were sampled from two urban sites and two natural habitats. Upon capture, chipmunks were subjected to an open field test, weighed, measured, and both fecal and hair samples were collected for cortisol analysis. Chipmunks from urban sites showed more vigilant behavior and reduced locomotory behavior compared with counterparts from natural habitats. In addition, urban chipmunks had lower cortisol levels and higher body condition. Our results indicate that chipmunks in urban environments seem to enjoy relatively benign conditions relative to their counterparts in natural habitats. Chipmunks may need to be more vigilant in urban habitats to enhance awareness of novel threats, yet urban habitats appear to be less stressful for chipmunks and may contain more or higher quality food resources than natural habitats.

97 - WHAT'S IN YOUR BACKYARD? CITIZEN SCIENCE CAMERA TRAPPING AS A LENS TO STUDY MAMMAL DIVERSITY IN CLASSROOMS.

Stephanie Schuttler

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A current concern among conservationists is that people are increasingly becoming disconnected from nature, living in urban environments and spending more time indoors, which may cause an "extinction of experience" resulting in a decline in support for conservation and wildlife initiatives. Our goal was to provide opportunities for connecting kids to nature in the classroom by engaging them in authentic research through the eMammal program. Students collect data with camera traps, archiving raw results with eMammal, a citizen science camera trapping project. By working with citizen scientists, eMammal has collected a large range of data, providing a rich set of comparisons with schools. Camera traps are ideal for science classrooms because the species recorded by these cameras can be verified by experts. We are working with teachers from North Carolina public schools to develop lesson plans that integrate the latest national and state science standards. The implementation of these lessons will result in peer-review quality scientific research, while also providing structure for teachers to allow scaling across the state and nation. We are extending the lesson plans for use in cross-cultural learning between schools in North Carolina, Mexico, and India. All lesson plans will be available for other schools, and accompanied by instructional videos. Finally, we are also studying the attitudes of students towards local mammals to determine if participation in eMammal improves attitudes and perception of wildlife. The data collected by students, and research questions addressed in lesson plans, will be used by scientific publications extending our knowledge of mammal ecology. We hope that the excitement of studying charismatic animals through camera trapping will not only motivate students to expand our knowledge of mammal ecology, but also have a stronger sense of place, and understanding that nature can be experienced in urban settings.

L'ARBRE À PALABRES" INCUBATOR AS SOCIAL ISSUES BINDING CLIMATE AND BIODIVERSITY.

Lionel Scotto

GDR PARCS

Although there is a tendency to reverse technocratic logic top-down control of ecological and environmental issues, there is yet a constant lack of dialogue between Sciences and Societies on climate issues and their impacts on biodiversity. This communication proposes to present the first results of the research device called in French « l'arbre à palabres », the "Tree Palabres" designed specifically for climate issues, and also invite participants of this original session to effectively participate in this participatory engineering. Following a logical



bottom-up, the objective is to synergize citizen initiatives with representatives of civil life to bring out a proposal for action for public authorities. Inspired by the African tradition, « l'arbre à palabres » is designated a gathering at which villagers discuss "freely" social and political problems. In this session we will discuss climate issues and their impact on biodiversity by placing them in their social context as for example the monetary compensatory mechanisms related to biodiversity loss. In a participatory action research approach each participant is required to express its view in relation to the others. L'« Arbre à Palabres » acts as a social and political kaleidoscope where are in are closely intertwined epistemological dimensions, norms and values.

IMPROVING FOREST CONSERVATION OUTCOMES: A CASE STUDY IN MADRE DE DIOS, PERU

Jason Scullion

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As global forests decline, targeting conservation policy is becoming increasingly important. Though much progress has been made to target forest conservation policies, there is much room for refinement. To improve policymaking in forest landscapes we present a case study from the Manu-Tambopata biological corridor in Madre de Dios, Peru, which includes a diverse mix of land-use activities, including actively exploited gold deposits, agricultural expansion, and commercial logging. To identify policy "leverage points," or places in a system where small interventions can result in large system changes, farmers and miners actively working in the corridor were surveyed. The surveys included questions related to land-user demographics, current and future land-use practices, and preferences for alternative conservation policies. The results of the surveys show that despite rapidly increasing deforestation in the study area, many local land-users are implementing conservation measures to improve forest conservation outcomes, including the majority of both miners and farmers who stated they partake in at least one form of forest conservation. Additionally, both miners and farmers expressed high interest in various forest conservation policies proposed. Farmers held a strong preference for technical support in exchange for private forest conservation (97%) and 73% of miners were interested in alternative jobs. Additionally, 67% of farmers said they were interested in payments for ecosystem services at double voluntary carbon market pricing. The results of this case study demonstrate the strength of using field surveys to understand local conditions and to identify conservation policies that are both desired and effective. Lastly, due to the high variability

in local socio-economic conditions, designing effective forest conservation policies is particularly challenging because of wide variations in forest vulnerability and uncertainties in future socio-economic conditions.

IMPROVING GENETIC STATUS DESPITE FRAGMENTATION AND SMALL EFFECTIVE POPULATION SIZE IN HILL'S THISTLE (CIRSIMUM HILLII)

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Small, fragmented populations are at greater risk of extirpation due to reduced genetic diversity from inbreeding and genetic drift. These processes ultimately reduce the ability of a population to adapt, and decrease individual fitness. Hill's thistle (*Cirsium hillii*) is classified as a threatened species throughout much of its range, primarily due to the destruction and fragmentation of its habitat. This study addresses the impact of population size and isolation on the genetic diversity of Hill's thistle. We used microsatellite markers to genotype plants collected from the Lower Peninsula of Michigan in 2001, and from the Lower Peninsula and Drummond Island in 2012, in order to assess genetic differentiation across time and space, as well as to investigate rates of inbreeding in isolated and non-isolated populations. Genetic differentiation between the sample sites in the mainland population of Hill's thistle increased significantly since 2001 (all $P < 0.01$), indicative of increased fragmentation and isolation of the sample sites. However, the 2012 population exhibited lower inbreeding ($P < 0.001$) and higher heterozygosity ($P = 0.018$) compared to 2001, suggesting that the population is growing in spite of isolation. Conversely, the population on Drummond Island had higher levels of inbreeding ($P < 0.001$) and lower allelic richness ($P = 0.04$) and heterozygosity ($P = 0.0055$) compared to the mainland, typical of a small, isolated population. Our results indicate that the mainland population of Hill's thistle is persisting, but should continue to be monitored due to ongoing habitat loss.

HOW CAN GENETICS GUIDE TRANSLOCATIONS - LESSONS LEARNED FROM ENDANGERED BIRD SPECIES

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Translocations are seen as a valid option for many species when populations become extinct or too small to survive on their own. A number of facts (demographic, logistic, ...) need to be considered for successful translocations and genetic methods now can help us in monitoring these projects closely and evaluate the success or failure of management action. I will here present a case studies in several endangered bird species (capercaillie tetrao urogallus, black grouse tetrao tatrix, and the pale-headed brushfinch atlapetes pallidiceps), where genetic tools helped us in developing proper management plans and to evaluate the outcome of this actions. Genetic information can be used in assessing the genetic status of the population in focus, identifying the appropriate individuals for a given translocation and further on in monitoring the respective populations. Proper genetic surveys during this process are crucial to avoid the failure of such projects and I will highlight where and how genetic tools can make a difference.

CONSERVING BIODIVERSITY OF SAPROXYLIC INSECTS - A MATTER OF DEAD-WOOD AMOUNT OR DEAD-WOOD DIVERSITY?

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Dead wood is a crucial factor for biodiversity in forests and thus, various conservation strategies aim on increasing the amount of dead-wood in managed forests. Many field surveys have shown a positive relationship between dead-wood amount and species diversity, but dead-wood amount is, however, strongly correlated with dead-wood diversity. For conservation strategies, detailed knowledge about this relationship is of high interest as an independent positive effect of dead-wood diversity would mean that lower dead-wood amounts are sufficient when dead-wood substrates are diverse. This could help to reduce costs for conservation by means of unharvested timber while increasing the number of species that benefit from such strategies. To disentangle the single effects of both parameters on biodiversity, we manipulated 800m³ of freshly cut logs and 5000 branches of two tree species (*Fagus sylvatica* and *Abies alba*) in a large field experiment covering gradients of dead-wood quantity and dead-wood diversity on sunny clearings and in shady forest stands. All treatments and control plots without dead wood were replicated five times in the Bavarian Forest National Park, Germany. Saproxylic beetles were sampled over the first three years using flight-interception traps. Species communities differed greatly according to sun exposure. Generalized linear mixed models revealed positive effects of both dead-wood amount and dead-wood diversity on species richness of all saproxylic beetles and red-listed species only. This indicates

that not only the amount of dead wood is crucial to maintain diversity of saproxylic beetles, but also the diversity of dead-wood substrates as well as microclimatic conditions. Based on these results, we recommend forest and conservation managers to provide sufficiently high dead-wood volumes, but moreover, to provide a high diversity of dead-wood substrates regarding tree species, diameter class, decay stage and sun exposure.

RESEARCH CAN INFORM MANAGEMENT PRACTICES TO DETER CROP RAIDING BY MOUNTAIN GORILLAS

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A challenge facing wildlife conservation is the conflict between humans and wildlife due to competition for resources. Crop-raiding and ranging outside the park by the critically endangered mountain gorillas (*Gorilla beringei beringei*) of Bwindi Impenetrable National Park, Uganda has negative impacts on wildlife conservation and local livelihoods, thereby compromising conservation efforts. The objective of this study was to assess the ecological factors influencing mountain gorilla ranging outside the national park and crop-raiding to help guide management practices in areas bordering the park. Using Mixed Models, we examined the relationship between the availability of crops, including tea plantations, grown adjacent to Bwindi as well as food availability inside the park and the number of days gorillas ranged outside the park and crop-raided. We found that incidences of gorillas' ranging outside Bwindi and crop-raiding to be positively related to the availability of tea and other land-use types immediately bordering the park. Food availability inside Bwindi did not have an impact. We suggest that gorillas do not range outside the park and crop-raid due to food scarcity, but are attracted by certain food resources outside Bwindi. Our results show that tea does not deter gorillas from leaving the park, largely because tea plantations are interspersed with other land-use practices, which attract gorillas, and currently do not form a contiguous barrier to stop gorillas from ranging further into community land. However, if planted continuously in areas vulnerable to crop-raiding, tea may best serve as a buffer crop and a deterrent against gorillas. We suggest establishing buffer zones and implementing wildlife sensitive land-use planning strategies along the boundary. This study emphasizes how it is crucial to gain a better understanding of the determinants of wildlife ranging and crop-raiding to guide conservation strategies based on the species' behavioral ecology.



UNDERSTANDING MOTIVATIONS, SATISFACTION, AND COMMITMENT OF LANDOWNERS TO CONSERVATION STEWARDSHIP

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Private land conservation is an increasingly popular approach to protect critical biodiversity. In the Western Cape Province of South Africa private land conservation is the focal strategy for CapeNature, the provincial conservation agency. Despite its importance, little is known about the drivers of landowner participation in the CapeNature program and how these varied motivations influence participant satisfaction and retention. Our psychometric survey of 75 enrolled landowners found that the highest ranked motivations to participate were Conservation and Place Attachment but Social Learning had a stronger influence on program satisfaction. Landowners participate to fulfill a motivation or set of motivations but their satisfaction and commitment may hinge on other unforeseen motivations or factors. Understanding the relationship between motivations, satisfaction, and commitment is necessary for a successful retention strategy in any conservation program, especially on private lands where success is dependent on landowner commitment. Evaluating the social and not simply the biological or ecological “ingredients” of effective PLC programs is critical for understanding obstacles to implementation and measuring effectiveness. Application of psychology theory and practice can improve the effectiveness of conservation programs by the fostering stewardship commitment that facilitates sustained behavioral change.

CURRENT EVOLUTION AND FUTURE OF THE VEGETABLE BIODIVERSITY IN THE NORTH-WEST OF THE ALGERIAN SAHARA

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In the Northwest of the Algerian Sahara, several authors, like Guinochet and Quezel (1954), Monod (1972) Barry et al. (1985) Gehu et al. (1990), have tried to propose a phyto-sociological typology of the different habitats, taking into account the plant communities that develop there. Barry et al. (1985) note that these habitats “are highly representative phytocenosis of the conditions characterized Sahara habitats, and are stable through time, because there is no regressive or evolutionary dynamics,” but are all these phytocenosis really as stable now? Trying to find an answer to this question, we chose, in 2010, the Great Western Erg, an area described 65 years ago by Guinochet and

Quezel (1954). This area is about 600 km straight line distance south of Oran, Algeria, and extends between 29 ° and 32 ° north latitude and 20°W to 3 °E longitude, covering an area of 270,000 km². We followed the same way as Guinochet et al. (1954), and we have made a phyto-ecological survey of 52 different sites; rigorously scoring all the site conditions such as soil type, slope, the vegetation and various offenses such as overgrazing, logging and mowing. Our results show that the environment is deteriorating. This resulted from natural factors such as drought and the proliferation of wood-eating insects. On the other hand, human is involved, as well, in this deteriorating. Human increases desertification, e.g. Acacia trees are increasingly disappearing as a result of logging and collecting of gravel for building. «Everywhere ... we would have thought that the use of butane gas would reduce the need for plant fuels ... everything converges in the sense of the devastation of the Saharan flora» (Bisson, 2003). We look forward to continue this work with other complementary studies. We could propose to create a vegetation map that would be considered a tool for any development. In addition, local people are to be advised to help preserve local ecosystems.

RELATION BETWEEN FORMER FOREST MANAGEMENT AND HABITAT DEGRADATION IN A RIPARIAN OAK FOREST

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Detailed information on earlier stages is required to understand ongoing processes since landuse and management change was proved to have significant effect on natural vegetation. For that reason long-term studies are important to reveal degree of change at different levels, where the former state serves as a reference point to evaluate present conditions, plan or predict future processes. The research area – Tölgy-erdő/Oak-forest – is located at the eastern periphery of Hanság in Hungary. Based on checking of historical maps (1784-1944) the extension and landuse type of the research area was identical (110 ha). According to written data significant change in the use of the floodplain forest started after 1952 and economic view in forest management had begun after the 70's but fortunately the area was declared protected on national level in 1999 and accepted as Natura 2000 SCI due to threatened floodplain



habitat (91F0). To follow the effect of the former management on the vegetation we defined 4 disturbance categories to group the forest units based on available detailed forest plans (1968-2000), completed and controlled with geographical information and aerial photographs from the same period. The coenological survey was implemented in 30 homogeneous management units (6-6 quadrat/A-B-C vegetation layer/unit) in year 2013. The hierarchical cluster analysis of plant diversity showed the separation of units previously managed with clear-felling and renewed partly with alien ligneous species. Although significant difference couldn't be confirmed among units covered with native species but higher cover of invasive heliophilous plant species was detected dormant in the shrub layer close beside former intensively managed units. In consequence of that forest management with permanent cover is required in the future to fulfill sustainable protection and appropriate management which corresponds to the ecological state of the natural habitat type.

95. WHY REMAINING ROAD-FREE MATTERS: THE IMPORTANCE OF PROTECTING ROADLESS AND LOW-TRAFFIC AREAS FOR CONSERVING BIODIVERSITY UNDER GLOBAL CHANGE

Nuria Selva

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The road network shapes the environment worldwide. Road impacts are numerous, very complex, time-lagged and extend far beyond the road itself. Among the most detrimental effects is the "contagious development" triggered by roads, i.e. roads provide access to remote areas, thus promoting more roads and developments, land-use changes, resource extraction and human disturbance. In this context, keeping road-free the remaining large unfragmented patches of natural ecosystems is of crucial importance for biodiversity conservation. Roadless

and low-traffic areas represent relatively undisturbed natural habitats and functioning ecosystems. They increase landscape connectivity, act as barrier against pests and invasions, and render many ecosystem services. Roadless areas contribute to the preservation of native biodiversity and of species with large spatial requirements and sensitive to human disturbance. They get special relevance in the context of climate change because of their higher resilience and buffering capacity. We propose that planning of new transport routes should avoid dissecting valuable roadless areas. It is important to evaluate whether a road is really needed and, if so, assess different route options before dissecting roadless areas. Road-free areas should be maintained by concentrating traffic on existing highly travelled roads and bundling infrastructure close together. Contagious development should be avoided through sustainable development schemes at large spatial scales. We propose the implementation of compensation policies of "no-net-loss" of unfragmented lands. Unnecessary and ecologically damaging roads may also be reclaimed to enlarge roadless areas and restore landscape-level processes. Roadless and low-traffic areas conservation is a timely tool to preserve intact functioning ecosystems at local and global scales in the face of climate change.

210. THE SCB ROADLESS AREAS INITIATIVE

Nuria Selva

Policy Committee of the Society for Conservation Biology-Europe Section
Vassiliki KATI, Policy Committee of the Society for Conservation Biology- Europe Section ; Stefan KREFT, Policy Committee of the Society for Conservation Biology- Europe Section ; Pierre L. IBISCH, Policy Committee of the Society for Conservation Biology- Europe Section

The main aim of the Roadless Areas Initiative is to highlight the importance of roadless areas as a cost-efficient instrument for biodiversity conservation and the need to consider them explicitly in legislation. The Roadless Areas Initiative was launched in 2007 by the Policy Committee of the Europe Section of the Society for Conservation Biology (SCB). In the last years, the initiative has turned global, with most SCB Regional sections involved, and has established a growing network of partners. It has also been presented at high-level policy fora, such as the Rio + 20 event. The Roadless Areas Initiative represents an alternative approach to the species and habitat protection focus in nature conservation, as well as to the traditional mitigation and compensation measures in road ecology. Additionally, it combines conceptual considerations, including ecological theory and conservation policies, with practical aspects and methodology developed to identify areas free of road disturbance. The inclusion of roadless areas into road design, biodiversity conservation and policy is a formidable challenge.



THE IMPORTANCE OF FLOODPLAINS AS POTENTIAL DROUGHT REFUGIA FOR TERRESTRIAL BIRDS

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Climate change has led to more, and more severe, droughts. Climate refugia are locations in landscapes in which the physical effects of drought are less owing to topography or access to water and potentially allow populations to resist and recover from droughts. Floodplains are potential drought refugia in that they are more productive, have more water or more moderate microclimates than the surrounding uplands. The Murray-Darling Basin of eastern Australia experienced an unprecedented 13-year drought (the 'Big Dry') followed by 3 wet years, which allowed us to assess how terrestrial birds responded spatially to the drought and afterwards. We estimated temporal trends in reporting rates for 145 birds over the 14 years using Atlas of Australian Birds survey data for 28,000 sites in floodplain and non-floodplain areas. There was greater resistance to drought in floodplain zones; fewer species declined in floodplain zones (19%) than in non-floodplain zones (29%) during the Big Dry, and more species had increased reporting rates (13% vs 8%). As expected, more species recovered in non-floodplain zones (40.3%) than in floodplain zones (15.3%) after the drought, given the greater number of declines during the Big Dry in non-floodplain zones. Just 17.9% of species that declined in floodplain zones during the drought subsequently recovered, suggesting limited resilience. Floodplains enhance resistance to drought for many birds, and are likely to be particularly important as refugia in more arid areas. Floodplain ecosystems require long-term management to ameliorate human pressures and to restore ecological condition so that their role as drought refugia is maintained or enhanced.

LINKING HISTORIC LAND-USE CHANGE AND SHIFTS IN POLLINATOR COMMUNITIES

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Pollinators are not only an important component of biodiversity in their own right, but they also provide vital

pollination services both to agriculture and to wild plant populations. There is growing evidence that wild and managed insect pollinators have declined in both abundance and diversity and while the main causes of decline in pollinators remain unclear, one of the most likely causes is shifts in land use, mostly due to agricultural intensification. Our study is the first of its kind to test for the impact of historic land-use change in Britain, and explores land cover changes over 80 years and relates them to concurrent shifts in insect pollinator communities. Utilising historic data from 20 sites across four counties, we quantified the key land cover changes within and around these sites by utilising a land-cover map of 1930s Britain as well as a current land-cover map (LCM 2007). We then analysed spatial correspondence between past land use change and the corresponding shifts in pollinator communities by estimating the changes in richness and composition of bees and wasps. Land cover changes within sites, as well as changes within a 1km radius outside the sites, were found to have significant effects on pollinator richness and composition, with changes in edge habitats between major land classes also having a key influence. Our results highlight not just the land cover changes that may be detrimental to pollinator communities but also provides an insight into how changes from a single land cover type to a more diverse habitat may benefit species diversity and could help inform policy and practice for future land management

IMPACT OF HISTORIC SEASONAL CLIMATE ON BEE FLIGHT PERIODS

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There is immense current interest in the impact of seasonal climate on insect phenology. Research to date however has focussed solely on the impact of spring climate as the major driver of emergence dates and flight times. There is however evidence to suggest that key developmental stages like insect diapause which have knock-on impacts on spring emergence as well as voltinism could be driven by temperature changes in the summer, autumn and winter. As yet there is no research looking at how long-term climatic trends in summer, autumn or winter have impacted spring emergence or flight times of insects. Using historic climate data from 32 weather stations in Britain from 1900 onwards combined with long-term data on flight times and first emergence dates of bees for the same period and landscape we explore the impact of seasonal temperature trends on bee behaviour and analyse if these relationships vary on latitudinal basis. In addition to providing information on the impact of seasonal climatic trends on insect phenology, this study also provides the basis for further



research on mismatches between flight time of pollinators and flowering times in plants.

META-ANALYSES OF WHALEWATCHING IMPACT STUDIES: DIFFERENCES AND SIMILARITIES IN DISTURBANCE RESPONSES AMONG SPECIES

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Whalewatching activities are known to induce behavioural changes that are compatible with anti-predatory responses. However anti-predatory responses can vary depending on the species, population and/or site-specific environmental features. This variability makes it challenging to evaluate whalewatching disturbance and multiple metrics should therefore be used for any impact study. In this study we used meta-analyses to assess the consistency of anti-predatory responses among several studies on whalewatching disturbance. Changes in swimming speed, activity budget, inter-breath intervals, and deviation and directness index were used as proxies to measure whalewatching disturbance. We also assessed if these changes were due to extrinsic factors (the presence of whale watching regulations), intrinsic factors (species and animal body size) or environmental factors (habitat type). Our results showed that changes in the activity budget and directness and deviation index were the most consistently reliable metrics in capturing cetacean responses to whalewatching disturbance. Animals were more likely to travel and less likely to rest and forage as a consequence of whalewatching presence. Body size also had an effect on resting activity with smaller animals being less likely to rest in the presence of boats. Our results showed a generalized tendency of cetaceans to increase their path sinuosity (deviation index) and decrease path linearity (directness index) in response to whalewatching disturbance. Path linearity and predictability also increased in corridor type habitats. We found that cetaceans overall showed similar anti-predatory responses to whalewatching activities. These behavioural changes reflect greater direct energy expenditure and fewer opportunities for energy recovery and may cause long-term consequences to population fitness.

TRANSFERABILITY OF PREDICTIVE MODELS FOR CORAL REEF FISHES

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Transferring predictive models developed for one ecosystem to another could prove a cost-effective tool for understanding biodiversity patterns in under-studied systems - an urgent and challenging task in the current context of accelerating rates of biodiversity loss. Applications of model transferability are, however, still in their infancy and research is required to optimize model transferability. We developed a framework for improving model transferability based on the spatial and temporal resolutions used during model calibration, and tested it by transferring predictive models for coral reef fish species density and abundance developed for the Great Barrier Reef (GBR) on Australia's east coast, to Ningaloo Reef (NR) on Australia's west coast. Our results suggest that transferred models can retain predictive ability despite substantial differences in the biogeography and local ecology (NR is a fringing reef, while the GBR is a lagoonal system), and the degree of separation between the two ecosystems (Indian and Pacific oceans, respectively). Transferability of models of species density between these two ecosystems was considerably improved (models were > 70 % transferable) when the GBR model was calibrated with datasets of similar spatio-temporal scales (i.e., sampling duration, sampling year and transect size) to those available from NR. For fish abundance, transferability was possible (i.e., > 50 %) but variable for different fish families. The modelling framework we have developed can provide insights in to how species-environment relationships vary with the biogeography of the biological system of interest and how this should be accounted for in ecological modelling studies. Our work shows that transferability of predictive models has the potential to become a cost-effective tool for understanding biodiversity patterns in under-studied ecosystems and provide ecologically meaningful information to support management and conservation.

EVOLUTIONARY ECOLOGY AND CONSERVATION OF BAMBOO BREEDING FROGS IN THE WESTERN GHATS BIODIVERSITY HOTSPOT

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Amphibians face threats of extinction and population declines globally. Effective conservation interventions have often been



challenging to implement due to knowledge gaps in the species' ecology and behaviour. The Western Ghats biodiversity hotspot of India is a centre for adaptive radiations of frogs. In the last decade, over one hundred new species have been discovered. The conservation status and ecology of many of these frogs are unknown. Members of the tree frog genus *Raorchestes* possess the greatest diversity with 52 extant species and several lineages yet to be described. With such rapid increase in species discovery and description, natural history and ecological information are sparse and anecdotal. In an attempt to bridge this gap, field surveys were conducted in the Southern Western Ghats. This led to the discovery of new species and novel reproductive mode in one critically endangered frog *Raorchestes chalazodes* and its sister taxon, *R. ochlandrae*. In this mode, adult frogs enter *Ochlandrae* bamboo via narrow natural openings, deposit direct developing eggs, and provide parental care. However, bamboo habitats where frogs breed are threatened by overharvesting and habitat destruction during the breeding season. This study focuses on determining the range of bamboo breeding frog species using niche modeling; characterizing their reproductive strategy; identifying factors affecting reproductive success and drivers for the evolution of parental care in the group. Reproductive success is quantified using adult removal experiments and nest cavity examinations aided by camera probes. Organisms making openings in bamboo are quantified using field surveys. Forest managers and harvesting agencies are involved during the study to facilitate capacity building and identifying suitable protected breeding habitats for frogs and regulate harvesting practices in order to both protect the frogs and deliver provisions to humans using the forest.

ECOLOGICAL FACTORS INFLUENCING THE PERSISTENCE OF ANURAN ASSEMBLAGES IN WET-PADDY AGRICULTURE FIELDS IN SOUTH INDIA.

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Loss of habitat, intensification of agriculture and pesticide abuse has contributed significantly to amphibian decline. Studies documenting amphibian distribution; community assemblage; ecological correlates and their response to human induced changes are scant in developing countries like India with over 20% of all land being irrigated for agriculture. In South India, wet paddy agriculture is an important agricultural activity. Vast expanses of land near rivers and deltas are converted for cultivating rice and the impacts of these on the ecosystem not well understood. Abuse of subsidized availability of agrochemicals could potentially harm biodiversity in such human dominated landscapes. This study

examines the ecological correlates on anurans in an agro-ecosystem framework. Sixty sampling sites across three villages were surveyed in five minute audio-visual survey units. The community complexity was low and only six anuran species and 1705 individuals with an average of 12.1 ± 9 individ./unit were recorded. A generalized linear mixed effects model was used for analysis. Encounter rates varied and were positively affected by water depth and negatively affected by crop height and the presence of wet bund. Pesticide inputs were assessed by interviewing the farm owner and incorporated into the model. It appeared that pesticides did not significantly affect anurans. It is likely that pesticides get leached and diluted and anurans may be affected by pesticide concentrations in the water. This was however not accounted for in the model. Subsequent studies would need to focus measuring the soil and water chemistry in paddy fields to determine precise correlates of agricultural practices on amphibians. Findings from this study serve as a benchmark for ecological assessment of amphibians in agro-ecosystems and other human modified landscapes across South-South East Asia and framing best practice socio-economic and agro-ecosystem policies.

TEMPORAL AND SPATIAL POPULATION FLUCTUATIONS OF MEDIUM SIZED MAMMALS IN A MEDITERRANEAN AGRICULTURAL MATRIX

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David SALTZ, Swiss Institute for Dryland Energy and Environmental Research, Blaustein Institutes for Desert Research, Ben Gurion University ; Tamar DAYAN, Tel Aviv University

Mediterranean ecosystems are human-dominated landscapes composed of a mosaic of agricultural, natural and semi-natural habitats alongside urban areas. The size, spatial pattern and connectivity of these "modified landscapes" have a crucial effect on wildlife behavior, movement patterns and habitat use. We used a camera trap grid located in an agricultural valley in the Mediterranean region of Israel to determine how wildlife respond to human mediated resource changes. We quantified multi-season activity rates, density and occupancy from encounters data using N-mixture models. Twenty cameras were located in 25 sites, divided into 5 categories: isolated nature reserve; large natural area; vineyards within natural area; vineyards near settlements and vineyards within the agricultural matrix. Each sampling season was divided to 5 intervals and cameras were rotated between sites. Five carnivore and 5 herbivore species were captured on cameras. The depletion of natural food resources during the dry season shifted animals to the agricultural system. Different species demonstrated unique responses to human disturbance based on their ecological and behavioral adaptations: Canid (*Canis aureus*, *Vulpus vulpus*) co-occurrence was influenced



by anthropogenic food availability and European hare (*Lepus europaeus*) densities. European wildcat (*Felis silvestris*) and European badgers (*Meles meles*) co-occurred with red fox in natural patches more often than with golden jackals and had low activity rates in the agricultural system. Mountain gazelles (*Gazella gazella*) were restricted to natural patches and expressed different behavioral responses to human presence in protected or hunting areas thus emphasizing the importance of planning protected ecological corridors between the remaining natural patches. Our results demonstrate that wildlife responses to a patchy and dynamic agricultural matrix vary across species and present a challenge for conservation planning.

99. THE CONNECTION BETWEEN PEOPLE, NATURE AND HEALTH.

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There is compelling evidence for a range of physical, mental and social health benefits that people gain from urban nature. Yet our research shows that a large proportion of the population does not spend time in urban parks on a regular basis. This represents a substantial missed opportunity given the potential scale of the health and wellbeing benefits. Here we use an Australian data set to explore who in society is less likely to engage with nature, showing links with socio-economic factors and nature orientation. We then go on to examine the connection between key health responses (depression, high blood pressure and social cohesion) and exposure to nature. Ultimately we show that the prevalence of depression and high blood pressure could potentially be reduced within the general population by up to 14% and 8% respectively if those who do not currently engage with nature experiences were encouraged to do so. Our results show that urban nature already makes a substantial contribution to the social and economic wellbeing of communities. However, this contribution could be further enhanced through the use of social or educational interventions that enhance people's connection to nature.

HOW WELL IS RAIN FOREST PHYLOGENETIC DIVERSITY CONSERVED IN SOUTH EAST QUEENSLAND? A CASE STUDY IN THE USE OF DNA BARCODES TO ASSESS BIODIVERSITY AND CONSERVATION.

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Paul I FORSTER, Queensland Herbarium ; Gordon P GUYMER, Queensland Herbarium ; William J F MCDONALD, Queensland Herbarium ; Daniel P FAITH, Australian Museum ; David ERICKSON, Consultant ; W John KRESS, National Museum of Natural History, Smithsonian Institution

The application of DNA barcodes to plants has been rapidly expanding as reference libraries are generated for ever more species. Community phylogenies of forest habitats based on DNA barcode data are now commonly used to understand the evolution and assembly of these communities and have been mostly confined to forest species within long term monitoring plots. We have sampled an entire rainforest plant species assemblage within a bioregion to assess species and phylogenetic diversity and the adequacy of conservation. Australian rainforests have been fragmented due to past climate change and human-based clearing. The subtropical rainforests of south eastern Queensland are significantly more fragmented than the tropical rainforests and are subject to greater population pressures. The Australian rainforest flora is relatively diverse at the family-level but less so at the species-level. Current methods to assess biodiversity based on species numbers fail to adequately capture this richness at higher taxonomic levels. We developed a DNA barcode library for the SE Qld rainforest flora for biodiversity assessment that incorporates both taxonomic diversity and phylogenetic relationships. We compared phylogenetic diversity measures, species composition and richness and ecosystem diversity, to identify which bio-subregions contain greatest rainforest diversity, subregion relationships and their level of protection. Diversity was not correlated with rainforest area in SE Qld subregions, but PD was correlated with both the percent of the subregion occupied by rainforest and the diversity of regional ecosystems (RE) present. The patterns of species diversity and phylogenetic diversity suggest a strong influence of historical biogeography. Some subregions contain significantly more PD than expected by chance, consistent with the concept of refugia, while others are significantly phylogenetically-clustered consistent with recent range expansions.

REAL, ADDITIONAL, MEASURABLE, PERMANENT AND VERIFIABLE? COMMUNITY-BASED FOREST CARBON OFFSETS IN MEXICO

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Conservation trading mechanisms, in which degrading activities are offset by conservation or restoration in other areas, are currently widely implemented for biodiversity conservation, habitat restoration and reduction of greenhouse gas emissions. However, these projects have been heavily critiqued for perceived failures in creating real, additional,



permanent and verifiable offsets and for the potential for negative environmental and social impacts. The central focus of this study was to test the validity of these critiques in the context of a community-based forest carbon project in Mexico that sells offsets on a voluntary, national market. Our analysis is based primarily on interview data from key actors at multiple scales: the participating communities, intermediary non-profit organizations and carbon credit buyers. We find that the project avoided many of the potential pitfalls of forest carbon offset projects. Whether this model could be replicated would likely depend on the presence of key conditions: preexisting institutional strength at the local level; high levels of social capital between buyers, intermediaries and producers; and the ability to operate in the voluntary market. In particular, we find that a voluntary offset market can allow for higher, more stable prices, avoids the high transaction costs of certifications, and permits activities tailored to the local conditions and context of the producers.

DOES LIVESTOCK BENEFIT SNOW LEOPARDS?

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Large carnivores commonly prey on livestock when their ranges overlap. Pastoralism is the dominant land use type across the distributional range of the endangered snow leopard *Panthera uncia*. Snow leopards are often killed in retaliation against livestock depredation. Whether livestock, by forming an alternative prey, could potentially benefit snow leopards, or, whether livestock use of an area is detrimental to snow leopards is poorly understood. We examined snow leopard habitat use in a multiple use landscape that was comprised of sites varying in livestock abundance, wild prey abundance and human population size. We photographically sampled ten sites (average size 70 sq. km) using ten camera traps in each site, deployed for a period of 60 days. Snow leopard habitat use was computed as a Relative Use Index based on the total independent photographic captures and the number of snow leopard individuals captured at each site. We quantified livestock abundance, wild prey abundance, human population size and terrain ruggedness in each of the sites. Key variables influencing snow leopard habitat use were identified using Information Theory based model selection approach. Snow leopard habitat use was best explained by wild prey density, and showed a positive linear relationship with the abundance of wild ungulates. We found a hump-shaped relationship between snow leopard habitat use and livestock stocking density, with an initial increase in habitat use followed by a decline beyond a threshold of livestock density. Our results suggest that in the absence of direct persecution of snow leopards, livestock grazing and snow leopard habitat use

are potentially compatible up to a certain threshold of livestock density, beyond which habitat use declines, presumably due to depressed wild ungulate abundance and associated anthropogenic disturbance.

GENETIC VARIATION, STRUCTURE, AND GENE FLOW IN A SLOTH BEAR (*MELURUS URSINUS*) METAPOPULATION IN THE SATPURA-MAIKAL LANDSCAPE OF CENTRAL INDIA

Sandeep Sharma

Smithsonian Conservation Biology Institute

Trishna DUTTA, Columbia University ; Jesus MALDONADO, Smithsonian Conservation Biology Institute ; Hemendra Singh PANWAR, Peace Charitable Institute ; John SEIDENSTICKER, Smithsonian Conservation Biology Institute

Sloth bears (*Melursus ursinus*) are endemic to the Indian subcontinent. As a result of continued habitat loss and degradation over the past century, sloth bear populations have been in steady decline and now exist only in isolated or fragmented habitat across the entire range. We investigated the genetic connectivity of the sloth bear meta-population in five tiger reserves in the Satpura-Maikal landscape of central India. We used noninvasively collected fecal and hair samples to obtain genotypic information using a panel of seven polymorphic loci. We identified 55 individuals from this meta-population. We found that this meta-population has moderate genetic variation, and is subdivided into two genetic clusters. Further, we identified five first-generation migrants and signatures of contemporary gene flow. We found evidence of sloth bears in the corridor between the Kanha and Pench Tiger Reserves, and our results suggest that habitat connectivity and corridors play an important role in maintaining gene flow in this meta-population. These corridors face several anthropogenic and infrastructure development threats that have the potential to sever ongoing gene flow, if policies to protect them are not put into action immediately.

RELEVANCE OF TRADITIONAL ECOLOGICAL KNOWLEDGE IN AGRICULTURAL SUSTAINABILITY OF THE SEMI ARID TROPICS

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The semi arid tropics are resource scarce in agriculture in terms of soil quality and harsh climatic conditions and the sustainability of agro-ecosystems in these areas is an important issue. In India there is enormous wealth of Traditional Ecological Knowledge (TEK) but it is being lost and is surviving only in bits and pieces. Kachchh, is a very unique ecological terrain of Western India where some progressive farmers



in spite of harsh climatic conditions are adopting the long lost traditional farming practices which needs to be given a sound scientific backing to make it feasible as synthetic inputs based farming practices are deteriorating the soil health and quality of produce. Indiscriminate use of chemical fertilisers and pesticides in farming practices has threatened the ecosystem in many ways. The agricultural activities in past two decades have become intensive chemical inputs based due to government policies to promote chemical fertilizers and farmer's greed to have higher yields in short term. As a consequence the resource poor farmers are giving up their indigenous knowledge of organic and natural farming practices which can sustain them and the agro-ecosystems in the long run. The resource poor farmers of the semi arid tropics have lost their ancient knowledge of sustainable farming practices. The present study was undertaken to assess how ecosystem sustainability is achievable using the NRI (Natural Resource Integration). Agro-ecosystems practising different amendments viz. Natural, integrated and chemical inputs were evaluated in a long term study for their physico-chemical and biological parameters. The results of the study have shown that agri-management systems need to be geared to more inputs of traditional manures, pesticides and practices like indigenous seeds, mulching, best suited for the native climatic conditions, which can help in long term sustainability of the agriculture, soil and the society.

DNA METABARCODING- APPLICATION TO COMMON LEOPARD DIET

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Metabarcoding is a rapid method of biodiversity assessment that combines two technologies: DNA taxonomy and high-throughput DNA sequencing. Short sequences of DNA are widely used to differentiate and assign taxonomies to specimens of animals, plants, and fungi and other microbes. The common leopard diet was characterized from prey DNA present in fecal samples collected from Ayubia National Park, after amplification of a diagnostic fragment and sequencing of polymerase chain reaction (PCR) products, using next-generation (Illumina) sequencing. This provides diet information without any a priori knowledge about the prey and is a cost-effective method as millions of readings can be generated from a single sequencing run. This method has several advantages over classical microscopy, which requires substantial skill and time and is prone to misidentification in the case of closely related species. Of 111 putative fecal samples, sixty samples were identified as of leopard. While

three samples showed no prey item. Eleven prey taxa were identified in the remaining 57 samples. Three prey items were identified in one sample, two prey items in seven samples, and single prey items in 49 samples. Based on the frequency of occurrence of prey items in the 57 faecal samples, the domestic goat predominated the diet (64.9%), followed by dog (17.5%) and cow (12.3%). Domestic animals (goat, dog, cow, water buffalo *Bubalus bubalis*, horse *Equus caballus* and sheep) occurred in 54 of 57 samples, corresponding to a frequency of occurrence of 0.95, and five samples contained two items of domestic prey.

MAPPING OF CULTURALLY SENSITIVE AREAS IMPORTANT TO BIODIVERSITY: SACRED NATURAL SITES IN COASTAL KENYA

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Despite their importance for biodiversity conservation, little accurate mapping of the Mijikenda sacred natural sites (SNS) in coastal Kenya has been performed. SNS are often culturally sensitive areas with limited and/or no access zones in certain locations. While these restrictions hinder biodiversity surveys, it is important that researchers respect and adhere to the traditional practices and values of local communities. This study used habitat mapping as an alternative method to investigate the potential biodiversity of the SNS; their relative contribution to the amount of remaining coastal forest in Kenya; and the level of threat that they face from development and encroachment. The results show that the sites contain a significant proportion of coastal forest and are important for biodiversity conservation. However, all sites suffer from encroachment, which was found to correlate with the level of development surrounding the sites. The current management plans for SNS are based on traditional practices, however they do not account for the threat of encroachment and development that they are facing. In addition, development in the region is likely to increase, which is likely to increase the threats to the SNS. Due to their importance for biodiversity it is vital that management approaches are modified to encompass the current threat of development and encroachment. The results show that habitat mapping is a useful tool for evaluating the biodiversity of, and threats to, culturally sensitive areas. In addition, it provides a standard methodology which can be used to compare sites across the region and on a global scale.



EFFECTS OF CLIMATE CHANGE ON THE ENDANGERED RAINFOREST SHRUB TRIUNIA ROBUSTA (PROTEACEAE), ENDEMIC TO SOUTHEAST QUEENSLAND, AUSTRALIA

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The potential impacts of climate change on biodiversity are predicted to be extensive, and it is expected that species with small populations and limited dispersal will be highly vulnerable. This study investigated the potential impacts of climate change on the endangered subtropical rainforest shrub *Triunia robusta* by integrating species distribution models and population models. All populations were re-censused to obtain demographic data at two time steps for model parameterisation. Seed dispersal dynamics of *T. robusta* were also investigated. The current and future habitat distributions were modelled at four time steps (2010, 2030, 2050 and 2070) under IPCC A1F1 emission scenarios at continental and regional scales. Finally the potential effects of climate change (habitat loss, changes in rainfall and temperature) on the viability of *T. robusta* populations were examined over a 90-year period (2010 - 2100) with the integrated models. The results revealed high vulnerability of small populations (<30) to local extinction regardless of geographical location, whilst larger populations (>100) in the southern range are likely to show persistence in-situ for the next 90 years, highlighting the importance of maintaining larger population sizes for long-term survival. Despite results indicating a dramatic contraction of the species habitat range, the model predicted greater impacts on the species viability due to changes in temperature and rainfall. Inter-population dispersal was practically negligible, indicating the species limited potential for migration or rescue effects under climate change.

EQUITABLE GOVERNANCE OF INTEGRATED CONSERVATION AND DEVELOPMENT - THE VIEWS OF LOCAL PEOPLE AND IMPLICATIONS FOR CONSERVATION POLICY AND PRACTICE IN UGANDA

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The Convention on Biological Diversity (CBD) has set an agenda for conservation through poverty alleviation in its 2011-2020 Strategic Plan. This requires that issues of

governance, human rights, equity and power are addressed at all levels, from international to local. However, efforts to improve local community participation, such as Integrated Conservation and Development (ICD) interventions, often do not take into account local people's understanding of good governance, which can lead to inappropriate or ineffective function of institutions and negative outcomes. Understanding community views on what constitutes 'good governance' and adopting locally appropriate governance systems may enable conservation managers to involve local communities more effectively in decision-making, and adopt more equitable approaches in collaborative natural resource management. We assessed local perceptions of governance of ICD programmes around Bwindi Impenetrable National Park in Uganda through Focus Group Discussions with community groups and interviews with members of the Multiple Use Programme (MUP), which is one of the prominent ICD interventions at Bwindi. MUP enables local people to harvest certain natural resources in specified areas of Bwindi NP. Local people identified the MUP as an important mechanism for sustainable natural resource harvesting within the Park and expressed their strong desire to be actively involved in the management process. They also identified governance issues that hindered their involvement, notably equitable benefit sharing and more effective communication with conservation managers. Given a choice of potential governance structures, local people preferred a power sharing system. Based on this research, the Uganda Wildlife Authority carried out immediate actions on the ground to improve the governance of the MUP. MUP identity cards for authorized resource users were renewed, in order to improve equity of access to NP benefits.

123-ECOSYSTEM SERVICES AND BENEFITS FROM PRIMEVAL BOREAL FORESTS

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Criteria of human well-being create demands for ecosystem services. The potentials for ecosystem services depend on ecosystem structures and functions. Neither ecosystem services provided by primeval forests nor human benefits from them are completely understood and valued. This study reviews the regulating and cultural ecosystem services and human benefits obtained from primeval boreal forests. Natural disturbance regimes ensure self-organization and long-term resilience of primeval forest ecosystems. Some essential natural forest structures and functions have been transformed or disappeared owing to forest management. Dead wood in all its forms and decomposition stages is one of the most noticeable examples of such structures. The ecosystem functions related to it include carbon, nutrient and energy cycles, tree species



recruitment, soil formation etc. The full range of natural variability of dead wood of different size, decomposition class and position type safeguards the high quality of regulating ecosystem services. The carbon and nutrient stores of dead wood in primeval European boreal Norway spruce forests exceed those in managed forests by tens and hundreds of times. Numerous ecological niches created by dead wood result in high diversity of dead wood dependent organisms and successful tree species regeneration in northern forests. In general, the primeval forests, as enclosed systems, secure sustainability of key ecosystem services, such as the regulation of global and local climate, carbon sequestration, water balance, insect outbreaks and other natural hazards. The rarity of primeval forests increases the attractiveness of their cultural ecosystem services and non-material human benefits such as spiritual, religious, educational, inspiration and aesthetic values as well as genetic and information resources. In conclusion, primeval forests in a socio-ecological system indicate its resilience and secure the flow of ecosystem services.

DISENTANGLING THE NET: THE SOCIO-ECOLOGICAL DYNAMICS OF MOSQUITO NET FISHING

Rebecca Short

Imperial College London

Ej MILNER-GULLAND, Imperial College London ; Marcus ROWCLIFFE, Institute of Zoology ; Nicholas HILL, Zoological Society of London ; Sergio ROSENDO, University of East Anglia

Anti-malarial programmes, supported by the World Health Organisation, have distributed millions of mosquito nets (MNs) across sub-Saharan Africa in recent years with great success; in 2013 almost half of the population at risk had access to an insecticide-treated net, compared to 3% in 2004. Misuse of MNs within artisanal fisheries is now anecdotally widespread in these regions but formal investigation is lacking. Artisanal and subsistence fisheries globally have been referred to as “the occupation of last resort”, attracting developing nations’ dispossessed. As growing populations become unable to survive on depleted terrestrial resources, new entrants to what are generally already overexploited fisheries are an increasing problem. Small mesh sizes undermine traditional fisheries management which have been founded on increasing selectivity for mature adults, meaning use of MNs as fishing gear is generally illegal. However, ready availability, lack of necessary skill for deployment and low cost means they appeal to these new entrants and Mozambique’s most vulnerable people, whose dependence on them is unquantified. Recent paradigm shifts promote the theory of balanced fishing; where exploitation of juveniles (using fine mesh gears) may play a valuable role in ecosystem-based management of artisanal fisheries. This questions the validity of bans on gears like MNs. This study investigates the dependence of local people on MNs for food security, wellbeing and livelihoods in five

coastal communities in Cabo Delgado, Northern Mozambique, building on a previous case study from Kenya. These case studies are contextualised by a global review of the extent and prevalence of the issue. Additionally, we will explore how increasing fishing pressure interacts with the use of MNs in ecological communities, framing the issue within co-management of the wider fishery and integrating the results into participatory scenario analyses.

UNDERSTANDING DYNAMICS OF HUMAN-LEOPARD CONFLICT IN NEPAL: A COMPARATIVE STUDY BETWEEN LOWLAND TERAI AND HIGHLAND MID-HILL

Anil Shrestha

Green Governance Nepal

Aashish GURUNG, Freelance researcher[INSTITUTE]Kathmandu University

Human-leopard conflict (HLC) has been recently increasing throughout its range in Nepal. As a consequence, HLC cause emotional, physical and/or financial hardships for local people due to depredation of livestock, injury and death of humans which likely erodes decades of community support for local conservation efforts in Nepal. On the other hand, HLC cause retaliatory killings of these responsible leopards as a revenge causing reduced population viability of already near threatened species. The conventional hypothesis that cause increased HLC is of anthropogenic nature. However, recently, it has been proposed that such increase in HLC in and around Terai protected areas is a recent increased tiger population in Terai protected area (as much as 50%) that displaces leopard from their original habitat, hence, leopards inhabits in fringe habitat and has to rely more on livestock as major source of survival defined here as displacement hypothesis. To test this hypothesis, this study investigates and compares nature, extent and pattern of spatio-temporal HLC incidences along an altitudinal gradient: one in Terai lowland where leopard is living sympatrically with apex predator tiger and another one in Mid-hills, where leopard is an apex predator. We collected 538 incidences of HLC in Terai while 388 incidences in case of Mid-hills by using field observations, semi-structured interview, focus group discussion, key informant survey and records of human leopard conflict maintained by protected area in Terai and district forest office in Mid-hills. The first author will discuss the results to understand the mechanisms, by which such conflicts are caused and sustained with an attempt to test the displacement hypothesis of HLC, which eventually helps to formulate management actions to reduce HLC and hardship of local people for conservation of near threatened leopard.



EDUCATIONAL AND OUTREACH ACTIVITIES: THEIR TYPES AND EFFECT ON BIODIVERSITY CONSERVATION

Samridhi Shrestha

Arizona State University

A commonly expressed goal of environmental education programs (EEPs) is to encourage environmentally responsible behavior. However, balancing conservation goals and needs of local residents is always challenging. While some believe protected areas are a safe paradise for wildlife, others suggest that ignoring social and economic challenges that surround protected areas is not realistic to meet conservation objectives. The purpose of this research was to evaluate the effectiveness of EEPs offered by different organizations in three different protected areas of Nepal: Bardia National Park, Chitwan National Park and Parsa Wildlife Reserve. This research was conducted in the Terai Arc belt of Nepal which is home to some of the largest surviving populations of the Greater One Horned Rhinoceros and Royal Bengal Tiger. Data were collected through questionnaire surveys of local people living in the buffer zones adjacent to these protected areas and interviews with park officials. The questionnaire consisted of four parts, social context (age, income, education and gender), environmental attitude, environmental behavior and participation in EEPs provided by schools, non-governmental organizations and international non-governmental organizations. Results of the study show that EEPs provided by both schools and non-governmental and international non-governmental organizations failed to change local people's attitude and behavior. Poverty and lack of alternative resources is mainly blamed for failure of such EEPs.

SYMPOSIUM 97: CITIZEN SCIENCE AS A POTENTIAL TOOL TO PREVENT THE EXTINCTION OF EXPERIENCE

Assaf Shwartz

Technion - Israel Institute of Technology

Broad-based public support is needed to achieve biodiversity conservation goals. However, the very global processes that threaten biodiversity, such as urbanization and agriculture intensification, also separate people from the experience of nature, affecting the way people value and benefit from nature's quality. This "extinction of experience" is therefore a major concern, first given the important role interaction with nature plays in people's health and wellbeing. Second, because this estrangement can undermine people's action and public support for biodiversity conservation. Recent studies exploring the relationship between people and biodiversity have unveiled a "people-biodiversity paradox" comprising a fundamental mismatch between: (1) the preferences people

have for biodiversity, the wellbeing they claim to obtain from it and (2) their limited ability to perceive and benefit from this diversity. The extinction of experience could explain this paradox, as it could cause a reduction in people's abilities to experience the complexity of nature (i.e., biodiversity). In a study conducted in Paris France, we experimentally increased the diversity of birds, butterflies and flowering plants in small public gardens. We found that people underestimated species richness in the gardens and only noticed the changes in native flower richness in the gardens where advertisement and public involvement were organized. In additional studies we explored which animal species people want to have in the public gardens near their homes. We found that people showed a tendency to prefer colourful species they were familiar with. Therefore, we argue that enhancing conscious interaction between people, biodiversity and learning processes could potentially lead to a win-win situation, aligning the agendas of public health and conservation. Citizen science could help achieving this goal by consolidating people's ecological expertise and reinforcing their experience biodiversity.

REVEALING BETA DIVERSITY PATTERNS OF BREEDING BIRD AND LIZARD COMMUNITIES IN FRAGMENTED HABITATS BY THE TURNOVER AND NESTEDNESS COMPONENTS

Xingfeng Si

Zhejiang University

Andrés Baselga, Universidad de Santiago de Compostela ; Ping Ding, Zhejiang University

Beta diversity describes changes in species composition among sites in a region that has particular relevance for potential applications in conservation planning in fragmented habitats. However, it is difficult to reveal the mechanisms and develop specific conservation strategies if broad sense beta-diversity indices (i.e. yielding identical values under nestedness and species replacement) are used. Partitioning beta diversity into turnover (caused by species replacement from site to site) and nestedness-resultant components (caused by nested species losses) could provide a unique way to understand the variation of species composition in fragmented habitats. Here, we collected long-term occupancy data of breeding birds and lizards on islands in an inundated lake in China. We decomposed beta diversity of breeding bird and lizard communities into spatial turnover and nestedness-resultant components to assess their relative contributions and respective relationships to differences in island area, isolation, and habitat richness. Our results showed that spatial turnover contributed more to beta diversity than the nestedness-resultant component. The degree of isolation had no significant effect on total beta diversity or their components, neither for breeding birds nor for lizards. In turn, in both groups the nestedness-resultant component increased with larger



differences in island area and habitat richness, respectively, while turnover component decreased with them. The major difference among birds and lizards was a higher relevance of nestedness-resultant dissimilarity in lizards, suggesting that they more prone to local extinctions derived from habitat fragmentation. Despite the existence of some nested patterns, according to the dominance of the spatial turnover component of beta diversity, we suggest that all islands have potential conservation values and deserve protection for breeding bird and lizard communities.

POPULATION TRENDS OF 3 AMPHIBIANS FROM THE NAPO RIVER, PERU: HOW DO THESE COMPARE WITH CLIMATE CHANGE VULNERABILITY ASSESSMENTS

Marcy Sieggreen

Detroit Zoological Society

Marked effects of climate change on amphibians have been demonstrated, including increasing and decreasing population sizes and ranges. To anticipate how such impacts will affect amphibians and their conservation in the medium and longer terms, much research has focused on assessing their vulnerability to extinction due climate change. Species distribution modeling is often used to predict long-term change, but more recently species' biological traits and their effects of contributing to or reducing climate change impacts have begun to be included in these assessments. The results of both and combined climate change vulnerability assessment approaches, however, are seldom tested to determine whether they hold true in the field. Validation and verification of the accuracy of assessments using documented species changes is a high priority for this field. In this study, I explore the population trends of 3 amphibian species from the lower elevations of the Napo River, Peru. While these species are currently listed as of Least Concern species on the International Union for the Conservation of Nature (IUCN) Red List, I find strong fluctuations in population sizes between 2010 and 2014 and compare these to climate change vulnerability assessments conducted using both species distribution modelling and trait-based approaches. The results have important implications both for amphibians and the assessment of climate change vulnerability of species.

FROM BASIC SCIENCE TO HANDS ON CONSERVATION AND EVERYTHING IN BETWEEN: THE JANOS BIOSPHERE RESERVE, CHIHUAHUA MEXICO, A CASE STUDY.

Rodrigo Sierra-Corona

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Eduardo PONCE-GUEVARA, Universidad Nacional Autonoma de Mexico ; Rurik LIST, Departamento de Ciencias Ambientales,

Universidad Autonoma Metropolitana ; Jesús PACHECO, Universidad Nacional Autonoma de Mexico ; Gerardo CEBALLOS, Universidad Nacional Autonoma de Mexico

The Janos Biosphere Reserve (1,300,000 acre), is located on the northwestern corner of the Mexican state of Chihuahua, just across the US-Mexico borderline. This natural protected area was recently designated (2009) with the main objective of preserve its massive native Chihuahuan Desert grasslands, some of the last remains of this threatened ecosystems in North America, as well as its biodiversity. Our research team arrived during late 1980's to Janos, attracted by reports of black tailed prairie dog colonies, and extensive grasslands, discovering at the time, the biggest prairie dog colony in North America and the only free ranging bison herd of Southwestern USA and Northern Mexico, inhabiting in a vast prairie environment, on a extraordinary conservation state. By late 1990's the whole region started to transform, because of the shift of the local inhabitants production practices. Electricity distribution infrastructure was built, and unregulated industrial agriculture has been devouring these invaluable ecosystems and together with unsustainable cattle ranching practices and natural drought cycles, this once healthy ecosystem was being degraded with some areas in advanced decertified conditions, treating its biological integrity. Being primary witness of this rapid transformation, prompted us to adapt our research focus and expand our activities in to activism and lobbying in order to stop and revert this degradation. The Biosphere Reserve decreed was the culmination of a decade long campaign to preserve this amazing area and the beginning of our full time involvement on community based conservation, ecological restoration, sustainable cattle management and policy making, while continuing our ecological research, achieving important successes. This talk addressed this process from the beginning to date, offering a clear example of the complexity of a successful science-based conservation effort in Mexico, one of the most biodiverse countries in the world.

CONFLICTING CONSERVATIONS GOALS: WHEN A THREATENED SPECIES JEOPARDIZES RESTORATION OF AN ENDANGERED PLANT COMMUNITY

Marie Sigaud

Université Laval

As the rate of biodiversity loss driven by human activities continue to accelerate unabated, conservation challenges are becoming increasingly numerous and diverse, as are the management and conservation programs being developed to address these challenges. Conservation conflicts arise when competing conservation projects being implemented in the same space hinder each other's progress. Conflicts can become even more complex when sanctioned management measures



to favour a specific threatened species impede ongoing management efforts aimed towards another threatened species, resulting into an inextricable conservation dilemma. Resolving conflicting conservation goals, and preventing them from arising in the first place, requires a detailed understanding of the ecological mechanisms that create such conflicts. We used a combination of vegetation surveys, fecal analysis, GIS data, and GPS collar data, to explore whether free-ranging bison (*Bison bison*) transport non-native seed species and by doing so impede ongoing efforts toward fescue grassland restoration in Prince Albert National Park (PANP). We showed that bison facilitate long distance dispersal and establishment of non-native plant species by transporting seeds via endozoochory and epizoochory and depositing them in sites where they are more likely to get established (i.e., sites that are locally disturbed and intensively used by bison). As the bison range largely overlaps with fescue grasslands, it appears that bison conservation endangers the persistence of these threatened fescue plant communities. Our analysis illustrates the ecological mechanism resulting in the spatially structured conservation conflict, and we demonstrate how this mechanistic understanding can be used to identify priority areas where conservation actions will benefit both conservation objectives.

EXAMINING COMMUNITY STRUCTURE AND INVENTORY TEMPORAL PATTERNS OF TURTLE SPECIES SOLD IN THE WILDLIFE MARKETS OF GUANGZHOU, CHINA

Amanda Sigouin

Columbia University

Mingxia ZHANG, Wildlife Conservation Society ; Colin POOLE, Wildlife Conservation Society ; Aili KANG, Wildlife Conservation Society ; Tien Ming LEE, Princeton University

Globally, chelonians face many threats including loss of habitat, increased pollution levels, and pressure from invasive species; however, the biggest single threat is the international turtle trade. Freshwater turtles and tortoises are some of the most valuable fauna in the wildlife trade in Asia, in demand for food, use in traditional Chinese medicine and increasingly for the international pet trade. China is the largest consumer of freshwater turtles and tortoises in the world, and as such its demand has a significant impact on the size and dynamics of the trade. Following the depletion of many native Chinese turtles, and due to increased regional and international trade, turtles from neighboring Southeast Asian countries and other regions of the world have been harvested to meet the growing Chinese demand. Given the conspicuous nature of the wildlife trade, market data can provide conservationists and regulators important information regarding its size, scope, and dynamics. We analyze empirical data from a decade of market surveys of wild-caught and farmed freshwater turtles and tortoises sold

in the food and pet markets of Guangzhou, China, a major hub of wildlife trade in Southern China. We find that the underlying pattern and structure of turtle species on sale across 141 shops over 24 months from 2011-2013 varied substantially. In particular, the community structures across shops in both food and pet markets reveal the stark differences in the prevalence and distribution of threatened, CITES-listed, and China Protected List species. This community analysis provides important insights into turtle sourcing patterns and end-market demand trends. Work such as this can have important conservation implications such as identifying indicator species and specific shop inventory patterns that are useful in improving the efficiency of enforcement and monitoring efforts of endangered and protected turtle species.

SYSTEMATIC CONSERVATION PLANNING USING INFORMATION FROM STRUCTURED EXPERT JUDGMENT ASSESSMENT: TARGETING PROTECTION OF CONTINENTAL BIODIVERSITY IN LATIN AMERICA AND THE CARIBBEAN

Juha Siikamaki

Resources for the Future

Roger COOKE, Resources for the Future ; Francisco SANTIAGO-AVILA, Resources for the Future ; Rebecca EPANCHIN-NIELL, Resources for the Future ; Peter VAIL, Resources for the Future

Determining the optimal design of networks of nature reserves, known as the reserve site selection (RSS) or systematic conservation planning (SCP) is an important problem in conservation science. These problems are framed as constrained optimization to maximize an ecological value function by targeting conservation on a set of land parcels. SCP can be subject to considerable uncertainties and information gaps. For example, conservation often seeks to reduce future threats to biodiversity, but future threats to species and habitat themselves are regularly poorly understood. In this study, we develop a new approach to addressing information gaps and uncertainties in SCP by using structured expert judgment assessment (e.g. Cooke and Goossens 2004). Structured expert judgment assessment is an approach developed in risk analysis to systematically elicit and aggregate information from a pool of experts with intimate knowledge of the relevant subject. Our study concerns prioritization of continental biodiversity in Latin America and the Caribbean (LAC). Using ecoregions as the main units of analysis, we used currently available sources to develop rich data on biodiversity and its threats. We designed, tested, and implemented a structured expert judgment assessment of LAC conservation experts. It yields data from almost 100 experts from throughout the region and many relevant fields. The survey elicited data for current species richness (by taxa) and current and future threats to species and habitat. The survey is spatially explicit so the data



are developed at local level relevant to the SCP problem. We construct performance-based information weights by expert and use them for final predictions. Finally, we develop an RSS model which directly incorporates key data from the structured expert judgment assessment. Results from conventional and expert data based SCP show similarities and differences, indicating broader potential for expert judgment in conservation planning.

#171 - TRAINING CONSERVATION LEADERS: HOW WILL WE KNOW IF WE'VE DONE IT?

Janet Silbernagel

University of Wisconsin-Madison

At the time of this symposium in August 2015, the first cohort of 25 students in our newly redesigned professional masters in Environmental Conservation will be completing their degrees. The programme's mission, to train conservation leaders, has been attractive to those who apply, and to the many professional partners with whom we work. While it makes a compelling pitch for a program, and we have incorporated a variety of leadership training requirements into the curriculum, at the end of the day (or programme), how do we assess the effectiveness of such training? Is it enough to establish specific learning outcomes for a curriculum that define the leadership skills expected? Or rather, might we rely on alumni employment statistics and employer feedback demonstrating that graduates are in high-level positions? These questions are germane beyond the conservation sector. Recognition of the need for training in environmental and sustainability leadership continues to grow. As it does, academic leaders are beginning to ask, can leadership be taught, or is leadership capacity developed only through experience? In this talk I will further describe the approach our program takes to prepare students as conservation leaders to tackle complex decisions and challenges in a changing world. I will place our experience within the context of current literature on teaching conservation leadership, sharing some of our lessons learned and successes in light of that research. Most importantly, I will pose provocative questions to the panel to encourage the debate and collective thinking around training conservation leaders.

THE POWER OF VISUALIZING CHANGE: ASSESSING THE IMPACT OF INTEGRATING SATELLITE IMAGERY INTO ENVIRONMENTAL EDUCATION

Majory Silisyene

University of Minnesota

Environmental education (EE) is considered a critical element in conservation, as it has proven to yield positive influence on peoples' environmental behaviors. While EE has been implemented using various tool, including printed materials, videos, smart phones, and tablets, satellite images have never been employed as EE tool. I evaluate the impact of participating in marking earth's features on satellite photos, on local peoples' knowledge of a community owned forest in Loliondo, Tanzania. This study emulates the designed controlled experiment, where individuals in a treatment group participate in marking various earth features within boundaries of the forest, while the individuals in a control group do not. The study uses survey data from both before and after the intervention to determine whether the observed results in control and treatment groups are significantly different. In order to determine the reliability of participants' knowledge about the condition of their forest, I compare survey findings to land cover change percentages of the community forest between two time periods. Results suggest that PPM can significantly improve local peoples' understanding of their resources; i.e., local people understand better to what extent their forest resources have been depleted, and places where these resources are being cleared most.

95-USING VOLUNTEER SCIENCE, SOCIAL NETWORKING AND EMERGING TECHNOLOGIES TO EFFICIENTLY AND ACCURATELY COLLECT DATA ON THE IMPACTS OF ROADS AND TRAFFIC ON WILDLIFE

Neftalí Sillero

Universidade do Porto

John A. BISSONETTE, Utah State University ; Fraser SHILLING, University of California ; Sarah PERKINS, Cardiff School of Biosciences

Collecting, processing and validating data on roads impacts can be a challenging and time-consuming task. New technologies are currently being developed to increase the efficiency and accuracy of data collection. Recently, these technologies have increasingly been supported by collaboration with volunteers. Coupled with social networking, volunteer science is an emerging tool for collecting and analysing data for multiple purposes. In road ecology, volunteer participation is critical to establish extensive and frequent data collection. Social networks (Facebook, Twitter for example) bring new ways of collecting and sharing data as well as discussing science. We present several projects and applications that collect data on wildlife-vehicle collisions (WVC) and other road impacts on wildlife. Numerous applications for smartphones deals with data collection of WVC. GPS location points for a WVC observation can be input directly into a database. Some databases are predefined



(e.g. Urubu project, ObsMapp), but others can be completely customized (e.g. Cybertracker, EpiCollect+), defining as desired any type of fields and their associated values. Several applications are associated with websites where the user can store his/her own data (e.g. EpiCollect+, iNaturalist, Observado) and share them with others. In fact, there has been a burst of websites for storing chorological data, many dedicated to WVC, or live observations of wildlife (e.g. www.wildlifecrossing.net). Other projects deal with intelligent systems for collecting systematic data on WVC. Volunteers can generate huge amounts of data, making validation a very time-consuming task. Data sharing between projects poses challenges due to different database structures and data upload systems. The Darwin Core initiative proposes to use a common system for collecting chorological data. Understanding and standardizing volunteer-based wildlife observation systems will change data supply for road ecology studies.

HABITAT SUITABILITY MODELLING OF AMPHIBIANS AND REPTILES IN FIRE-PRONE REGIONS UNCOVER CONTRASTED RESPONSES ACCORDING TO SPECIES-SPECIFIC BIOGEOGRAPHIC AFFINITIES

Neftalí Sillero

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Wildfires are considered within the disturbances that produce major impact in ecosystems functioning and composition in many areas of the world. In the Mediterranean region, natural fire regimes contribute to maintain habitat heterogeneity and biological diversity at a landscape scale. Within a community, species show contrasted responses to fire, varying the community composition from unburned to burned habitats. Some species are resilient or early colonizers whereas others are late-colonizers of burnt areas. Species may be adapted to particular stages of this succession. Reptiles are often dependent on habitat structure and type, these characteristics varying along the post-fire succession. Amphibians have also specific responses to fire according to habitat preferences and activity. We hypothesize that Mediterranean herps will respond positively to fire with an increasing distribution range due to an increase of suitable habitats. In contrast, non-Mediterranean herps are expected to respond negatively to fire by a degradation of suitable points linked to the openness of the habitat. We examined the response on amphibians and

reptiles to fire in the Massif des Maures (Provence, Southern France), a Mediterranean area with Centro-European influence due to moderate rainfall and non-degraded vegetation cover. We modelled the habitat suitability of 7 amphibian and 16 reptile species with a data set of 3612 exact locations collected along 63 years. We divided the set of locations into two periods (before and during the fire occurrence, 1958-2003 and 2004-2011) and calculated the realised niche models with Maxent and Bioclim methods. We included fire-related variables (time since fire and number of fires) only in models of the second period. Our preliminary results suggest that Mediterranean species increased the extent of habitat suitability as the fire frequency increase in the study region, meanwhile Centro-European species did not present a similar increment.

PLANT PHYLOGENETIC DIVERSITY AS A TOOL TO IDENTIFY PRIORITY AREAS FOR CONSERVATION

Danilo Silva

Universidade Federal de São Carlos

Biodiversity measures are used as criterium to define areas for biological conservation. But, in most cases, phylogenetic relationships among species are neglected, taking into account only the species number. However, phylogenetic diversity brings useful information on evolutive history of species. Moreover, considering that phylogenetic diversity is an important component of biodiversity, being related to many ecosystem functions and ecological process; there is a risk to lose those species that contribute more to many levels of diversity if we ignore phylogenetic information. Thus, we seek to incorporate phylogenetic diversity into the current models of biological conservation to improve them. Here, we used plant species lists for an entire Brazilian state to calculate three measures of phylogenetic diversity: Faith's phylogenetic diversity, mean pairwise distance and mean nearest taxon distance. Faith's diversity was highly correlated to the species number, therefore was not used in further analyses. The other two measures were lowly correlated to number of species and between themselves, therefore were good candidates to model adjustments. We are testing if these new models would lead to the conservation of more species in regional scale than the models considering only species number.

THE RETURN OF THE KING: REINVENTING THE IMAGE OF THE KING COBRA (OPHIOPHAGUS HANNAH) AS A FLAGSHIP SPECIES IN RURAL THAILAND

Inês Silva

University of Lisbon



Colin STRINE, Suranaree University of Technology ; Matthew CRANE, Suranaree University of Technology ; Taksin ARTCHAWAKOM, Sakaerat Environmental Research Station

Locally supported flagship species can serve as a rallying point for conservation activities and increased fundraising. Reptiles, and particularly snakes, are often viewed more negatively than other taxa, and thus generally forgotten for flagship consideration. Despite the fear attached to snakes they may prove efficient flagships for conservation education as many species are commonly found in human-dominated landscapes. We selected the king cobra, the largest venomous snake in the world, as a flagship species candidate in Thailand due to its high profile, large home range, and its Vulnerable status under the IUCN Red List. Our work with Thai student groups found that the king cobra is the most feared snake; however, hospital records for the area contained no king cobra hospitalizations. These results showcase the major gap between local perception and reality, and the demand for educational outreach to reinvent the image of the king cobra. While radio-tracking king cobras in the disturbed areas of Sakaerat Biosphere Reserve in Northeastern Thailand, we have engaged in in situ conservation education, which has successfully changed how both king cobras and other venomous snake species are perceived by local communities: many villagers have shifted from killing the snakes to using our removal program, which has led to the rescue of 7 king cobras since its inception. Additionally, we have taught over 5,000 students from 58 different schools on king cobra ecology and conservation. King cobras show potential to be the anchor of a conservation action plan to preserve both intact areas and forest fragments within human-dominated landscapes, by harnessing the support of local communities and students. Our end goal is to drive the conservation of multiple species and habitats within the Southeast Asia region.

WILD POPULATIONS AND PROTECTION OF DISPERSAL CORRIDORS ARE VITAL FOR THE CONSERVATION OF GENETIC DIVERSITY AND GENE FLOW IN NORTH AFRICAN DORCAS GAZELLE

Teresa L Silva

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Wild populations face extinction risks caused by deterministic factors, such as habitat loss, and by stochastic events of demographic, genetic, or environmental nature. Populations experiencing range and demographic reductions due to poaching are particularly sensible to population fragmentation, genetic drift and inbreeding. For such species, captive programs are important to maintain genetic diversity for potentially supplementing wild populations. North African gazelles are excellent models to understand factors determining genetic structure in wide-range vertebrates that have undergone strong population declines. This is the case of *Gazella dorcas*, a Vulnerable antelope threatened by population reduction and habitat loss. We aim to quantify genetic diversity/structure in differently managed populations of Dorcas gazelle and to estimate gene flow levels between wild populations across the north-western range of the species, an area subjected to intense poaching. Invasive and non-invasive molecular methods were used to sequence five fragments of mitochondrial and nuclear DNA and genotype 222 individuals from the differently managed populations with 15 microsatellite loci. Genetic diversity in all markers showed that wild populations exhibited higher levels of genetic diversity in comparison to captive/semi-captive populations. Gene flow levels were high between wild populations resulting in shallow genetic structure and weak spatial isolation. The isolated population from Tidra Island (Banc d'Arguin National Park, Mauritania) exhibited unique genetic characteristics that should be effectively preserved. High-dispersal ability is probably associated to high gene flow levels detected along the Atlantic Sahara and the Sahel. Integrative conservation strategies, combining ecological niche modelling and landscape genetics, are needed to fundament conservation action plans for wild populations. The protection of dispersal corridors allowing gene flow is paramount.

THINKING ABOUT ECOLOGICALLY UNBALANCED NATIVE SPECIES - EXAMPLES FROM BRAZIL

Dalva Maria Silva Matos

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The understanding of the meaning of invasive species remained very inconsistent for several decades, perhaps understandably, because the notion of invasive species brings together a series of concepts from different fields, such as biogeography, demography, ecological succession, and community ecology. Compared to exotics, native species are much less likely to develop invasive behavior in a community because co-evolution tends to accommodate species requirements and attenuate competition. In this work we aim to draw the attention of the scientific community, managers of protected areas and policy makers to the super-dominant native species (or "native-invasives") in order to stimulate more research on the topic and the development of management actions. We tried to select native terrestrial and aquatic species of plants and animals that most frequently show the "invasive" behavior in their original habitats, as well as to discuss the possible causes of their atypical dominance and the negative impacts they may cause. We performed a non-systematic review of published material, including thesis and gray literature, as well as from our own experience. We present a list of 24 taxa (species or genera) of terrestrial plants, aquatic macrophytes and mammals that have shown explosive population growth in their original habitats, and we discuss the causes and consequences of such behavior. Disturbance is the main driver of their spread. For terrestrial species, habitat fragmentation, forest gaps, wildfires, and climate change, although eutrophication and the construction of reservoirs are the main drivers of the aquatic plants super-dominance. In the future scenario disturbances may promote not only invisibility by exotic species but also changes the dynamics of native species, which may spread and threaten the persistence of natives. Management strategies must identify how land use, habitat fragmentation and climate change interact to cause explosive population growth.

LA MACHORRA" HILL DIVERSITY

Beatriz Silva-Torres

UNIVERSIDAD AUTONOMA METROPOLITANA
Minerva GONZALEZ-IBARRA, UNIVERSIDAD AUTONOMA METROPOLITANA ; Aurora CHIMAL-HERNANDEZ, UNIVERSIDAD AUTONOMA METROPOLITANA

"La Machorra" hill is located between 100° 16' North latitude and 20° 31' East longitude, in Querétaro State, Mexico. The studied area is located in the semiarid zone of central Mexico; It is considered an large area with an important industrial activity and population growth. The investigated area presents a particular arid vegetation, its thorn shrub association, which

at the highlands presents the characteristics of low deciduous forest and the low fields features as a crasicaule shrub. Currently the landscape of "La Machorra" hill is surrounded by cultivated fields, small communities and an industrial park is located 3 km from it. The area has a private land tenancy and it has remained preserved at the top of the hill, mainly due to this is an area of steep slopes. A current estate development seems to be underway by environmental authorities have requested that "La Machorra" Hill to be kept as a preserved area. The main objective of this work was to characterize the Hill physically (soil, water, geology, climate) and biologically (vegetal plants and wild animals). The knowledge of this specific diversity is considered basic information to develop a management plan. For the study of biotic component, cluster sampling was performed, recording 75 species of flora and 89 of fauna. Some of the recorded species have protected status in accordance with Mexican law were: *Dasyllirion acrotiche*, *Echinocactus platyacanthus*, *Aquila chrysaetos*, *Falco peregrinus*, *Crotalus durissus*, *Pituophis deppei*. The Simpson diversity index was calculated. The Simpson index obtained in this area was 0.09541, which means it has a high diversity, and to corroborate the above, the Shannon-Weaver index was calculated with a 5.038 value, which confirms the high diversity beforehand mentioned. Currently we are working in the management environment plan for the "La Machorra" Hill.

ACCOUNTING FOR NON-RANDOM CLEARING IN LANDSCAPE-SCALE SPECIES-AREA RELATIONSHIPS

Jeremy Simmonds

University of Queensland
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Enhancing species richness is a key goal in the management of modified landscapes. Understanding how species richness relates to the amount of habitat in a landscape can guide targets for habitat protection and restoration. However, often the area of remaining habitat in a landscape is a legacy of non-random clearing practices associated with land uses such as agriculture. Thus, detecting the effect of habitat area per se is complicated by confounding factors. Indeed, abiotic attributes such as soil properties that are likely to confound habitat area in modified systems are rarely considered in studies that relate area to an ecological response like species richness. We examined species-area relationships whilst accounting for confounds of area that are associated with non-random clearing. Focussing on anthropogenically-transformed regions of Australia and South Africa, we show that the shape and functional form of the relationship between woodland bird species richness and landscape-scale habitat area varies when abiotic factors such as soil properties and topographic variability are held constant. In particular, we test for thresholds in woodland bird species-area relationships, and generalities



in the shape and form of the relationship among regions. This study provides a clearer understanding of the effect of landscape-scale habitat area on woodland bird species richness, with implications for management actions that are based on conserving or restoring habitat. More generally, this research highlights the consequences of not accounting for non-random clearing when relating an ecological response to area, and underscores the importance of considering landscape patterns when analysing human-modified systems.

PROTECTED AREA NETWORKS DESIGNED FOR GEOCONSERVATION DO NOT REPRESENT SPECIES DIVERSITY

Benno Simmons

Imperial College London

Richard GRENYER, University of Oxford

Geoconservation is rapidly becoming a major policy consideration for governments around the world. Proponents argue for the intrinsic, economic, scientific, cultural, aesthetic and functional benefits of abiotic nature, yet additionally often cite how its preservation can produce concomitant gains for biodiversity. This view likely stems from macroecology and biogeography, where studies have long-established positive spatial correlations between measures of abiotic heterogeneity and species richness. However, congruent distributions in space do not demonstrate the degree to which biodiversity conservation and geoconservation can be performed by the same network of protected areas. For this, an explicit test of the sampling of biodiversity by the set of choices made to maximize representation of geodiversity is needed. Here, for the first time, we perform such a test by modelling the outcome for biodiversity of a hypothetical geodiversity conservation policy that prioritises geodiverse landscapes in the UK. We find that, contrary to suggestions, protected area networks designed for geoconservation represent species diversity only poorly. Consequently, geoconservation and biodiversity conservation should be viewed as competing landuses that involve a spatial and resourcing tradeoff.

CONSERVATION GENETICS AND POPULATION VIABILITY OF ENDANGERED SWAMP ORCHID PHAIUS AUSTRALIS IN AUSTRALIA

Laura Simmons

University of the Sunshine Coast

Alison SHAPCOTT, University of the Sunshine Coast ; Michael MATHIESON, Queensland Herbarium, Department of Science, Innovation, Information Technology and the Arts

The Swamp Orchid *Phaius australis* occurs in disjunct populations along Australia's east coast in ecotones of coastal wetlands and springs vulnerable to climate change and fire-prone heathland. The orchids are endangered due to narrow

environmental tolerance, past illegal collection, continued habitat loss and limited connectivity between populations. We have investigated the viability and persistence of *P. australis* by combining genetic and demographic studies across a 2000km latitudinal range. We sampled for population genetics at 34 locations; undertook paired population demographic surveys over several years and a pollination experiment. Using NextGen microsatellite markers and morphology assessments, we confirmed *P. australis* population size and locations in Australia and genetic differences between two congeners. Spatial patterns of genetic diversity indicate post-colonisation divergence from the tropics southwards to current climate niche limits. Fitting with genetics theory, loss of populations and population size has resulted in lower genetic diversity in small populations. Despite small population sizes and the presence of cloned genotypes within populations, the species is not inbred. Pollination experiments support spontaneous self-fertilisation in wild populations and potential heterozygote advantage in floral output and success. Climate change vulnerability has been modelled through population viability analysis based on the climate related vital rates we observed and SIMCLIM generated climate change predictions. Fires occurred in several populations during the study allowing us to monitor recovery and undertake extinction risk analysis to different fire severity and frequency. An understanding of the genetic viability and demographic persistence of populations now and in the future will influence the likelihood of long-term survival in the context of population recovery and restoration, fire management and assisted migrations.

CONSERVATION OF FRESHWATER PEARL MUSSEL (MARGARITIFERA MARGARITIFERA) AS THE FLAGSHIP SPECIES FOR OLIGOTROPHIC CATCHMENT AREAS: ACHIEVEMENTS AND FAILURES OF 30 YEAR ACTION PLAN IN THE CZECH REPUBLIC

Ondrej Prokop Simon

T.G. Masaryk Water Research Institute[INSTITUTE]Faculty of Environmental Sciences, Czech University of Life Sciences Jan SVANYGA, Nature Conservation Agency ; Jaroslav HRUSKA, Miletínský 7 ; Karel DOUDA, Faculty of Agrobiological, Food and Natural Resources, Czech University of Life Science ; Ivana VANICKOVA, Nature Conservation Agency ; Kamila TICHÁ, T.G. Masaryk Water Research Institute ; Michal BILY, T.G. Masaryk Water Research Institute[INSTITUTE]Faculty of Environmental Sciences, Czech University of Life Sciences ; Miriam JANDAKOVA, T.G. Masaryk Water Research Institute ; Bohumil DORT, Gammarus

Freshwater invertebrates such as molluscs, gastropods and crayfish are considerably endangered by extinction. The anthropogenic eutrophication has substantial impact on the biodiversity in many countries worldwide. The Action Plan



for Freshwater Pearl mussel (FPM) was implemented in the headwaters of the Elbe/Vltava River in the Czech Republic for over 30 years. The FPM represents an umbrella species to protect the rest of a submontane oligotrophic catchment with low agricultural impact. This long-living mollusc also represents an important keystone species for these ecosystems. Throughout the action plan three large protected areas (6.9 – 59.6 km²) were founded in order to protect the FPM stream and the whole catchments. Many organisms profited from the eutrophication decline resulting from different measures. However, the other key factors limiting natural reproduction of the FPM (land use changes, drainage and soil erosion) have changed very little. The current status of natural habitat does not enable the survival of the youngest mussel stages (1 – 5 years) or natural reproduction. Although many problems persist, new semi-natural breeding helped to rejuvenate the over-aged populations. The local habitat quality was improved by new successful management methods too. The conservation of the mollusc formerly hunted for pearls, seems to be attractive both for the public and the conservation authorities. That allows long-time project funding in a politically unstable environment. The natural reproduction of FPM has not been restored yet; thus the main goal of the Action Plan was not reached. Nevertheless, many endangered water, wetland and terrestrial organisms profit from ecosystem protection. Consequently, focusing conservation on an attractive flagship animal with a wide, complex of strict habitat demands seems to be beneficial even for usually neglected invertebrate species.

POPULATION VIABILITY OF OSCILLATING POPULATIONS

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Theory on the viability of small established populations is well developed. The theoretical knowledge has guided development of methods to analyze population viability. By now, population viability analysis (PVA) is a standard tool to support conservation of single species. However, more complex situations involving community dynamics or environmental change violate basic assumptions of that theory. Synthesizing concepts from population, community and conservation ecology, we enhance theory of population viability analysis to cope with cyclic populations. We find that the interplay of periodic population decline and demographic stochasticity causes varying population extinction risk and modifies the temporal structure of viability. Temporal variability in viability depends on population establishment and cycle coherence. The temporal structure in viability can be visualized and assessed. For this purpose, we develop a mathematically founded method to calculate from simulation models two

viability metrics that are known to be sensitive to temporal changes in population viability. The metrics describe how population cycles impact viability at short management relevant time scales and at long time scales that cover the general condition of a cyclic population. This improvement makes a standard PVA method applicable to populations responding to e.g. seasonality or trophic interactions. Particularly, viability analysis becomes comparable among trophic levels and therefore equips biodiversity conservation with a long missing tool.

SPECTRAL CHARACTERISTICS OF AVIAN COMMUNAL ROOSTING IN URBAN HABITATS OF DELHI, INDIA

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Urbanization is occurring at a rapid pace resulting in restructuring of habitats and avifaunal diversity. Biotic and abiotic sound in urban areas interferes with signal detection and restricts communication range of birds. Therefore, the acoustic ambient environment of a habitat is one of the key factors influencing the effective communication system in birds. It also has high ambient noise levels, which makes vocal communication difficult for birds. The spectral characterization of chorus (bird's vocalization) provides us an insight of avian communication and their adaptation to overcome extrinsic noise levels. The present study was undertaken to understand the vocal communication of birds in urban habitat. This study compares the spectral characteristics of dusk chorus between urban and forest habitats. The sound pressure levels of birds roosting activities in ridge forest and urban habitats of Delhi were recorded during dusk for a period of one year. It was observed that the dusk chorus at urban sites were mainly dominated by two generalist species, i.e., *Corvus splendens* (House Crow) and *Acridotheres tristis* (Common Myna) while in Ridge forest the avifaunal diversity was high. Time series and spectral graphs of sound pressure levels at different 1/3rd octave frequencies were plotted. During the time of chorus a significant increase in the frequency (1-4 kHz) was observed as compare to background noise levels of the sites. Maximum SPL during the dusk chorus in urban habitats and ridge forest ranged between 68-73dB and 50-55dB levels respectively. So, it can be concluded that dusk chorus at urban sites are more intense than ridge forest sites. This might be due to lower tree densities in urban site. This study might provide evidence for acoustic dependent adaptations in birds dwelling in urban habitats.



ELEPHANTS IN A TEA CUP: UNDERSTANDING HUMAN-ELEPHANT RELATIONSHIPS AND ASSESSMENT OF THE EFFECTIVENESS OF CONFLICT MITIGATION MEASURES IN VALPARAI, TAMILNADU, INDIA

Rashmi Singh

Ambedkar University Delhi

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The Annamalai hill range in Southern Western Ghats is identified as the largest potential area for the long term conservation of elephants in India. The Vaparai region of Annamalai has seen an increase in human-elephant conflict rates in last two decades. Nature Conservation Foundation (NCF), an NGO initiated a few conflict mitigation measures (CMM) to reduce the conflict. However little is understood about how people in this region view elephants and whether the conflict mitigation measures initiated by NCF have been effective. We collected qualitative and quantitative data using semi-structured interviews to understand human and elephant relations in the region and effectiveness of the CMMs. A total of 204 locals were interviewed in 17 randomly selected tea estates. The data was analyzed using a mixed methods examination using exploratory data analysis, descriptive statistics and an information-theoretic model selection approach. Majority of people (78 %) had a positive attitude towards elephants with little difference in attitudes across age, education or nativity. People showed a complex range of emotions including empathy, respect, fear and love towards elephants. Human attitudes towards elephants were best explained by gender and past experience. Negative attitudes towards elephants were primarily driven by past bad experiences, while men were likely to view elephants more positively. SMS based elephant alerts were received by 38 percent of respondents, news flash on the local channel by 89 percent in 14 estates while early warning beacon lights were working in 9 out of 17 estates. All the respondents felt that mitigations measures were important while 96 % said they had benefited and avoided accidents in the past due to these measures. Since negative attitudes are driven by past bad experiences, mitigation measures should now prioritize estates which are remote and prone to high risk of negative interactions between people and elephants.

CAN INCREASING CROP HETEROGENEITY IMPROVE SYNERGIES BETWEEN ECOSYSTEM SERVICES AND BIODIVERSITY CONSERVATION IN EUROPEAN AND NORTH-AMERICAN FARMLANDS?

Sirami C. Representing The Farmland Consortium
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Agricultural landscapes occupy nearly 40% of the available land area in the world. They play an important role in providing habitat for wild species that in return contribute significantly to food production through ecosystem services such as crop pollination and pest control. Over the last half-century, intensification of agriculture has resulted in losses to biodiversity and associated ecosystem services. Landscape heterogeneity has been proposed as a key tool in conserving farmland biodiversity. Indeed, agricultural landscapes which contain higher amounts of semi-natural habitats tend to host more species. However, current policies either aim at increasing the proportion of semi-natural elements, which requires taking crop area out of production and is often not feasible, or focus on a particular group of species, which may lead to the decrease of other species or ecosystem services. It has been suggested that increasing crop heterogeneity may also increase species diversity through landscape complementation processes and improve synergies between ecosystem services. The FarmLand project tested this hypothesis on seven taxa and four services across eight regions of Europe and North America. Surveys and experiments were conducted in 453 landscapes located along two independent gradients of crop compositional and configurational heterogeneity: crop diversity and crop total border length. We compared species richness and total abundance of seven taxa as well as pollination, predation and food production potentials. Results to date suggest that crop configurational heterogeneity may have a stronger effect on biodiversity in some regions but that effects of crop heterogeneity are not consistent across taxonomic groups, ecosystem services and agricultural regions. Multi-taxa and multi-region results will be key in developing more efficient agricultural policies and identify more acceptable trade-offs between ecosystem services and biodiversity conservation.

PARTICIPATORY ANALYSIS, LANDSCAPE ASSESSMENT AND CONSERVATION IN THE GREATER GRAND CANYON REGION

Thomas Sisk

Northern Arizona University

Todd CHAUDHRY, National Park Service ; Clare ASLAN, Northern Arizona University ; Jill RUNDALL, Northern Arizona University [INSTITUTE] Northern Arizona University [INSTITUTE] Northern Arizona University ; Sasha STORTZ, Northern Arizona University

Conservation areas do not exist in isolation, and administrative boundaries seldom capture ecosystem dynamics to a degree that adequately protects biodiversity. While conservation science is increasingly able to integrate compositional and functional attributes at the landscape-level, acting on this



knowledge though transboundary management remains challenging. To address broad-scale management issues exacerbated by land use and climate change, we designed a collaborative assessment process for the Grand Canyon region. After convening stakeholders representing private landowners, state and federal agencies, Native American tribes, and other engaged citizens, we identified a 2M ha study region with the 490K ha Grand Canyon National Park at its core. Drawing on existing data from multiple sources, we applied spatial analysis and modeling to inform a multi-step deliberative process, through which stakeholders identified focal resources and processes, as well as threats and stressors. Participants mapped priority areas to guide planning and enhance stewardship. Analyses revealed priority areas and stewardship needs that unite upper watersheds with downstream resources within Grand Canyon National Park, as well as park management efforts that affect adjoining lands. Engagement engendered confidence in data and analysis, while results influenced park management and provided a scientific foundation for addressing complex problems that demand socioeconomic and cultural sensitivity, as well as environmental understanding.

BIRD FUNCTIONAL DIVERSITY DECREASES WITH TIME SINCE DISTURBANCE: DOES PATCHY PLANNED FIRE ENHANCE ECOSYSTEM FUNCTION?

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The effects of disturbance on animal functional diversity are unknown. Functional diversity measures the trait values in a community, and links changes in species composition with the consequences for ecosystem functions, such as seed dispersal, pollination and nutrient cycling. Improved understanding of the relationship between time since fire (TSF) and functional diversity is critical to biodiversity conservation because the frequency and severity of fire are expected to increase. We examined responses of bird functional diversity to TSF and two measures of habitat variation across a 70-year chronosequence spanning four vegetation types. Six bird functional traits were used to derive measures of functional richness and evenness, and we investigated the effects of TSF, plant diversity and vegetation structure on the functional diversity indices. Functional richness was negatively associated with TSF in all vegetation types, suggesting that recent planned fire generates variable habitat and provides greater opportunities for species to partition resources. A positive relationship between functional evenness and structural heterogeneity was common to all vegetation types, suggesting that fine-scale (10s of metres) structural variation can enhance ecosystem function

and resilience. Species more common in young vegetation were primarily linked by their specialist diets, indicating that ecosystem services such as seed dispersal and insect control are enhanced in more recently burnt vegetation. Our data indicate that patchy, planned fire sustains functional diversity, and we suggest that controlled use of patchy fire to break up large expanses of mature vegetation will enhance ecosystem function and resilience, while protecting species that rely on old vegetation.

ENGAGING DIVERSE PARTNERS: THE MULTI-PARTY CONSERVATION AGREEMENT AND STRATEGY AS AN EFFECTIVE FRAMEWORK FOR ARID-LAND AQUATIC SPECIES CONSERVATION AT A LANDSCAPE SCALE

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In arid lands of the American west, rare and imperiled aquatic species often occur in isolated and geographically dispersed populations across multiple political and administrative jurisdictions, creating unique challenges to implementing conservation for those species. In Nevada, conservation providers have used the multi-party Conservation Agreement and Strategy (CAS) as an effective tool to implement proactive strategies and actions at a landscape scale across the range of included species. The CAS approach has been successfully applied to both endemic fish and amphibian species, and an agreement is currently under development to guide conservation implementation for a suite of rare gastropod species occurring in isolated habitats across the Great Basin ecosystem that share similar habitats and threats. CASs for three imperiled amphibians, Amargosa toad, relict leopard frog, and Columbia spotted frog, have guided successful implementation of more than 90 percent of conservation targets by multiple partners over 10-year timelines, and are currently being renewed for additional terms. Key to these successes is the high level of certainty for conservation through signatory commitments by participants including: Federal, State, and local governments; NGOs; academic institutions; and other private and public parties. Through a combination of successful implementation and commitment to long-term conservation efforts, CASs for two species, Virgin spinedace and Amargosa toad, have been instrumental in supporting findings that the listing of these species under the Endangered Species Act was not warranted. The CAS format provides a flexible and adaptive method for insuring that needed conservation practices are delivered effectively to at-risk species at a scale



necessary to maintain and enhance populations of these species across large landscapes, while accommodating the challenge of working with diverse partners whom often have conflicting needs and requirements.

GENETICS IN CONSERVATION ISSUES: DIFFERENT METHODS YIELD DIFFERENT RESULTS

Per Sjögren-Gulve

The Swedish Environmental Protection Agency

Methods and theories in population genetics can be very useful in both conservation policy-making and management (e.g. www.congressgenetics.eu). But different methods may also yield different answers to a conservation-management question, for example: Are these two subpopulations so much genetically interconnected that they constitute, and should be viewed as, one single population? Applying this question to the brown bear (*Ursus arctos*) in Northern Europe with different genetic methods (already done by other authors), produced two different results and answers: an FST analysis implied "Yes" while an assignment test implied "No". While population geneticists may be aware of the pitfalls in the interpretations of results from such analyses, most ecologists, conservation managers and policy-makers are not. I discuss the implications of this general problem for practical conservation management to illustrate the importance of science-policy collaborative learning in biodiversity conservation.

DEER DRIVE COMMUNITY AND EVOLUTIONARY CHANGES IN THE THREATENED GARRY OAK ECOSYSTEM

Cora Skaien

University of British Columbia

Peter ARCESE, University of British Columbia

Ungulate browsing can drastically alter species abundance or performance, or cause evolutionary change in species' traits related to fitness and survival that allow a plant to tolerate or resist ungulate browsing. In the Southern Gulf Islands of British Columbia, Canada, the threatened and heavily invaded Garry Oak and Maritime Meadow ecosystems experience deer densities as high as 100 deer/km². To experimentally assess the impact of deer browsing in these ecosystems, we erected two exclosures (c. 750 m² each) on Sidney Island, Canada in April, 2012 and assessed native species performance after three growing seasons of protection from deer. In August, 2013, 4800 seeds of the iconic *Plectritis congesta*, which originated from islands with histories of high or low deer densities, were systematically planted in and outside exclosures to determine if browsing history influenced plant survival over the subsequent growing season. In May 2014, native species cover was 2-fold greater inside exclosures than outside. Iconic *Brodiaea* species particularly benefited from deer exclusion,

with 3.7 times more cover, 2.3 times higher corm abundance and 3.4 times more volume per corm inside exclosures than outside. The survival of *P. congesta* plants was severely reduced outside exclosures regardless of browsing history, but plants originating from islands with deer had 3-fold higher survival than plants from islands without deer. Plants that originated from islands with deer grew low to the ground until mid-spring to avoid herbivory and achieved shorter final heights, whereas plants from islands without deer bolted several months earlier making them more conspicuous to deer. Together, these results suggest that removal of deer is sufficient to instigate restoration of these degraded ecosystems as manifested through increased native cover and native species performance, and that *P. congesta* populations have become locally adapted to resist herbivory on islands with deer.

BEYOND GREEN-PLANNING POLITICAL ORIENTATIONS: CONTRASTED PUBLIC POLICIES IN TWO EUROPEAN CAPITALS

Zina Skandrani

French National Museum of Natural History

Anne-Caroline PRÉVOT, French National Museum of Natural History

In the international agenda of conserving biodiversity and urban green planning, we explored how biodiversity-friendly political orientations in two European metropolises (Paris – France and Berlin – Germany) were translated in public urban park management. To do so, we used a mixed methods research strategy: we analyzed both cities' strategies for biodiversity and landscape, conducted semi-directive interviews with park managers, surveyed park design and management, and administered questionnaire to specific city dwellers. We showed that the biodiversity strategies in both cities similarly aim at increasing urban biodiversity and city dwellers' awareness; however, they are highly contrasted in their implementation, with Paris having a high level of control and top-down processes compared to Berlin. Accordingly, nature perceptions of city-dwellers differed between both capitals only in their willingness for nature-control (which was more present in Paris than in Berlin). With this example, we discuss how integrative environmental planning can encourage specific implementations of a global strategy.

ID34 REMOTELY-SENSED ESSENTIAL BIODIVERSITY VARIABLES

Andrew Skidmore

University Twente



Sander MUCHER, Alterra ; Martin WEGMANN, DLR ; Nathalie PETTORELLI, Zoological Society London ; Tiejun WANG, Universiy Twente

The original concept of Essential Climate Variables was used as a conceptual basis by the Group on Earth Observation Biodiversity Observation Network (GEOBON) to develop the concept of Essential Biodiversity Variables (EBVs). Here, we present the outcome of 2 workshops which explored the concept of EBVs from the perspective of remote sensing. Translating the conceptual biological ideas of biodiversity, as developed primarily by ecologists, into variables that can be monitored from space proved challenging. However, a framework was developed that recognizes EBVs generated from remote sensing as being global, standardized, repeatable, continuous and synoptic. These features in turn allow the EBVs, directly derived from remote sensing, to be monitored at a global scale. In this presentation, the outcome of the workshops is summarized, and the 'RS4EBV' (remote sensing for EBV) framework is presented. Some case studies based on species monitoring, primary productivity and phenology are used as examples to highlight and explain the RS4EBV framework.

REVIVING STREAMS AND WETLANDS IN ISRAEL - IN A LAND OF SEAWATER DESALINATION

Orit Skutelsky

Society for Protection of Nature Israel (SPNI)

The deep crisis in Israel's national water system is mainly expressed in deterioration in the state of natural water resources, and desiccation of natural aquatic habitats (wetlands, springs and streams). As a result, wetland biodiversity is deeply threatened. For example, over 50% of the plant and animal species that have gone extinct in the region, and over 30% of the plant species currently endangered, are wetland related species. During the second half of the 20th Century, three large-scale developmental projects desiccated the local streams and wetlands. The first was a wide-spread river drainage project that straightened the rivers' meanders, and located agricultural fields and fish ponds in close proximity to river banks – at the expense of river corridors and floodplains. The second national development project was diversion of spring water to agricultural use; and the third was large scale aquifer depletion. Pumping and over-use of groundwater has led to reduction of water levels in aquifers, consequently leading to salinization and waning of the water flow in many springs. Our research shows that 60 out of 90 springs surveyed have lost over 30% of their natural flow during the last 30 years. Processes of degradation of spring water flow raise concern over the government's "treading on the edge" policy of over-exploitation of natural water resources.

Recently the State of Israel has entered an era of large scale sea-water desalination. Currently, over 450 million cubic meters of water are desalinated annually. In the near future most of the country's urban water consumption will be supplied with desalinated water. Releasing the dependence of the urban sector on natural water resources, and increased usage of treated wastewater for agriculture, should lead to policy of rehabilitation and stabilization of aquifers and consequently to restoration of springs and wetlands.

ADVOCATING POLICY AS AN EDUCATIONAL TOOL FOR ENVIRONMENTAL STUDIES STUDENTS

Peter Smallwood

University of Richmond

Stephen NASH, University of Richmond

Undergraduate programs in Conservation Biology have developed a diversity of approaches to employ some form of experiential learning in the curriculum. They range from having the class participate in clean-up projects, create programs for their campus, to having the class work as an environmental consulting organization to help clients in the community beyond campus. Each approach has its own advantages and disadvantages, both for the students and the faculty of the courses. We co-taught the capstone course for our Environmental Studies degree, where we have used policy advocacy as the basis for experiential learning. After studying the scientific, economic and policy aspects of our chosen environmental problem, students in the course developed specific policy recommendations for officials of the Commonwealth of Virginia, and advocated for those policies. Our choices for specific problem areas to address with our recommendations have been very opportunistic. For example, in our most recent iteration of the course, we noted that the Governor of our state had appointed a commission to make recommendations for actions to help the state adapt to climate change in the coming decades. We found the structure of the committee focused on the built environment, with little attention to the natural environment. Therefore, we developed recommendations for conserving the state's biodiversity in the face of climate change, and presented them to members of the Governor's Climate Change Commission. Mechanisms of advocacy included writing and submitting opinion pieces for local newspapers, and face-to-face meetings with Virginia officials. Here, we review our approach to experiential learning for environmental studies, the advantages and disadvantages to our approach, and compare them to a selection of other approaches. We again advocate an opportunistic approach to bringing experiential learning into the classroom.



IMPACTS OF HIGHWAY 40 ON THE GREATER OCALA NATIONAL FOREST ECOSYSTEM, FLORIDA, USA

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Univ of Central Florida

The greater Ocala National Forest ecosystem (2,000 km²) serves as an important conservation reserve in the heart of central Florida, USA. Highway 40 is a major two-lane road (traffic exceeds 15,000 vehicles/day) that bisects the forest. Rapid growth and development have necessitated widening the road to four lanes. A comprehensive approach that employed several methods was used to determine the current and potential impacts. Survey methods included road-kills, tracks, capture-mark-recapture, landscape genetics and radio-telemetry. Each method was used to evaluate road impacts on different taxa. The study was conducted from 2011-2014 along a 5.5 km stretch of road. Road-kills included over 63,000 individuals from 100 species, while more than 27,000 sets of tracks were recorded of 14 species. Locations of road-kills and tracks were recorded for hotspot analysis. Hair snares were used to evaluate likely road crossings by large mammals. We collected 164 samples of eight species; genetic analysis was conducted on black bear hair identifying 16 separate individuals from 39 samples. Nearly 14,000 herptiles were captured in 39 drift fence arrays. Only two lizards and one frog were recaptured crossing the road, yet herptile road-kills were relatively common. Of 1,529 small mammals captured, none were recaptured crossing the road and only 33 road-kills were documented. The road presents a significant barrier to small mammal movement. Average home range of 12 gopher tortoises was 0.88 ha; none of these were recorded crossing the road, though three road-kills of other individuals occurred. Home range of the 16 Florida box turtles monitored averaged 13.8 ha. Although the road appeared to form a home range boundary, five recorded road-kills indicate that crossings are attempted. For gopher tortoise and Florida box turtle, the road is a significant barrier. To improve habitat connectivity and eliminate road mortality several wildlife crossings and fencing are planned.

15. QUANTIFYING THE ROLE OF BIODIVERSITY AND ECOSYSTEM SERVICES IN CROP PRODUCTION AT FARM AND LANDSCAPE SCALES

Henrik G Smith

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While demand for food and bioenergy produced on agricultural land is expected to increase substantially in the near future, agricultural intensification has been shown to negatively impact biodiversity and potentially undermine the production of supporting ecosystem services such as nutrient retention, biological control and pollination that are important for yields. An alternative to conventional intensification is to instead promote these supporting ecosystem services, resulting in increased productivity and/or reduced environmental damage. Models informed by data can be used to evaluate alternative agricultural land-use and management on ecosystem services and yield. However, modelling ecosystem services in real landscapes is challenging because consequences of management on biodiversity depend on both local and landscape-scale land-use and may also be highly context dependent. We develop mechanistic models based on ecological understanding of key processes affecting ecosystem-service providing organisms and how this translates into effects on yield of major temperate arable crops. By integrated modelling of multiple supporting ecosystem services we account for uncertainty of service generation and interactions between services. An explicit linkage with multiple empirical datasets and multiple levels of uncertainty makes the modelling and parametrisation transparent and emphasizes its evidence-based nature. We show how these models can be used to inform management of biodiversity when consequences of decisions taken by individual farmers even have consequences for neighbouring farms. In particular, by combining the modelling of ecosystem services with agent-based models driven by farmers' optimizing behaviour, we can evaluate the potential benefits of landscape scale governance of biodiversity and ecosystem services. Thus, we show how landscape-scale modelling of ecosystem services can be used to inform multi-level governance of agricultural landscapes.

TOWARDS A BLUE ECONOMY IN SEYCHELLES: MARINE SPATIAL PLANNING AND A DEBT SWAP

Joanna Smith

TNC Canada

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The Seychelles is a rich, tropical marine ecosystem situated in the Western Indian Ocean. Encompassing 1.37 million km² and 115 islands, Seychelles has two UNESCO World Heritage Sites and is home to approximately 85,000 inhabitants. A recognised global biodiversity hotspot, there are high rates of endemism and 735 species on the IUCN Red List. Biodiversity is one of the countries most important assets and it supports two major



economic sectors: tourism and fisheries. The sustainability of existing and future uses is very important to Seychelles, as is meeting their biodiversity protection goals and reducing their national debt. Development and environmental pressures along the coast and at sea, including climate change and extreme ocean events, are impacting Seychelles' natural heritage, affecting livelihoods and economic prosperity. The Seychelles Marine Spatial Planning Initiative is focused on planning for, and management of, the sustainable and long-term use and health of the Seychelles Exclusive Economic Zone. The government-led process includes planning and facilitation in a partnership between The Nature Conservancy and the UNDP-GEF-PCU. The Initiative takes an integrated, multi-sector approach to addressing the challenges in Seychelles, a process with input from all major sectors such as fishing, tourism, conservation, recreation, maritime safety, infrastructure, shipping, and petroleum development. Ecological and socio-economic spatial data sets, a UNDP biodiversity analysis, participatory mapping, and Marxan are being used to develop a zoning design for the entire Exclusive Economic Zone. Management considerations are being drafted that will link the zoning to national policies and strategies, including the Blue Economy. Implementation of the plan will be made possible through a debt swap and creation of a Trust Fund that will provide a sustainable revenue stream for ocean management and climate change, and consolidate foreign debt.

EFFECTS OF HURRICANE IRIS ON RIPARIAN BIRD COMMUNITY STRUCTURE IN SOUTHERN BELIZE

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University of Arkansas

Rose Ann BARNHILL, University of Arkansas

Hurricanes are frequent and integral features in the Caribbean, but limited quantitative data exist on response of bird communities to their influence. Lack of pre-hurricane data in affected areas is the primary factor limiting those studies. We began a study of the riparian birds associated with the Bladen branch of the Monkey River in the Bladen Nature Reserve in southern Belize in February of 2000. Two transects were established, one in old secondary-growth (T1) and one in mature forest that did not appear to have been logged (T2). In October of 2001, Hurricane Iris, a category 4 hurricane with sustained winds of 225 km/hr, passed directly over our study sites, effectively destroying the tropical riparian forest along the two transects we had censused from February to June in 2000 and 2001. Although obviously different, we compared pre-hurricane vegetation data (2001, N = 80 plots) with post-hurricane vegetation data (2002), using a modified James-Shugart method for 21 variables. In 2001, 33 species of migrants and 143 permanent residents occurred on T1 and 28 migrants and 111 residents occurred on T2. After the hurricane in 2002, 34 migrants and 133 residents occurred on T1 and 26

migrant and 122 residents occurred on T2. Although numbers of species are superficially similar between years, relative abundances changed dramatically, with common species becoming rarer and rare species becoming more common. Some species disappeared post-hurricane, while some new species appeared. Significant changes also occurred based on strata a species foraged in, foraging substrate, and diet. The dramatic change from forest to early successional vegetation had an equally dramatic change in the composition of the riparian bird communities.

CLASSICAL BIOLOGICAL CONTROL FOR THE MANAGEMENT OF INVASIVE ALIEN INSECTS AND PLANTS

Lincoln Smith

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Invasive alien species have become an increasing problem for the conservation of native plant communities and ecosystems worldwide. They can kill or displace desirable native species, reduce biodiversity, increase frequency of wild fires, and change ecosystem services, such as the production of timber or forage and storage of ground water. In the United States, classical biological control, the introduction of host specific natural enemies (parasitoids, herbivores or pathogens), has been used to control invasive plants in forests, grasslands and aquatic habitats, and to control invasive insects attacking desirable plants. This strategy can produce self-perpetuating reduction of the target pest with negligible nontarget impacts. Plant species successfully controlled in the United States include, musk thistle (*Carduus nutans*), diffuse knapweed (*Centaurea diffusa*), water hyacinth (*Eichhornia crassipes*), leafy spurge (*Euphorbia esula*), purple loosestrife (*Lythrum salicaria*), cajeput tree (*Melaleuca quinquenervia*), and saltcedar (*Tamarix* spp.). The European Biological Control Laboratory is conducting foreign exploration, genetic analysis and host specificity testing of prospective agents to control invasive plants, including giant reed (*Arundo donax*), yellow starthistle (*Centaurea solstitialis*), hoary cress (*Lepidium draba*), French broom (*Genista monspessulana*), medusahead rye (*Taeniatherum caput-medusae*), and North African wire grass (*Ventenata dubia*). Research is also being conducted to control invasive alien insects that attack native trees, including Asian longhorned beetle (*Anoplophora glabripennis*).

191 SPECIES, SPACES AND SCIENCE: BROADENING THE FLAGSHIP CONCEPT IN CONSERVATION MARKETING

Robert Smith



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Flagship species have been defined as “a species used as the focus of a broader conservation marketing campaign based on its possession of one or more traits that appeal to the target audience.” This concept is widely and successfully used in conservation to raise funds and awareness but the flagship species approach has been criticised for focusing on a narrow range of biodiversity, leaving many neglected species and ecosystems. Here we discuss several ways to overcome this criticism and argue that the flagship concept should be applied more broadly in conservation. First, we discuss the “Cinderella species” approach, which has been used to identify threatened species that are currently ignored by conservation fundraisers but have the potential to be effective flagships. Second, we discuss the role of “flagship fleets”, where several species are selected to appeal to different segments of the target audience. Finally we discuss how the flagship concept can be applied to conservation features other than species, using Conservation International’s biodiversity hotspots programme and the Zoological Society of London’s EDGE of Existence programme as case studies. We argue these two projects have successfully combined conservation science with marketing expertise to create flagships that cover a broader range of biodiversity.

134 USING MARXAN AND CLUZ TO GUIDE NEGOTIATIONS WITH CONSERVATION STAKEHOLDERS

Robert Smith

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Rachel SYKES, DICE, University of Kent ; Bruno NHANCALE, Fauna and Flora International ; Kristian METCALFE, University of Exeter

Designing protected area systems and other conservation networks often involves working with a range of stakeholders representing different sectors and user groups. Systematic conservation planning was developed to make this stakeholder engagement more effective, as it defines explicit conservation goals at the beginning of the process and helps identify trade-offs and opportunities. Here we discuss four projects that illustrate the different ways in which stakeholder opinion can be incorporated into spatial conservation prioritisation. First, we introduce the Conservation Land-Use Zoning (CLUZ) plugin for QGIS that allows on-screen conservation planning so that stakeholders can investigate how modifying different options affects target attainment. Second, we discuss a case study from Southern Africa where we used Marxan to identify the broad location of a corridor between two protected areas, which was then refined using input from local farmers and fine-scale

land-use data. Third, we demonstrate a Marxan-based method for modifying the boundaries of existing protected areas to remove land that has been settled by people and replace it with land of similar conservation value elsewhere. Finally, we present a study from the Eastern English Channel that used Marxan with Zones to investigate the ecological and fisheries impacts of different combinations of no-take and limited-take marine protected areas.

LARGE-SCALE COMPLIANCE WITH SUGARCANE SUSTAINABILITY STANDARDS COULD RESULT IN MIXED CONSERVATION OUTCOMES

William K. Smith

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Society faces the pressing challenge of meeting growing human demand for food, fuel, and other materials while sustaining critical environmental services and biodiversity. In an effort to address this challenge, the World Wildlife Fund and other global conservation and business entities have made significant strategic investments to develop and promote standards and certification for key agricultural commodities. However, the assumption that adoption of sustainability standards will result in conservation benefits has not been well tested at the large scale. Here, we address this knowledge gap by evaluating current sugarcane standards using spatially explicit global data on current extent, yield, and management practices. We combine these data with future scenarios of demand-driven increases in sugarcane production under various levels of compliance with standards. We find that large-scale certification has the potential to help close global yield gaps, while reducing greenhouse gas emissions, conserving biodiversity, and improving water availability and quality. Yet, we also identify critical shortcomings of current sugarcane standards, and highlight a number of potential improvements that could better conservation outcomes. This type of



global geospatial analysis serves as a general framework for evaluating and improving the potential conservation benefits of both existing and future certification programs.

OYSTER AQUACULTURE AND THE ENVIRONMENT: IS IT A WIN-WIN?

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Virginia Institute of Marine Science

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Human activities have drastically altered the structure and function of coastal ecosystems. Increased nutrient inputs, especially nitrogen, have fueled eutrophication, with increased frequency of low oxygen events, fish kills and harmful algal blooms. Concomitantly, overharvesting has devastated fisheries. The combined effects of unsustainable fishing and pollution diminish resilience and threaten biodiversity. Moreover, the demand for a viable protein source continues to increase with global population expansion, resulting in a shift towards aquaculture. Conservation is often at odds with aquaculture, including Not-In-My-Backyard issues and specific concerns over carrying capacity, competition with natural habitats, nutrient dynamics and disease. Bivalve aquaculture provides a sustainable protein source while also having positive environmental impacts, including removing nutrients through enhanced denitrification, improving water clarity, and decreasing fishing pressure on wild stocks. However, at high bivalve densities, aquaculture can deplete resources for other species and contribute to poor sediment quality. As clear distinctions exist between the ecological role of oyster reefs and the various oyster culture methods, understanding whether and how the services provided by oyster reefs translate to culture methods is critical. Using eastern oyster (*Crassostrea virginica*) aquaculture as a case study, we will assess the matches and mismatches of maximizing aquaculture yield and environmental quality and will discuss key questions about the ecological effects of aquaculture to improve best management practices. Critical questions regarding the impact of aquaculture at the ecosystem scale require further attention to ensure practices provide a safe food source while sustaining ecosystem functions.

95 THE PROMISE AND REALITY OF USING GENETIC TECHNIQUES TO QUANTIFY THE IMPACTS OF LINEAR INFRASTRUCTURE AND EVALUATE THE EFFECTIVENESS OF MITIGATION

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Australian Research Centre for Urban Ecology

Michael A SAWAYA, Sinopah Wildlife Research Associates ; Niko BALKENHOL, Georg-August-Universität Göttingen

Roads, railways and other linear infrastructure can affect the movement and survival of wildlife, with negative consequences for gene flow and genetic diversity. Several reviews highlight the importance of these issues, yet genetic approaches are relatively underutilised in road ecology. Further, many researchers seem unaware of the power of genetic techniques to address 'non-genetic' road ecology questions. Here, we revisit the importance of conservation genetic approaches in road ecology research, discuss the latest advances in 'molecular road ecology', and introduce studies that apply these techniques to common road ecology questions. Individual-based approaches, simulation modelling, next generation sequencing and non-invasive genetic sampling have the potential to provide great insights to genetic and ecological road effects. For example, genetic approaches can be used to quantify barrier effect, identify 'unidentifiable' roadkill carcasses and estimate demographic parameters. Genetic approaches are particularly valuable when investigating the impacts of roads and wildlife crossing structures on animal movement and functional connectivity. We also discuss some of the perceived hurdles to using genetic approaches (e.g. cost, expertise, time constraints, scale) and suggest ways that they can be overcome. Finally, it is important to remember that while genetic techniques are powerful, they are not a cure-all. They are most informative when applied in the context of question-driven science, a robust study design (e.g. BACI) and sufficient replication. Further, combining genetic and non-genetic approaches will provide a more comprehensive understanding of the effects of linear infrastructure and mitigation on population viability. Our goal is to provide a realistic overview of the opportunities, challenges and requirements of genetic approaches in the hope that people will feel better prepared to include them in road ecology research.

CONFORMITY OF EUROPEAN AND NATIONAL CONSERVATION PRIORITIES: BIOGEOGRAPHIC ISSUES

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CBD Aichi target 11 requires establishing a coherent system of protected areas by 2020. European countries input to this target according to the Action Plan on the strategic development of the Pan-European Ecological Network (PEEN) for the period 2012-2020. The Emerald Network of Areas of Special Conservation Interest (including the Natura 2000 Network of the European Union) is considered as a set of Core Areas of the PEEN. The Calendar for the implementation of the Emerald Network of Areas of Special Conservation Interest



2011-2020 envisions the enlargement of the Network up to the expected space of the PEEN including the Far East of the Russian Federation and the Central Asia. This new challenge enhances the importance of a coherence between European and national conservation priority, especially between the list of species of European importance requiring territorial conservation measures and national and sub-national red lists of endangered and protected species. We have analysed the conformity of the mentioned European list and the red lists issued by the entities (administrative regions) of the Russian Federation. The studied index decreases from the western to the eastern part of Russia, as well as from the North to the South. Birds show the better average conformity, than other species groups, Mammals are the second, then – Amphibians and Reptiles, Pisces, Invertebrates, and Plants. We consider this to be the result of difference of a level of endemism in each groups. The endemism in its turn depends on the mobility of individuals (bionts) and on the size of the territories necessary for living population. We propose the set of biogeographic regions for developing the its-own priority list of species for the purposes of the Emerald Network and the PEEN establishment. If being correctly compiled, such a geographical based system of priority may be used for assessment of the expected level of ecosystem function by the share of really saved endangered species.

134 USING MARXAN TO AID IN MITIGATION PLANNING

Kei Sochi

The Nature Conservancy

Mike HEINER, The Nature Conservancy; Joseph KIESECKER, The Nature Conservancy

Designing protected area systems and other conservation networks often involves working with a range of stakeholders representing different sectors and user groups. Systematic conservation planning was developed to make this stakeholder engagement more effective, as it defines explicit conservation goals at the beginning of the process and helps identify trade-offs and opportunities. Here we discuss four projects that illustrate the different ways in which stakeholder opinion can be incorporated into spatial conservation prioritisation. First, we introduce the Conservation Land-Use Zoning (CLUZ) plugin for QGIS that allows on-screen conservation planning so that stakeholders can investigate how modifying different options affects target attainment. Second, we discuss a case study from Southern Africa where we used Marxan to identify the broad location of a corridor between two protected areas, which was then refined using input from local farmers and fine-scale land-use data. Third, we demonstrate a Marxan-based method for modifying the boundaries of existing protected areas to remove land that has been settled by people and replace it with land of similar conservation value elsewhere. Finally, we

present a study from the Eastern English Channel that used Marxan with Zones to investigate the ecological and fisheries impacts of different combinations of no-take and limited-take marine protected areas.

WHAT WILL HAPPEN IF YOU DECLARE PROTECTION AND DO NOTHING? THE PAPER PARK EFFECT IN HPONKANRAZI WILDLIFE SANCTUARY, NORTH MYANMAR

Paing Soe

International Centre for Integrated Mountain Development (ICIMOD)

Rucha GHATE, International Centre for Integrated Mountain Development (ICIMOD); Pooja PATHAK, International Centre for Integrated Mountain Development (ICIMOD); Bandana SHAKYA, International Centre for Integrated Mountain Development (ICIMOD)

Many of the protected areas around the world and in Myanmar do not have adequate infrastructure or resources for management appropriate for the status of the protected area (Leverington et al. 2010; Rao et al. 2002). It is therefore important to study the realities of forest conservation in such a setting and the effect of protected areas where there is almost no actual protection despite their legal status of being a protected area. We studied the local residents' perceptions on the topic in Hponkanrazi Wildlife Sanctuary in north Myanmar as a rapid way to examine protected area effectiveness that can aid the management decision making process (Allendorf et al. 2012). We have found that local forest users, having known the declaration of protected area status for the area but not knowing when and how much they will be restricted from use of the forest, feel that they have to extract as much as they can while it is not prohibited. Villages that fall inside the protected area boundary also feel resentment towards people from outside of the area coming in for extraction because of the restrictions perceived to be unfairly placed on their land use, which villages outside the protected area do not have to abide by. Residents living inside the protected area boundary however, have expectations to be afforded forest use rights even after active management would begin. These perceptions, although they can be subjective, are important and of substantial relevance as they come from the people who use the forest themselves. Therefore, we contend from the findings that gazettement alone without following up with management action is likely to be counter-productive, and that giving forest use rights to local residents can foster protection activities by the local people to protect the forest areas under their management when the protected area management is under-staffed and under-resourced.



TRADE IN WILD ANIMALS (MOLLUSCAN, REPTILIAN AND AVIAN SPECIES) FOR TRADITIONAL AFRICAN MEDICINE IN OGUN STATE, NIGERIA

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A steady rise in the patronage for Traditional African Medicine (TAM) has caused a corresponding increase in the demand for the ingredients used in the preparation of the trado-medicines. These ingredients are the various wild animals and plants parts, cropped from the wild. The attendant rise in demand for ingredients calls for a need to document the extent of utilisation of these natural resources as a measure of the impact of such trade on biodiversity conservation. This paper examined diversity of molluscan, reptilian and avian species traded for use in TAM; the quantity of each species traded over a period of time, and, seasonal fluctuations in abundance and utilisation of these species. A multi-stage stratified random sampling technique was employed. An open-ended questionnaire was administered on vendors in selected market stalls for six consecutive markets days in each of dry and rainy seasons. The study identified twenty-three species, 8 were listed in CITES and Nigerian Decree 11(1985). A total of 3196 (molluscan), 2527 (reptilian), 2894 (avian) carcasses were traded over an average period of twenty days. The mean number of carcasses traded per dealer per month in the two seasons were: Molluscs (24.0 ± 1.6); Reptiles (19.0 ± 1.9) and Aves (21.7 ± 2.3). Trade in, and utilisation of wild animal species in TAM had no consideration for conservation status, hence it involved species under various degree of conservation threats. There seems to be no implementation of regulation of trade in wild animal species, including those purportedly protected by Decree 11 (1985). A twin approach of increase in yield and decrease in demand is required to stem the negative impact of trade and utilisation on biodiversity. Massive conservation education and extension services for the entire populace, capacity building and involvement of indigenous communities in conservation projects are also urgently required.

WOOD DENSITY FOR FOREST CONSERVATION: TOWARDS IMPROVEMENT OF BIOMASS AND CARBON STOCKS IN TROPICAL REGIONS

Gaël Sola

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The assessment of forest biomass has important consequences for climate-related policies, including conservation and activities related to deforestation and forest degradation. Tree and forest biomass are most efficiently assessed by a combination of remote-sensing, ground-based measurements and allometric models to predict tree and forest characteristics such as tree volume and biomass. The accuracy of these allometric models and therefore of biomass estimates can be improved greatly if wood density is used as an input variable. It is the most commonly used species functional trait in multispecies biomass models, which are frequently used in tropical ecosystems. However, wood density is difficult to measure accurately and thus is not included in large-scale forest inventories. This issue can be bypassed by using species average values, but often wood density values are only available at coarse taxonomic and/or spatial scales. Applying regional multi-species averages reintroduces to the models the potential bias originally removed by the use of wood density values. Therefore more wood density data is needed to cover the diversity of species and environments. This paper presents the work carried out to complement current initiatives aiming to collect, harmonize and share existing wood density data stored in national research institutes across the tropics. The database compiles raw data and calculated averages, with 70 information fields including GPS coordinates, measurement methods and sample size, when available, for a wide range of taxonomic and environmental values. Where precision in both taxonomic and environmental scales remains difficult to meet, the trade-off between the two can be better understood as the database includes both very accurate data and coarse averages. This database will improve forest biomass estimates, towards increasing the potential of climate change mitigation initiatives in the forestry sector.

HOW PERVASIVE IS BIOTIC HOMOGENIZATION IN HUMAN-MODIFIED TROPICAL FORESTS?

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Land-cover change and forest degradation in the tropics is leading to large-scale biotic homogenization (BH), or the simplification of regional biotas to a subset of generalist and resilient taxa. However, we still have poor understanding of how patterns of BH play out across different land-cover types, taxa and spatial scales. Here we analyse a multi-taxa tropical forest data set from the Brazilian Amazon, with 335 samples from 36 landscapes to assess how the species diversity of five taxonomic groups (plants, birds, ants, dung beetles and orchid bees) responds to land-cover changes at site, landscape and regional scales. We used multiplicative diversity partitioning and generalized linear models to examine how patterns of species loss at both site (α diversity) and landscape (γ diversity) scales change as a function of land-cover change; as well as how differences in species composition (β diversity) respond to land-cover changes at both scales. We also assess the contribution of nestedness and turnover in determining changes in assemblage composition within different land-cover types. While α diversity exhibited a steady decline with increasing land-cover intensification as expected, γ diversity was found to only decline in production areas. β diversity patterns were highly scale and land-cover dependent, with greater differences between species assemblages among forest vs. non-forest sites, while β diversity between landscapes remained high irrespective of land-cover type. At both site and landscape scales, the contribution of nestedness to β diversity, and hence the degree of biotic homogenization, increased with land-use intensification. Our finding highlights the importance of underlying environmental heterogeneity, spatially heterogeneous pressures, and stochastic processes in driving divergence in species composition across landscapes that have already been widely modified by humans. We discuss the role of effective conservation strategies on private land.

ENVIRONMENTAL AND BIODIVERSITY IMPACTS OF VARIABLE RETENTION FORESTRY IN TIERRA DEL FUEGO (ARGENTINA)

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Variable retention (VR) harvesting was suggested to maintain postharvest continuity of structural and compositional diversity, and a series of studies for *Nothofagus pumilio* forests in Tierra del Fuego (Argentina) seem to confirm this suggestion. VR applied in *Nothofagus* forests combines two types of retention: aggregates of original forest (AR) and dispersed single trees (DR). This study assesses the assumption that VR maintains mature forest conditions after harvesting by synthesizing 605 individual results from two regions of Tierra del Fuego with permanent monitoring. VR effects on (i) microenvironment, (ii) forest structure, (iii) forest reproduction, and (iv) biodiversity were investigated. AR had no effect on microenvironmental variables and forest structure, but increased the values of forest reproduction. DR did not affect microclimate and forest reproduction, but negatively affected forest structure. Species richness and abundance of native plants were significantly increased in AR; in DR richness of native plants was increased while their abundance was slightly decreased. Alien plants significantly increased in both treatments, with particularly strong effects in DR. Insect richness and abundance were hardly affected by the treatments, whereas for birds, these indicators were significantly increased in AR and in DR. Species of *N. pumilio* forests maintained their populations only in AR, whereas species of neighboring environments were positively affected by DR. We conclude that the ecological conditions of *N. pumilio* forests are influenced by VR, but direction and magnitude of the effect depend on the treatment and the kind of variable. Inside aggregates several primary forest components and conditions were maintained. Due to the considerable increase of alien species and of such from associated environments, particularly in DR, VR has still significant ecological impact over the original forest characteristics.

156 - MODELING FRAMEWORKS FOR IDNA DATA ANALYSES

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Invertebrate-parasite-derived, iDNA, has recently emerged as a powerful tool to detect vertebrate species, and has been discussed as a new non-invasive method to survey wildlife populations. But so far little attention has been given to whether and how iDNA-derived data can be combined



with state-of-the-art analytical tools to estimate wildlife demographic parameters and distributions. We discuss the challenges that face the application of existing analytical methods such as site-occupancy and spatial capture-recapture (SCR) models to iDNA, in particular, possible violations of key assumptions arising from factors intrinsic to invertebrate parasite biology. We focus on terrestrial leeches as a model iDNA source and their utility for occupancy and spatial capture-recapture modeling. The main source of uncertainty regarding target species detections from leech gut contents stems from uncertainty about the spatio-temporal sampling frame, since leeches retain host-blood for months and can move after feeding. This influences the spatial resolution of species detection data and consequently, the resolution of explanatory habitat covariates. It further complicates approximating a closed population (i.e., no losses or additions during the study) in spatial capture-recapture surveys. Lack of knowledge about leech feeding and habitat preferences, the inability to target a particular species with leech surveys, and the current lack of field experience to guide allocation of sampling effort can all complicate the implementation of efficient leech surveys. However, we conclude that with careful planning and under certain assumptions about leech movement, iDNA from leeches should be appropriate for occupancy models. On the other hand, the uncertainties associated with this method currently make SCR surveys unlikely. Future research should focus on resolving questions of leech feeding and movement ecology and blood retention, to try and resolve these outstanding uncertainties.

INFECTIOUS AGENTS SURVEY IN PIED TAMARINS SUBPOPULATIONS IN MANAUS, AMAZONAS STATE, BRAZIL.

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In past decades, numerous studies have highlighted how urban expansion, habitat fragmentation, deforestation, and superposition of human and wildlife population areas contribute to surges in emergent and reemergent diseases. As a result of continuing anthropogenic disturbance in the Amazon, wildlife populations find themselves increasingly exposed to human populations and their domestic animals, bringing higher risks of transmission of a variety of infectious agents. Manaus, located in the Brazilian Amazon, represents a potentially useful model to understand the mechanisms of disease transmission. The city has undergone a disorganized and precipitous growth with ongoing industrial development, causing constant landscape alteration. Because non-human primates are closely evolutionary related to humans they share a diversity of infectious agents. The present study proposes to use subpopulations of critically endangered Pied tamarins (*Saguinus bicolor*) occupying urban forest fragments in Manaus as a flagship species to evaluate the presence of infectious agents at the human-nonhuman primate interface. It will also assess whether anthropogenic perturbation at sites favors transmission of agents within this human dominated matrix. During the period of 2011-2014 a total of 49 pied tamarins in 9 urban forest fragments and 2 control areas. Molecular analyses were performed for the detection of Rotavirus, Hantavirus, Coronavirus, Flavivirus, Enterovirus, Influenza A, Adenovirus, Human Metapneumovirus, Human Respiratory Syncytial Virus, Parainfluenza Virus 1, 2, 3, 4, West Nile Virus and Plasmodium spp. The results indicate prevalence for Hantavirus (n =4), Rotavirus (n =9), and Plasmodium brasilianum (n =1). This is the first record of Hantavirus in neotropical primates. Data indicate that smaller fragments have proportionally higher prevalence rates, however small sample sizes did not allow formal statistical testing.

PARASITIC FLIES IN ARTIFICIAL RED-FOOTED FALCON'S NEST BOXES

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MTA Centre for Ecological Research

The Red-footed Falcon (*Falco vespertinus* Linnaeus, 1766) is listed in the Red List of IUCN and is a strictly protected raptor species in Hungary. Followed by the eradication campaign in the 1980s against Rook (*Corvus frugilegus* Linnaeus, 1758), and consequent reduction in rook nest number, Red-footed Falcon population collapsed. Ornithologists installed more than 3000 artificial nest boxes in Hungary in order to increase the breeding populations. Actually there are more than 1000 breeding pairs in Hungary. Red-footed Falcon primarily uses crow or magpie nests for breeding, in nature these nests are



rebuilt in every year. The aim was to ascertain whether the material in the artificial nests accumulated over the years increase the number of parasitic, blood sucking flies. The study was performed in Northern Hungarian colonies during 2009 and 2010. Prior to 2009 the nest boxes were not cleaned for 3 years. After the youngsters left the artificial nest boxes the remaining nest material was collected. Nest material has been collected from 42 nest boxes in 2009 and from 17 nest boxes in 2010. The material has been stored in linen bags, and overwintered in a cellar. The hatching flies have been collected and preserved. Altogether 23,406 flies have been identified. 83% of the material (19,524 specimens) belonged to *Carnus hemapterus* Nitzsch, 1818. However, this fly was described from other *Falco* spp. hosts earlier, this is the first record from *F. vespertinus*. The number of *C. hemapterus* was one order of magnitude lower in 2010 than in 2009. These flies (the imagoes) suck the blood of especially the chicks. Therefore we suggest that artificial nest boxes are important in order to protect the species, but their annual cleaning is important. While the natural nests are rebuilt (consequently cleaned) in every year, without cleaning the number of the parasitic species increases during the accumulation of materials in the artificial nest boxes.

OCCUPANCY AND ABUNDANCE ESTIMATION IN THE PRESENCE OF DETECTION ERROR: WHAT CAN WE DO WITH A SINGLE SURVEY?

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Detection error is present in almost all ecological surveys. The method of replicate surveys, where one visits the same survey location multiple times, is one of the most commonly used methods to correct for detection error. Multiple-visits based methods to estimate occupancy and abundance suffer from various shortcomings: (1) the assumption of closed population is hard to satisfy in practice, (2) multiple-visits can be costly and logistically unfeasible, and (3) historical data often lack temporal replication. We show that if information on habitat covariates that affect occupancy/abundance and detection is collected, then one can estimate detection probability as well as occupancy/abundance parameters. This removes the need for replicate surveys. We discuss abundance estimation in N-mixture models and their extension to distance sampling situations where data might have been collected under many different survey protocols.

COMPARISON OF BUTTERFLY ASSEMBLAGES ON OLD-FIELDS AND NATURAL HABITATS IN KISKUNSAĞ REGION, CENTRAL HUNGARY

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Abandoned agricultural lands become more important in biodiversity conservation because of decrease of natural habitats. In our study we assessed the difference of butterfly assemblages between abandoned old-fields and natural habitat types. The study was carried out on KISKUN LTER field site network in Kiskunság sand forest-steppe region, Central Hungary. Old-fields were compared to locally most important butterfly habitats: sandy grasslands, forest edges and meadows. We studied 3 stands of 4 habitat types in 6 different landscape areas. Butterflies were counted and the amount of flowering nectar source plant species were estimated along 500 m long fixed transects at each sampling plot. The relationships between habitat types, flowering plant species and butterfly assemblages were explored by redundancy analysis (RDA). A total of 4418 individuals belonging to 44 species were observed in 4 visits between June and September. Butterfly species numbers were similar at each habitat types. The butterfly abundance was significantly higher on meadows, while in case of butterfly diversity only sandy grasslands had significantly lower value. Abundance of butterflies was strongly positively correlated with flower abundance, while butterfly species number with flowering plant species number. The butterfly assemblage of meadows differed from other habitat types which had similar species composition to each other. Using flowering plant species as explanatory variables, not only meadows, but old-fields and dry natural habitats (sandy grasslands and forest edges) had different species composition. On old-fields typically wide ranging, larger sized, bi- or multivoltine species occurred (e.g. *Vanessa cardui*, *Pontia daplidice edusa*, *Pieris rapae*, *Colias* spp., *Issoria lathonia*). Summarizing the results we can conclude that, although simple assemblage characteristics of old-fields did not differ from natural habitat types but their butterfly species composition was different.

126 BIODIVERSITY, GLOBAL CHANGE, AND SUSTAINABLE LAND MANAGEMENT: EXAMPLES FROM WESTERN AND CONTINENTAL AFRICA

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The maintenance of ecosystem functionality and ecosystem services is essential for human development. Hence, human wellbeing is closely connected to the wellbeing of ecosystems. Biodiversity facilitates provisioning, regulating and supporting ecosystem services at genetic, species-, and ecosystem level. Even though climate change represents a major challenge to the maintenance of global biodiversity and to human development, little is known about the magnitude and direction of its future impacts. This is a challenge for the set-up of appropriate mitigation and adaptation strategies. Given the comparatively high dependence of many agricultural production systems on climatic and environmental conditions in tropical and subtropical Africa, comprehensive land management strategies need to consider the status and dynamics of the biodiversity matrix in which they are embedded. This presentation spotlights distribution patterns of biodiversity across Africa, the actual status of habitats and their potential threat in order to derive vulnerability indicators and to identify trade-offs between biodiversity conservation and human land use claims. This is mandatory for the analysis of scale-crossing linkages of human-environment interactions and to evaluate the resilience of social-ecological systems under different development scenarios and under future climate change projections.

PARTICIPATORY MONITORING OF REINTRODUCED PRZEWALSKI'S HORSES IN KALAMAILI NATURE RESERVE, XINJIANG, CHINA

Melissa Songer

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Przewalski's horses (*Equus ferus przewalskii*) went extinct in the wild during the 1960s but have made a comeback through reintroduction projects in Mongolia and China. Based on these efforts, the species has recently been upgraded from Critically Endangered to Endangered on the IUCN Red List. Xinjiang Forestry Department initiated a project in 2001 to release captive horses to Kalamaili Nature Reserve (KNR) in Xinjiang, China. Currently there are approximately 100 individuals are released, but due to difficult winters and presence of livestock for winter grazing, most horses are enclosed and fed through winter. We are working together to find solutions through research and working with local Kazakh families to improve management and monitoring, with the goal of moving the population towards into year-round release and self-sufficiency. In 2012-13, SCBI conducted workshops among nearby Kazakh

communities to exchange ideas for a winter release, discuss means for involving the community, and find solutions that won't negatively impact people or wildlife. Partners agreed to a full winter release for several harem groups in 2013-14 at a new site, with a plan to establish a community scout program to train and hire local Kazakh herdsman to monitor horses through winter. We met with families to discuss concerns and identified 3 herdsman interested in becoming scouts. We collected data to evaluate the scout program along with socioeconomic interviews with over 70 households. We had mixed results but were able to identify methods for improving the scouting program. Results showed community involvement had positive impacts on the reintroduction project and that local conservation awareness was raised. We also gained insights for improving our overall management strategy for the reintroduction.

DESIGNING FOREST RESERVES NETWORKS USING SYSTEMATIC CONSERVATION PLANNING

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Public policies promote the designation of forest reserve networks that are set-aside from conventional forestry. Designing a network of old-growth woodland is a challenging task for forest managers trying to balance ecological benefits and economical/social costs over large spatial and temporal scales. We applied the systematic conservation planning (SCP) framework to the largest uninterrupted stand of forest on the Swiss Plateau in order to identify forest stands maximizing the biological potential for old-growth reserves, while minimizing the surface to 10% of the total area under scrutiny. Each planning unit was characterized by seven conservation features describing forest structure, composition, and function. The product of this approach is an irreplaceability value that is attributed to each planning unit, and reflects how important a given hectare is to achieving the conservation goals. Because identified hotspots are relatively small and disjoint, they do not allow for the emergence of large scale ecological processes. Larger high-value woodlands patches were selected, concentrated on core areas while expanding towards areas of lower irreplaceability, but allowing the appearance of large-scale ecological processes. The use of systematic conservation planning allowed for the emergence of a general spatial pattern (a heat map of irreplaceability values) and proved an efficient communication tool for community-wide workshops on the design of a forest reserve network.

STRUCTURE OF COCOA AGROFOREST IN WEST AND CENTRAL AFRICA: OVERVIEW

Denis Jean Sonwa



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Cocoa agroforest had been gradually recognized as a space for forest biodiversity management and conservation. This recognition affects expectations from cocoa landscapes. While farmers see forest species associated with cocoa a way to diversify the list of farm products from their farms, conservation agencies see cocoa agroforests as a way to increase the network of biodiversity conservation areas. At the same time, the chocolate industry considers cocoa farms as an opportunity to free the acquisition of cocoa beans from deforestation. Several companies have expressed their will to be "deforestation" certified in one/two decades. The characteristic of a cocoa farm is one of the main parameters illustrating its sustainability. Research efforts have been more focused on identifying plant species that can be grown in association with cocoa but few studies have investigated the horizontal and vertical arrangement of cocoa and non-cocoa plants (mostly forest trees) that are grown together in the same field. The spatial organization of cocoa and non-cocoa is expected to improve the productivity of the cocoa farms as well as ecological services expected from cocoa orchard/agroforest. This paper reviews the: (a) the density of cocoa, (b) the density of associated plants, (c) the basal area, and (d) the space between components and stratification in 4 of the main cocoa producing countries of West and Central Africa (Cameroon, Nigeria, Ghana and Cote d'Ivoire) with the perspective of improving the product and services within cocoa landscapes.

COMPARING RESULTS FROM DUNG COUNTS AND CAMERA-TRAPPING TO ASSESS RED DEER POPULATION IN HYRCANIAN MOUNTAIN FORESTS, IRAN

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The elusive Caspian red deer (*Cervus elaphus maral*) lives at low densities in rugged forest habitats of the Caucasus and the South Caspian region and its declining population requires urgent attention. In order to establish a population monitoring plan, we applied dung counts (Fecal Standing Crop, FSC) from 18 two-km transects and accumulated 1,585 trap days of camera-trapping (Random Encounter Model, REM) to estimate deer numbers in the mountain forests (421.77 km²) of Golestan National Park, Iran. Decay rates were not habitat-specific; time to decay was $141.81 \pm SE 15.07$ days, being much shorter than in northern Europe. Estimated deer population size and density from FSC was lower (105 ± 15 individuals, 0.25 ± 0.07 ind/km²) than from REM (240 ± 25 individuals, 0.57 ± 0.19 ind/km²), but this difference was not statistically significant. Density estimates reached a stable level and were most precise at a sampling effort of 12 transects (FSC) and 300 camera trap-days (REM). Costs for both methods were almost identical when not taking into account the initial investment for camera traps. With regard to reliability, we discuss necessary improvements in assessments of the following variables: dung count (FSC method: line vs. strip approach, season), animal daily range and group size (REM method).

SPECIES PATTERNS IN SMALL FRESHWATER BODIES GUIDES TOWARDS FOCAL SPECIES APPROACH IN AQUATIC HABITAT RESTORATION

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Small, isolated freshwater bodies are essential habitats supporting high regional biodiversity. In metapopulation conception, isolated waters as a part of sink-source systems are unique habitats for many species of amphibian and water macro-invertebrates. However, this type of waters are highly vulnerable by a number of human activities. To avoid habitat change from source to sink, habitat restoration and construction should be considered. Our aim was to detect species patterns in various types of restored and unrestored water-bodies to find out whether the habitat restoration targeted to focal species could support other species in conservation concern. We linked focal species approach, nestedness (NODF, PN) and co-occurrence (C-score) analysis and set of different type of water bodies with pond-breeding amphibians and threatened aquatic macro-invertebrates. *Triturus cristatus* and *Pelobates fuscus* were chosen as focal species, being among the most threatened amphibians in Estonia. We compared species co-occurrence patterns inter and intra: natural, man-made, and restored/constructed water



bodies. Nestedness pattern occurred in all studied water-body types. In natural and man-made waters it depended on site's area, while in constructed waters sun exposure and the age of water body raised the level of nestedness. In natural and constructed waters *T. cristatus* has obvious niche overlap with *Lissotriton vulgaris*, *Pelophylax lessonae*, *Rana arvalis*, *R. temporaria*, *Leucorrhinia albifrons* and *L. caudalis*, in constructed waters it co-occurred also with *P. fuscus* and *Leucorrhinia rubicunda*. In all types of waters *P. fuscus* shared the niche with *Pelophylax lessonae* and *Lissotriton vulgaris*. However, in constructed waters also *Triturus cristatus*, *Rana temporaria*, *Leucorrhinia pectoralis*, *L. caudalis*, *L. dubia* and *L. rubicunda* co-occurred. Our study demonstrated that habitat restoration targeted to focal species may offer quality habitats also for other co-occurring species.

99 - BOOSTING BIODIVERSITY AND CONTACT WITH NATURE THROUGH SOWN MEADOWS IN URBAN GREEN SPACES

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Urban green space provides numerous and essential environmental benefits and is a vital resource for the promotion and awareness of biodiversity. However, the potential for urban green spaces to deliver these benefits is often under exploited, as many such green spaces are characterised by large expanses of mown amenity grass that fail to optimise biodiversity potential as well as being resource intensive. Our research aims to address this through a large scale biodiversity manipulation experiment in which we investigate how variations in the structural and species diversity of a sequence of sown meadow plots influences ecosystem services that include increased biodiversity, water infiltration, carbon sequestration and human wellbeing via perceptions of visual and aesthetic quality. Using a factorial design across two axes of variation we measure how manipulations to vegetation height and floristic diversity influences key soil processes and plant and invertebrate richness in addition to public responses to a range of aesthetic and biodiversity parameters including perceptions of beauty, attractiveness and naturalness. Given that standard nature conservation practice pays little regard to aesthetic considerations, this research is crucial in understanding how methods to increase biodiversity can be integrated into the urban system in a way that is acceptable and enjoyable to urban residents.

COST AND FEASIBILITY OF A BARRIER ZONE TO CONTAIN THE SPREAD OF CANE TOADS IN NORTH-WESTERN AUSTRALIA

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Cane toads (*Rhinella marina*) have spread rapidly throughout more than 1 million km² of Australia, causing population declines of many species of frog-eating predators. In arid Australia, cane toad spread depends critically on the arrangement of artificial water bodies (AWB) that have been created for pastoralism. One approach to containing the spread of cane toads is to create a 'waterless' barrier zone in the landscape by managing AWB's. However, an effective barrier zone requires a number of decisions regarding its location, size and shape in the landscape. In this study, we developed a predictive model of cane toad spread across arid regions of Australia to identify the most cost-effective location for a barrier zone. While developing our model, we actively engaged potential end-users to improve trust in its capabilities and increase the likelihood that it is adopted by decision-makers. Our modelling suggests that toads can be contained by managing less than 100 AWB's in an arid corridor of pastoral land between the Pilbara and Kimberly regions of north-western Australia. The optimal location for a barrier zone was sensitive to alternative management objectives, management actions, and assumptions about cane toad biology. Few conservation actions have successfully halted or slowed the spread of an invasive species at a comparable spatial scale. We demonstrate that a relatively small conservation investment could prevent toads from spreading into approximately 268,000 km² of their potential range, which would help secure numerous endemic and endangered predators that are vulnerable to the toads toxin.

MAIN FEATURES OF ILLEGAL TRADE IN ENDANGERED SPECIES WORLDWIDE

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The illegal wildlife trade is one of the main threats to biodiversity, and monitoring this at a global level presents severe challenges. Therefore, any information that countries can offer is of great value to obtain a more accurate vision of the species and volume traded. In the present study, we collected data from the largest seizures occurring between



1996 and 2012, reported by 79 countries worldwide. We recorded species, type of merchandise, amount seized and conservation status of the species. We first determined the characteristics of illegal wildlife trade during the study period. Results show that there is no significant relationship between the number of countries reporting seizures and the number of species seized, which leads us to conclude that illegal trade of species is primarily linked to a few countries. More than half of the species seized (63%) are birds and reptiles, followed by mammals (22%). The remaining 15% consists of species from other groups. A total of 56% of live animals seized were reptiles, followed in descending order by fish (27%), birds (7%), other animal groups (7%) and mammals (3%). During the study period, we observed a significant increase in seizures of mammals, molluscs and fish. For birds the trend was descending. In the case of reptiles, no significant variations were found. During the period analyzed there was an increase in seizures of species classified in the three IUCN red list higher threat categories (vulnerable, endangered and critically endangered). This increase was significant in the case of mammals, for the three categories analyzed jointly and separately, reptiles, for the endangered category, and fish and shellfish, for the three categories together and for the endangered category.

4.03 PRIORITY AREAS FOR CONSERVATION OF ATLANTIC FOREST ENDEMIC BIRDS UNDER CLIMATE CHANGE SCENARIOS

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A key strategy in biodiversity conservation is the establishment of protected areas. Efficient protected areas are those able to, at least, represent the biodiversity of the region of interest. In the future, however, the redistribution of species due to global climate change is likely to affect species' representativeness in protected area networks. Here we assess the effectiveness of protected areas in representing 155 endemic birds of the Brazilian Atlantic Forest, a major biodiversity hotspot, both today and under climate change scenarios for 2050. The study combined species distribution modeling and systematic conservation planning. Species distribution models used the consensus between several algorithms and global circulation models, weighted by True Skill Statistics. The systematic conservation planning used municipalities as planning units, fixing those that currently have $\geq 50\%$ of its area covered by forest and/or within a protected area, and weighting species according to their IUCN conservation status. For the vast majority of the species, we predicted range reduction and southward shifts. We estimated an average range reduction of 29,500 km², with future ranges that were 53% of the original

range size. As a consequence, the regions of the Atlantic Forest that today have the highest species' richness were greatly reduced in future scenarios, except for small areas in the south. The systematic conservation planning created final solutions that included all species, selecting 321 municipalities today and 309 under climate change scenarios. Of these, 207 were selected both in the present and in the future. Very few of the selected municipalities, however, has protected areas. We conclude that the Atlantic Forest current protected areas network does not adequately protect its endemic birds, neither today nor in the future, and recommend some selected municipalities to be prioritized for the establishment of new protected areas.

BOTANICAL GARDEN OF SALVADOR: CONSERVING THE URBAN PLANT DIVERSITY

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The conservation of urban forests is increasingly threatened by rapidly growth of Latin America cities, due to demand for housing, transportation and real estate overvaluation. Their environmental benefits are incontestable, especially for maintaining the forest genetic resources. In Salvador, a forest fragment located in the Botanical Garden of Salvador (BGS) has been resisting to serious threats. Even thus, this singular urban forest fragment presents good conservation state, sheltering endemic and endangered species, some rare and indicators of preserved areas. Being the biodiversity conservation one of its missions, BGS develops and supports projects focusing species conservation, particularly from the Bahia State's flora (Brazilian Atlantic Rainforest and Restinga vegetation). BGS seeks to integrate researchers from various institutions, university students and NGOs in order to participate in projects with the objective of knowing, mapping and analyzing the biodiversity, proposing alternatives and public policies to conservation. The priority tasks are focused on in situ conservation of forest species and ex situ conservation of Brazilian native species used by Afro-Brazilian population, besides controlling plant health and invasive species. Having a Research Section, the conservation investigation is addressed to the Plant Diversity Conservation Program (PDCP), aiming at conducting research to preserve the native species from the local flora, promoting the knowledge of regional plant resources and protecting the endangered species for maintenance and restoration of ecosystems. PDCP also includes the Floristic Survey of BGS Forest, restructuring of Seedling Nursery of Atlantic Rainforest Native Species, Conservation Education, as well as, study projects to be carried out such as: propagation of native tree



species; substrate assessment for development of native plant species; germination and growth of BGS forest's seedlings and recovery of degraded areas.

LARGE MAMMAL DIVERSITY IN THE PROVINCE OF KASTAMONU, TURKEY: CAMERA-TRAPPING FOR AN INTACT ASSEMBLAGE

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Province of Kastamonu is situated at the central part of Black Sea Region of northern Anatolia and it is one of the largest provinces in Turkey with 13108 km² land area, stretching between coast line and mountains with a peak at 2565 m. The mountainous and forest habitats cover 74.6% of Kastamonu including old-growth forest habitat types, and there are four wildlife reserves and one national park in the province. This diversity in habitat types leads to high biodiversity and the region hosts an intact large mammal community. Camera-trapping studies are being conducted since 2009 in Kastamonu in eight different study areas including protected and unprotected areas with 105 systematic cam-trap stations in total; and large carnivores and herbivores such as brown bear (*Ursus arctos*), grey wolf (*Canis lupus*), Eurasian lynx (*Lynx lynx*), wild cat (*Felis silvestris*), golden jackal (*Canis aureus*), red deer (*Cervus elaphus*), wild boar (*Sus scrofa*) and European roe deer (*Capreolus capreolus*) are being monitored. The distribution, relative abundance and activity patterns of the target species are determined with concrete data based on camera-trap records and assessments on protected areas were evaluated in accordance with the results of the study to lead more effective conservation efforts in the region. The study reveals the importance of the province of Kastamonu for the large mammals but the high rate of poaching in the region is detected as a major threat especially on brown bear, grey wolf, red deer and roe deer.

ACCESSING THE EFFECTIVENESS OF LANDSCAPE MANAGEMENT PRACTICES FOR A LANDSCAPE SPECIES: ARE CORE AREAS WORKING TO PROTECT SAGE-GROUSE?

Emma Spence

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Greater sage-grouse (*Centrocercus urophasianus*) are a species of conservation concern in 11 western states and 2 Canadian provinces, and have been in decline for 50 years. Sage-grouse have been petitioned for listing under the Endangered

Species Act 7 times; the 8th listing is currently being reviewed. Wyoming contains ~40% of the extant sage-grouse population, and is located at the center of the distribution of this species. These factors and concern for ESA listing of sage-grouse, the state of Wyoming designated and limited human disturbance in "core areas" in 2008. Using Wyoming Game and Fish Department male sage-grouse lek count data and oil and gas development data from the Wyoming Oil and Gas Conservation Commission, we investigated the effectiveness of core areas on sage-grouse persistence. In 2013, core areas contained 77% of the Wyoming sage-grouse male population and 64% of active leks. Using a Bayesian binomial probability analysis, we analyzed the conditional probability of leks going extinct in and out of core areas pre and post core area development. We observed a 10.9% probability of a lek going extinct in core areas and a 20.4% probability going extinct outside core areas. When we regressed the difference in conditional probability of non-core and core lek extinction versus oil and gas development density within 1.6 and 4.8 km of the core area boundary we found the difference in extinction probabilities was correlated to oil and gas development density within 1.6 km of the core area ($R^2 = 0.83, p = 0.01$). Development density inside the core areas was not related to the probability of extinction in core areas ($R^2 = 0.04, p = 0.82$). Collectively these data show that the core area strategy is likely working; however, development outside of core areas effects populations inside core areas. Consequently, additional guidelines to limit development densities in regions adjacent to core areas may also be necessary to effectively protect core area populations.

68 RESPONSE OF FOREST BIODIVERSITY TO PARTIAL RETENTION HARVEST IN A BOREAL MIXEDWOOD FOREST: HOW TO MANAGE IT?

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Results of the large-scale (1000 ha) EMEND experiment in northwestern Alberta show that forest biodiversity is recovering more quickly toward pre-harvest condition after partial retention harvest than after traditional clear-cuts in four commercially exploited mixedwood cover-types. Both initial impact on and recovery of plant, invertebrate and songbird communities varies with harvest intensity in a way consistent with the view that partial harvest approaches better meet the sustainability criterion of conserving biodiversity than do traditional clear-cuts. Interestingly, assemblages of songbirds and epigeic invertebrates appear to recover more rapidly than do those of understory plants. The current approach to



'extensive forest management' in Alberta that incorporates consideration of ecosystem criteria in addition to those focused on sustained yield promises improved conservation of stand-level biodiversity. Effective forest management will link stand-level treatments in a way that promotes fully integrated landscapes. An understanding of relationships between forest ecosites and biodiversity that is rooted in knowledge about historical forest development can assist in up-scaling biodiversity conservation from stands to forests and establishing landscape level conservation goals.

SYM ID 88: MOVING BEYOND CURVE-FITTING: USING COMPLEMENTARY DATA TO ASSESS ALTERNATIVE EXPLANATIONS FOR LONG MOVEMENTS

Orr Spiegel

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Management often includes supplementary release of captive-raised (naïve) individuals. In contrast to re-introduction of a (locally) extinct species, this scenario facilitates the establishment of naïve individuals through their ability to interact or follow wild individuals. Hence, the movements of wild individuals during releases inform managers on the population's space-use and provide a template for comparing with introduced individuals' movements. The Eurasian Griffon vulture (*Gyps fulvus*) is declining in the eastern Mediterranean despite intensive management efforts. Here we describe the movement of wild-individuals and explore possible explanations for a distinct pattern of long-range movements that may shed light on lack of management success in this region. We tracked adult vultures caught in southern Israel using high-resolution GPS/accelerometer tags accompanied by behavioral, genetic and morphological data. Curve fitting of mixed models suggests vultures combined distinct movement modes operating at three different scales. The larger spatial scale was partly a result of long-range forays – rare, short-term, large-scale circular journeys that greatly exceed the typical foraging range of this species. We rejected optimal foraging as an explanation for these forays and found no support for preferred weather conditions or population genetic structure as alternative explanations. The hypothesis that these forays represent failed breeding dispersal attempts to find mates remains our most plausible explanation. We conclude that 1) inference about the mechanisms underlying animal movement should be confronted with complementary data, and suggest that mixed behavioral-modes likely explain commonly

observed fat-tailed movement distributions. 2) Conservation of species with large home-ranges should consider the suitability of local management and strive to obtain international collaborations for achieving the relevant spatial scale for these species

ARE THEY FRIENDS OR JUST NEIGHBORS? A BETTER USE OF SOCIAL NETWORKS IN CONSERVATION THROUGH SEPARATION OF SOCIAL PREFERENCE FROM ENVIRONMENTAL CONSTRAINTS

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Understanding how animals interact with their natural and social environment is a major question in behavioral ecology with implications for conservation. Social networks (SNs) are commonly used to study sociality and disease spread in free-ranging animals. However, observed proximity-based SNs may also reflect constraints imposed by environmental heterogeneity. For instance, two individuals can co-occur due to conspecific attraction or simply since they share clumped/ephemeral resources. Despite recent advances in SNs randomization procedures, less attention has been devoted to teasing apart these two effects. Here we suggest a new method that takes environmental constraints into account, and show how this can modify previous conclusions on sociability of free ranging animals. We constructed SN for a population of Sleepy lizards (*Tiliqua rugosa*), a large-bodied pair-living Australian skink. Simultaneous GPS-tracking of 60 individuals (30 males) at 10 min interval for the entire activity season allows identification of almost all social interactions in this population. We compared observed SN-properties (e.g. lizard's degrees or strength) with those obtained from SNs generated from randomized paths. By using existing movement data to generate a more realistic null model we could identify the distinct contributions of sociability and spatial environmental constraints. In contrast to previous finding using null models that ignore such constraints (e.g., ideal gas), our results shows that male lizards interact more than expected by chance. Our results suggest that better consideration of environmental constraints is important when testing ecological hypotheses about sociability. Building a better mechanistic understanding of animal behavior will help to inform species-conservation plans. The proposed method can be broadly applied to proximity-based SN studies (e.g., from GPS tracking) in various species.

THE SWISS BREEDING BIRD ATLAS 2013-2016

Martin Spiess

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In Switzerland, two national breeding bird atlases have been published. The first one covered the period 1972–1976 (Schifferli et al. 1980), the second one the period 1993–1996 (Schmid et al. 1998). Fieldwork for the new, third atlas started in 2013 and will last up to 2016. Because many species had suffered massive declines already before the 1970s, a historic atlas additionally documents the distribution of the breeding birds in the 1950s (Knaus et al. 2011). The bird census methods for the new atlas are in general similar to the last atlas 1993–1996. The grid is the same (467 atlas squares of 10 × 10 km), and simplified territory mapping in 5 squares of 1 × 1 km per atlas square delivers the data set for density calculations. The voluntary collaborators are instructed with extensive information available online. The online portal www.ornitho.ch plays a key role in data transmission. Also the analyses of the simplified territory mapping are carried out online. The final data will allow comparisons with the two previous atlases and for 100 species also with the Historic Breeding Bird Atlas. First results show dramatic changes in both the distribution and density of some species. While many species in the agricultural zone or long-distance migrants got extinct or experienced serious declines, other species appeared newly in Switzerland or have increased, especially water birds. Differences in the altitudinal distribution since 1993–1996 allow the estimation of the effects of climate and habitat change. Finally, the new atlas will allow improved estimates of the population size of all breeding birds in Switzerland. The data of the Swiss Breeding Bird Atlas 2013–2016 will of course also be available for the new European Breeding Bird Atlas.

DIFFERENTIAL EFFECTS OF FOREST PROXIMITY ON FRUIT SET OF TROPICAL TREE CROPS DEPENDS ON POLLINATION GUILDS

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Deforestation and forest fragmentation are leading to declines in crop pollinators. To date, studies have focused on the reproductive success and pollination ecology of single crop species in given locations. However, comparing the effect of distance to forest on multiple crop species is important because this distance may have different impacts on different group of pollinators, such as for example, insects versus bats, differentially affecting pollination services. We

evaluated flower-visiting animal diversity, visitation frequency and number of fruits set in three species of economic crops: rambutan, durian, and mango, near (<1 km.) and far (>7 km.) from forest edge. The number of fruits set in rambutan was significantly affected by distance to forest, while distance to forest played no role for number of fruits set in durian and mango. The main flower visitors of rambutan were stingless bees. The dominant flower visitor to durian and mango were fruit bats and flies, respectively. The effect of proximity to forest on pollination success varied between plant species which depend on the visiting animal group. This study provides empirical evidence that not only forest but also caves can act as a source of flower-visiting agents that provide pollination services to agricultural crops, and underscore the importance of tropical rainforest and cave conservation for maintaining such services.

DUNG ENCOUNTERS AND PHOTO-CAPTURES SHOW SIMILAR SPACE-USE PATTERNS BY MOUNTAIN UNGULATES IN THE HIMALAYA

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The use of dung encounters as an indicator of space use by ungulates has been highly debatable due to differences in species-specific defecation rates and dung decay rates. In this study we used dung encounter rates and camera trap photo-capture rates to examine variation in the use of four elevation zones by three mountain ungulates: Himalayan musk deer (*Moschus chrysogaster*), Himalayan goral (*Naemorhedus goral*) and Himalayan serow (*Capricornis thar*). The study was carried out in Kyongnosla Alpine Sanctuary situated in East district of Sikkim, India. We laid 16 permanent trails, each 600 m long, between 3000 m and 4200 m elevation to estimate dung encounter rates. One camera station was established at each of these trails. Each trail was monitored once every month, thus generating continuous data for winter when temperature went down to -15°C and post winter when temperature went up to 19°C. We walked a total distance of 108.00 km and camera trapped for 2219 nights in all. Goral had the highest mean dung encounter rate (dung groups/km) (1.27±0.28) followed by musk deer (1.07±0.19) and serow (0.13±0.06). Mean photo-capture rate (number of photographs/100 days) was the highest for musk deer (5.60 ± 0.90) followed by goral (1.96 ± 0.44) and serow (1.45 ± 0.59). Both dung encounter rates and photo-capture rates were significantly different at different elevation zones. Though the mean values for the dung encounter rates were lower than that of photo-capture rates of the three ungulates at different elevation zones, the overall patterns exhibited by the two indices along the elevation



gradient were almost similar. The space-use patterns from the two indices were similar in two different seasons. Our study, therefore suggests that camera trap and dung encounter surveys can be reliably used to assess space use of ungulates inhabiting such mid-elevation gradients.

HABITAT USE BY MOUNTAIN UNGULATES IN A SUBALPINE HABITAT IN SIKKIM HIMALAYA, INDIA

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Habitat use and factors affecting the same were studied in three mountain ungulates viz. Himalayan musk deer (*Moschus chrysogaster*), Himalayan goral (*Naemorhedus goral*) and Himalayan serow (*Capricornis thar*) inhabiting a subalpine habitat of Sikkim Himalaya, India between April 2011 and March 2012. Permanent trails (16) between 3000 m and 4200 m elevation were repeatedly sampled to estimate dung encounter rates and photo-capture rates as indicators of habitat use. The trails were sampled in winter when temperature went down to - 15°C and post winter when temperature went up to 19°C. Both photo-capture and dung encounter rates showed musk deer and serow to be distributed all along the elevation gradient with goral mostly restricted till 3600 m. Both dung encounter and photo-capture rates increased for musk deer and decreased for goral and serow along the elevation gradient, thus authenticating unimodal distribution patterns of the species. Zero-inflated Poisson regression was used to identify key factors affecting the habitat use patterns of the ungulates. Elevation was found to be the most important factor in determining the habitat use patterns of both musk deer (positively) and goral (negatively) with season having significant effects on habitat use of serow. Musk deer showed strong associations with steeper south-east and south-west facing slopes. However, habitat use of goral and serow was not affected by slope and aspect. Quantile regression showed goral photo-capture rates to be negatively affected by dogs at their highest abundances. The study further authenticates elevation, slope and aspect to be critical in determining ungulate habitat use patterns inhabiting these subalpine habitats. Moreover, the study suggests that these mid-elevation ungulates may not be affected by season to the extent as reported in species occupying much higher elevation areas, which are known to exhibit strong seasonal shifts.

TOLERATING TIGERS: UNDERSTANDING HUMAN BEHAVIOUR TOWARDS TIGERS AND OTHER WILDLIFE IN SUMATRA

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People come into greater contact with wildlife as rural populations grow. At worst, where animals are perceived to threaten human lives or livelihoods, they may be killed. Such a response poses a threat to wide-ranging species such as large and potentially dangerous carnivores. However, local opinions and behaviour towards carnivores can vary radically within and across human societies and landscapes. Further, behaviour towards different types of wildlife also varies. Tigers have undergone abrupt declines across much of their former range as a result of retribution killings and an unsustainable increase in poaching driven largely by demand for body parts. Increased persecution is frequently observed where local tolerance for carnivores has declined, a situation exploited by poachers. However, whilst poaching has caused dramatic declines of tigers elsewhere in Asia, against a backdrop of ongoing encounters, Sumatran people continue to coexist with tigers. In order to understand an apparent tolerance for living with tigers, we draw on theories of human behaviour to investigate underlying social psychological characteristics associated with tolerance (no intention to kill), or intolerance (intention to kill), for tigers and other species found within the Kerinci Seblat landscape, Indonesia. We estimate the prevalence of illegal hunting using multiple configurations of the randomized response technique, a method developed specifically for investigating sensitive topics. Preliminary analysis reveals the importance of exploring the role of attitudes, injunctive and descriptive norms, and affect/emotion in determining people's behaviour towards wildlife. Moreover, behavioural beliefs and intentions are not homogenous across species. This study highlights the interacting effects of internal and external factors influencing human decision making.

AN ALLELOPATHIC STUDY OF THE HAYSCENTED FERN

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In Pennsylvania, forest ecosystems can be found in any direction. These areas are a wealth of nature; they provide habitat for local wildlife, serve as natural air and water filtration systems, and are a great source of timber. However, the forests are suffering from the over herbivory of deer, and the aftermath it has caused. As deer are selective browsers, they are capable of picking and choosing their food source. Many young tree



seedlings are eaten until almost all individuals of the younger cohorts are gone, while plant species that the deer do not eat, particularly the hayscented fern or *Dennstaedtia punctilobula*, remain to flourish and can even begin to act as native invasive species. As the hayscented fern has been shown to be allelopathic towards other fern species, the question remains as to whether or not the fern is allelopathic towards tree species. Allelopathy works in one of three ways; exuding chemicals through the roots, exuding chemicals through decaying leaf litter, and exuding chemical vapors during photosynthesis. One of the main goals of this study is to determine whether the hayscented fern uses allelopathy to suppress its competitors, and if so by which of the three ways. The second goal is to determine if the fern is simply preventing seed germination or is actually inhibiting growth of established plants, both leading to the mortality of the plant. To test this, seeds and seedlings of up to four different tree species will be divided into groups, and each group given a treatment to replicate a different form of allelopathy. Seed germination and the seedling growth will be measured over a maximum of a 3 month period to determine if any of the fern treatments have a negative effect. It is my hypothesis that the fern will only use one mode of allelopathy that effects either the seeds or the seedlings, but not both.

EMERGING THREATS TO URBAN ECOSYSTEMS

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Urbanisation is rapidly increasing, with more than half the world's population living in towns and cities. The UN predicts that by 2050, 86% of the developed world will be urbanised, resulting in increasing pressures on urban ecosystems and biodiversity. Far from being depauperate, the unique diversity of habitat structures in cities supports a wide variety of biodiversity, often the only connection with nature experienced by much of the world's population. While existing threats to urban ecosystems (e.g. building intensification) are being exacerbated by globalisation and climate change, there are a number of emerging threats that are likely to be drivers of change in urban ecosystems. A multidisciplinary team of scientists, encompassing ecology, ecophysiology, soil science, hydrology, landscape design, environmental physics and human epidemiology, undertook a horizon scan of emerging issues (not well known or well understood) in urban environments. Early identification of such issues is important

in order to commence research that can inform policy and management. We consulted widely (scientists, government, NGOs) to encompass a range of views and ideas in a long list, before ranking and reducing the list in an iterative process during a 3-day workshop. Ten emerging threats were identified and they were most commonly associated with rapid advances in technology (e.g. solar panels, LED light, self-healing concrete) or with the demands of people on urban nature (e.g. green prescriptions). We anticipate this horizon scan will be of interest to policy makers and researchers looking to mitigate threats to urban ecosystems.

159 THE NEW NATURE IN EUROPE: WHAT IS IT?

Mark Stanley Price

WildCRU

Considering landscapes, 'wilderness' and 'wild' in Europe, it is easy to be trapped in the tension between perception and reality. Our perception is that green landscapes are natural and wildlife habitats. The reality is that very few of Europe's landscapes are not highly modified by human activities, and intensely farmed areas are green deserts for wildlife. Species have demonstrably shifted their ranges since the end of the Ice Age, and we can now observe species on the move. Climate change is only starting, with the prospect of new species' ranges, new communities of species assemblages, and even novel ecosystems. Conservation needs to respond with clarity on what it wants for Nature, and what is acceptable. Redford et al (2011) define six attributes of successfully conserved vertebrate species and five stages of their conservation, ranging from captivity to self-sustaining without specifying where such successful conservation takes place. IUCN (2013) permits conservation introductions outside indigenous range provided there is a conservation benefit. On the other hand, the Red List definition of Extinct in Wild uses the term historic range, and populations outside this range are not considered as contributing to a Red List assessment. Given the realities of more species either naturally extending their range, shifting them or even jumping into new areas, with the further appearance of hitherto non-native species, we must accept the reality, the consequences and risks inherent in such situations. So, we have to decide what we want for Nature in Europe: do we prefer to see species go extinct in their ranges as we knew them, or would we prefer to see them persist, albeit in different ranges, probably managed with only some attributes of 'wild' and self-sustaining? Should our position be 'pragmatic but prudent'?



PROTECT YOUR LOCAL SPECIES: THE POTENTIAL OF ZOOS IN THE CONSERVATION OF EUROPE'S THREATENED SPECIES

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Zoos play an important role in species conservation, mainly through public education and by providing funding to protect species in their natural habitat and in captivity. However, given that most threatened species are located along the equator, European threatened species might not be a major priority for conservation programs in European zoos. The conservation of European species is important though, in raising public awareness that extinction is not only an abstract global process but can be observed on a very local scale. In this sense, it is important to know to what extent local threatened species are already represented in European zoos. Therefore, we accounted the number of European threatened species represented in European zoos using data from the International Species Information System (ISIS), the European IUCN Red List of threatened species and other risk indices. Our results show that 23% of European threatened vertebrates are represented in European zoos (birds excluded). Most European species held in captivity are mammals (35%), with lower numbers for reptiles and amphibians (15% and 9%). Most species listed at highest-risk are not represented in any zoo. With this study we aim to raise awareness on the conservation of local species and the role that zoos can play protecting these species. The results can be used to inform future prioritization efforts in zoo collection planning and European conservation programs.

UNDERSTANDING PARTNERSHIPS FOR DELIVERING CONSERVATION OUTCOMES: HOW AND WHY DO CORPORATIONS AND NGOS COLLABORATE?

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Environmental issues are typically too large for a single organisation to tackle independently, thus partnerships between different sector organisations, such as conservation NGOs and corporations, are beginning to proliferate. Little

research has been conducted on this topic from a conservation perspective, with many assumptions about partnerships being based on anecdotal rather than empirical evidence. This research therefore aimed to provide valuable baseline information on the prevalence of conservation NGO-corporate interactions, as well as highlighting the key motivations which underpin partnership initiation. These objectives were assessed using two structured quantitative questionnaires, one being administered to UK-based conservation NGOs and the other to FTSE350 listed corporations. The results illustrate that while philanthropic donations are a prominent form of interaction, other types of activities are regularly engaged in such as terrestrial ecosystem restoration, educational activities and stakeholder outreach programmes. For corporations, drivers of partnership initiation are centred on reputational benefits by association, whereas conservation NGOs are motivated by access to financial resources. Our findings represent a first step in providing a basis for informing more effective relationships between NGOs and corporations in the future which should, in turn, deliver better conservation outcomes. This is important, as these types of interactions are currently not standardised, unmonitored and poorly understood.

ENERGETICS AND THE LIMITS OF RARITY

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The limits to population viability have long been of interest to conservation biologists. Two particular areas of research, Allee effects and Minimum Viable Populations, might have been expected to cast light on the subject; however, they have yet to expose generally applicable explanations for where the limits to viability might lie. An alternative approach to the problem is via macroecology, where considerable attention has been given to documenting relationships between population density and body mass. Typically, density-mass relationships appear to exhibit a reasonably clear lower bound. At present, however, we have "only the haziest notion" (Lawton 1990) about the lower limits to abundance, how they are determined and how they scale with body size. Here, we ask whether simple energetic models can shed light on this question. We focus on terrestrial Carnivora, using published allometries for energetic expenditure and resource acquisition to predict the scaling of minimum viable resource densities. We discuss how to infer carnivore population densities that might be supported at these limits to resource availability. With reference to extensive data on carnivore densities, our results suggest that carnivore populations might often persist at levels of resource availability close to their energetic limits. This has implications for our understanding of time and energy budgets in wild animals, and major drivers of extinction.



CONSERVING ASIAN ELEPHANT'S POST-MORTEM - A REVIEW OF AGE DETERMINANT TECHNIQUES ASSESSING THE USE OF DENTITION, SKULL MORPHOLOGY AND CRANIAL SUTURE SCHEDULING.

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Modelling mortality events for endangered species can be a useful tool to assess and direct conservation initiatives. The ability to model such events is limited by methods to age skeletal remains. Despite a lack of validation Laws Scale, reliant on categorising teeth in wear, is the primary method used for Asian elephants. Originally developed for African elephants, Laws Scale is not reliable for Asian elephants. This study aimed to apply Laws Scale to 24 Asian elephant skulls of unknown age, to identify areas of discrepancy and review the use of two additional techniques, skull morphology and cranial suture scheduling. Skull morphology was assessed through 36 cranial and 19 mandibular measurements. Cranial suture scheduling was tested by identifying five sutures as 'open' or 'closed' for each specimen. During this study it became evident that Laws Scale focussed on age as a number of years, whilst modelling mortality is reliant on age as a physiological class. For Asian elephants however, a consensus on well-defined physiological classes do not exist. Based on an extensive collation of available literature sources, this study therefore proposes six age classes; 'Calf', 'Juvenile', 'Sub-adult', 'Adult', 'Mature-adult' and 'Geriatric'. Using Laws Scale, age classes 'Sub-Adult' and 'Adult' were indistinguishable. The skull morphology results correlated with age, however they did not provide further refinement of Laws Scale. The results of the cranial suture assessment found four of the five sutures correlated positively with age. Furthermore, the naso-frontal suture directly addressed discrepancies between 'Sub-adult' and 'Adult'. From current understandings and these results, an age determinant protocol was developed. This novel protocol and the refined age classes await validation in specimens of known age but this does not reduce its potential as a practical tool for gathering information on mortality events to assess and direct current conservation initiatives.

129- USING EVIDENCE BASED SCIENCE TO ASSESS WWF'S GLOBAL CONSERVATION PROGRAMME WITH REFERENCE TO THE VALUE OF THE OPEN STANDARDS IN CONSERVATION PROJECTS

P. J. Stephenson

WWF

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WWF has a presence in over 90+ countries with offices managing over 4000 projects and more than 70 large scale programmes with the aim of conserving nature and reducing humanity's footprint for One Planet Living. WWF is a network of independent offices and hundreds of partnerships at local, national, regional and international scales. Ten years ago WWF had a myriad of approaches to design, implement, and monitor projects and programmes due to the breadth of its network. Working with other conservation organisations to develop the Open Standards helped WWF focus on the most important elements for adaptive management. A recent review of WWF's 70+ priority programmes has provided evidence to the value of the Open Standards in improving effectiveness and impact. However our decade long experience with the OS has also indicated where improvements can be made, and the challenges associated with organisation-wide adoption. ÅÅ During the review, scores for each programme were allocated to an assessment framework [based loosely on the OS] after which a series of correlations were analysed showing support for the theory that better design and ÅÇ'management' is related to improved effectiveness and impact. We will share the assessment framework and methodology, evidence and recommendations from the review as well as some specific case studies of projects that have benefitted from the application of the Open Standards.

OVERCOMING THE CHALLENGES TO CONSERVATION MONITORING: INTEGRATING DATA FROM IN SITU REPORTING AND GLOBAL DATASETS TO MEASURE IMPACT AND PERFORMANCE

Pj Stephenson

WWF International

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If Parties to the Convention on Biological Diversity (CBD) and their partners are to report effectively on progress against national, regional and global biodiversity conservation goals, data will need to be collected at multiple levels. Global datasets, many fuelled by remote sensing techniques, offer partial solutions but need to be complemented by field-level observations to provide the resolution necessary to track key conservation measures in a meaningful way. This paper summarizes efforts made by the conservation organization WWF, working with several partner organizations, to integrate



global datasets with data collected by its field programmes to determine progress against multi-level organizational goals and to assess conservation impacts and programme performance. We assessed the quality and usefulness of data collated on ten indicators of relevance to CBD Parties, as well as a conservation achievement key performance indicator tracking annual results of WWF programmes. Integration of in situ and ex situ data into reporting dashboards allowed some degree of assessment of progress and adaptive management of the programme portfolio. However key challenges remain to be overcome if global and local monitoring objectives are to be attained, including increased collection of data by field projects, improved harmonization of indicators, and greater sharing of data in formats of use to practitioners.

SYMPOSIUM ID_181_ IDENTIFYING BIOCULTURAL INDICATORS THAT INTEGRATE LOCAL AND GLOBAL CONSERVATION OUTCOMES

Eleanor Sterling

American Museum of Natural History
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Biocultural approaches to resource management emphasize actions to sustain dynamic, interdependent social-ecological systems. These approaches implicitly seek to overcome perceptions of human activities and ecological systems as separate or independent of one another. They are founded on local perspectives, perceptions and knowledge. Implementation of these approaches entails multiple types of evidence in decision-making and requires sets of indicators capable of reflecting local as well as global influences and perspectives. This presentation will define and explain the need for biocultural approaches to local management partnerships with an emphasis on developing new kinds of indicators and indices. The talk will outline current efforts to

define and implement biocultural indicators and also explore specific challenges and opportunities in setting targets in biocultural land and seascapes. Challenges include: identifying robust social-ecological resilience metrics across mosaics of land and seascapes; integrating qualitative with quantitative information; integrating across diverse groups with differing values and perspectives; adopting valuation and measurement techniques that make sense to local community members; identifying methods for bringing local voices to national and international arenas; and translating relevant international principles to local settings. The opportunities, however, are significant. Biocultural approaches have the ability to identify underlying value differences that may be confounding conservation activities, to achieve conservation goals through eliciting broad support from multiple stakeholders, and to increase the long-term sustainability of initiatives. Local interactions with land and seascapes are critical to global conservation strategies and local strategies may well help to overcome global threats. Thus biocultural approaches will be integral to biodiversity conservation and natural resource management into the future.

MARINE SPATIAL PLANNING MAKES ROOM FOR OFFSHORE AQUACULTURE IN CROWDED WATERS

Joel Stevens

California Polytechnic State University
Rebecca GENTRY, University of California ; Thomas BELL, University of California ; Carrie KAPPEL, University of California ; Sarah LESTER, University of California ; Dean WENDT, California Polytechnic State University ; Crow WHITE, California Polytechnic State University

Offshore aquaculture is an emerging industry predicted to contribute significantly to global seafood production and food security. However, aquaculture farms can generate conflicts by displacing existing ocean user groups and impacting ecosystems. Further, there are multiple farm types with different seafood species, productivity levels and impacts. Thus, it is important to strategically and simultaneously plan farm type and location in relation to the seascape in order to most effectively maximize aquaculture value while also minimizing conflicts and environmental impacts. We address this problem and demonstrate the value of multi-objective planning with a case study that integrates bioeconomic modeling with ecosystem service tradeoff analysis to inform the marine spatial planning (MSP) of mussel, finfish and kelp aquaculture farms in the already-crowded Southern California Bight (SCB) ecosystem. We considered four user groups predicted to conflict with or be impacted by the three types of aquaculture: wild-capture fisheries, ocean viewshed from coastal properties, marine benthic habitat protection, and risk of disease outbreak between farms. Results indicate that significant conflicts and impacts, expected under conventional planning, can be



reduced substantially by strategic planning. For example, 28% of potential mussel farm sites overlap with wild-capture halibut fishery grounds, yet MSP can enable mussel aquaculture to generate up to a third of its total potential industry value without impacting halibut fishery yield. This study comprehensively informs aquaculture farm design in the SCB, and demonstrates the value of multi-objective planning as a key component in MSP.

129-THE OPEN STANDARDS FOR THE PRACTICE OF CONSERVATION AS A TRANSFORMATIVE TOOL IN MANAGING THE BUSINESS OF CONSERVATION

Annette Stewart

Bush Heritage Australia

Bush Heritage Australia manages a million hectares of land for conservation, and assists partner Aboriginal organisations in managing a further 4 million hectares. Several years ago we faced many challenges with the range and complexity of projects that these responsibilities entail. We scanned the market for processes and tools to help us manage our work and decided to adopt the Open Standards for the Practice of Conservation, along with its supporting software, Miradi. We have since applied these tools to all of our projects, including a variation known as Healthy Country Planning which we use with Aboriginal partners. The result has been a step-change in the quality of our conservation plans, the efficiency of our project implementations, and our ability to report results to donors and other stakeholders. Application of the Open Standards assists conservation practitioners to be more effective - guiding them in choosing the right targets, involving stakeholders, planning projects, monitoring outcomes, and adapting their plans in light of the evidence resulting from their actions. We have built upon this approach by adding a focus on efficiency, developing tools that create linkages to the broader business processes that support conservation activities. We will show examples of how we apply the Open Standards, the outcomes achieved, and the steps we went through to get to where we are today.

CONSERVATION OF OCEANIC MANTA RAYS: DOES THE HIGHLY MIGRATORY PARADIGM HOLD UP?

Joshua David Stewart

UC San Diego

Calvin Beale, Misool Eco Resort Conservation Center ; Daniel Fernando, Linneaus University ; Octavio Aburto-Oropeza, UC San Diego ; Ronald S Burton, UC San Diego ; Brice X Semmens, UC San Diego

Decades of research on the spatial ecology of large marine vertebrates have shown that these species almost invariably exhibit migratory behavior on a regular basis. As a result, large

marine vertebrates often have extensive home ranges that may straddle the exclusive economic zones of multiple countries or extend into international waters. The ubiquity of these spatial patterns in large marine vertebrates has created a paradigm of highly migratory species that are notoriously challenging to manage effectively. The oceanic manta ray (*Manta birostris*) is an example of a large marine vertebrate that has been heavily impacted by fisheries over the last decade. Oceanic manta rays, along with closely related mobula rays, are caught frequently as bycatch in pelagic fisheries, and have been increasingly targeted in direct fisheries as demand for manta and mobula gill plates has increased in traditional Asian medicine. Low fecundity and small population sizes make mantas highly susceptible to fisheries-driven population decline. Due to their large size and pelagic lifestyle, mantas have long been assumed to be highly migratory, an assumption reinforced by low resighting rates in photo identification databases. Using a combination of satellite telemetry, stable isotope analysis, and next-generation genetic methods, we have studied the population dynamics and spatial ecology of four oceanic manta populations separated by 600km to 18,000km. Our results indicate that oceanic manta ray populations have very limited connectivity, and highlight the susceptibility of manta populations to local fisheries. We comment on previous observations of fisheries impacts in the context of our findings, and present notable conservation management action that has been implemented in response to an improved understanding of oceanic manta ray spatial ecology. We provide recommendations for effective management to prevent population decline in light of these findings.

ECOSYSTEM CONTEXT AND HISTORICAL CONTINGENCY IN APEX PREDATOR RECOVERIES

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Habitat loss, overexploitation, and numerous other stressors have caused global declines in apex predators. This “trophic downgrading” has generated widespread concern because of the fundamental role apex predators play in ecosystem functioning, disease regulation, and biodiversity maintenance. In attempts to combat declines, managers have conducted reintroductions, imposed stricter harvest regulations, and implemented protected areas. Here we suggest that full recovery of viable apex predator populations is currently the exception rather than the rule. We argue that, in addition to well-known considerations such as continued exploitation and slow life histories, there are several underappreciated factors that complicate predator recoveries. These factors



include the challenges of: (i) identifying the suite of trophic interactions that will influence recovery a priori, (ii) defining and accomplishing predator recovery in the context of a dynamic ecosystem, and (iii) designing adaptive sequences of management strategies that embrace key interactions. Consideration of recent research on food web modules, alternative stable states, and community assembly offer important insights for predator recovery efforts, and restoration ecology more generally. Foremost among these is the importance of a social-ecological perspective in facilitating a long-lasting predator restoration while avoiding unintended consequences

THE CURRENT STATUS OF BIRD CONSERVATION IN THE SOUTH PACIFIC

Rebecca Stirnemann

Samoan conservation Society

Bird populations in the South Pacific are declining and the need for conservation actions to address threats is increasingly acknowledged. Effective conservation requires a robust knowledge base on which decisions over appropriate actions can be made, yet at present there is no current and accessible synthesis of the status of populations, the threats they face and knowledge gaps. In this study we begin to address this disparity for red listed bird species in the South Pacific region. We review the current status of conservation of birds in the South Pacific, identify areas where critical knowledge is lacking and highlight opportunities to address them. We emphasize the degree to which even knowledge of basic biology is missing for many red listed species in this area and discuss contributing factors. This review aims to provide a base line upon which progress towards an improved understanding of the conservation needs of threatened and endangered birds in the South Pacific can be made while highlighting the critical need for further research and conservation efforts. This technique could be applied to other species groups as a method of assessing conservation progress over a shorter period than is currently possible using red listing processes.

INTERACTION OF LANDSCAPE STRUCTURE, LIGHT, AND PREDATORS ON RISK PERCEIVED BY BEACH MICE: IMPLICATIONS FOR CURRENT AND FUTURE HABITAT UNDER A CHANGING CLIMATE

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Weather- and development-related habitat fragmentation on barrier islands can interact with factors that elevate perceived risk of predation to affect the amount of habitat available

for use by dune-dependent species, such as beach mice (*Peromyscus polionotus* spp). On two barrier islands along the Florida Gulf Coast (USA), we used foraging trays to relate the amount of food eaten (surrogate for perceived risk) to microhabitat and landscape structure (e.g., vegetation cover, patch size, and connectedness) under ambient and heightened (light or predator cues present) risk conditions. Using occurrence data and results from these behavioral studies, we created habitat suitability maps and combined them with results from sea level rise and storm surge models to estimate how habitat would change over the next century. Finally, we used tracking tubes to examine use of natural, open sand, and planted linear dune restoration plots to assess how habitat connectivity might be increased to facilitate movement of beach mice in areas affected by large storms. Our findings confirm ambient and artificial light, owl (predator) cues, and distance to vegetation can increase risk perceived—and thus decrease activity—by beach mice. We found some factors measured at intermediate and broader spatial scales, such as distance to vegetation and presence of a vegetated corridor, be scale- and season-dependent. At the broadest spatial and temporal scales, sea level rise reduced the amount of habitat usable by beach mice in all scenarios examined (0.64, 1.0 or 2.0 m increase by 2100), with most drastic changes observed when effects of large storms were considered along with sea level rise. If conservation of beach mice and other coastal species remains a concern over the next century, management activities that facilitate movement by mice, e.g., reducing artificial light near dunes and restoring vegetation in overwashed areas—should be implemented.

SYMPOSIUM #20 FIELD SENSOR TECHNOLOGY FOR IMPROVING CONSERVATION EFFECTIVENESS: OPPORTUNITIES, LIMITATIONS AND FUTURE HORIZONS

Emma Stokes

Wildlife Conservation Society

Biodiversity is currently facing unprecedented human pressures and conservation efforts are rightly coming under increasing scrutiny in achieving effective outcomes. Scientists, conservation practitioners and the private sector alike are increasingly looking to harness technology in meeting biodiversity conservation goals. Technology has much to offer in the way of innovative solutions to intractable conservation problems; perhaps none more so than the global illegal trade in wildlife. I discuss here the different objectives for technology support in combatting wildlife crime specifically, including surveillance and detection, tactical and operational support, communications and logistics, and investigative and analytical support. I assess a number of existing and emerging technologies, with a focus on remote field sensors, including,



but not limited to, cameras and UAVs. Using a series of global field case studies I provide an overview of the efficacy of these technologies with respect to their reactivity, accuracy, endurance, scalability, capacity needs and cost-efficiency. This review emphasizes the importance of a needs-based approach rather than one that is technology development-led, and identifies a suite of key human and operational capacity criteria for consideration in the implementation effectiveness of any field-based technology. The role of 'technology competitions and challenges' in promoting innovative solutions is discussed. Looking forward, conservation technology needs to excite and inspire new solutions and directions, yet remain grounded to its user base in order to achieve tangible conservation outcomes. We highlight some proof of concept cases where technology has directly contributed to improved conservation effectiveness.

THE IMPACTS OF NEW STREET LIGHT TECHNOLOGIES: EXPERIMENTALLY TESTING THE EFFECTS ON BATS OF CHANGING FROM LOW PRESSURE SODIUM TO WHITE METAL HALIDE

Emma Stone

University of Bristol / African Bat Conservation

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Artificial light at night is a major feature of anthropogenic global change, and is increasingly recognized as affecting biodiversity, often negatively. Increasingly, on a global scale, newer technology white lights are replacing orange sodium lights to reduce energy waste. In 2009 Cornwall County Council (UK) commenced replacement of existing low pressure sodium (LPS) high intensity discharge (HID) street lights with new Phillips CosmoPolis white ceramic metal halide street lights to reduce energy wastage. This changeover provided a unique collaborative opportunity to implement a before-after-control-impact field experiment to investigate the ecological effects of newly installed broad spectrum light technologies. Activity of the bat species *Pipistrellus pipistrellus*, *P. pygmaeus* and *Nyctalus/Eptesicus* spp. was significantly higher at metal halide than LPS lights, as found in other studies of bat activity at old technology (i.e. mercury vapor) white light types. No significant difference was found in feeding attempts per bat pass between light types, though more passes overall were recorded at metal halide lights. Species-specific attraction of bats to the metal halide lights could have cascading effects at lower trophic levels. We highlight the need for further research on possible ecosystem-level effects of light technologies before they are installed on a wide scale.

RESOLVING WOLF AND SHEEP CONFLICTS WITH NONLETHAL METHODS AND COMMUNITY COLLABORATION

Suzanne Stone

Defenders of Wildlife

Jesse TIMBERLAKE, Defenders of Wildlife ; Peter HASWELL, Bangor University ; Fernando NAJERA, University of Madrid ; Stewart BRECK, USDA National Wildlife Research Center ; Lawrence SCHOEN, Blaine County Commission ; Brian BEAN, Lava Lake Lamb and Livestock ; Daniel THORNHILL, Defenders of Wildlife

Worldwide, lethal control of predators to manage conflict with livestock is commonly employed and can inhibit wildlife conservation efforts. Our study focuses on developing non-lethal solutions that reduce conflict and the need for lethal management of carnivores. Wolf restoration to the USA northern Rockies is heralded as a biological success but with the re-establishment of wolves, conflict in the form of livestock depredation is an important driver for current policies setting hunting quotas and lethal control actions to protect agricultural interests. We present results from a seven year study where we employed animal husbandry techniques to manage livestock and nonlethal techniques to manage wolves in place of lethal control measures. Our paper discusses the range of nonlethal adaptive mitigation methods we used to protect sheep and compares rates of depredation to other areas in the state that employed lethal control strategies. Data was collected on wolf activity, sheep-herder activity, sheep losses to predators, and nonlethal tools used for keep wolves from attacking sheep. We employed a variety of nonlethal tools including corralling sheep at night with fladry, light and noise devices, and human activity but did so judiciously when threats from wolves were believed to be elevated. Preliminary results indicate that over the seven year period sheep predation rate was lowest in the state (0.03 percent of the total sheep present in the area) with fewer than 30 sheep killed by wolves out of total of 110,000 sheep animal units present. A cost-benefit analysis also demonstrates that our methods are economically competitive with traditional lethal wolf control methods. Critical to our success was working with local stakeholders to construct a community model for peacefully addressing conflicts and implementing solutions.

THE ROLE OF FIRE DISTURBANCES ON THE DISTRIBUTION OF STRUCTURAL RESOURCES FOR THE EASTERN BRISTLEBIRD

Zoe Stone

The University of Queensland



Martine MARON, The University of Queensland ; Elizabeth TASKER, Office of Environment and Heritage, NSW Government

Many ecosystems are experiencing changing disturbance regimes. In Queensland, Australia, many species rely on frequent disturbance patterns for the maintenance of habitat in grassy eucalypt forests. In particular, ground dwelling species that rely on structural resources provided by the grassy layer, such as the Eastern Bristlebird (*Dasyornis brachypterus*), are sensitive to disrupted fire regimes. The Northern population of the Eastern Bristlebird (NEBB) is rapidly declining, with an estimated population of less than 30 individuals. As a small bird with limited flight ability, it relies heavily on local resources provided by the grassy layer within its habitat. This research looks at how fire has affected the spatiotemporal distribution of structural resources within grassy eucalypt forests of Southern Queensland and Northern New South Wales, Australia. Current and historic distribution of suitable grassy habitat was mapped across the known range of the NEBB and assessed against bristlebird distribution. At a more local scale, grass structure was measured across all known currently occupied and historical bristlebird sites. Grass height, thickness, and diversity were measured within bristlebird territories, along with shrub and canopy cover. Preliminary results suggest decreased fire has led to a significant reduction in grassy habitat available to NEBB across its range, as a result of shrub encroachment. In addition, the quality of structural resources that are provided by the grassy layer for the NEBB has degraded with decreasing disturbance. Inappropriate burning practises have led to decreased structural resources for these ground dwelling birds, which require a dense and complex grass layer for breeding, protection and foraging. Understanding how these resources have been influenced by changing disturbance patterns will assist in the preservation of grassy eucalypt forest types, and therefore the conservation of threatened species associated with them.

VALUES SHAPE THE WAY ECOLOGICAL INFORMATION INFLUENCES PEOPLE'S ATTITUDES TOWARDS URBAN WETLANDS

Tanja Straka

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Urban wetlands are important for wildlife conservation and valued by people. However, wetlands that are beneficial for wildlife are not necessarily aesthetically pleasing to people. This is important in human-dominated areas where people's preferences influence the design and management of wildlife habitats. We investigated people's preferences towards urban wetlands that benefit insectivorous bats, the effect of

ecological information on people's preferences, and the role of underlying values for wildlife in mediating this process. Residents ($n = 1,200$) living around wetlands in Melbourne, Australia were posted a photo-booklet containing images of 27 wetlands and a questionnaire which was used to rate their preferences and their wildlife value orientations. To test the effect of ecological information, half the participants also received information about insectivorous bats and the ecological quality of each wetland for these cryptic mammals. We hypothesized that this information would change people's preferences for some types of wetlands, and that this effect would be mediated by their wildlife values. People generally preferred urban wetlands that were beneficial for insectivorous bats. Somewhat surprisingly, people who received ecological information did not have higher preferences for wetlands that provided good habitat for bats; instead, their preferences were lower for wetlands that were less beneficial for insectivorous bats. This effect was mediated by high wildlife value orientations. Results of this study suggest that wetlands with high quality habitat for bats can be enjoyed in an Australian urban context. More importantly, our results show that preferences for landscapes can be influenced by the provision of ecological information when that information is consistent with people's value orientations.

PARKS IN HUMAN-DOMINATED LANDSCAPES: RELATIVE VULNERABILITY TO CLIMATE AND LAND USE CHANGES

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Many national parks in the American Midwest are islands of natural vegetation surrounded by agricultural or urban land uses or are in highly fragmented or rapidly changing landscapes. Climate change is just one of many stressors on park natural resources. Understanding the relative vulnerability of these parks to climate and land use changes is important for region-wide planning. We conducted a relative vulnerability assessment of 60 units in the (US) National Park Service Midwestern administrative region to climate and land use change using data from multiple sources. We assessed individual parks' exposure (5 metrics), sensitivity (5 metrics), and adaptive constraints (8 metrics) under two climate change scenarios (A1B and A2). The metrics from these three components were combined into an overall vulnerability score. Metrics were measures of existing or projected conditions within park boundaries, within 10 km buffers surrounding parks, and within ecoregions that contain or intersect the parks. Data were normalized within the range of values for all assessed parks, resulting in relative scores for exposure,



sensitivity, adaptive capacity, and overall vulnerability within the 13-state area. Results are consistent with recent assessments regarding patterns and rates of climate change nation-wide, but provide greater detail and relative risk for Midwestern park units. Overall relative vulnerability ranking of parks did not differ much between climate scenarios. Scores for the vulnerability components of exposure, sensitivity, and adaptive constraints varied geographically and indicate mitigation opportunities and constraints. Output will allow individual parks to understand which metrics weigh most heavily in their overall vulnerability and can be used for region-wide responses and resource allocation for mitigation efforts.

HOW WELL DO WE KNOW OUR BIODIVERSITY? A CASE STUDY OF MAMMALS OF COLOMBIA

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Species checklists provide basic information for taxonomic and geographic studies, and usually, are the first tool for those involved in wildlife management and conservation. However, their use is constrained by the completeness and accuracy of updated information. Here, we reviewed changes in the number of species of native mammals from Colombia over the last fifteen years (2000-2015). Based on data from natural history collections and online databases, we analysed diversity and distributional patterns in order to identify research efforts in different regions of the country. Forty seven species were added since 2000, increasing the diversity of mammals in the country to 503 species and 208 genera. Most of the additions (17) correspond to bats (order Chiroptera), one of the most studied groups in the country. Nevertheless, the increasing number of mammal diversity is not restricted to small mammals. This is reflected by the discovery of new species of primates (2), carnivores (1), and perissodactyls (1) in the last decade. We also highlight some groups that require urgent taxonomic and systematic reviews. Although Colombia is one of the global hotspots for mammalian diversity, our results show that little or nothing is known about diversity or distributional patterns of certain species, especially the endemic taxa. The presence of the main cities and roads in the Andes have allowed for higher levels of sampling effort in this region. In contrast, the Amazonia is the least studied region. Therefore, many conservation decision and quantification tools have a limited ability to determine impacts of anthropic changes on biodiversity. Given this sampling bias, we suggest fieldwork efforts based on the updated distribution data of the species. Finally, we propose new approaches to update the checklist of Colombian mammals in order to identify advances and information gaps in a more accurate way.

AMPHIBIAN DISTRIBUTION AND CONSERVATION IN THE EASTERN HIMALAYA

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Ashoka Trust for Research in Ecology and Environment (ATREE)

The Eastern Himalaya (EH) Hotspot offers a unique and vast altitudinal and environmental gradient for studying species turnover and species adaptation in a rapidly changing landscape. The amphibians of EH are the least studied group among vertebrates. Their cryptic nature, inconspicuousness, highly seasonal activity and inaccessibility due to difficult terrain have resulted in limited studies on this fauna. My study area is Sikkim Himalaya and my work seeks to understand the role of multiple factors on species richness and distribution pattern of amphibians along an elevation gradient and mapping the distribution of amphibians in the entire EH region. I used Ecological Niche Modeling to predict the present and future distributions of amphibians in the EH and possible conservation issues and mitigation with regard to these high altitude species in the light of climate change. In addition to the ecological aspects, I also used participatory tools, like, focus group discussion, questionnaire surveys among the communities inhabiting the fringe villages to understand the local practices with respect to the use of amphibians. In rural settlements, especially the buffer villages, people had knowledge about the ecological role of the anurans but unfortunately they were also preyed upon by these people for various reasons, like medicine, meat and culture of hunting. Furthermore, the Indian Wildlife Protection Act (WPA), 1972 has added greater pressure towards the anuran population. Before the WPA, the ethnic people hunted for larger preys in addition to hunting for frogs but now it seems the whole focus has shifted towards hunting of frogs for keeping their hunting-tradition alive, sustenance for some and also for sports. As frogs are small and inconspicuous, their hunting usually goes unnoticed. These ecological and social surveys have helped identify various threats to the high altitude amphibian population and initiated development of a comprehensive conservation protocol.

SIZE DOES NOT ALWAYS MATTER. POLLINATION OF A SPECIALIST PLANT TROLLIUS EUROPAEUS IN A FRAGMENTED HABITAT.

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Many plant species are experiencing negative consequences of habitat fragmentation, a process resulting, for instance, in a decrease of population sizes and an increase of the isolation between remnant populations. Moreover, such changes can



potentially affect biotic interactions within communities, such as pollination success, further disturbing the reproduction and survival of the remaining populations. It is speculated that specialized plant-pollinator interactions should be particularly sensitive to such processes. In this study we focused on the European globeflower *Trollius europaeus*, a specialist plant, pollinated mostly by *Chiastocheta* flies. This well studied interaction can be used as a model plant-pollinator interaction, as the interacting partners are well defined - one plant interacting with one genus of main pollinators. We measured pollination efficiency, defined as the proportion of fertilized ovules, in natural *T. europaeus* populations of varying size, isolation, and plant density on a local, within-population scale. Contrary to our expectations, *T. europaeus* population size and isolation did not have negative effect on pollination efficiency. Instead, the fine-scale plant population density was the determining factor for pollination success. Our findings highlight the fact the plant population size is not always the main factor determining the processes occurring in fragmented populations. Other factors, such as local plant density can also play an important role in attracting pollinators and may thus affect plant reproduction.

SPECIES DISTRIBUTION AND ABUNDANCE OF AMPHIBIANS USING GEOGRAPHIC INFORMATION SYSTEM MAP IN TWO VEGETATION TYPES OF AGUSAN MARSH, PHILIPPINES

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Agusan Marsh is the 1009th RAMSAR site, a wildlife sanctuary which harbour unique and pristine faunal species. It is considered one of the most ecologically significant wetland ecosystems in the Philippines. The study assessed species distribution and abundance using Geographic Information System Map in Agusan Marsh between Sago Palm and Terminalia Forest. Results showed a total of 322 individuals, 11 species and 6 families of amphibians documented. Of the eleven (11) species of amphibians documented in Sago Palm and Terminalia Forest, six (6) were Philippine endemics, three (3) were invasive species in the area. Terminalia forest had the highest number of individuals documented during the conduct of the study. Sago Palm and Terminalia Forest have almost the same type of vegetation where amphibian species thrive most. Furthermore, ecological and environmental threats (conversion of Terminalia Forest to agricultural land, run-off of environmental pollutants such as pesticides and Kaingin or Slash and Burns) being identified in the two habitat types, posed immediate attention. Agusan Marsh is home of 6 Philippine endemic amphibian species and should therefore be better managed and protected. Key words: Abundance,

Agusan Marsh, Biodiversity, Distribution, Frogs, Sago Palm, Terminalia Forest

MODELING THE IMPACT OF HYDROLOGICAL ALTERATIONS: SHIFTS IN EURASIAN SPOONBILL HABITAT IN POYANG LAKE, CHINA

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Poyang Lake, the largest freshwater lake in China, provides critical wintering refuge for over 300 species of migratory waterbirds. Suitable habitat for these birds, including an available and abundant food supply, is driven by a seasonal flood-pulse system fed by the Yangtze River. To protect livelihoods such as agriculture and fishing, people have manipulated local hydrology to a great extent. Future alterations – namely, a proposed Yangtze-Poyang outlet dam – could have a much larger ecological impact, although little is currently known about this relationship. To quantify the role of hydrology in habitat suitability, I used a hybrid approach integrating behavioral observations with long-term monitoring in Poyang Lake National Nature Reserve. I selected the Eurasian spoonbill (*Platalea leucorodia*) as an indicator for co-occurring waterbirds of concern such as the endangered Oriental stork (*Ciconia boyciana*). In winter 2014-2015, I conducted a series of focal and scan samples to examine preferred habitat and flock activity budget. These observations indicate that water level is the main driver of habitat suitability due to its role in both spoonbill behavior and foraging success rates. 64% of bird activity occurred in 35-55cm of water, and birds foraging at these depths acquired 3.1 food items per 5-minute bout compared to 1.2 items at other depths. I used these findings to inform a spatially explicit logistic regression model of spoonbill habitat based on surveys from 1999-2015. After determining the baseline relationship, I adjusted parameters based on potential hydrological changes and found that reducing water levels would have a disproportionate impact on habitat: 10% and 15% reductions in winter water level would decrease optimal foraging habitat by 15.2% and 42.9% respectively. Although altering hydrology may benefit human livelihoods, changes exceeding the narrow range of suitable water depth would displace, reduce, or entirely eliminate available habitat.

PUBLIC-PRIVATE PARTNERSHIPS AS A FINANCIAL MECHANISM FOR BIODIVERSITY CONSERVATION AT THE LANDSCAPE SCALE: THE ALTO MAYO CASE IN THE NORTHEASTERN PERUVIAN AMAZON

Percy Summers

Conservation International



Claudio SCHNEIDER, Conservation International [INSTITUTE] Conservation International ; Agustin SILVANI, Conservation International HQ ; Ivo ENCOMENDEROS, Conservation International ; Fabiano GODOY, Conservation International HQ ; Annie WALLACE, USAID ; Dora SAMANIEGO, Conservation International

A sustainable landscape integrates good governance, sustainable production and natural capital conservation to improve health, human well-being and social equity. However, in practice, the changes required for managing the landscape sustainably are daunting. The private sector can be a key component for driving change of land use and land cover processes that can spur economic growth and biodiversity conservation. This session explores the ways in which the public sector and NGOs are attracting private sector investment compatible with the vision of a sustainable landscape. We take as an example the demonstration project being developed jointly with the Peruvian Ministry of Environment, the Regional Government of San Martin, USAID and various private sector entities. By bringing together real-world experiences we will explore the hurdles preventing the public and private sector from cooperating more closely, how non-government actors such as NGOs can facilitate this exchange, and spark a discussion on what is needed to break from the business as usual and move towards sustainable investment models that spur economic growth and maintain a country's natural capital. How can we effectively tie investments to a decision making process based on science to maximize economic, environmental and social outcomes? How can we guide investments for multiple benefits? How can we integrate information and stakeholder expectations for optimum outcomes? Other lessons include the design and implementation of a landscape accounting system to track how investments and other project activities are reducing emissions on the ground, as well as increasing production, while maintaining natural capital and biodiversity, and improving human well-being.

INTEGRATING AQUACULTURE, AGRICULTURE AND VETERINARY COMPONENTS IN POND AQUAPONICS FOR FOOD SECURITY AND INCOME OF FARMING HOUSEHOLDS IN COASTAL BANGLADESH

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Aquaponics is an agricultural technology of integrated culture of fish and vegetables that is emerging with global popularity. The present study was designed for integrated culture of fish and vegetables with pigeons in pond aquaponics in the Barisal region of Bangladesh. Using cheaper, locally available inputs and farmers' skills and labor, 3 square meter

(1.52m x 2.12m) aquaponics cage structure was introduced in pond; made by bamboo-spilt within the costing range from 1200 to 2000 BDT. In the three sides of the cages, there were sunshades like structures to support vegetables like basil, green pepper, tomato, brinjal, ornamental flowers, medicinal plants etc. Above the cage; a trellis supported spreading plants like bean, bitter gourd, long bean etc. Three treatments of aquaculture were introduced; monoculture of Tilapia (*Oreochromis niloticus*), monoculture of Koi (*Anabas testudineus*), polyculture of Koi and Tilapia. After 80 days of stock, Tilapia becomes 178.5g and 174g in monoculture and polyculture with 19cm and 17 cm in size respectively from 24g and 22g initial weight respectively with 4cm of initial size. Whereas Koi become 70g weight in monoculture and 57.6g in polyculture from 0.5g initial weight. Farmers' acceptance of the modified aquaponics is encouraging and they are constructing aquaponics by their own effort since the production and profit of vegetables was comparatively higher than other traditional aquaponics. Considering the adaptability of this culture system in relation to tidal surges, flood, this culture system could increase resilience of the farming households in relation to environmental changes in the coastal region of Bangladesh.

ASSESSING TROPICAL BIRD DIVERSITY WITH THE DYNAMIC HABITAT INDEX

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Biodiversity loss is a global crisis. Predicting how species will respond to a changing environment requires assessments of biodiversity at relevant temporal and spatial scales. Inconsistent and incomplete biodiversity assessments hamper conservation efforts in many tropical regions. Our goal was to assess the strength of the relationship between the Dynamic Habitat Index (DHI), derived from satellite data, and tropical breeding bird species richness in Thailand. The DHI summarizes three measures of annual vegetation productivity that characterize the capacity of a given habitat to support a number of species: a) cumulative productivity, as sites with more available energy are generally more biodiverse; b) minimum productivity, as sites that never exhibit extreme lows are more biodiverse; and c) seasonality in productivity, as sites with less intra-annual variability are more biodiverse. We calculated the DHI for Thailand at 8-km resolution for 2002-2009 from NASA's MODIS FPAR data, and breeding bird richness from IUCN species range maps. We modeled richness of all breeding bird species and for different functional guilds as explained by the DHI, climate, topography, latitudinal



gradients, habitat heterogeneity and area, with best-subsets and hierarchical partitioning regressions. Species richness was highest where the DHI had high cumulative productivity, high minimum productivity, and low seasonality. Cumulative productivity best explained species richness (up to 63%). Together, DHI and environmental factors explained up to 87% of variation in richness overall and among guilds, with DHI being the most important factor. The DHI is a promising tool for biodiversity assessments and conservation because it quantifies those aspects of the dynamics of vegetation productivity that strongly correlate to diversity.

SPATIAL ECOLOGY OF FEMALE TRIMERESURUS MACROPS IN NATURAL AND HUMAN-DISTURBED FOREST OF SAKAERAT BIOSPHERE RESERVE, THAILAND

Pongthep Suwanwaree

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Colin T. STRINE, Suranaree University of Technology ; Inês SILVA, Sakaerat Environmental Research Station ; Curt BARNES, Sakaerat Environmental Research Station ; Jacques HILL, University of Arkansas ; Taksin ARTCHAWAKOM, Sakaerat Environmental Research Station

The Big-eyed green pit viper (*Trimeresurus macrops*) is a venomous snake species, endemic to Southeast Asia. Although we have some knowledge of the systematics and toxicology of *T. macrops*, little is known about the spatial ecology of this species. Considering the increase in habitat fragmentation and isolation, it is important to study the impact of human presence and expansion on snake species. During 2013–2014, we used radio-telemetry to determine home-range sizes of 13 adult female *T. macrops* inhabiting Sakaerat Biosphere Reserve, a patchy landscape of undisturbed and disturbed habitats. We found that individual home ranges for *T. macrops* averaged 0.175 ha, with activity areas ranging from 0.112–0.303 ha and core areas ranging from 0.023–0.052 ha. There was little overlap between conspecific tracked females, especially for the most used areas of their home ranges. We did not detect significant differences in home ranges, movement patterns, or behavior between individuals living in forested areas and near the research station. Our study suggests that *T. macrops* are not significantly affected by human disturbance, likely due to their cryptic behavior and limited movement patterns.

SYMPOSIUM #151_ METACOMMUNITY THEORY AND INFECTIOUS DISEASES. EMPIRICAL DATA AT LOCAL AND BROADER SCALES.

Gerardo Suzan

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It is proposed that metacommunity and phylogenetic structure encompasses assemblages of hosts and non-hosts that interact and influence pathogen spread and transmission in time and space but empirical data is lacking. Here we investigate the metacommunity structures and substructures of 4 zoonotic systems, across taxa and geographical areas. These include: (1) vectors (fleas) in rodent communities at local scales, (2) hosts and non-hosts rodents at local scales, (3) rodents (hosts and non-hosts) at continental scales, and 4) viral diversity in bat communities at regional scale. Our results show different structures including random, nested, and anti-nested with several substructures. Although no idealized structure is identified to describe host-non host and host-non host-parasite distributions across taxa or scales. We identify indeed that metacommunity and phylogenetic structure relates with both, the distribution and prevalence of parasites, and the distribution and abundances of host and non-host in different scales. Our results suggest that patterns observed at different scales relates to the ecological and phylogenetic assemblages involved in each system. Using a metacommunity approach, public health scientists may better evaluate the factors that predispose certain times and places for the origin and emergence of infectious diseases, and will provide important information for conservation biologists to identify emerging patterns that compromise diversity or ecosystem services.

88: THE BIG MOVE: HABITAT SELECTION, DISPERSAL AND REINTRODUCTION

Ronald Swaisgood

San Diego Zoo Institute for Conservation Research



Behavioral ecology has yet to be fully integrated into conservation biology, yet many behavioral processes are likely to influence the success of conservation programs. Habitat selection, particularly how dispersing animals choose where to settle, provides a rich theoretical framework generating testable hypotheses that can guide many conservation actions. Here I review how some of these ideas may be incorporated into conservation programs, with a focus on reintroduction biology. Perceptual and decision-making mechanisms in dispersers determine the distribution of members of a species on the landscape. Decisions made by dispersers sometimes run counter to goals set by conservation managers; for example, suitable habitat may be set aside but target species fail to settle there. Reintroduction and translocation programs suffer from high post-release mortality and long-distance, unpredictable dispersal behavior that exacerbates risks. These programs are essentially exercises in “forced dispersal” and thus lessons learned from dispersal ecology are informative. Several mechanisms are known to influence dispersal and settlement, including conspecific cueing and natal habitat preference induction (NHPI). The conspecific cueing hypothesis posits that dispersers rely on the presence of conspecifics to assess habitat suitability. Similar to the concept of habitat imprinting, NHPI occurs when an animal’s experience with its natal habitat shapes its post-dispersal preference for habitat settlement. Dispersers may not settle until they find “someplace like home” or “someone like me,” exposing themselves to the cumulative risks associated with long-distance movements. I explore the possibility that these and other mechanisms can be manipulated in pre- or post-release contexts to encourage animals to settle, quickly and safely, in appropriate protected habitat.

CITIZEN SCIENCE ONLINE: PRODUCING HIGH-QUALITY DATA FROM CAMERA TRAP IMAGES

Alexandra Swanson

University of Oxford

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Remote monitoring networks, such as camera trap surveys, are revolutionizing wildlife conservation and research by providing large-scale monitoring in remote areas. However, these surveys often produce overwhelming amounts of imagery that create data-processing bottlenecks. Citizen science holds enormous potential to quickly process overwhelming numbers of images produced by remote camera surveys, but requires careful attention to data quality. Snapshot Serengeti, a project on the citizen science platform The Zooniverse (www.zooniverse.org) engages members of the general public to help process photographs produced by a large-scale camera survey operating in Serengeti National Park, Tanzania. Here I will present generalizable techniques utilized by Snapshot

Serengeti to rapidly and accurately classify 1.51 million images. On Snapshot Serengeti, volunteers classify species, number of individuals, and behaviors captured in each image. By circulating each image to multiple users, and then applying straightforward algorithms to aggregate answers, we produced expert-quality “consensus” data that has directly contributed to Serengeti monitoring. Since 2012, over 28,000 volunteers have contributed 13 million classifications on the 1.55 million images processed to date. Applying a “plurality” algorithm to raw classifications yielded a “consensus dataset” that was 97% accurate when compared to a gold-standard dataset of 4,149 expert-classified images. In this talk, I will explore 1) how the performance of this algorithm varies across species of varying difficulty and rarity, 2) how we can use measures of agreement among raw classifications to predict when consensus answers are likely to be correct, and 3) how many citizen-scientist classifications are required to produce reliable data with this algorithm. These analyses will help other science teams optimize similar citizen science projects for their specific data needs.

GREENING - BEST PRACTICE AND WORSE

Stanisław Świtek

Poznan University of Life Science

Victoria TAKACS, Poznan University of Life Science

One of the main thing New Common Agricultural Policy is Greening. Farmers have to follow new environmental rules to take payment. Pro ecological farm management should improve biodiversity, landscape quality and sustainable agriculture. In this case ecosystem services play also important role. One of the point of greening is EFA- Ecological Focus Area. This minimum 5% of total land area each farm have to be used ecologically friendly. The general aim of this paper is to contrast several ways of understanding this in practice on the example of Wielkopolska region, Western Poland. In Poland there were several ways of “green agricultural practice” in the past. In 2001 1,3mln ha of the agricultural land was characterized as a fallow land. Following EU accession the agro – environmental schemes made it possible to get subsidies for so called “Green agriculture”. In practice however there are several ways of understanding these ideas – all are sound legally, however the ecological, cultural and scenic value of them is different. Several types of “green agricultural practice” as field margins, grassland, forest belts are characterized using ortophotomaps and via contrasting them to old maps from the same area – supplementing this to statistical data on land cover at certain areas we can show trends. As a part of LIBERATION project we collected data on faunal and weed diversity from a long term experimental management (over 50 years non sown area – experimental station in Brody). Using these data we can show a clear evidence for the value of these green areas in increasing biodiversity. We argue that the scenic and biodiversity value



of traditionally managed “greening” is high – thus we should advocate this type of management.

EUROPE’S FRESHWATER BIODIVERSITY: PRIORITIES, PATTERNS AND GAPS IN CURRENT CONSERVATION

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Freshwater ecosystems host disproportionately high numbers of species relative to their surface area and are more threatened than marine or terrestrial ecosystems. Yet freshwater biodiversity is poorly protected globally, which necessitates scientifically sound prioritisation and evaluation of conservation effort. Our aim was to determine conservation priorities for 18,816 river and lake catchments of Europe (over 10 million km²) using data on the distribution of 1631 species of freshwater fishes, molluscs, odonates and aquatic plants while also considering their IUCN Red List category, range restriction and level of endemism. We used the MARXAN systematic conservation planning software to estimate the irreplaceability of catchments as a proxy for conservation priority. We found that catchments with high irreplaceability were mostly in the Balkan, Iberian and Italian peninsulas or in the Danube and Volga river systems. Starting the prioritisation with the inclusion of well-protected catchments resulted in clearer priorities and better coverage of threatened species. The correspondence between irreplaceability and proportion of protected areas was as expected in central and N Europe, whereas we found underprotection (high irreplaceability, low protection) in the Balkans and E Europe and overprotection (low irreplaceability, high protection) in NW Europe. Finally, starting the prioritisation with the exclusion of well-protected catchments further increased the priority of some S European catchments, which can thus be recommended for increased protection, management or restoration. Our study presents continental-scale conservation priorities based on a large

database of freshwater biodiversity by focusing on species conservation status, range-restriction and uniqueness of species assemblages and it contributes to a higher efficiency of the protection of freshwater biodiversity by providing relevant input for conservation policy and action.

STAKEHOLDER ATTITUDES AND OPINIONS REGARDING THE MANAGEMENT OF LARGE MAMMALS IN THE CARPATHIANS

László Szemethy

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The Carpathians are one of the strongholds of the large carnivore and herbivore populations in Europe and form a cross-border bioregion. In the framework of the BioREGIO Carpathians SEE Project we collected Common Integrated Management Measure ideas, that should be implemented by the stakeholder groups and directly contribute to the long-term conservation of brown bear (*Ursus arctos*), grey wolf (*Canis lupus*), Eurasian lynx (*Lynx lynx*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*) and chamois (*Rupicapra rupicapra*). Based on the demand-driven concept of conservation we organized four stakeholder meetings in Hungary, Romania, Slovakia and Serbia, with 42, 50, 72 and 54 participants. Representatives of National Parks, universities, forestries, game managers, farmers, water management, nature conservation and tourism experts, as well as researchers, took part on these meetings. The ecological and socio-economic importance/impact, ecological and socio-economic conservation conflicts and threats, data requirement, accessible databases, problem solving system, integration of different interests were discussed. The ecological importance of the large mammals was generally not questioned. According to the stakeholders they increase the biodiversity, maintain the balance of the ecosystem and play an important role in the trophic web. The opinions about the problems of target species are different among the countries. The carnivores cause the most problems in Romania, while the herbivores are considered as problematic species mostly in Hungary. The main conflicts are based on the economic damages in case of both groups. The stakeholders generally agree with that, the accessible databases are quite poor and more realistic population data are needed in the conservation and planning. According to a frequent opinion, the stakeholders are often not involved enough in planning and management.



BROWN HARE AS AN INDICATOR SPECIES FOR AGRI-ENVIRONMENTAL PROGRAMS IN HUNGARY

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Agri-environment schemes (AES) exist to enhance agricultural landscape's biodiversity all across Europe. Brown hare (*Lepus europaeus*) is one among the few useful AES mammal indicator species. Previous researches showed controversial data on the indicator effect of hares. Based on the population estimation and harvest data of 482 game management units (Hungarian National Game Management Database {NGMD}) we have analysed the effect of the Hungarian AEP (2007-2014) and red fox culling on brown hare population and harvest density. According to our hypothesis red fox culling and increasing AEP proportions will have beneficial effects on the hare population. Based on all the game managements units compiled data we have found that higher AEP proportion did not influence hare numbers, but it has a small negative effect on harvest density (linear regression). Cull index has a slightly positive impact of harvest density in every year. With natural breaks of the AEP proportions, we got significantly lower hare harvest density in the higher AEP category (Kruskall-Wallis with Dunn's test). Based on fox cull intensity we could separate three categories and found that larger culling index means more brown hares can be harvested (Kruskall-Wallis with Dunn's test). It seems that large AEP grasslands can affect brown hare population negatively, while arable lands have no detectable effect on large-scale in Hungary. We believe that AES protocols might not be well targeted on brown hares. More local fox control results in more obvious hare population increase. Yet, on a small-scale these effects might change, thus our future goal is to develop a theoretical model on how small-scale agri-environmental improvements can be beneficial for hares, and we also want to verify our models on a practical way at the fields.

SEX-SPECIFIC ADRENOCORTICAL RESPONSES IN BIRDS DEPEND ON THE PERIOD OF THE YEAR

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In face of threatening situations, vertebrates activate an adrenocortical stress response aimed to help animals to escape

and promote survival. This response, however, is modulated according to factors such as sex or life history stage. In birds, it has been shown that during breeding stages the sex providing more parental care tends to dampen their stress response to favour brood success. However, little is known about non-breeding stages. That is why the aim of this study was to investigate how adrenocortical reactivity varies across periods of the year depending on sex. For this, we performed a comprehensive literature review and compiled information about sex-specific levels of baseline and stress corticosterone for numerous bird species in different life history stages (e.g. moult, wintering, and breeding). Then, we carried out a meta-analysis to examine the interaction between sex and season of the year on the adrenocortical response. We observed that, as shown in previous studies, females tended to have a lower reactivity than males during breeding season, although it depended on the parental care allocation of each species and the exact phase within the breeding season. However, in other periods of the year, there were no differences among sexes or even in some cases; we found the opposite trend with females having higher reactivity than males. Our results suggest that variation in stress responses not only depend on sex and period of the year, but also on the interaction between them. These findings could have important implications for interpreting and predicting the physiological response of animals to environmental stressors, such human disturbance and habitat degradation.

LINKING WOODLARK ABUNDANCE TO FOREST MANAGEMENT PRACTICE

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Woodlark is a protected species included in Birds Directive - though in many areas still can be considered as common. This species adopted to the contemporary forest management practice - occupying clearings and young stands (<10 years), therefore to successful species conservation eventual The study site is one of the largest NATURA 2000 sites - Notec Forest (Western Poland). This is a large forest complex mostly consisting of planted scotch pine. As a part of N2k monitoring in 2010 we started a systematic woodlark survey in 20 randomly selected plots of 4 km². Within these plots all potential habitats for woodlark were controlled, minimum 3 times within the breeding season. The habitat was considered as occupied if a singing male occurred twice at the site. Our goal is to show the population trend of this species and face its habitat occupancy pattern to habitat characteristics (elevation, forest stand type and age habitat size and shape, presence of left-over trees) and forest management clues (these two are strongly correlated at the study sites). We used



QGIS and "Statistica" program packages for the data analysis. Altogether 320 woodlark pairs were found in the monitored area. The suitable habitat varied from The suitable habitats in the monitored plots were 539 to 397 Ha (varying among the years) within 234 to 252 habitats in a year within the monitored area. Within the study period a 40 % decrease occurred between 2010 and 2014, this cannot be explained by any of the factors. There was a strong correlation with the habitat size, also with the abundance of remaining tree spots on a clearing / young tree stands. Habitat shape, elevation and forest management activities did not influence the abundance patterns of woodlarks. The observed decline during the study period cannot be explained by the checked. Woodlark is still numerous in the Notec forest however, the observed trends call for special attention.

FACTORS INFLUENCING THE OCCURRENCE AND DISTRIBUTION OF THE ADMIRALTY ISLAND CUSCUS (*SPILOCUSCUS KRAEMERI*), MANUS ISLAND, PAPUA NEW GUINEA

Wallace Takendu

Wildlife Conservation Society Papua New Guinea

The Admiralty Island Cuscus *Spilocuscus kraemeri* is a cryptic and elusive cat-sized member of the Phalangeridae family which is endemic to the Admiralty group of Islands, Papua New Guinea. Despite the importance of the animal in the local diet as the primary source of terrestrial protein and widespread concerns over the sustainability of the harvest, little is known of the ecology of the species. In this study we investigated the factors affecting the occurrence, relative density and distribution of *S.kraemeri* on Manus Island through a network of camera traps (13 May – 14 June 2013). Our study focused on three traditional villages on the north coast of Manus Island: Tulu 1, Tulu 2, and Lahapau. Camera traps were placed on arboreal crossings (tree branches which allowed cuscus to cross village tracks in the forest without descending to the ground). Count data from photo capture events together with environmental data were modelled through generalised linear models in program R while presence-absence data was modelled through a variable detection probability occupancy method in program MARK. We used a model selection framework to analyse a suite of candidate models to identify the factors had the greatest influence. The occupancy analysis revealed two distinct clusters amongst the villages: Lahapau had the highest occupancy and detection probability ($\hat{N} \pm = 1$, $p=0.40$) while Tulu 1 and Tulu 2 formed a single cluster with lower occupancy and detection probability ($\hat{N} \pm = 0.50$, $p=0.25$). Both the generalised linear modelling and occupancy analyses highlighted the importance of vegetation type (a preference for secondary forest) and to lesser a role for canopy cover and tree height. On this basis we recommend the development of

community driven land-use plans for Tulu 1 and Tulu 2 in order to help sustain the local cuscus populations.

ONLINE LEARNING: HOW CAN WE BEST USE IT TO STRENGTHEN CAPACITY FOR CONSERVATION?

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Online learning offers a new path to cost-efficient capacity-building. It has the potential to overcome challenges of traditional face-to-face teaching such as the diversity and geographic dispersion of training needs, fitting classroom study around the demands of field schedules, and the limited availability of trainers. However, the new paradigm poses many questions. How does the quality of learning compare with face-to-face workshops? How do participants experience and value online learning in comparison to classroom training? How do we teach practical conservation skills in a virtual environment? How likely are people to complete the course, and how confident are they in applying their new skills? Online learning promises exciting possibilities for greater flexibility in the pace and breadth of learning, and better support and engagement of non-native speakers. By connecting practitioners across the globe, it highlights how conservation problems and their solutions aren't constrained by geographic boundaries. Conversely, barriers include differing cultural expectations, the reliability of internet access, and the difficulty of motivating people to study in physical isolation and with competing demands on their attention. Based on our experience creating and teaching online courses, we describe different approaches and explore the strengths and weaknesses of online versus face-to-face teaching for conservation. We summarise what to consider when commissioning, creating or teaching online courses, and address how online training can complement and extend existing efforts to strengthen conservation capacity globally.

EXTINCTION AND INVASION RISK ARE NOT TWO SIDES OF THE SAME COIN, AT LEAST NOT FOR REPTILES

Aimee Tallian

Utah State University

Reid TINGLEY, The University of Melbourne ; Peter MAHONEY, Utah State University ; Andrew DURSO, Utah State University ; Alejandra MORÁN-ORDÓÑEZ, The University of Melbourne ; Karen BEARD, Utah State University

Anthropogenic activities homogenize biodiversity by increasing extinction risk, while simultaneously facilitating the transition of species through each stage of the invasion pathway. It is often assumed that trait values that predispose



species to become either threatened or invasive (i.e., those associated with population growth rates) lie on opposite ends of a continuum (i.e., the ‘two sides of the same coin’ hypothesis). In contrast, we might assume that anthropogenic threats will have analogous effects on threatened and invasive species. To test these hypotheses, we compared 1) extinction risk of 765 threatened and least concerned reptile species, and 2) 302 introduced established and non-established reptile species around the globe using a Bayesian generalized linear mixed model with a binomial response that accounted for confounding effects. Comparing predictors of threat status and invasion success in reptiles revealed little support for the two sides of the same coin hypothesis. Only 50% of model coefficients describing 12 aspects of a species’ life-history, ecology, geographic origin, and environmental niche breadth were opposite in sign between the two groups. The variables showing strong and opposing relationships were body size, insularity, and parthenogenesis. Larger-bodied, non-parthenogenetic species that exclusively occupied islands were more likely to be threatened, whereas small-bodied, parthenogenetic species that were not island endemics were more likely to become invasive. Variables relating to anthropogenic threats showed the opposite pattern. The strongest variable was mean human population density across a species’ native geographic range, which had a strong positive effect on both threat and invasion probability. Our results support the notion that threat status and establishment success can be predicted using a combination of species traits and anthropogenic threats, but that not all variables will follow the two coins hypothesis.

177 - PAWS : RANDOMIZED PATROLS FOR WILDLIFE SECURITY

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Optimizing the use of limited security resources, e.g., patrols, is a critical concern in protected areas where organizations are focused on wildlife security. Limited security resources must be scheduled efficiently, simultaneously taking into account how actors engage in illegal activities in protected areas may respond to security coverage, and any past available data about previous patrols and adversary actions. This talk will present PAWS, Protection Assistant for Wildlife Security, a decision aid for security resource optimization that builds on our previous work. Specifically, to help in generating efficient and randomized patrols and security resource allocation more generally, we build on past research in “security games”. Security games is a novel area of research that is founded on computational and behavioral game theory and machine learning. Research in security games has allowed us to build decision-aids for a number of security agencies in the United

States. These decision aids have been deployed for security of ports and ferry traffic with the US coast guard (in the ports of New York, Boston, Los Angeles/Long Beach, Houston and others), deployed for security of airports and air traffic with the Federal Air Marshals (FAMS) and evaluated for assisting police in deployment against urban crime in the Los Angeles area. While building on this past work in security games, PAWS leads the way in “green security games”, focused on protection of forests, fish and wildlife. PAWS complements current tools available to security organizations such as MIST and SMART; it uses data collected by these tools in planning for the future using the predictive model it learns of adversary behavior. PAWS was earlier tested at various sites, e.g., Queen Elizabeth National Park in Uganda, providing us feedback on its efficiency. This presentation will discuss PAWS and the interdisciplinary research issues it raises.

15 POTENTIAL INTERACTIONS BETWEEN BIODIVERSITY-BASED ECOSYSTEM SERVICES SUPPORTING MAJOR EUROPEAN CROPPING SYSTEMS

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University of Padova

Riccardo BOMMARCO, Swedish University of Agricultural Sciences ; Lorenzo Marini, University of Padova

Yield formation is sustained and regulated by bundles of ecosystem services delivered by above- and belowground biodiversity. Ignoring potential interactions occurring between different ecosystem services may lead to unwanted tradeoffs and synergies, resulting in unexpected outcomes when turned into management practices. Although pollination is an important service to agriculture that has recently received great attention, it has been usually studied in isolation. Using several manipulative experiments, we studied potential interactions between soil services and pollination for two important European crops, oilseed rape and sunflower. In both crops, pollination benefits to yield formation were strongly influenced by soil services, although the response was crop-dependent. In sunflower, benefits to crop yield from insect pollination were observable only under good soil fertility conditions whereas they were canceled in highly deteriorated soils. In oilseed rape, decreased nitrogen inputs enhanced pollination benefits to yield, indicating that nitrogen use efficiency increased with optimal insect pollination. Hence, fertilizer applications can partly compensate degraded pollination service whereas optimal pollination can compensate for low nitrogen inputs. Management practices that aim to augment insect pollination should include not only measures to enhance pollinator abundance and diversity but also measures to improve soil fertility together with accurate application of inorganic fertilizers. Currently, economic evaluation of multiple ecosystem services is primarily based on land-cover mapping



assuming an additive effect of the different services. Expanding our knowledge about service interactions and making them explicit in the available predictive models will improve our ability to define sustainable management strategies both at the local and regional scale.

CONSERVATION TILLAGE MITIGATES THE NEGATIVE EFFECT OF LANDSCAPE SIMPLIFICATION ON BIOLOGICAL CONTROL

Giovanni Tamburini

University of Padova

Serena DE SIMONE, University of Udine ; Maurizia SIGURA, University of Udine ; Francesco BOSCUCCI, University of Udine ; Lorenzo MARINI, University of Padova

Pest biological control (BC) is a key ecosystem service and it depends on multiple factors acting from the local to the landscape scale. However, the effects of soil management on BC and its potential interaction with landscape are still poorly understood. In a field exclusion experiment, we explored the relative effect of tillage system (conservation vs. conventional tillage) on aphid BC in 15 pairs of winter cereal fields (barley and wheat) selected along a gradient of landscape complexity. We sampled the abundance of the main natural enemy guilds and we evaluated their relative contribution to aphid predation and parasitism. Conservation tillage was found to support more abundant predator communities and higher predation (16% higher than in the fields managed under conventional tillage). In particular, both the abundance and the predation of vegetation- and ground-dwelling arthropods were considerably increased under conservation tillage conditions. Conservation tillage also increased parasitism. High proportion of semi-natural habitats in the landscape enhanced both aphid parasitism and predation by vegetation-dwelling organisms but only in the fields managed under conventional tillage showing that the better local habitat quality provided by conservation tillage may compensate for a low-quality landscape. Our study stresses the importance of considering both soil management and landscape composition when planning strategies for maximize BC service in agro-ecosystems, highlighting the role played by conservation tillage in supporting natural enemy communities. The benefits obtained by introducing conservation tillage will, however, depend on landscape composition. In simple landscapes, the adoption of conservation tillage will locally improve the BC provided by both predators and parasitoids mitigating the negative effects of landscape simplification.

INSPIRING FUTURE GENERATIONS OF CONSERVATION LEADERS AND STEWARDS IN PRIMATE RANGE COUNTRIES

Chia Luen Tan

San Diego Zoo Institute for Conservation Research

Most nonhuman primate species are distributed in tropical and subtropical regions, and many countries in these regions, particularly Asia and Africa (Madagascar included), are densely populated by humans often living in impoverished conditions. As approximately 40% of nonhuman primate taxa in these geographic areas are threatened by human activities, we need more than hope to ensure a future for our closest relatives. Investing in in-country conservation talents and improving children's education are two important ways that can lead to meaningful, long-term conservation solutions. This presentation will feature two programs I created in Asia using a global partnership approach to cultivate range country conservation leaders and foster local conservation stewards. The Training in Primatology Series (TIPS) is a no-fee, professional development program with practical workshops and mentoring support tailored toward early career conservation practitioners for the purpose of elevating their core, leadership and professional competencies. The Little Green Guards (LGG) is an education program that fosters appreciation and understanding of wildlife in children, especially those living in and around critical habitats with threatened primate populations. As many TIPS alumni now serve as role models or "conservation heroes" for local children and lead in-country LGG initiatives, the synergistic effect created by these two programs cannot be overstated. Examples of both programs have been adopted in other geographic regions where primate species and habitat conservation are a top priority.

IMPROVING CAMERA TRAP PERFORMANCE ENHANCES LONG-TERM ECOLOGICAL STUDIES

Chia Luen Tan

San Diego Zoo Institute for Conservation Research
Rose Marie RANDRIANARISON, Groupe d'Etude et de Recherche sur les Primates de Madagascar ; Cristina GIACOMA, University of Turin ; John Andrew PHILLIPS, LVDI International

Scientific field studies aimed at remotely monitoring natural animal populations frequently employ camera trap technology. The reliability of data derived from such studies is often dependent upon continuous operation of commercially available trail cameras originally designed for short-term use by hunters. Limited battery life and camera malfunction caused by moisture accumulation inside the camera housing are common issues reported. To overcome these technical problems, we tested if simple, inexpensive modifications to a commercially available model would allow cameras to operate continuously and untended for periods of over 12 months, even in high humidity, low temperature environments. First, under controlled but variable conditions, we examined the



effects of ambient temperature on battery life and length of operation of cameras, as well as how moisture infiltrates the camera housing. We then devised solutions that eliminate moisture incursion in the camera housing, and designed an inexpensive subterranean external battery pack that increases battery performance by relying on the nominal annual fluctuations in ambient ground temperature. We subsequently tested 5 camera traps incorporating these modifications in a 12-month study in a rainforest in Madagascar. All cameras operated continuously throughout the study period with no degradation in image quality when powered by our specially designed external battery pack (LVDI-4F). Also, the external battery setup extended the lifespan of the cameras while simultaneously minimizing human disturbance at each camera trap location. Accordingly, our camera trap data have identified long-term ecological trends among potentially competing species, as well as captured glimpses of elusive species and rare predation events. Our technical improvements are applicable to most brands of camera traps and should lead to successful long-term, continuous research and monitoring of wildlife under varied field conditions.

REPRESENTATION OF THE PROTECTED AREA SYSTEMS IN THE INDO-BURMA HOTSPOT: INCREASING COMPLETENESS

Naruemon Tantipisanuh

KMUTT

Tommaso SAVINI, KMUTT; George GALE, KMUTT

The designation of protected areas in the past has been clearly biased toward specific habitat types, resulting in insufficient representation of several habitats and their associated species. This study identified gaps in current protected area systems of the Indo-Burma Hotspot, proposed additional areas which could be included in such systems to increase their overall representation, and identified high priority areas. Representations of habitat types and 199 threatened species were assessed using gap analysis. Areas which could be potentially added to improve the current protected area system were identified using MARXAN software, while high priority areas were selected based on irreplaceability and vulnerability. From the gap analysis, the representations of biodiversity in the Indo-Burma Hotspot were notably skewed for both habitats and species. To achieve the representation targets for all conservation features, 21% of the hotspot's entire land area would need to be included in a protected area system. Approximately two-third of the proposed additional areas were smaller than 10 sq.km., while most of the large (>1,000 sq.km.) proposed areas were located in Myanmar and Cambodia. Many of the suggested additional areas are located along the borders between multiple countries. Four of the five largest high priority areas are located in Thailand. In conclusion, protected areas in the Indo-Burma Hotspot can be significantly

improved by focusing on maintaining as well as restoring linkages between smaller patches to create and sustain larger protected area networks. As part of this, transboundary collaboration among countries within this hotspot will be particularly important.

BUILDING CAPACITY FOR BIODIVERSITY CONSERVATION IN UKRAINE: NETWORK AND TRAINING SUPPORT

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National University of Kyiv-Mohyla Academy

Natalia GUDKOVA, State Environmental Academy of Postgraduate Education and Management at the Ministry of Ecology; Natalia GOZAK, National University of Kyiv-Mohyla Academy

The project was implemented co-financed by MAVA FONDATION POUR LA NATURE and MATRA Programme Embassy of the Netherlands in cooperation with the Centre of Biodiversity and Conservation at the American Museum of Natural History in New York (09.2012 - 09.2014). The overall goal of the project was to assist Ukraine in fulfillment of its obligations under the Convention on Biodiversity, especially Articles 12 and 13 on setting educational programmes. The target group included students, conservation practitioners, managers and educators who represent both governmental and non-governmental sectors (protected areas, universities, NGOs, business and local authorities in charge of coordination of conservation activities). A core set of 24 modular educational resources on key topics in biodiversity conservation were developed, adapted, and disseminated among academic institutions (78 universities), protected areas (148 representatives), business companies (80 members of Global Compact), and local relevant authorities. A case study competition was held, and 3 Ukrainian case studies on biodiversity conservation were included into the educational modules as examples of good practices. As a result of project Ukrainian Network of Conservation Educators and Practitioners was established. As project activities were highly evaluated by Ministry of Ecology and Natural Resources in Ukraine, a training on biodiversity conservation will be conducted in the State Environmental Academy of Postgraduate Education and Management at the Ministry of Ecology. The course was also recommended by National University of Kyiv-Mohyla Academy, Department of Ecology for Master level.

ORAL PRESENTATION

Kanuma Nathan Taremwa

University of Rwanda



Thimmayiah RANGANATHAN, Gandhigram Rural University (GRU); Jean Lambert SEBAREZE, World Vision Rwanda

Protected Areas in Rwanda have continued to face serious problems and are at the risk of declining despite efforts made to conserve them. Currently, 79 percent of Rwanda's land is classified as agricultural; 11 percent of total land is permanent cropland, of which only 0.6 percent is irrigated. Six percent of the land is marshland, and about 20 percent of total land is classified as forests and only 8 percent of total land area is in PAs. Akagera National Park (ANP), one of the major Protected Areas in Rwanda is threatened by human pressure following the high demand for grazing together with conflicts between wildlife and agriculture. The objectives of the study were to: (i) to assess the impact of household behavior on the conservation of protected areas; (ii) to determine the nature and extent of the current relationship or dependence of the adjacent community to ANP. Data was collected from 66 households around ANP from the communities within 5 Km from the park boundaries. Research instruments applied in data collection mainly included questionnaire, interview schedules and Focus Group Discussions (FGDs). Descriptive statistics and logistic regression were run for data analysis. Findings indicated that the adjacent communities to ANP highly depend on park mainly through livestock grazing which consequently have a negative impact on conservation of biodiversity within the park. Impact has been observed through habitat alteration, erosion, disease transmission and wildlife extinction. Crop raiding, lack of compensation policy to crop damage and lack of effective law enforcement policy were the major challenges affecting the adjacent communities. Due to competing claims for resources from ANP, the conservation objectives and community livelihood improvement requires concerted efforts from various stakeholders in Rwanda. Market based mechanisms are very essential to mitigate the impact of community behavior on the national parks of Rwanda.

FIRE MANAGEMENT FOR CONSERVATION IN A MEGA-DIVERSE AND HIGHLY FLAMMABLE WORLD HERITAGE AREA: A COLLABORATIVE PARTNERSHIP BETWEEN SCIENTISTS AND LAND MANAGERS IN THE BLUE MOUNTAINS, AUSTRALIA

Elizabeth Tasker

Office of Environment & Heritage NSW

Kathryn HAMMILL, Office of Environment & Heritage NSW

The Greater Blue Mountains is a UNESCO-listed World Heritage Area of international conservation significance. More than a million hectares of native vegetation on the western fringes of Sydney, its wild and rugged landscapes are home to a high biodiversity with more than 400 species of vertebrate animals, 484 genera of plants, of which 114 species are endemic, including the very rare Wollemi Pine. It is also one

of the most flammable landscapes on earth. Fires occur every year, and once or twice per decade massive bushfires burn a large proportion of the region and can result in significant property losses. Climate change predictions suggest that the frequency and severity of fires may increase. The paradox is that a large proportion of the plants and ecosystems of the region need fire (e.g. more than 1,000 species depend on fire to break the dormancy of their seeds). Thus managers have a complex challenge. In this collaborative science-management project we have compiled a fire history of unprecedented spatial (1 million hectares) and temporal (40+ years) coverage. We have combined this with life history information for more than a thousand plant species, and with vegetation surveys, to better understand the patterns and causes of fire in the landscape, and the impacts on biodiversity. Over the past four decades more than 80% of the World Heritage Area has burnt, with up to 25% in a single year. While successive fires mostly burn different areas, we have identified a series of hotspots of conservation concern where repeated high intensity and/or too-frequent fires have occurred. Our floristic surveys in these areas suggest that the biggest effect of adverse fire regimes is on vegetation structure, with a surprising resilience of the floral diversity, even for many rainforest plants. The results are now being used in conservation and fire management planning of this iconic World Heritage Area.

EVIDENCE FOR THE DISTURBANCE OF BATS BY SMALL SCALE TURBINES IN THE UK

Cerian Tatchley

University of Stirling

Kirsty PARK, University of Stirling; Jeroen MINDERMAN, University of St Andrews

Wind power is an increasingly important method of electricity generation employed worldwide. While much of the focus in wind energy technology to date has been on wind farms, a relatively recent development is the expansion of the micro-wind sector (turbines generating < 50 kW), and there are now over 800,000 small wind turbines (SWTs) installed globally. There are a range of potential negative effects wind power can exert on wildlife and quantification of the potential wildlife impacts is necessary to inform planning guidance. Yet to date, there has been little research into the wildlife impacts of SWTs. We present the results of a field experiment investigating the impact of SWTs on bat activity with particular focus on the role of distance from known favoured bat foraging habitat (e.g. hedgerows, treelines). *Pipistrellus pygmaeus* activity declined near to operating turbines installed close to hedgerows (5m distance), while *Pipistrellus pipistrellus* activity declined only marginally after SWT installation, both at the turbine and at a control site 30m away. Activity of both species declined rapidly with distance from the hedgerow. This highlights the importance of installing SWTs away from linear habitat features



to reduce their disturbance impact on bats. These results will contribute to quantifying a minimum installation distance from linear habitat features needed to minimise any disturbance impact on bats.

INBREEDING DEPRESSION IN TRANSLOCATED POPULATIONS OF A RECOVERING RATITE: THE LITTLE SPOTTED KIWI (APTERYX OWENII)

Helen Ruth Taylor

Allan Wilson Centre, University of Otago
Nicola J NELSON, Allan Wilson Centre, Victoria University of Wellington ; Hugh A ROBERTSON, Department of Conservation ; Fred W ALLENDORF, University of Montana ; Kristina M RAMSTAD, Allan Wilson Centre, Victoria University of Wellington

Translocations are a necessary and popular conservation tool, but often involve populations being founded with small numbers of individuals. This creates population bottlenecks that can lead to a loss of genetic diversity relative to the source population, inbreeding, and inbreeding depression. However, few studies have investigated these effects in wild populations founded via translocation. We studied genetic erosion and inbreeding depression in New Zealand's little spotted kiwi (*Apteryx owenii*) (LSK), a species that experienced a bottleneck of, at most, five individuals ~100 years ago and has been managed solely via translocations ever since. Our work focused on two seemingly healthy (i.e., growing) translocated populations of LSK; one founded with 40 individuals and the other with just 2 birds, all from the same source population. Using a suite of 21 microsatellite markers developed for this species, we show that i) the 40 founder population has retained all the allelic diversity of the source population, but the population founded with 2 individuals exhibits severely reduced allelic diversity, (ii) both populations show continued erosion of heterozygosity over generations, indicating an on-going bottleneck in each site, (iii) the recorded growth in the population with 2 founders is mainly driven by first generation individuals (i.e., the offspring of the 2 founders) with only 26% of the population comprised of subsequent generation inbred individuals and (iv) this inbreeding depression particularly affects females. Our findings highlight the importance of selecting sufficient numbers of founders for translocations, the potential for on-going genetic erosion following bottlenecks and the impact that inbreeding depression can have on a population's demography. We also stress the need for genetic monitoring in order to avoid the failure of conservation translocations.

SEEDS OF DESTRUCTION? MEASURING SPERM HEALTH IN BIRD SPECIES WITH RECENT POPULATION BOTTLENECKS

Helen Ruth Taylor

Allan Wilson Centre, University of Otago
James V BRISKIE, University of Canterbury ; Neil J GEMMELL, Allan Wilson Centre, University of Otago

In the midst of the current extinction crisis, severe population bottlenecks have become increasingly common. These bottlenecks can lead to loss of genetic diversity, and increased inbreeding and inbreeding depression. Although the negative impacts of low genetic diversity and inbreeding are clear, the underlying mechanisms driving loss of fitness are not yet fully understood. One neglected area in which inbreeding depression often manifests is male reproductive fitness. Sperm quality (sperm count, motility and percentage of abnormal sperm) has been shown to be related to fertility in a variety of species and is known to be negatively associated with inbreeding. However sperm health (in particular motility) can be challenging to measure in wild populations. We are conducting the first ever assessment of bird sperm health in New Zealand, a country where the majority of native species have experienced recent population bottlenecks. We have developed a new "mobile lab" facility that can be taken to remote sites and used to assess bird sperm motility in situ, almost immediately on collection of semen samples. Here, we focus on the South Island robin (*Petroica australis australis*), which has experienced a number of translocation-induced bottlenecks in the past few decades. By comparing males from populations founded by translocation with those in the original source population, we are able to illustrate the negative effects of population bottlenecks on sperm motility and, thus, fertility. Inbred robins are known to exhibit higher nest failure than less inbred individuals and our sperm data suggests that at least some of these failures are due to infertility as a result of reduced genetic diversity and increased inbreeding. We will discuss the implications of this for species management (in particular conservation translocations) as well as explaining how the techniques implemented here could be extended to provide data for a wide range of bird species.

RAD-SEQUENCING AND SNP GENOTYPING TO EXAMINE ADAPTATION IN GLOBALLY INVASIVE PARAKEETS

James Taylor

DICE
Jim GROOMBRIDGE, DICE

The ringneck parakeet *Psittacula krameri*, native to the African and Indian continents, is now a globally introduced species with the current UK population now numbering over 30,000



birds. Evidence from the native range suggests that the species may become invasive in introduced regions, impacting upon native biodiversity and agriculture. The spread of invasive species is considered one of the greatest ecological and economical threats to our planet and the need to further understand how species adapt to and succeed in, their new environments is essential. European ringneck parakeet populations have conquered a substantial temperature gradient in expanding from their native range, adapting to environmental change and subsequently provide an ideal scientific framework to examine how species evolve in response to environmental change and to identify the potential genetic basis for such adaptability and invasion success. By identifying single nucleotide polymorphisms (SNP's) within ringneck parakeets and using these genetic markers to compare the level and type of genetic diversity between their native and introduced ranges we can potentially capture signatures of adaptation to the extremes of the climatic gradient across which the species has spread RAD sequencing is a reduced-representation technique, employing next generation DNA sequencing. The technique allows for comprehensive identification of genetic markers (RAD markers) across the genome for population analysis, without having to sequence the entire genome itself. This allows us to identify areas of the ringneck parakeet genome that may be responsible for the behavioural flexibility seen in the species that have resulted in successful adaptation. Such a framework may also be applicable to other species and represent a step forward in our understanding of how species may respond to future climate change.

ASSESSING THE QUALITY OF THE GREAT BARRIER REEF'S CURRENT PROTECTED AREAS IN TERMS OF CONNECTIVITY AND HABITAT QUALITY

Matthieu Taymans

Université Catholique de Louvain

Christopher THOMAS, Université Catholique de Louvain ; Jolan WOLTER, Université Catholique de Louvain ; Jérôme MALLEFET, Université Catholique de Louvain ; Alana GRECH, Macquarie University ; Emmanuel HANERT, Université Catholique de Louvain

Over the last 30 years, the Great Barrier Reef (GBR) has lost about half of its coral cover due to key ecosystem-level pressures such as industrial development in coastal areas, overfishing and climate change. In the past decades considerable efforts have progressively been made in order to improve the protection of this outstanding natural icon. Since 2003, the implementation of protection areas has become a primary management tool for biodiversity conservation as it regulates the activities allowed to take place in the GBR. Since then, a minimum of 20 percent of all 70 bioregions has been protected. Despite this amount of management efforts and

the benefits they provided, this ecosystem's health continues to decline. The rate of exchange of larvae, or connectivity, among populations affects the ecosystem's ability to recover after disturbance events. The presence of marine protected areas (MPA) and their ability to provide other reefs with larvae for recovery could play a big role in enhancing the resilience of the whole ecosystem. Our study exploits the numerical hydrodynamic SLIM model (Second-generation Louvain-la-Neuve Ice-Ocean Model) to assess the role of existing MPA's in the resilience they confer to other areas through the transfer of larvae. The simulation of coral and fish larvae dispersion allows us to observe the strength of the connections between reefs and to identify key reefs in the network the GBR forms. Studying the habitat characteristics of such reefs through GIS analysis of environmental data enables us to better understand what makes a reef particularly important. Assessing whether or not the current protected areas contain such reefs and analysing the way reefs in those areas are connected to other reefs help us apprehend the pertinence of the current MPA's. The results of our analysis could be used in order to assess the quality of the current MPA network and to point out its drawbacks, hence enabling the managing sphere to improve it.

SUSTAINABLE MANAGEMENT OF LOVOA TRICHILIOIDES HARMS: PHENOLOGY AND NATURAL REGENERATION IN NATURAL FOREST AND PLANTATION.

Felenou I Tchinnmegni

Higher Institute of Environmental Science

Alain Calice Tsobeng, World Agroforestry Centre ; Eddy Ngonkeu, University of Yaoundé I ; Zacharie Tchoundjeu, World Agroforestry Centre

A study on phenology and natural regeneration of *Lovoa trichilioides* had been conducted in the Kienké-Sud Reserve and Deng-Deng Rserve. Our study was also conducted in the following Forest Management Unit: 10 021 (GVI) and 10 01-2-3-4 (CFC). The specific objectives were firstly to describe the actual state of the forest plantations, secondly to characterise the phenology of *L. trichilioides* and thirdly to evaluate the natural regeneration of this species. Two sets of data were used; Primary and secondary data. The data analysis has led to the following results. The forest plantations were created in the 70s following the regrowth and line planting method. These forest plantations hadn't undergone any silvicultural treatments for at least ten years. Human activities in these forests plantations are noticeable. The flowering occurs between April and May followed by fruit bearing. The maturity of occurs by the end of the year (November to December) followed by seed dissemination. The dimensions of the lives before flowering are approximately the double of the dimension after flowering (9.6 x 4.8 cm against 4.8 x 2.2 cm) The density of seedlings per hectare varies from 12310 to 20461 in forest plantation



according to the stand density. This density varies from 1014 to 47083 seedlings per hectare in natural forest according to the degree of forest perturbation. *L. trichilioides* requires more light to perform its growth and its development; it can't tolerate the competition for light at the early stage. Due to this reason, young trees are very scarce and even absent in forest plantation and natural forest. Its natural regeneration is negligible and even inexistent because only less than 1% of seedlings emerges and become a big tree. *L. trichilioides* is a semigregarious species which dissemination can't exceed a distance of 40 meters from the seed tree.

99-ONE SIZE DOES NOT FIT ALL: CASE STUDIES IN USING VALUES FRAMING FOR CONNECTING FAMILIES TO NATURE

Tara Teel

Colorado State University
Michael MANFREDO, Colorado State University; Brett BRUYERE, Colorado State University; Rebecca THOMAS, Colorado State University

Societal changes occurring as a result of modernization are tied to a decrease in direct day-to-day interaction with nature which in turn has implications for human health and future commitment to natural resource stewardship. While conservation agencies and organizations increasingly embrace the need to address this phenomenon by connecting people with nature through educational initiatives, programs are often focused on traditional constituents and/or those already engaged in nature-based activities. Recent research on human values toward wildlife in the United States provides a framework for thinking about ways to improve these initiatives in the face of changing societal conditions. Findings highlight the need for tailored approaches that readily attend to the diversity of values in contemporary society, advancing the notion that individuals are more inclined to participate in programs consistent with their pre-existing value set. Building from this prior work, the purpose of our study was to develop, implement, and evaluate pilot programs for connecting families to nature that account for the wildlife values of the public in six locations throughout the U.S.: Spearfish, South Dakota; Ka'u, Hawaii; Helena, Montana; Raleigh, North Carolina; New York, New York; and Lincoln, Nebraska. Program development was informed by qualitative (e.g., focus groups) and quantitative (e.g., surveys) research assessments of value orientations toward wildlife and nature, barriers to program participation, and preferences for program formats and content. Lessons learned from this study offer guidance for conservation practitioners wanting to expand the reach and effectiveness of their educational efforts to connect people with the natural environment and garner broad-based support for conservation initiatives in the future.

BUSY OCEAN: DOES ANTHROPOGENIC ACTIVITIES AT SEA AFFECT CETACEAN SPATIAL DISTRIBUTION? A CASE STUDY IN MALTA

Ana Tejedor

Kai Marine Services
Bruno CLARO, Kai Marine Services; Ricardo SAGARMINAGA, Kai Marine Services; Natacha AGUILAR, BIOECOMAC - University of La Laguna; Salvador SÁNCHEZ, BIOECOMAC - University of La Laguna; Lorenzo BRAMANTI, LECOB - Observatoire Océanologique de Banyuls; Sylvia FREY, OceanCare

The information about the spatial interactions between anthropogenic activities and top-predators, such as cetaceans, is fundamental for reducing conflicts between direct users of marine and coastal resources. The mapping of such information is an essential tool that facilitates decision-making for ecosystem-based management. Due to its small scale, the Maltese waters provide a unique opportunity to study this issue at a national level. Data from two research campaigns of LIFE+ Migrate project (2013-2014) was used to perform a geographic descriptive analysis of cetaceans and human activities. The study area was divided into a 10 km resolution grid, and a probability of occurrence was calculated for the presence of cetaceans and each of the selected human activities. Three anthropogenic activities were selected, involving cargo ships, sport motorboats and FADs (Fishing Aggregating Devices). Percent volume contours of 95% and 50% were used to spatially represent the probability density distribution for cetaceans in the area. Results suggested an inverse relationship between abundance of cetaceans and the presence of cargos and sport motorboats. This work presents key data for a successful marine spatial planning in Maltese waters that contribute to cetacean conservation.

INNOVATIVE INSTRUMENTS FOR MANAGING AND CONSERVING URBAN ECOLOGY - SELECT CASE FROM INDIA

Surayya Teki

Adikavi nannaya university

Sustainable urban ecological development warrants Greening cities (surroundings). This drive can be materialized at two levels viz. 1) organizational / institutional level and 2) Individual households. That requires financial outlays. Apart from traditional exchequer budget allocations, innovative financial instruments to raise funds includes levying cess on building plan approval tax by local administrative bodies (municipal corporation and Municipalities), provisioning in Corporate Social Responsibility (CSR) and Individual Social (S. Teki-2011) Responsibility (ISR), Public, Private and People Participation (PPPPs) and soft loans to individual households etc. Urban



agriculture, including growing fruits, vegetables, cereals, pulses, flowers, corn etc., on roof / window tops, on balconies. This would render multi benefits viz. a) supply of fresh and pure food stuffs and flowers, b) financial gains, empirical evidence shows, with about Rs. 12,000 capital expenditure and about Rs. 8000, revenue / maintenance expenditure (per annum) one can get 5 to 6 times returns, c) contributes for sustainable city development and d) managing climate change.

SMART FIRE MONITORING

William Temperley

Joint Research Centre of the European Commission
Ilaria PALUMBO, Joint Research Centre of the European Commission ; Raj AMIN, ZSL ; Steven PEEDELL, Joint Research Centre of the European Commission

Within tropical ecosystems, fire is a widespread natural phenomenon as well as a result of human activities, such as land clearance for agriculture. Poachers notoriously use fire to clear vegetation to control movement of wild animals and increase their visibility. Information on fire occurrence is therefore essential to track and identify human induced threats and pressures and quickly react to them. A standardized law enforcement and ecological monitoring and reporting tool, called SMART, has been developed by a partnership of conservation institutions for strategic management of conservation areas. In this context we are developing a Fire Monitoring plugin for SMART which will provide access to satellite data of fire occurrence. Fire occurrence can be tracked in near-real time using publicly available NASA-FIRMS fire products derived from the MODIS sensor. Although these data are freely available, significant technical barriers prevent their usage where they are needed most, such as in protected areas. Our aim is to ensure conservation practitioners can access this information in the simplest and most timely manner possible. A plugin has been developed which retrieves MODIS fire information and integrates this into the SMART data model, thereby providing query and reporting tools built into SMART direct access to fire occurrence and burned area data. The near real-time nature of the fire information, combined with field derived intelligence provides opportunities for active management. Historical fire information (from 2002 onwards) can also be retrieved, which can be used to define the status of the habitat and identify trends and anomalies. We plan to extend this plugin into an operational product in partnership with managers of protected areas that are significantly affected by fire. Future developments may include using fire data within a threat-alert system in combination with land cover, species and field derived information.

124-THE MITIGATION HIERARCHY, NO NET LOSS AND BIODIVERSITY OFFSETS: WHERE HAVE WE REACHED?

Kerry Ten Kate

Forest Trends

In the past decade, and particularly since 2012, the attention of governments, companies, banks and civil society organisations has focussed on improving the application of the mitigation hierarchy: taking steps to avoid and minimise impacts on biodiversity, to undertake restoration and finally to offset residual impacts with a view to achieving no net loss or a net gain of biodiversity. This paper will take stock of recent development and the challenges that remain in defining best practice, embedding it in government, corporate and financial policy, and building the capacity to ensure it is applied in practice in projects on the ground. It will explore whether there is the political and corporate will to do a good job, the extent to which there is agreement on the standards and methods to apply, whether we are making sufficient progress on the underlying science, and what should be the next steps for the community of conservation biologists and those with whom they work.

TOWARDS A REGIONAL STRATEGY ON INVASIVE PLANTS SPECIES (PROVENCE-ALPES-CÔTE D'AZUR, FRANCE)

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Conservatoire botanique national méditerranéen de Porquerolles

Katia DIADEMA, Conservatoire botanique national méditerranéen de Porquerolles ; Noémie FORT, Conservatoire botanique national alpin ; Virgile NOBLE, Conservatoire botanique national méditerranéen de Porquerolles

The french national strategy for biodiversity 2011–2020 identified invasive species as one of the main threats to biodiversity. Thus, one aim is to provide practical measures in order to prevent and to control invasive species. In this context, both environmental and administrative organizations of the Provence-Alpes-Côte d'Azur (PACA) region initiated a regional strategy to associate all stakeholders concerned by invasive species (environnement, agriculture, horticulture, forestry and urban planning professionals sectors). Here we present main steps to elaborate this regional strategy which is planned over two years (2013-2014). Local context, regional issues and stakeholders' expectations will be considered into this regional strategy, with guidelines of the national strategy for biodiversity 2010-2020. Lists of invasive or potentially invasive species in PACA have been elaborated at different scales (administrative and biogeographical scales). Those



lists are intended to be used for the management of natural areas. A regional survey of different professional sector (environment, agriculture, horticulture, forestry) has also been carried out to identify: (i) all stakeholders in the project area, (ii) their perception of invasive species, (iii) their expectations and (iv) the elaboration of a regional assessment of actions concerning invasive species. A Technical Committee composed of professional representatives is set up to give an advisory opinion on methodological and technical guidelines for the project. Three territorial workshops will be held in 2014. Further expectations, local specificities, aims and actions of the strategy, the level of involvement of each stakeholder, opportunities for collaboration and funding possibilities will be listed during these workshops to formulate a regional strategy and an actions plan.

THE GREAT INDIAN CONSERVATION DEBATE: CONTEXTUALIZING POVERTY

Sneha Thapliyal

Indian Institute of Management

It is typically argued that the flows from economically significant ecosystem services of Protected Areas (PAs) are greater than the cost of conservation borne by the population living proximal to these areas. However, there is a significant overlap between global biodiversity hot spots (and hence PAs) and the incidence of poverty. Restricted access to natural resources further compromises livelihood practises and may even lead to poverty traps in a region. Yet, there is a lack of rigorous empirical evidence on the net impact of PAs on the economic well-being within a region. Inference on this causal impact has significant bearings on conservation policies, especially for the developing nations rich in biodiversity but poor in public welfare outcomes. India, with 4% of its geographical area under PA network and over 60% of the rural population directly dependent on forests, exemplifies this conservation debate. Focussing on IUCN type I and II terrestrial PAs in India, the objective of this paper is to assess if PAs exacerbate or alleviate poverty. We compare the performance on poverty outcomes over the last two decades for districts with PAs and their counterfactuals – districts that are nearly identical to the ones with PAs on a host of other attributes but do not have PAs – using the quasi-experimental method of propensity scores matching. We use the quinquennial large-scale nationally representative household-level data on consumption expenditure to estimate poverty for five points in time between 1990 and 2012. For these years, we map the common attributes of districts (covariates) including a host of environmental characteristics assimilated from various national reports and GIS data. Preliminary results indicate that districts with PAs have indeed fared better in poverty reduction. We

posit that this positive effect of conservation is driven largely by tourism-related revenue.

HOW CONNECTED WILL TIGER POPULATIONS BE IN THE FUTURE?

Prachi Thatte

National Center for Biological Sciences

Aditya JOSHI, Wildlife Conservation Trust ; Srinivas

VAIDYANATHAN, Foundation for Ecological Research, Advocacy and Learning ; Uma RAMAKRISHNAN, National Center for Biological Sciences

Harboring more than 60% of the world's wild tigers, India is a stronghold for their conservation. However, tiger habitat in India is getting increasingly fragmented with growing population and anthropogenic development. Tigers are restricted to protected areas and forest fragments embedded in a matrix of multiple landuse types. While conservation efforts focused inside protected areas have led to an increase in tiger numbers over the last few years, the status of tigers outside protected areas is not known. Habitats outside protected areas may act as stepping-stones for maintaining connectivity between protected areas. Recent research suggests that just increasing the number of tigers is inadequate and maintenance of connectivity between populations is critical to sustain genetic variability. We examined connectivity among tiger populations (110 samples, 14 microsatellites) in Central India, one of the six landscape complexes considered important for tiger conservation in India, using scat samples collected from within and outside protected areas. Our results suggest that currently tiger populations have varying levels of connectivity. However, maintaining connectivity in the face of increasing development may be a challenge in the future and presence of tigers outside protected areas may be critical. We carried out simulations to investigate how connectivity may change in the next 100 years under different landscape change and development scenarios with and without the presence of tigers outside protected areas. Preliminary results suggest that connectivity between populations will decrease with high risk of local extinction in some small and/ or isolated populations; this would happen faster in the absence of individuals outside protected areas. Our results can be used to prioritize conservation efforts in sensitive areas and stress the importance of a landscape approach to conservation, shifting the current focus from conservation inside protected areas.

A COLLABORATIVE SCIENCE PLATFORM FOR SEAMLESS LAND USE AND LAND COVER DATA TO INFORM CONSERVATION: THE GLOBAL LAND USE EMERGENT (GLUE) PROJECT

David Theobald

Conservation Science Partners



Dylan HARRISON-ATLAS, *Graduate Degree Program in Ecology, Colorado State University*; Nicole SHAW, *Conservation Science Partners*; Luke ZACHMANN, *Conservation Science Partners*; Brett DICKSON, *Conservation Science Partners*

Central to understanding current patterns of biodiversity, validating models of threats and effects, monitoring habitat change, leveraging past and future data collection efforts, and collaborating across agencies, ownership, and political boundaries is some representation of land use and land cover. We have worked with a variety of conservation partners to construct a platform to collect and share data on detailed land use and land cover, generated through interpretation of high-resolution areal photography. This provides an efficient means to collect data at a fine resolution, for current and historical landscapes, and to leverage expert and local knowledge. We find these “glue” data especially important because they: (a) provide a means to link detailed understanding of land use drivers to the vast collections of remotely-sensed imagery and other landscape data; and (b) connect with interested agencies, groups, and even individuals (citizen science). We will demonstrate how we leverage the Google Earth platform to provide a means to visualize and input data in careful, coordinate, and consistent way. A flexible, comprehensive, multi-scale random-based design provides a probability-based sampling framework necessary for rigorous design-based estimates, while additional opportunistic points are also supported for modeling purposes. We will describe two transboundary examples of the application of GLUE data to generate: (1) US-Mexico land cover and land use dataset for the Madrean archipelago ecoregion; and (2) a flexible, freshwater sampling design for the US and Canada.

SOCIAL-ECOLOGICAL TRAJECTORIES OF PROTECTED AREAS: LESSONS LEARNT FROM THE FRENCH NATURE RESERVES NETWORK

Clara Therville
CNRS

Raphaël MATHEVET, CNRS; Frédéric BIORET, Institut de Géoarchitecture, Université de Bretagne Occidentale

At the global scale, protected areas (PAs) are one of the main tools used for nature conservation. However, the ongoing biodiversity loss and the lack of social acceptance of PAs question their ability to enable long-term biodiversity conservation. As a consequence, since the 1980s, conservation scientists and practitioners have switched from segregative to integrative models of PAs, by opening up their objectives, governance systems and consideration of surrounding landscapes. Within this paradigmatic evolution, PAs are more and more considered as open social-ecological systems (SESs), strongly interconnected with their surrounding landscapes. This evolution is associated with new challenges for

conservationists. How to manage these complex and uncertain SESs? How to characterize and pilot their trajectories to support long-term conservation projects? In the present contribution, we propose a framework for analyzing the trajectories of PAs. As case studies, we focus on French Nature Reserves (NRs), one of the main regulatory tools of the French nature conservation policy. We identify the trajectories of NRs within their social-ecological landscape according to their degree of openness: to the surrounding landscape (spatial), of their management objectives (sectoral), and in their governance systems (institutional). Making use of three related attributes of SESs’ dynamics (resilience, adaptation, transformation), we analyze how NR managers cope with changes in SESs, anticipate their future trajectories and avoid undesirable states. We identify key variables in the implementation of collective action and adaptive management of SESs. We show the values and limits of considering PAs and their surrounding landscapes as a single complex and adaptive SES. By simultaneously integrating their spatial, sectoral and institutional trajectories, our framework is a powerful tool for exploring opportunities and constraints for action and for long-term conservation.

159. TRANSLOCATIONS IN EUROPE, WHAT KIND OF WILDNESS DO WE RESTORE ?

Charles Thévenin

Université de Grenoble

Alexandre ROBERT, Museum National d’Histoire Naturelle; Christian KERBIRIOU, Univ. Pierre et Marie Curie; Sakina HASNAOUI, Univ. Pierre et Marie Curie; François SARRAZIN, Univ. Pierre et Marie Curie

Over the last decades a strong debate about the relevance of population and species-centered approaches versus community, or ecosystem conservation has emerged. In that context translocation programs are often criticized for being costly and strongly biased toward charismatic species. The actual efficiency of these programs is also difficult to analyse due to the heterogeneity of success criteria implemented for each of them. However, the aim of conservation translocations should be to restore the long term viability of populations. Ultimately it should contribute to recover elements of wildness through the restoration of evolutionary trajectories and spontaneous dynamics of genes and phenotypic traits exhibited by the focal species and populations that may contribute to shape community and ecosystem dynamics as well as evolutionary trajectories of resident organisms in the target habitat of translocations. Thus, the choice of the focal species, the efficiency of their translocations, and the ecological and evolutionary consequences of these translocations may depend on these life history and functional traits. In this study we focused on more than 340 animal translocation programs (mostly mammals and birds) that occurred in Europe over the last 150 years. For both groups we compared the taxonomic



distributions of translocated vs non translocated species and the distribution of life history traits and functional traits to identify potential biases among translocated populations. These biases were discussed accounting for the potential link between these traits and the local extinction risks that enhance the potential for reintroduction. All these analyses were placed in the framework of the IUCN regional red list criteria to consider the past and present conservation status of the focal species at various scales as well as the conservation efficiency of the translocations.

TOWARD A BETTER ASSESSMENT OF INVASIVE RODENT IMPACTS ON ISLAND ENDEMIC REPTILES. A PILOT STUDY IN TOWARD A BETTER ASSESSMENT OF INVASIVE RODENT IMPACTS ON ISLAND ENDEMIC REPTILES. A PILOT STUDY IN NEW CALEDONIA

Martin Thibault

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Among insular vertebrates, reptiles are one of the most threatened taxa which face high pressures from exotic introduced species and human-induced habitat disturbances. However, the magnitude of the impact of invasive species particularly rodents on small reptiles remains poorly investigated, because of the persistent lack of tools to accurately identified reptile chewed fragments in gut content. New Caledonia archipelago (South Pacific) hosts an exceptional terrestrial reptile fauna (105 species, 91.6% endemic) dealing with several invasive species (rodents, cats, ants) and strong human pressures. Our study aimed at evaluating endemic skinks predation by introduced rodents in mining areas. Four rodent trapping sessions were implemented in two mining sites and for two distinct habitats (dense forest and open habitat). 284 rats were trapped from two species: the black rat *Rattus rattus*, and the Pacific rat *R. exulans*. Rodent diet analysis was focused on skink predation by developing a new identification tool based on skink scales morphology. Combined analysis of stomach and caecum contents provided much more information than usual stomach analysis only. Moreover our new identification tool allowed us to determine 91% of preyed skinks at the species level. 15.9% of rat samples

included skink remains for at least 12 different skink species. 5 of them were classified as threatened by IUCN among which the most endangered were *Marmorosphax taom* (CR) and *Kanaky viviparus* (EN). This pilot study provides new insights in the assessment of invasive rodent impacts. It improves our understanding of the respective impacts on native skinks of two sympatric invasive rodent species. We think that generalization of our identification key to other reptile communities and in other habitats, combined with the use of the method we suggest here for specific diet studies will enhance future researches dedicated to the conservation of island endemic reptiles.

73. CONNECTIVITY MEASUREMENT AS A USEFUL TOOL FOR THE SPATIAL MANAGEMENT OF MARINE RESOURCES: THE CASE OF THE GREAT SCALLOP PECTEN MAXIMUS IN THE ENGLISH CHANNEL

Eric Thiebaut

Université Pierre & Marie Curie
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For species with a complex life cycle like the great scallop *Pecten maximus*, which forms the most important fishery in landings in the English Channel, the knowledge of larval dispersal and population connectivity is an essential prerequisite for defining effective strategies of spatial fishery management (e.g. delineation of management units). Faced with the difficulty of quantifying dispersal and connectivity among benthic populations from field observations, a high-resolution Lagrangian biophysical model of scallop dispersal was developed. It included a variable planktonic larval duration related to water temperature and a vertical larval behaviour. Eighteen different scallop beds have been identified from different sources including ICES data and VMS data. For each stock, larval dispersal pathways were calculated for two spawning events per year between 2000 and 2009 to assess the intra- and inter-annual variability of dispersal and connectivity. Results highlight a large variability among stocks in the hydrodynamic processes which govern larval transport (tidal currents vs. wind-induced currents). On the other hand, the larval retention rate and the self-recruitment rates, two metrics commonly reported in studies on local populations' persistence, are highly variable among populations, ranging from about 1 to 35 %; and 5 to 95 % respectively. Although self-recruitment plays a major role for some stocks, the maintenance of other stocks is highly dependent of external larval supply. Using a graph theoretic approach based on the adaptation of community structure algorithms, three major management units which act as metapopulation have been identified: the eastern Channel, the Gulf of Saint-Malo, the SW of England. Complex patterns of exchanges are reported



within each metapopulation with local populations acting as source or sink. The biophysical model can be also a useful tool to determine the efficiency of MPA implementation or juvenile seeding.

PREDICTING GROWTH TRAJECTORIES WITH FUNCTIONAL TRAITS FOR MULTIPLE PLANT SPECIES IN FIRE-PRONE COMMUNITIES.

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The University of Melbourne

Peter VESK, The University of Melbourne

Data required for optimal fire management of multiple plant species are quantitative information on 'vital rates' and 'life history characteristics', which specifically relate to growth, reproduction and survival. Our research aims to investigate the application of using plant functional traits to generalize patterns of plant growth and reproduction. Including functional traits into models of demographic rates is useful in producing predictions of growth trajectories based on trait information. Data on functional traits can be generalised across species that share similar traits and is easier to gather for many species compared to species-specific demographic data and using hierarchical multi-species models also allows for the growth of unknown or rare species to be estimated. Using height and trait data collected for multiple species along a chronosequence of time-since-fire sites in a region of semi-arid South-Eastern Australia, we built a hierarchical multi-species model of plant growth with parameters that vary by species. Functional traits (wood density, specific leaf area, seed mass and nitrogen content of leaves) are included into this multi-species model as species-specific linear predictors of the model parameters. This approach reveals not just plant growth through time for individual species, but also how functional traits contribute to intraspecific species variation. These results will be discussed in relation to the practical application of generalising growth patterns and designating tolerable fire intervals for multiple plant species.

SOCIAL DIMENSIONS OF CONSERVATION: AN ORGANISATIONAL PERSPECTIVE

Sarah Thomas

Zoological Society of London

I argue in this paper that one of the most important dimensions of biodiversity conservation is the individuals and organisations that undertake this conservation work. There has been a distinct growth of awareness by the conservation community of the importance of the social sciences as a critical component of conservation success. However, this awareness is not necessarily matched by the conservation workforce's knowledge of, attitude towards and efficacy in these social

dimensions of conservation. Many conservationists received their formal training in the natural sciences, yet increasingly find themselves out of their 'disciplinary comfort zones' with the requirement to include social and human elements in their projects and programmes. This paper reports on a study addressing this issue through an organisational perspective, in which the perceptions of the social dimensions of conservation at one UK based NGO were researched. Using a mixed method empirical study, it aimed to uncover sociological themes around the workforce's practices, both within their organisation and on their conservation projects in the field. Secondly, it aimed to gain a sense of how the organisation prioritises, constructs, delivers and evaluates the social elements of their conservation projects. Finally through a co-constructed approach, it aimed to develop an implementation framework for the organisation which included training priorities, strategic direction and operational plans to meet the needs of their growing portfolio of interdisciplinary conservation projects and programmes. The paper presents some of the key findings of this study. These include: 1) Themes around the sociology of conservation practice, 2) The typologies of social and human aspects included in the organisation's conservation projects and 3) The strategic and operational recommendations for change within the organisation as a result of this study.

PRESIDIO OF SAN FRANCISCO CONSERVES AND ENHANCES BIOLOGICAL DIVERSITY OF TERRESTRIAL AND AQUATIC HABITATS THROUGH RESTORATION AND PUBLIC PARTICIPATION

Terri Thomas

Presidio Trust

The Presidio of San Francisco is a 1492 acre national park site on the south side of the Golden Gate Bridge in San Francisco, California. The 13 native plant communities survive on 6 geologic formations and water features include bay, marsh, creeks, ponds and fresh water lake. Recent species inventories identify 17 mammals, 8 reptiles and amphibians, 60 bees, 12 dragonflies and damselflies, 84 spiders, 38 ground beetles and 366 birds inhabit the Presidio. An Army Base for 220 years, its natural resources were built upon, fragmented, and landscaped. Its water features were filled and put in pipes. In the 1990s efforts began to restore endangered and rare species, native plant communities, water features, and enhance native biodiversity. The native plant genetic diversity is preserved through seed collection and native plant propagation on site. A variety of approaches, policies, communication, education and political tools have joined researchers, educators and land manager partnerships to provide San Francisco citizens the opportunity help re-create natural biodiversity. A state-of-the-art database is used to track success of the monitoring results of plants, birds, and



water quality. A discussion of opportunities and constraints of projects and how they were approached; monitoring results and biodiversity impacts; challenges and the learning for adaptive management. Through volunteer involvement, an internship program, and formal and informal education programs, the complexity of ecosystems and the values of individual species and ecological services are passed on in an intimate and personal hands-on approach. Citizen Science, Community Volunteers, and curriculum-based education enables public support that connects local ecosystems to the world. As the Presidio becomes more of a destination for international travel, these systems will be able to interpret the value of restoration to audiences throughout the world.

THE ROLE OF DEPTH IN DIVERSITY INDICES AND MARINE PROTECTED AREA RESILIENCE

Kelly Marie Thomasson
UC, Santa Barbara

Marine Protected Areas (MPAs) function both to protect the species and ecosystems of interest as well as to act as source populations for neighboring environments that face a high rate of exploitation and degradation. Some of these MPAs, caught in the crossfires of conflicting stakeholder opinions, are used in a manner that is suboptimal to the goals of habitat conservation. Many times, MPAs exhibit dangerously high rates of usage when they are established in areas where ecotourism acts a primary revenue source. Despite their potential to be used at a higher rate, Maui MPAs differ greatly in their percent coral cover, their species richness and their Shannon Diversity Indices. These MPA biodiversity indices, relative to those of unprotected sites, change not only as a factor of tourism and recreation, but also based on depth range. Given these factors, conservationists and policy makers are lead to ask: "Does depth play a role in the robustness and the resilience of an MPA differently than it does in a marine area with no protection status?" Using a series of photographic quadrat surveys, an analysis of three biodiversity indices was performed with respect to depth ranges on six protected and unprotected marine regions in Maui country. These quadrats were then quantified for the three biodiversity metrics: percent coral cover, species richness and Shannon Diversity Index. Special consideration was paid to the interaction values resulting from a multivariate analysis of variance (MANOVA) and the significance of depth in each category was analyzed for changes in robustness at two depths in protected and unprotected, biogeographically similar regions. Understanding that MPA design is of paramount importance to that MPA's success, these analyses may help to influence future decisions regarding MPA boundaries and the inclusion of depth meta-habitats.

82-LANDSCAPE PLANNING TO ALLOCATE RESOURCES AMONG FOREST RESTORATION, REHABILITATION AND PROTECTION.

Jim Thomson

Arthur Rylah Institute for Environmental Research

Maintaining and restoring critical ecosystem processes and ensuring the persistence of native biodiversity in human modified landscapes will require a combination of habitat protection, restoration and rehabilitation. But how should limited resources be allocated to these different conservation activities to achieve the best ecological outcomes at regional scales, while minimizing economic and social costs? Here we address the problem of strategic landscape planning in multiple-use mosaic landscapes of the eastern Amazon. We explore trade-offs among protecting relatively undisturbed primary forest, avoiding degradation and restoring degraded primary forest, and rehabilitating forest through passive reforestation and protection of secondary forests. Extensive survey data on bird, invertebrate and tree biodiversity were linked with remote sensing data to model species distributions and biodiversity patterns in a range of land-use types and forest conditions. Validated models were used to map habitat values across two municipalities in the eastern Amazon under current and possible future management scenarios. The resulting maps were used to explore trade-offs among management actions and to identify priority areas for habitat protection, rehabilitation and restoration, using conservation planning software Zonation. These prioritization analyses identified the most cost-effective balance and spatial configuration of forest protection, restoration and rehabilitation, while accounting for connectivity requirements, relative costs, risks of fire and logging, forest code regulations, and uncertainty in species distributions and other inputs. Systemic planning of management options at regional scales can substantially improve expected biodiversity outcomes while minimizing costs and risks, and provide valuable information for regulators, conservation practitioners and landowners in this biologically unique region.

EFFECTS OF SEABIRD ECOSYSTEM ENGINEERING ON INVERTEBRATE FOOD WEB STRUCTURE.

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Seabirds are the archetypal ecosystem engineer, while nesting on islands they transfer nutrients from the sea and disturb the soil through burrowing. However, seabirds are in decline worldwide and so too are the ecosystems they create. Research on these ecosystems is extensive, but little is known about the



effects of seabirds on ecological network dynamics. Eighteen leaf-litter invertebrate ecological networks were constructed across nine seabird and nine non-seabird islands in order to determine how seabirds act to structure these networks. Ten environmental variables associated with seabirds and nine network structural metrics were compared against island type (i.e. seabird vs. non-seabird islands) using Student's t-tests. Principal component analyses, Akaike Information Criterion (AIC) algorithms and linear models were carried out to determine the predominant seabird effect driving the observed changes in network metrics. We found that seabird islands demonstrated significant changes in most environmental variables and all measured network structural metrics, with these islands demonstrating significantly greater network complexity and size. The linear models demonstrated that the predominant driving variables of these changes involved nutrient subsidies and to a lesser extent, habitat area. We concluded that as seabirds return to newly restored (i.e. pest eradicated) islands we can expect the invertebrate ecological networks to become successively larger and more complex over time. This complexity may then serve to increase the efficiency of invertebrate network functionality, the predominant function being nutrient cycling.

SCRATCHING OF SPRUCE BARK ENABLES PEST CONTROL BUT MITIGATES COLLATERAL DAMAGE TO BIODIVERSITY - IMPLICATIONS FOR PROTECTED AREA MANAGEMENT FROM EXPERIMENTAL WINDTHROWS

Simon Thorn

Bavarian Forest National Park

The amount of forest area affected by stand-replacing natural disturbances such as fire, windthrows or bark-beetle outbreaks has increased over recent decades and is expected to increase further. Recently, the past practice of removing the resulting dead or injured trees to restore economical values and to avoid outbreaks of pest species (i.e. post-disturbance or salvage logging) has increasingly become controversial. Hence, protected area managers are increasingly challenged to balance between benign neglect strategies to sustain natural dynamics on the one hand and political constraints to avoid outbreaks of pest species on the other hand; particularly in disturbance-prone conifer dominated forests. To avoid infestations of European spruce bark beetles (*Ips typographus*) but simultaneously retain tree biomass, managers of protected areas debark spruce trees, weakened by natural disturbances. We investigated three different types of mechanical bark treatments (complete debarking, bark scratching and control) applied to 12 small, artificial windthrows in the Bavarian forest National Park. Based on 30,000 individuals of saproxylic beetles

trapped by stem-emergence traps we demonstrate, that a complete debarking of wind-felled trees lead to a significant decrease in species richness of saproxylic beetles. Furthermore debarking caused significant changes in species communities. In contrast, bark scratching did not lead to significant losses of species richness or community changes but reduced the number of *I. typographus* individuals to 10% of the control value. In the light of increasing natural disturbances, we recommend bark scratching as an appropriate tool to prevent pest species outbreaks in wind-felled coniferous forests but likewise retain saproxylic biodiversity.

ERADICATION OF INTRODUCED BROOK TROUT AND RECOVERY OF ALPINE LAKES IN THE GRAN PARADISO NATIONAL PARK (ITALY)

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Alien fish have been introduced into once fishless mountain lakes worldwide, seriously affecting biota. In the Gran Paradiso National Park (GPNP, Western Italian Alps), the impact of introduced brook trouts (*Salvelinus fontinalis*) on biodiversity in high altitude alpine lakes was quantified, and was so strong as to lead the GPNP to undertake an eradication campaign, within the EU financed LIFE+ BIOAQUAE (Biodiversity Improvement of Aquatic Alpine Ecosystems) project. The eradication started in June 2013 in three small lakes (depth range: 3-7.4 m) and one large lake (depth: 22.1 m). Intensive gill netting and electrofishing have been used as non-invasive eradication techniques, without lethal effects for native species, potentially including unique taxa evolved thanks to the island-like nature of alpine lakes (e.g. rare alpine haplotypes of *Daphnia pulex*). The effects of the eradication are being monitored, along with the eradication campaign, comparing the lakes subject of the eradication project with a set of control lakes (both naturally fishless lakes and lakes still containing brook trouts) as a reference to quantify the ecosystem resilience using several indicators (hydrochemistry, water transparency, zooplankton and macroinvertebrate communities, emergent insects, and amphibians populations). At the end of its second season, the eradication action within the LIFE+ BIOAQUAE project was successful in eradicating *S. fontinalis* from two small lakes, the fish population is collapsing in the other two lakes, and there are strong



evidence of ecological resilience, with macroinvertebrates being particularly sensitive to fish removal. To the best of our knowledge, this is the first time that such an eradication programme is successfully implemented in high altitude lakes in the European Alps.

SPRING WETLANDS - THEIR ROLE IN NUTRIENT CYCLING AND MAINTAINING LOCAL BIODIVERSITY

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The beginnings of river systems have often been poorly understood, mapped and researched in many cases, and therefore neglected. Recently, many biologists and conservationists realize their importance and go "to the sources", as shown in the latest studies in different parts of the world. Since 2007, we have examined the headwater area of the river Blanice (CZ, South Bohemia). An extensive survey of macroinvertebrates was carried out, and the ecological status and food preferences of about 80 taxa were determined. Remarkably, in a certain type of springs - spring wetlands - many benthic filter feeders, shredders and detritivores were found in high abundances. How can these feeding guilds subsist in coldwater oligotrophic springs? How come there is plenty of particulate detritus at the very beginning of the river continuum? Subsequently, we examined fine particulate organic matter (FPOM) drained from spring wetlands downstream: the quantity, nutrient content and distinguishable components. The FPOM was relatively rich in nutrients. The C:N and C:P ratios in the local leaf litter deposition were higher than in suspended FPOM, indicating that FPOM is more nutritious for consumers. The results demonstrate that spring wetlands represent a significant source of high-quality detritus not only for feeding its own benthic community, but for downstream ecosystems as well. These "detrital reactors" full of microorganisms, algae, macrophytes and macroinvertebrates receive primary particles and dissolved organic matter, transforming and forwarding them as "tasty" particles to the consumers. Consequently, spring wetlands reduce the eutrophication in primary river networks. Conservation of these relatively small but very important patches in the landscape is essential, mainly in biomes highly modified by human activities.

A BIOCULTURAL APPROACH TO ASSESSING RESILIENCE TO CLIMATE AND ENVIRONMENTAL CHANGE ACROSS RIDGE-TO-REEF LANDSCAPES IN FIJIAN COASTAL COMMUNITIES

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Understanding how social-ecological systems can be resilient to climate and environmental change poses one of the most pressing challenges today. This is particularly true in the Pacific Islands, which are considered to be especially at risk to the effects of climate change. We used a biocultural approach to assess the main drivers of resilience in Fijian coastal communities across ridge-to-reef systems, encompassing agroforests and coral reefs. We asked: 1) What are the main drivers of resilience and how are these drivers linked across land and sea, and social and ecological realms?; 2) How are these drivers affected by external factors such as markets?; and 3) In what ways can local ecological knowledge (LEK) systems play a role in enhancing resilience? We carried out surveys in 20 coastal communities in five provinces across four Fijian islands. We conducted field surveys of indicators of resilience in 100 agroforests (including tree cover, species, crop and cultivar diversity, spatial heterogeneity, invasive species cover). We documented indicators of ecological resilience (e.g., herbivore biomass, coral to algae ratio) in the reefs adjoining the 20 villages and supported community catch logs in one village per region to document fishing pressures. We also used household and key informant interviews, focus group discussions and participatory mapping exercises to identify indicators of social resilience (including variables that relate to flexibility, capacity to learn, capacity to organize, and material assets) and LEK. We present the results of our analyses with structural equation models, and discuss their implications for both conservation and resilience in Fijian coastal communities.

UNDERSTANDING HOW LAND-USE CHANGE IN THE TRANS-MARA DISTRICT, KENYA IS DRIVING HUMAN-ELEPHANT CONFLICT AND ELEPHANT MOVEMENT.

Lydia Tiller

DICE, University of Kent

Rob SMITH, DICE, University of Kent ; Tatyana HUMLE, DICE, University of Kent ; Noah SITATI, African Wildlife Foundation ; Amin RAJAN, Zoological Society of London

The Trans-Mara District in Narok County neighbours the world famous Masai Mara National Reserve and is an important dispersal area for elephants (*Loxodonta africana*). The two areas are linked by at least 23 natural pathways which enable seasonal migration of elephants. However, unlike the Masai Mara, the Trans-Mara is unprotected and experiencing high levels of habitat transformation because the area has high agricultural potential and a growing human population. This encroachment of agricultural land has destroyed and fragmented elephant habitat and seemingly increased conflict with local farmers, predominantly through crop raiding. To



inform management and mitigation of this conservation problem, this project aims to: (1) quantify land-use and land-cover change within the last 30 years in the Trans-Mara; (2) assess the factors determining elephant movements along key pathways between the Masai Mara and Trans-Mara; (3) determine spatial and seasonal trends of human-elephant conflict in the Trans-Mara, and; (4) use spatial conservation prioritisation methods to identify land-use plans that could allow the long-term persistence of elephants and broader biodiversity in the Trans-Mara. The project will also compare patterns of human-elephant conflict and land-use change with data collected 15 years ago. A variety of methods are being used including land-use change modelling, elephant sign surveys, camera trapping, human-elephant monitoring, systematic conservation planning and remote sensing. This research should inform management and mitigation of human-elephant conflict in the Trans-Mara district.

181. RISK, RESILIENCE, AND PRIORITIZATION: THE EVOLVING ROLE OF CLIMATE CHANGE IN CONSERVATION

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Conservation strategies have long focused on protecting areas to attenuate risk to species, communities, and ecosystems. While protected status can help species cope with climate change through the dampening of other threats, climate change does not stop at park borders. Thus, climate change requires new strategies, new goals, and a new philosophy toward our conservation priorities. This presentation will open our symposium by focusing on the differences between pre-climate change conservation and the novel challenges and potential solutions currently being posed. In other words, how should climate change affect conservation strategies? The answer to such a question requires examining current conservation strategies as well as what we know about how climate change affects species. Drawing on empirical examples of the complex dynamics governing observed species' range shifts in montane ecosystems, I will examine how well prioritization metrics such as resilience may or may not adequately protect species and ecosystems. Climate change does not alone pose risks to species, however, and conservation actions need to simultaneously balance multiple threats that may have different degrees of certainty, severity, or reversibility. Conservation needs more approaches to tackling these multiple competing threats in ways that provide flexible responses to future outcomes.

SENSITIVITY AND COST-EFFICIENCY OF ENVIRONMENTAL DNA SAMPLING FOR DETECTING AN AQUATIC INVADER (LISSOTRITON V. VULGARIS) IN MELBOURNE, AUSTRALIA

Reid Tingley

The University of Melbourne

Adam SMART, The University of Melbourne ; Andrew WEEKS, The University of Melbourne ; Anthony VAN ROOYEN, Cesar Pty Ltd ; Michael MCCARTHY, The University of Melbourne

Effective management of alien species requires detecting populations in the early stages of invasion. Environmental DNA (eDNA: the genetic material shed from organisms into the environment) can be used to detect aquatic species at low densities, but it remains unclear whether eDNA sampling is more sensitive and cost-efficient than traditional sampling methods. We compared the ability of a traditional survey technique (bottle-trapping) and eDNA sampling to detect a recently established invader, the smooth newt *Lissotriton vulgaris*, at seven field sites in Melbourne, Australia. Over a contiguous four-month period, detection probabilities per-trap ranged from 0.01 to 0.26 among sites where *L. vulgaris* was detected, whereas per-sample eDNA estimates were much higher (0.29 – 1.0). Detection probabilities of both methods varied temporally (across days and months), but temporal variation appeared to be uncorrelated between methods. Only estimates of spatial variation were strongly correlated across the two sampling techniques. Environmental DNA sampling was more cost-efficient than bottle-trapping across a range of survey budgets when optimising survey effort at a single site; however, bottle-trapping was more cost-efficient when we considered a scenario in which extensive primer development and testing costs were necessary. Nevertheless, sampling several sites diluted these initial set-up costs such that eDNA sampling was again more cost-efficient. These results demonstrate that eDNA sampling can be more sensitive and cost-efficient than traditional survey methods.

CANNIBALISM AND REDUCED BODY CONDITION: WHY WOULD CORN CAUSE REPRODUCTIVE FAILURE IN THE COMMON HAMSTER (CRICETUS CRICETUS)?

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With agricultural modernization, cropland formerly dominated by mosaics of crops, has been replaced by large plots of cereal monocultures (mostly corn). Besides the widespread effects of corn monoculture on wildlife through increased predation-related mortality rates due to the lack of protective cover in spring, this monoculture also leads to an alarming decrease in food diversity and quality, thus affecting individuals' survival and reproduction. These modifications are involved in the decline of many farmland species such as the Common hamster (*Cricetus cricetus*), an endangered species in almost all European range states, with very severe declines and local extirpations having occurred in some countries. We have previously shown that body mass evolution of wild Common hamsters at emergence from hibernation are negatively related to corn monoculture expansion during the last century. Herein, we experimentally tested in captive individuals the effects of corn consumption on hamsters' reproduction rate in comparison with wheat. We submitted 30 reproductive females to corn- or wheat-based diets, complemented with proteins (earthworms or clover) after mating and until weaning. We show for the first time that a corn-based diet negatively affects hamsters' reproductive success and body condition of pups in a negative manner, reducing by up to 75% the reproductive success of females and by up to 50% pups' body mass at weaning. We discuss about the physiological mechanisms that could be involved. Our future work will aim to understand how this could affect wild individuals by studying the impact of corn and wheat ecosystems on hamsters held in semi-natural conditions.

82-THE IMPLICATIONS OF BIODIVERSITY LOSS FOR ECOSYSTEM FUNCTION AND SERVICES AT THE TROPICAL DEFORESTATION FRONTIER

Joseph Tobias

University of Oxford

Biodiversity often underpins ecosystem function, but the extent to which key processes are impaired by biodiversity loss is difficult to quantify in complex tropical forest systems. Here we estimate the structure of Amazonian frugivorous bird assemblages to examine the impact of anthropogenic land-use change on seed dispersal, a process integral to the maintenance of rainforest tree populations. Focusing on beak size and shape as an index of the fruit size classes consumed by frugivores, we show that the diversity and dispersion of functional traits is much reduced in secondary forest and agricultural land-uses but little changed in primary forests subject to logging and fire. However, we also found evidence that when habitat degradation exceeds 40% the abundance

(population size) of seed dispersers largely collapses in larger beak size classes, and that even 10% degradation can halve the level of dispersal service for trees with larger fruits, including many species of high commercial value. These results indicate that intensification of human land-use leads to a collapse in the seed dispersal service provided by birds, and also suggest that ecosystem function may be radically reduced even when species richness and functional diversity remains high.

THE PERCEIVED COST AND BENEFITS OF THE VIRUNGA-BWINDI MASSIF

Sarah Tolbert

Yale School of Forestry and Environmental Studies

The potential impacts of protected areas (PAs) on local livelihoods are as diverse as the ecosystems they protect. The costs range from the displacement of local communities from their land, to crop raiding by wildlife and restricted access to natural resources. Benefits can include access to employment in the tourism industry, new schools and health centers, and even improved organizational capacity. While the costs and benefits can vary widely, conservation organizations now increasingly take into account the interconnected nature of livelihoods, forests, and biodiversity conservation through integrated conservation and development projects (ICDP). While these programs focus on improving the livelihoods of communities through infrastructure projects, little attention is paid to the local perceptions of the forest ecosystems that the PA aims to protect. To address this need and to help build the understanding of how people living near gorilla protected areas in the Virunga-Bwindi Massif view the forest ecosystem, I examined the perceived costs and benefits of the forest during fieldwork conducted between May-August 2014 in Democratic Republic of the Congo, Rwanda, and Uganda. The results show that the cultural, political, and socioeconomic context greatly influences people's perceptions of the forest. This has an enormous impact on whether forest-related conflicts can be successfully resolved. In the areas in Uganda, for example, where a buffer zone was created to grow tea, people express a greater appreciation for the protected area and are more tolerant to crop raiding by baboons and gorillas. In areas where multiple use strategies are not implemented, however, few people reported any benefit from living next to the PA and expressed more negative attitudes towards conservation. I then conclude by arguing that local perceptions of forest ecosystem must be included in traditional monitoring and evaluation framework, if forest related conflicts are to be resolved.



DETAILED MONITORING OF A SMALL BUT RECOVERING POPULATION REVEALS SUBLETHAL EFFECTS OF DISEASE AND UNEXPECTED INTERACTIONS WITH SUPPLEMENTAL FEEDING

Simon Tollington

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Infectious diseases can have substantial impacts on wildlife populations but exploring the sublethal effects of disease outbreaks among natural populations is challenging and requires longitudinal, individual life-history data on patterns of reproductive success and other indicators of fitness. These impacts are sometimes exacerbated in small endangered populations and therefore the success of conservation reintroductions to aid the recovery of such species can be threatened by outbreaks of infectious disease. Intensive management strategies associated with conservation reintroductions can further compound these negative effects in such populations. Mauritius is renowned for successful avian conservation and long-term monitoring programmes which have provided detailed reproductive information on the reintroduced Mauritius parakeet population collected before, during and after a disease outbreak. Deleterious effects of an outbreak of beak and feather disease virus (BFDV) were revealed on hatch success but these effects were remarkably short-lived and disproportionately associated with breeding pairs which took supplemental food. Individual infection status was not predicted by any genetic, environmental or management factors and was not associated with any of our measures of immune function, perhaps suggesting immunological impairment. Experimental immunostimulation did however, provoke a significant immune response. We illustrate the resilience of this bottlenecked and once critically endangered, island-endemic species to an epidemic outbreak of BFDV and highlight the value of systematic monitoring in revealing inconspicuous but nonetheless substantial ecological interactions. Our study demonstrates that the emergence of such an infectious disease in a population ordinarily associated with increased susceptibility, does not necessarily lead to deleterious impacts on population growth and that negative effects on reproductive fitness can be short-lived.

HUMAN DIMENSION OF CONSERVATION PLANNING: THE CASE OF MADAGASCAR

Tendro Tondrasoa

University of Aberdeen

Recommendations from multiple conservation planning efforts have resulted in the current locations of reserves in Madagascar, based exclusively on species habitat and important conservation sites. However, socioeconomic cost of the reserve network has received little to no attention to date. I used a systematic conservation planning framework to identify a cost-effective reserve network for Madagascar. I considered habitat for 327 species of plants and animals and 7 important conservation sites as biodiversity surrogates, and threat and vulnerability of species habitat to alternative land uses as costs to systematic conservation planning. I developed cost-layer maps from current rice field cultivation, fire occurrence data, and deforestation data. I also considered suitable land for rice field cultivation under scenarios of future climate change to assess the likely persistence of the selected reserve network. My results show that at the national level, inclusion of costs in systematic conservation planning did not drastically change the design of the current reserve network. The effect of including costs may be more pronounced at the regional scale. My results were inconclusive with regards to taking into account shifting costs resulting from future climate change. I conclude by giving recommendations regarding new reserve areas regarding the government priority for setting up additional conservation areas.

PARALLELS IN THE OPTIMAL PRESERVATION OF GENETIC AND SPECIES DIVERSITY

David Tonkyn

Clemson University

Managers of threatened captive populations try to select individuals for breeding that jointly have the greatest genetic diversity. At a larger scale, managers of threatened landscapes try to select sites for protection that jointly have the greatest species diversity. I argue that these two problems, of optimal genetic management and optimal reserve design, are nearly identical in form and solution. In both cases, we can specify a clear measure of diversity to maximize, and may have essentially complete information on which to decide, from pedigrees, DNA or GIS mapping. Also in both cases, we generally cannot find the optimal solution because of the astronomical number of choices. This problem is exacerbated by the fact that many threatened individuals (sites) are nearly identical to one another in genes (species), so the choices are both more critical and difficult to make. I discuss the similarities and differences in data, goals and solution methods



to these two classes of problems, and argue that preserving both genetic and species diversity can be treated as optimal relocation problems. There are carriers (animals or regions) that each carry items (genes or species) that are the real concern, and we wish to choose the set of carriers with the best overall set of items. This approach is easily generalized to use all the multivariate data on individuals or sites, incorporate constraints and weights to reflect differences in cost, availability, etc., and allow for single, mixed or multiple objectives, all within a common framework. Therefore, optimization methods developed for one class of problems can sometimes be used for the other. However, there are differences and I conclude with new examples of problems that do not transfer, that exploit the Mendelian inheritance in genetic data, or seek to form spatially compact reserves in landscapes.

BUNDLING AND STACKING IN BIO-SEQUESTRATION SCHEMES: OPPORTUNITIES AND RISKS

Nooshin Torabi

RMIT University

Sarah BEKESSY, RMIT University

Stacking and bundling ecosystem services credits have emerged as mechanisms to promote the conservation of biodiversity in carbon sequestration schemes. Globally, apart from a few certification standards in the voluntary market (e.g. The Climate, Community and Biodiversity Standards), little genuine action has eventuated, but credit sellers and buyers in the markets are continuing to examine the idea of combining these ecosystem services. This research provides timely analysis of the opportunities and barriers of bundling and stacking carbon and biodiversity credits as articulated by policymakers and academics. Corporate social responsibility (CSR) acts as a driving force for businesses to demand co-benefits from carbon plantings; however, uncertainty in the market and policy setting are barriers for both sellers and buyers. Interviewees highlighted substantial benefits of both bundling and stacking, including easing transaction costs for landholders, reduced monitoring costs for regulators and CSR advantages. Nevertheless, there is a risk that stacking can affect the perceived additionality of carbon plantings, which has the potential to erode the integrity of carbon markets. Obstacles to the establishment of stacked/bundled markets include the lack of standards to show that co-benefits are real, dealing with the additionality rule, and designing stacking or bundling scenarios to achieve genuine outcomes for both biodiversity conservation and carbon abatement. Our interviews revealed that bundling biodiversity and carbon credits is the most viable incentivising option. We argue that prerequisites to introducing bundled or stacked carbon credits include prioritising conservation objectives in a landscape scale plan and improvement of carbon modelling techniques to accurately reflect carbon captured by biodiverse carbon plantings.

WILDLIFE IN A HUMAN-DOMINATED WORLD: THE THREAT OF INFRASTRUCTURAL DEVELOPMENT

Aurora Torres

Museo Nacional de Ciencias Naturales - Spanish National Research Council

Jochen A. G. JAEGER, Concordia University; Juan Carlos ALONSO, Museo Nacional de Ciencias Naturales - Spanish National Research Council

Habitat loss and degradation are the primary drivers of the decline and extinction of wildlife populations in terrestrial ecosystems, and roads and human settlements are their main precursors. A decade ago, Kurt Riitters and James D. Wickham (2003) suggested that effects from roads may be the rule rather than the exception in the conterminous US. Since then, knowledge about connectivity metrics, roadless areas, and the effectiveness of defragmentation measures has significantly improved. However, we have missed a critical point that might help respond to the challenges from future developments, including roads: That is, a consistent estimation of the spatial extent of the effects from human structures on wildlife populations. Here, we measure proximity to human structures in Spain, a developed country still harboring a rich vertebrate fauna. We model their overall and habitat-specific areas of influence for birds and mammals, based on taxon-specific functional response curves. The imprint of human structures extends over more than half of all land area for birds (54.2%), whereas for mammals it covers almost all of Spain (97.9%). Moreover, the response curves predict an average decline of about 50% in mammal numbers and 25% in bird numbers across Spain due to the influence of human structures alone, compared to an undisturbed situation, and human influence is still increasing. We conclude that the impact of human structures on wildlife has become massive and that the extinction debt of landscapes may be significant, particularly for wide-ranging mammals. Indeed, we may no longer be able to determine the whole extent of the effects from impervious areas for vulnerable species in most developed countries, as core areas of significant size that could be used as control areas no longer exist.

FROM GENETICS TO CONSERVATION IN LATIN AMERICA AND THE CARIBBEAN: ARE WE REALLY ACHIEVING CONSERVATION GOALS?

Juan Pablo Torres-Florez

Universidade Federal de Sao Carlos

Pedro GALETTI JR., Universidade Federal de Sao Carlos; Warren JOHNSON, Smithsonian Conservation Biology Institute; Mariana NERY, Universidade Estadual de Campinas

The conservation of genetic diversity has long been recognized as an important component of maintaining biodiversity and



is among the goals of efforts to mitigate the current high extinction rate and biodiversity loss. Conservation Genetics has arisen as an important discipline, and rapidly developing molecular methods have facilitated its integration into biological conservation sciences and management practices. Empowered by these technological advances, rapidly decreasing costs, and new analytical tools and databases, the scope and number of projects using molecular genetic approaches is increasing rapidly. However, these advances have not been used very often to specifically address biological conservation policies. Given this common disconnect between theory and conservation practices, we conducted a critical evaluation of the published literature on conservation management in Latin America and the Caribbean to assess how and to what extent genetics and conservation genetics approaches are contributing to biodiversity conservation in this region. We used the Web of Science® to search the title, abstract and keyword fields of all articles published between 1981 and 2013, for either the individual words or complete phrases of “conservation genetics” and “conservation of genetic diversity”. Our search was conducted for each of the Latin America and Caribbean countries. A total of 544 published papers were found among 14 countries. Although the majority of these papers used genetic methods to address at least a broad conservation problem, only a few were really successful at successfully linking their results with specific conservation goals or with relevant conservation policy. We discuss these trends and, provide suggestions of how conservation genetics might have a larger and more successful influence and impact on conservation management practices in developing countries.

EFFECTS OF URBANIZATION ON GROUND-DWELLING ARTHROPODS: A MULTI-TAXA APPROACH

Béla Tóthmérész

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The worldwide increase of urbanization is causing significant changes to the environment. Thus, a better understanding of the relationship between urbanization and ecosystem functioning is important for developing strategies to mitigate unwanted environmental impacts. In a multi-taxa research program, effects of urbanization on ground-dwelling arthropods with different mobility, and being at

different trophic level of the food web were studied along a rural-suburban-urban forested gradient in and around a city of Hungary. The following taxa were studied: millipedes (Myriapoda: Diplopoda), spiders (Araneae), isopods (Crustacea: Isopoda), rove beetles (Coleoptera: Staphylinidae) and ground beetles (Coleoptera: Carabidae). Diversity of the five studied arthropod taxa showed diverse trends of changes along the rural-urban gradient. There was no significant difference in the species richness between the rural and urban habitats for the millipedes, isopods and ground beetles. The species richness of rove beetles was significantly higher in the rural habitats compared to the urban ones, supporting the increasing disturbance hypothesis. The species richness of spiders was significantly the highest in the urban habitats. We stress that the change in the number of forest-associated species showed a consistent, robust pattern along the gradient. The number of forest-associated species was significantly higher in the rural habitats than in the urban ones for all studied arthropod groups. Our findings suggest that habitat alteration accompanying with urbanization have detrimental effects on the habitat specialist species. Moreover, our findings suggest that the overall diversity was not the most appropriate indicator of disturbance: species with different habitat affinity should be analyzed separately to get an ecologically relevant picture of the effect of urbanization. This research was supported by the TÁMOP-4.2.2.B-15/1/KONV-2015-0001 project.

THE IMPACT OF NATURE MANAGEMENT ACROSS THE ANNUAL CYCLE IN LONG-DISTANCE MIGRATORY SONGBIRDS

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Land-use and climatic changes are threatening wildlife worldwide. For migratory animals depending on several areas often separated by thousands of kilometres to successfully complete their annual cycle these threats are ever more difficult to approach because of lack of data. In cross-continental migratory songbirds, declines have been widely documented. Still, reasons remain poorly understood due to a lack of basic information regarding habitat requirements, spatial-temporal migration patterns and non-breeding ecology. With the aim of assessing direct effects of anthropogenic habitat alterations on migratory birds during breeding and non-breeding seasons, we studied spatial behaviour and habitat suitability across habitat types comparing home-range sizes and conspecific home range overlap using radio



telemetry. Results show surprisingly different non-breeding spatial strategies assessed by comparing home-ranges, territoriality and habitat selection. Combining these results with data on densities and body condition from each site, we show widely varying responses to habitat changes among species. Such information is crucial for predicting consequences of habitat changes on larger scales and population levels.

130 QUANTIFYING THE GLOBAL IMPACT OF DEFORESTATION ON TERRESTRIAL VERTEBRATES

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Deforestation is one of the major threats to biodiversity, as loss of forest degrades sites of importance and clears habitat for forest species. Forest loss is not evenly distributed across the planet, and threatens some species more than others. Assessments of species under greatest pressure can inform conservation prioritisation. Until recently, global assessments of forest loss were coarse, which diminished their value for conservation. Here we use the recent 30 m resolution map of forest change between 2000 and 2012, processed through cloud computing, to quantify loss of forest within the ranges of all forest-dependent birds, mammals and amphibians (n=13255 species). We then scaled this rate of habitat loss to three generations or ten years (whichever was longer) for each species, to estimate potential rates of population decline relevant to the IUCN Red List categories and criteria. Subsequently, we quantified the proportion of species in each group that may qualify for uplisting to higher categories of extinction risk than currently applied. Our forest loss calculations were applied consistently across regions and across taxa, including those situations where poor data availability resulted in uncertain assessments in the past. Global maps of forest loss enhance our ability to assess the extinction risk of forest species, uncovering a scenario of increased biodiversity decline.

ASSESSING THREATS AND CONSERVATION ACTIVITIES IN PROTECTED AREAS ACROSS TROPICAL AFRICA

Sandra Tranquilli

University College London

Several protected areas (PAs) have been designed and established in Africa to protect their natural resources. Nevertheless, significant threats from anthropogenic activities persist and conservation efforts in most PAs are still minimal causing decline of wildlife populations. In our study we assessed the impact level of threats to wildlife within 98 PAs and the relationship with conservation activities. We focused on PAs with tropical forest cover from 15 countries across West, East and Central Africa. For each area we assembled information about local threats to wildlife and conservation activities. Our results show that 89% of African tropical PAs are under high pressure from anthropogenic threats, while type and degree varies across the regions. Subsistence and commercial hunting are the most common direct threats to wildlife and mainly prevalent in West and Central Africa. Agriculture and logging represent instead the most common indirect threats, mostly prevalent in West Africa. General linear models were constructed to test the significance of specific conservation activities in relation to the threat impact level. We found that the long-term presence of conservation activities (such as law enforcement, research and tourism) is associated with lower threat impact levels. In general, our results provide important guidelines to policy makers, funding bodies and conservationists. In particular, they highlight deficiencies in the management effectiveness of several PAs occurring in tropical Africa, and conclude that PA management should invest more into conservation activities with long-term duration.

ID #38: USING BEHAVIOURAL ECONOMICS TO ELUCIDATE RESPONSES IN CONSERVATION INTERVENTIONS

Henry Travers

Imperial College London

In this talk, I will present case studies from Cambodia and Uganda to show how methodologies developed within the discipline of behavioural economics are being used to investigate the sensitive subject of wildlife crime and guide the formulation of conservation policies aimed at addressing this important issue. Within conservation, increasing attention is being given to evidence based approaches to improving decision-making and evaluating whether policies have been successful in achieving their stated goals. Yet the success of conservation policies is difficult to define or measure and may



be highly dependent on the local social, political, economic and institutional context. Despite recent advances, assessing the impact of conservation interventions is expensive, difficult to do well and only possible once an intervention has been operational for a sufficient period. This situation can be exacerbated when policies are aimed at tackling illegal wildlife use, a silent crime that is challenging to monitor or investigate directly. As such, even with approaches such as adaptive management, opportunities for improvements, time or goodwill may be lost. Hence, the ability to estimate the effectiveness of policies prior to implementation (either in absolute terms or relative to alternative policy options) offers the potential, if not necessarily to get things right first time, to minimise the risk of unnecessary policy failures and improve the effectiveness of efforts aimed at reducing wildlife crime.

BORN TO BE WILD: HOW TO QUANTIFY THE IMPACT OF AN INVASIVE SPECIES, PROSOPIS JULIFLORA, IN ETHIOPIAN RANGELANDS

Anna Treydte

University of Hohenheim

Emiru BIRHANE, Mekelle University ; Abeje ESHETE, Forestry Research Institute

Invasive alien species are a global phenomenon, often with detrimental effects on native fauna and flora biodiversity. In Ethiopia, rangelands are being invaded by *Prosopis juliflora*, a woody encroacher which drastically reduces forage productivity in already overgrazed areas. Little research has been conducted to quantify the environmental effects of its invasion and management strategies have been rather unsuccessful thus far. Across sites of different *P. juliflora* encroachment categories in the Afar region, Ethiopia, we investigated the prevalent soil physical and chemical properties, soil seed bank, vegetation composition and productivity as well as below- and above-ground Carbon (C) stocks. Plant species richness was reduced while overall plant biomass and above- and belowground C stocks were more than three times higher in highly infested sites compared to sites without *P. juliflora*. Soil moisture, Phosphorus, Nitrogen and C stocks were highest in highly infested sites. The soil seed bank was still intact, including a variety of native plant species, even in soils of highly infested sites. Low recruitment of *P. juliflora* in highly infested sites points towards self-thinning effects while plant population dynamics and remote sensing images show that *P. juliflora* is still spreading rapidly across rangelands. We conclude that soil properties of infested sites are rather beneficial for reclamation and immediate use of the rangeland after removal of this invasive species. Management should focus on preventing *P. juliflora* spread and removal of freshly invaded sites rather than on already highly infested sites; trade-offs between labor costs, forage biomass and potentially beneficial C stocks of the woody vegetation must

be taken into account. After *P. juliflora* removal, immediate use and continuous monitoring and management of the restored sites is necessary to prevent resprouting and further invasion spread.

OPTIMIZING BOREAL FOREST MANAGEMENT TO REDUCE TRADE-OFFS BETWEEN BIODIVERSITY, CARBON STORAGE AND TIMBER

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University of Jyväskylä

Tähti POHJANMIES, University of Jyväskylä ; Adriano MAZZIOTTA, University of Jyväskylä ; Eric LE TORTOREC, University of Jyväskylä ; Dmitry PODKOPAEV, University of Jyväskylä ; Artti JUUTINEN, University of Oulu ; Mikko MÖNKKÖNEN, University of Jyväskylä

Human well-being highly depends on ecosystem services and this dependence is expected to increase in the future with increasing population and economic growth. Understanding drivers of ecosystem service supply and biodiversity is important for developing efficient management strategies. Hence, studies that investigate trade-offs between ecosystem services and biodiversity are urgently needed for informing policy-makers. Moreover, in order to ensure the provision of ecosystem services in a landscape, it is important to maintain both ecosystem functions (like carbon storage) and structures (species representation). So far, most studies have focused on trade-offs between two ecosystem services, here we go one step further by analysing three objectives at the same time: (1) revenues from timber harvesting, (2) carbon storage, and (3) sustaining biodiversity. In our study, we apply seven alternative forest management regimes using a forest simulator in a large boreal forest production landscape. First, we estimate the potential of the landscape to provide timber, store carbon and sustain biodiversity (deadwood and species habitat availability) across a 50-year time period. Then, we apply multiobjective optimization to identify conflicts between the three objectives and to find the most preferred trade-offs in forest management regimes with as high timber revenues, carbon sequestration and sustained biodiversity as possible. Our results show that no management regime alone is able to maximize timber, carbon sequestration and biodiversity, and that a combination of different regimes is needed. We conclude that it is possible to achieve win-win situations by applying diversified forest management planning at a landscape-level.

CAN COAL COMBUSTION PRESERVE ENDANGERED BIODIVERSITY OF CONTINENTAL SAND DUNES? ARTHROPODS OF FLY ASH DEPOSITS WITH EVALUATION OF DIFFERENT RESTORATION PRACTICE IN THE CZECH REPUBLIC

Robert Tropek



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In the continental Europe, drift sand dunes rank highly among the most threatened environments, suffering accelerating losses of associated biodiversity. Despite strong evidence that various vanishing species find refuges at post-industrial barrens, arthropods specialised for the highly specific and extreme conditions of drift sands have not been known to colonise any surrogates. Based on the physical conditions of finely grained fly ash, we hypothesised that they could be colonised by drift sand communities. During our intensive surveys of arthropod communities (mainly wild bees and wasps, various groups of beetles, spiders, hoverflies, leafhoppers, orthopterans, moths, ants and neuropterans) of numerous fly ash deposits throughout the Czech Republic in the recent years, we have revealed that these relatively common landscape structures indeed host arthropod communities of extraordinary conservation value. Altogether we already found about 20 species considered as regionally extinct, several tens of critically endangered species and many other species included to the national and/or European red lists, majority of the most important species are strictly specialized for drift sand dunes. Simultaneously, we focused on effects of different restoration practice on this so far unknown tremendous conservation potential. After revealing technical reclamation (and especially artificial afforestation) as fatal for the majority of the most endangered species, we focused on anti-dust treatments as a potentially effective compromise between protection of human health and biodiversity conservation. In this contribution, the results of our biodiversity surveys as well as the studies of restoration

practise will be reviewed with a suggestion for future research and practical restoration.

PVA: DO POPULATION VIABILITY MEASURES CORRELATE?

Mario Trouillier

Georg-August-University Göttingen - Dept Ecosystem Modelling

Guy PE'ER, Dept Conservation Biology, UFZ ? Helmholtz Centre for Environmental Research ; Katrin MEYER, Georg-August-University Göttingen - Dept Ecosystem Modelling

Population viability analyses are broadly used to support conservation research and applications. Different studies use different viability measures – posing hurdles for comparability and meta-analyses. To enhance the capacity to generalize from PVAs, we compared different viability measures for two simulated species. We used the individual-based, spatially explicit model RangeShifter to simulate fourteen conservation scenarios on four landscape maps. These scenarios were ranked in terms of viability by eight commonly used viability measures (probability of extinction, probability of quasi-extinction, risk of decline, expected population size, expected minimum population size, extrapolated mean time to extinction, intrinsic mean time to extinction, growth rate). We found that the rankings were roughly similar, apart from the population growth rate λ . However, there were no general correlations between viability measure values. One reason for this is that model output data depend on model structure, species parameters and the landscape map. More importantly, each viability measure assesses a different subset of the same dataset. From this, it follows that some viability measures yield complementary information. Following this logic, we reassessed the relationship between extinctions ($N=0$) and other population sizes ($N>0$) to show that persistence should always be reported together with information on the population size distribution. This would enhance our understanding of the skewed distributions of the time to extinction, which is critical from a perspective of the risk affinity defined by decision makers. For future PVAs we recommend a) reporting several viability measures and b) reporting, or depositing, the full model outputs in terms of the population-size distributions over time.

BASAL ANGIOSPERM SPECIES AS LISTENING POSTS FOR CLIMATE CHANGE IN NEW CALEDONIA.

Santiago Trueba

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The "basal" angiosperms, encompassing the magnoliids and the ANA grade, are main elements of the New Caledonian forest communities. We show through species distribution models (SDM) for 60 species, that most of the early diverging angiosperms occurs in moist to wet rainforests with annual precipitation ranging from 1,500 to 2,300 mm/year and with moderate diurnal variations in temperature (below 7°C). Geographical shifts in the ranges of rainforest communities are predicted in response to a severe increase of drought according to current global change scenarios. Through measurements of vulnerability to xylem cavitation, a variable reflecting the ability of plants to withstand drought, along with leaf and wood traits such as leaf vein density and wood density, we assess the ecophysiology and drought resistance of 13 representative species. New Caledonian basal angiosperms have a spectrum of xylem cavitation vulnerability (ψ_{50}) of -4.03 to -2.00 MPa with most of species falling in a narrow resistivity range. We show a significant relation of drought resistance values of our studied species with spatial variables such as mean elevation. Additionally, we explore the influence of functional wood and leaf traits on their habitat distribution on the island. We propose monitoring of these species populations, which are restricted to rainforests and could serve as indicators of forest die-back because of their potential sensibility to drought. This study emphasizes the importance of considering together species' ecophysiological traits and habitat preferences in order to understand the response mechanisms of vegetation to climate change. Moreover, we highlight the importance of SDM in the design of biological conservation strategies.

GAMERS LIKE IT GREEN: VIRTUAL BIOPHILIA-LIKE EXPERIENCE IN THE WORLD OF WARCRAFT.

Minh-Xuan Truong

French National Museum of Natural History
Anne Caroline PREVOT, French National Museum of Natural History; *Susan CLAYTON, College of Wooster*

In the modern era of urban human development, the occidental way of life has increased a separation between humans and nature, together with a delegation of our sensory and cognitive abilities to technologies. For example, we delegate our senses of direction to GPS and other GoogleMap, our memory to search engines, and we can't do any calculations without our cell phone anymore! We can also choose virtual social interaction over physical social networking, using chat, video/audio/e-mails, and online video

games. Relationship to Nature is no exception to this and today, technology has begun to change human's long-standing experiences with nature: through videos and documentaries, we travel, discover magnificent windows opened onto wilderness, landscapes, places and species we would not be able to reach and see otherwise. Videogames contribute to this phenomenon. In this study, we focused on how players relate to Nature in the world's number one online role-playing game, the World of Warcraft (WoW, millions of players throughout the world). We proposed an on-line questionnaire to 1200 French-speaking gamers to assess their motivations to play, their relations to nature in the real life and their preferred landscapes in the virtual environment. We combined their answers to ecological descriptions of these virtual tridimensional environments. We showed that players prefer virtual areas displaying an important amount of green vegetation, but that this preference is not related to their nature connection, nor to their motivation to play, which is mostly escaping from their daily life, mostly urban. We discuss these results in terms of virtual biophilia, i.e., an attraction to virtual landscapes that are healthy and full of vegetation landscapes, when it is no longer possible to reach such landscapes in real life.

THE EFFECT OF AMBIENT ENVIRONMENTAL CUES AND INDIVIDUAL STATE ON RESOURCE SELECTION IN AFRICAN ELEPHANTS

Miriam Tsalyuk

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Wildlife movement patterns over different landscapes provide valuable information on which resources are important for the species' conservation. However, it is not well understood how the movement response to landscape variables changes over time, over ambient condition, and among individuals within a population. Here we examine how landscape variables, time variation (diurnal, seasonal), ambient environmental conditions (day length, temperature, rainfall), and internal cues (hunger, thirst) interact to determine the directional movement of African elephants (*Loxodonta africana*). We fitted fifteen elephants in Etosha National Park, Namibia, with GPS-GSM collars. We collected detailed landscape variables including vegetation density, cover, productivity, and temporal variability and distances to roads, fences, and water sources. We used Step Selection Function to determine the relative importance of landscape variables. We examined how changes in day length, ambient temperature, and rainfall, affect directional movement on the landscape. We further considered the effect of individuals' internal condition inferred from the time past since the recent drinking/feeding event. We found that elephants in Etosha prefer higher productivity, grass, and shrub biomass, but lower tree cover, and walk closer to water and roads. The importance of surface water, vegetation productivity, and grass



cover decreased as daily precipitation increased but increased with rising temperatures. We also show that environmental context and the inferred internal condition of the animal affect the relative importance of resources that were recently used (water, vegetation biomass and movement rates). Our holistic approach to examining the interaction of both internal and external cues in determining the animal's movement response to surrounding landscape variables sheds light on fine changes in wildlife resources selection over varying spatial and temporal scales.

49 LANDSCAPE CONTEXT DRIVING BIODIVERSITY PATTERNS AND PROCESSES IN FRAGMENTED HABITATS

Teja Tscharntke
Agroecology

49 The theory of island biogeography predicts decreasing species richness with decreasing area and increasing isolation of a habitat (MacArthur & Wilson, 1967), which has been claimed to be one of the few laws in ecology (Lawton, 1999; Holt, 2010). However, there are at least three distinct arguments why fragmentation per se has been often overestimated as a driver of landscape-wide biodiversity losses and why beta diversity has been underestimated as a driver of landscape-wide biodiversity. (1) Mechanisms driving biodiversity patterns in fragmented landscapes include not only the separate effects of habitat loss or fragmentation per se. When a given amount of habitat area is spread out in a landscape (via fragmentation) instead of remaining as a single large patch, beta diversity is increased, which relates to the observation that "single large" support usually less species (also less specialized ones) than "several small" (SLOSS) habitats. (2) Whenever the matrix surrounding habitat fragments is not entirely hostile to species, but rather contains usable resources, island biogeographical and early metapopulation theory have limited applicability. Matrix habitats can be surprisingly rich, even in species normally found in the fragments. (3) Most studies do not effectively discriminate habitat fragmentation from habitat loss (Fahrig 2003), and the few published studies explicitly discriminating these two effects do not support the hypothesis that fragmentation per se (i.e. fragmentation in addition to habitat loss) reduces landscape-wide diversity. Finding sustainable solutions that integrate conservation goals such as promoting landscape-wide biodiversity as well as maintaining viable populations of patch-area-sensitive (e.g. large or vagile) organisms is difficult and underlying conservation priorities need to be more clearly articulated. Tscharntke T et al (2012), *Biological Reviews* 87: 661-685.

141 INTEGRATING BIODIVERSITY IN AGRICULTURE

Teja Tscharntke
Agroecology

141 Under the current scenario of rapid human population increase, achieving efficient and productive agricultural land use while conserving biodiversity is a global challenge. Agriculture practiced under smallholder farmer-dominated landscapes, and not large-scale farming, is currently the backbone of global food security in the developing world. A major argument for wildlife friendly farming and agroecological intensification is that crucial ecosystem services are provided by "planned" and "associated" biodiversity, whereas the land sparing concept implies that biodiversity in agroecosystems is functionally negligible. However, loss of biological control can result in dramatic increases of pest densities, pollinator services affect a third of global human food supply, and inappropriate agricultural management can lead to environmental degradation. Hence, the true value of functional biodiversity on the farm is often inadequately acknowledged or understood, while conventional intensification tends to disrupt beneficial functions of biodiversity. In conclusion, linking agricultural intensification with biodiversity conservation and hunger reduction requires well-informed regional and targeted solutions, something which the land sparing vs sharing debate has failed to achieve so far. Tscharntke T et al. (2012): *Global food security, biodiversity conservation and the future of agricultural intensification. Biological Conservation* 151: 53-59.

PROTECTED AREAS MANAGEMENT AND CONSERVATION UNDER FUTURE CLIMATIC UNCERTAINTY: A CASE STUDY IN CHOBE NATIONAL PARK, BOTSWANA (SUB SAHARAN AFRICA)

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Climate change generates new challenges for biodiversity conservation and management. There are two ways in which climate change affects biodiversity (i) directly via physiological stress and (ii) indirectly via changing relationships among species. However, there is still limited understanding on how change in interspecific relationships as a result of climatic induced shifts will impact future sustainability of species composition and structure. This limitation makes current management and conservation strategies inadequate to ensure species long term persistence and survival within protected areas. This study seeks to provide the first assessment of the scale and type of indirect ecological impact that climate change could have on biodiversity in Chobe National Park (Botswana), by integrating ecological theory with predictive modelling of species. Qualitative information about the types



of ecological changes that might be experienced by species are assessed using literature reviews and expert knowledge. This is augmented with quantitative analysis of the potential impact of climate change on the distribution of habitat types and species, by a novel application of bioclimatic envelope modelling techniques. Species distribution models will be used to model dominant plant species from vegetation assemblages and animal species within the reserve. The model will be applied to a future 2050 and 2090 climate scenario in order to project the distribution of suitable habitat and species under new conditions. The study provides information and insights about future resilience and adaptation, that is, how to make robust protected area policy, management and conservation strategies that are effective in the face of climate change

HEAT STRESS IN AFRICAN PENGUINS IN THE FACE OF CLIMATE CHANGE

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The African Penguin was classified as 'Endangered' by the IUCN in 2010, due to the loss of 70% of its population in the last decade. Habitat loss from former guano scraping is a major issue as it exacerbates heat stress. Historically, most African Penguins bred in guano burrows that provided a buffered microclimate and shelter from predators. During very high temperatures, adults may leave their nests to cool down in the sea. This is often fatal for broods in surface nests due to predation and exposure. Since climate change increases extreme weather, the situation will only worsen. Previous studies indicate that these effects can be reduced by artificial nests. However, whether they can fully replace natural burrows is still unknown. This study seeks to 1) pinpoint the temperature where heat stress begins, 2) understand behavioural responses to temperature, 3) estimate inter-colony temperature differences, 4) determine how extreme weather affects breeding success and 5) evaluate the effectiveness of artificial nests. Results of a laboratory study showed that penguins' behavioural thermoregulation methods could no longer cope with the rise in ambient temperature once ambient temperatures exceeded 28.5°C (95% CI) – their "heat stress point." This is 2°C lower than expected from studies on other penguin species, suggesting that African Penguins are particularly sensitive to climate change. Field-based studies using operative temperature models show that heat stress may be occurring more often and at lower air temperatures than predicted, from the influences of weather and artificial nest design. Artificial burrows were shown to have extreme temperatures in summer, commonly above African Penguins'

heat stress point. Exposure to sun affected all artificial nest types except natural burrows. The results of this study will help to predict how populations may be affected by climate change, as well as informing management actions to limit impacts.

DYNAMICS IN SPECIES ASSOCIATIONS CHANGE SURROGATE SELECTION FOR MONITORING MANAGEMENT

Ayesha Tulloch

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Changes in threatening processes and environmental conditions make species associations dynamic and difficult to quantify. Limited funding for conservation means that we must select surrogates to represent hard-to-detect species, in spite of uncertainty about species associations. We test how temporal variability in species associations affects decisions about optimal surrogates. We ask if reductions in the temporal representativeness of data (e.g. from reduced-effort monitoring protocols) leads to inadequate surrogates being selected, and explore trade-offs in the benefits and costs of monitoring alternative surrogate sets. We use two case studies of dynamic bird species associations in south-eastern Australia, for finding surrogate species in woodland undergoing restoration, or heathland undergoing combined fire and invasive predator management. We find that reduced temporal representativeness of surrogacy data leads to over-estimation of the true value of the surrogacy decision, and selection of suboptimal surrogates with lower performance. Increasing the monitoring budget to learn about associations marginally increases the relative performance of selected surrogates. In general, fewer data available for selecting surrogates means that more surrogates should be chosen to allow for suboptimal or uninformative surrogates selected due to incomplete knowledge of species associations. Approaches to prioritise surrogate selection are increasing in popularity as the funds for conservation and evaluation fail to meet management budget needs. Our results demonstrate that reductions in data can considerably decrease the efficiency and cost-effectiveness of selected surrogates, but that careful consideration of monitoring protocols tied to hypotheses about how the landscape is likely to change over time can reduce this gap. Surrogate choices that fail to acknowledge dynamics in species associations can lead to changes being missed due to redundant surrogates being chosen.



NON-INVASIVE GENETICS OF THE EURASIAN LYNX OF THE WESTERN CARPATHIANS

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The population of the Eurasian lynx (*Lynx lynx*) in the Czech Republic occurs on the edge of the species distribution in the Western Carpathians. The population is threatened by many factors such as habitat fragmentation, migration barriers and poaching. Status of the population in the transboundary area of the Czech and Slovak Republics was investigated on the basis of non-invasive genetic material (scat, hair and urine samples) collected in years 2010–2013 during snow-tracking sessions. Using in total 19 microsatellite loci and the sex specific marker SRY we identified 18 individuals of lynx. Our aim was to describe genetic variability and structure of population, population size using capture-mark-recapture model, effective population size, kinship and spatial distribution. We also compared these results with data from the parallel camera traps survey and snow-tracking. We discuss the key factors important for the lynx conservation in the Central Europe as a basis of a trans-boundary management plan for Eurasian lynx.

SYMPOSIUM 108 REMOTE SENSING FOR CONSERVATION: NETWORKS HOLD THE KEY

Woody Turner

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There is a veritable explosion underway of remote sensing platforms and sensors. From satellites, aircraft, and a plethora of in situ devices, remote sensing is providing information about changes in biodiversity at spatial scales from global to microbial. New airborne and satellite remote sensing instruments provide observations of key biological patterns ranging from the biome to the ecosystem to the organism, while also tracking environmental drivers of these patterns (e.g., climate, land use, and sea surface state). At the same time, a revolution in in situ observations (e.g., camera traps, acoustic sensors, small drones, citizen scientists' cell phones, and environmental DNA) is detecting patterns at the ecosystem to organism to genome levels and revealing processes behind some of the larger-scale patterns. Today, a primary challenge

for conservation biology lies in assembling networks to integrate cross-scale observations from multiple sensors on a variety of platforms. Fortunately, computational advances enable processing of ever-larger volumes of information. The reward for developing such interoperable observation networks will be an unprecedented ability to tackle the global problem of biodiversity loss at a global level, as well as regionally and locally.

76-A MULTI-SPECIES COMPARATIVE APPROACH TO ASSESSING DRIVERS OF SUCCESS IN MAMMALIAN CONSERVATION RECOVERY PROGRAMMES

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The outcomes of species recovery programmes have been mixed, with high-profile population recoveries contrasting with species-level extinctions. Although each conservation intervention faces its own challenges, it is imperative to assess whether such lessons have wider general applicability. In order to contribute towards evidence-based improvement of future conservation strategies, we conducted a multi-species analysis of 48 mammalian recovery programmes based on peer-reviewed literature and semi-structured interviews with conservation scientists and practitioners. Using both quantitative and qualitative information derived from these data sources, we investigated ecological, management and political factors associated with population recoveries or declines. The importance of identifying and removing threats was emphasised most strongly from our results, indicating unsurprisingly that populations are likely to continue to be negatively impacted if threats are not reduced or removed, and highlighting the importance of management strategies such as robust threat monitoring. Informants also cited poor stakeholder coordination and management as a key weakness in recovery programmes, emphasising the importance of effective leadership and shared goals and management plans. Project outcomes were not influenced by ecological variables, suggesting that recommendations from our results are applicable to other recovery programmes. Despite the fact that the best approach to conserve a particular species will be context-dependent, our results suggest there is value in conducting broader-scale assessments of factors influencing the success of conservation interventions. We encourage further such studies, particularly at more localised scales, and recommend that the conservation community continues to evaluate and learn lessons from past experiences and adapt future strategies accordingly.



EVALUATING CONSERVATION NEEDS IN A WEST AFRICAN BIODIVERSITY HOTSPOT AND AN EBOLA EPICENTRE

Clement G. Tweh

Forestry Development Authority/Wild Chimpanzee Foundation

Menladi M. LORMIE, Forestry Development Authority ; Célestin Y. KOUAKOU, Wild Chimpanzee Foundation ; Annika HILLERS, The Royal Society for the Protection of Birds/Across the River - A transboundary Peace Park for Sierra Leone and Liberia ; Hjalmar S. KÜHL, Max-Planck Institute for Evolutionary Anthropology ; Jessica JUNKER, Max-Planck Institute for Evolutionary Anthropology

Over the past 12 months, Liberia has featured on international news due its prominence in the largest Ebola epidemic in human history. Liberia has yet to receive the same amount of public and media attention with respect to its exceptional biodiversity and natural heritage, and its role as a conservation priority in the region. The country's underrepresented reputation as a biodiversity hotspot and wildlife refuge can partly be explained by its long civil war that thwarted efforts to conduct biological surveys and gather evidence for its biological importance. From 2010-2012, we conducted the first nationwide survey to estimate abundance of chimpanzees (*Pan troglodytes verus*), large mammal diversity and human threats along 320 km of systematically located transect lines. With >7000 chimpanzees living in relatively large and continuous forest habitat, Liberia is home to the second largest and one of the most viable chimpanzee populations in West Africa. Our study also revealed that the majority of populations and some of the most species-diverse mammal communities exist outside protected areas, which cover only 2% of the country. This paucity of conservation protection, combined with proposed plans for large-scale timber and mineral extraction, present a serious threat to this important eco-region. Fortunately, our country-wide baseline dataset has already served as a platform to support government plans to establish a biologically representative network of conservation areas. Together with data on human livelihoods we currently investigate potential links between socio-economic variables and biodiversity, and address the effect of the recent Ebola crisis on natural resource consumption, and the country's economy and society. With this, we aim to inform future conservation strategies that provide human populations with the resources and ecological services they need without jeopardizing the long-term survival of the country's rich natural heritage.

DIFFERENCES IN SITE AND LIFE HISTORY DRIVE DEMOGRAPHIC RESPONSES TO CLIMATIC VARIATION IN SCANDINAVIAN ORCHIDS.

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Climate change has been identified as a threat to species persistence worldwide. However, climatic factors may affect populations in highly different ways. While these differences are apparent at large spatial and taxonomic scales, variation in life history, site factors, and ecological interactions at smaller scales also may influence a population's response to climate change. This study addresses such small scale variation by examining the effects of variation in four climatic variables on eight populations of closely related orchid species (genera *Dactylorhiza* and *Gymnadenia*) at two sites in central Norway. We used over 30 years of demographic and climatic data to construct matrix models parameterized by generalized linear mixed models (GLMMs). We examined the effects of current and previous year precipitation and temperature on standard vital rates (survival, stage transitions, flowering rate and flower production). We also used data on fruit production to estimate the effects of climate on pollination rate. The results show small and highly variable effects of climatic factors both between species as well as different populations of the same species. In addition we found that local climatic factors during the period of fruit production strongly affect the level of fruit production. These results underscore the importance of considering the local site and life history of populations when considering their response to large scale environmental changes such as climate. Understanding this small scale heterogeneity will be key for developing successful conservation and management plans at the population level.

141 LAND-USE INTENSIFICATION AND AGRICULTURAL YIELD - WHO NEEDS BIODIVERSITY?

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Land-use intensification drives extinctions, which should undermine ecosystem services and, in turn, harm production. Conversely, it has been argued that crop yields generally benefit from increasing intensification (seemingly unaffected by reduced services), and that set-aside conservation areas can mitigate biodiversity loss and allow further intensification of agriculture. However, both sides of these arguments are based several key assumptions, such as: 1) biodiversity consistently promotes ecosystem services in agricultural systems, provided that biodiversity is available in the system; 2) the environmental costs of intensification are limited to the agricultural habitat itself, so intensification does not reduce the value of nearby land spared for conservation; 3) what works



for increasing production now will always work. I will discuss the conditions under which biodiversity is most important for ecosystem services related to agriculture, and how these conditions relate to real-world native vs. production systems. I will also present evidence for offsite impacts of intensification, and discuss how these undermine the effectiveness of land sparing in mosaic landscapes. Finally, I will emphasise that increasing productivity while harming biodiversity may provide production benefits in the short term, but lead to system instability that threatens production in the long term. In essence, conserving biodiversity in production landscapes will be insufficient to maintain ecosystem services, unless we create the specific conditions under which biodiversity most effectively provides ecosystem functions and services in the face of changing environmental conditions.

A NOVEL BUTTERFLY MONITORING SCHEME IN GREECE

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Butterfly Monitoring Schemes (BMS) have been well developed in Europe and are widely recognized as efficient tools guiding conservation evaluation. In spite of its exceptional butterfly diversity, no such scheme has been implemented in Greece so far. In this paper we are presenting the first results of the national monitoring program of Greece that targeted the assessment of the conservation status of ten butterfly species of European conservation concern. We conducted 397 transects of 500 m standard length, located in their majority (80%) within Natura 2000 sites (45) all over the country. Although we visited sites only once, we recorded 138 species (11638 individuals), accounting for 59% of the Greek butterfly inventory. No significant difference between transects located within and outside Natura 2000 was revealed, in terms of their mean species richness and abundance (U test, $W = 10417.5$, $p > 0.05$). Therefore butterfly conservation management should consider the maintenance of adequate butterfly habitats on a broad scale, including areas outside the Natura 2000 network as well. Our preliminary results, combined with atlas data and expert opinions, concluded that only two species merited a favourable conservation status (*Parnassius mnemosyne*,

Zerynthia polyxena), two species had a bad conservation status with declining population trends (*Lycaena dispar*, *Papilio alexanor*), and six species have an inadequate status with declining populations as well (*Apatura metis*, *Euphydryas aurinia*, *Maculinea arion*, *Parnassius apollo*, *Polyommatus eroides*, *Pseudophilotes bavius*). The establishment of a permanent and systematic monitoring scheme is a necessity to increase the reliability of the conservation status assessment of butterflies in Greece, to improve ecological knowledge and to reach well-informed conservation management decisions on national and local scales.

CONSERVATION ECOLOGY OF BUTTERFLIES IN THE MEDITERRANEAN ISLAND OF CYPRUS UNDER THE NATURA 2000 CONTEXT

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Cyprus has a strong Natura 2000 network with 61 sites (SCIs and SPAs) covering more than 19% of the island. To investigate how well does the current network contribute to the conservation of butterfly species we collected data from 60 sites located inside and outside of the Natura 2000 network, between March-July 2011-2013, using the line transect method (300 m-Pollard walk). A total of 38 species (4708 individuals) were recorded, which represent 72% of the Cyprus butterfly fauna. The Natura 2000 network (34 out of 60 sites) was quite rich in terms of butterfly diversity, hosting 66% of butterfly species in the study area. However, the Natura 2000 network did not maintain significantly more butterfly species, or significantly more butterflies of conservation concern, though it hosted significantly more endemic species (U test, $W = 288$, $p < 0.05$), as compared with the sites outside the network. To test the effects of environmental parameters on the overall species richness of butterflies for all sites, we used Generalized Linear models (GLMs). Our results showed that flowerheads and soil humidity positively influenced butterfly richness. Redundancy analysis also revealed four environmental factors (altitude, flowerheads, herb and rock cover) that clearly affected the butterfly community within the study area. Taken together, the results suggest that the Natura 2000 network in Cyprus contributed significantly to preserve endemic butterfly diversity and that species composition was constrained mainly by gradients of either vegetation or abiotic parameters. These findings have significant conservation implications for the management of Natura 2000 sites but also for areas outside the network that should be taken into account to ensure adequate protection of Cyprus butterflies.



BIRD COMMUNITY COMPOSITION ALONG AN URBANIZATION GRADIENT IN A MEDITERRANEAN CITY

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Urbanization is considered one of the greatest challenges that humanity faces today, since it causes serious environmental degradation including habitat alterations and loss. Recent studies have shown that urbanization alters significantly avian communities. During the last decades, Greek cities have experienced intensive urban web expansion, without adequate spatial planning, producing a particularly restricted web of green patches. Our study examines the effects of urbanization on avian communities for the first time in Greece, taking as a case study the city of Patras. Breeding bird communities were sampled twice during spring time, using the point count method, from 90 randomly selected 500X500m grid cells evenly distributed along an urbanization gradient (urban, suburban, peri-urban zones). A total of 46 species (3306 individuals) were recorded, including 32 breeding species (3233 individuals) that were used for the analyses, of which 8 are of European Conservation Concern. Overall species richness increased from the urban zone (21 species) to the peri-urban one (31 species), though this difference was not significant (Spearman $\rho=0.180$, $p>0.05$). On the contrary, average species abundance exhibited a significantly decreasing pattern ($\rho=-0.316$, $p=0.002$), which was also observed when SPECs were separately considered ($\rho=-0.337$, $p=0.001$). This inverse pattern is attributed to a set of 10 urbanization-enhanced species (3 SPECs), such as sparrows and swallows, which are very abundant in the urban zone. The majority of the species (21) was detected more frequently outside the urban core, but presented generally lower abundances. Our results underline that the peri-urban zone is not as rich as expected, showing a great degree of habitat degradation due to anthropogenic disturbance, as well.

COMMUNITY ENGAGEMENT TO MITIGATE TIGER HUMAN CONFLICT IN BANGLADESH SUNDARBANS

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WildTeam

Tiger human conflict (THC) is a common occurring being recorded, every year numbers of human, tiger and livestock has been killed as a consequence of THC. THC is an alarming threat to Bengal tiger conservation in Sundarbans Reserve Forest (SRF). Village Tiger Response Team (VTRT), a voluntary group, was established by WildTeam in 2007 to ensure community engagement in Bengal tiger conservation in

Bangladesh. 350 VTRT members under 49 teams are doing voluntary work in around SRF to mitigate THC. The objectives of this study is to find out the involvement of VTRT and ways how VTRT are helping tiger conservation in SRF. THC management response data were collected from 2011 to 2013 and analyzed to find out VTRT involvement fro THC mitigation in SRF. Study result denotes that VTRTs were participated to mitigate all categories of THC incidents (stray tiger, livestock incidents and human incidents). VTRT responded to 176 cases out of 422 THC incidents. In response to tiger incidents they did 14 crowd conditions to mage stray tiger and did 40 village meeting to aware local people. In last three years. In response of human incident they retrieved 20 human dead bodies from forest, transported 22 injured human in the study period. To make local people aware about tiger attack inside the SRF they conducted 17 village meeting and arranged 11 trainings for villagers by themselves to peripheral villagers of f SRF. In response to livestock incident they collected 50 dead bodies from forest, transported 26 injured livestock to the community, and conducted 29 villages patrolling to mitigate direct THC. And to make people aware about livestock incidents management and to increase their involvement in tiger conservation they conducted 83 village meeting to the community. VTRT the small group of people is acting as inspiration source for local people to save Bengal. So VTRT activities should be promoted by supplying technical skills to ensure future conservation of Bengal tiger.

THE HUMAN AND NATURAL HISTORY OF A BIOLOGICAL INVASION. THE CASE OF GORSE (ULEX EUROPAEUS) ON THE ISLAND OF RÉUNION (INDIAN OCEAN)

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Michèle TARAYRE, CNRS / Université de Rennes 1 ; Anne ATLAN, CNRS / Université de Rennes 1

Biodiversity conservation involves the reduction of the threats endangering the survival of species, habitats and landscapes. Among these threats, biological invasions are a major issue. In order to reduce the impact of invasive species, it is necessary to both prevent their introduction and control their expansion. Given that these species often settle in areas where humans play a central role, the integration of the historical dimension and social context could help optimise management measures. This is what we studied in gorse (*Ulex europaeus*), a global invasive species that is strongly linked to human activities. Gorse was used as fodder and for several other agricultural purposes in its region of origin, and it was intentionally introduced from Europe to many colonies during the 19th century. It is now considered as "one of the 100 World's Worst Invasive Alien Species" by the IUCN. The invaded region studied here is the island of Réunion, where the presence



of humans is recent (within the past 350 years), and where archives are available for almost the entire history of human colonisation. By combining ecological methods, documentary research and semi-structured interviews, we were able to accurately retrace the spatiotemporal dynamics of gorse, and to link this with the joint progression of socio-economic and cultural factors. This multidisciplinary analysis helped identify natural and human dispersion factors, which have a very spatial interaction, and suggests that differential management should be considered according to the territories. They also showed how expansion in natural environments could depend on the dynamics of the plant in agricultural areas, and thus the socio-economic factors in the agricultural world. In general, they confirm the importance of a historical approach to understanding the synergistic relationship between socio-economic factors, environmental disturbances and geographic expansion of an alien species.

EFFECTS OF THE CONSERVATION MANAGEMENT ON THE GRASSLAND VEGETATION OF SÁR MOUNTAIN IN HUNGARY

Boglárka Uj

Szent István University

Judit HÁZI, Szent István University ; Gergely PÁPAY, Szent István University ; Dénes SALÁTA, Szent István University ; Károly PENKSZA, Szent István University

We studied the vegetation of grasslands on the Sár Mountain, in Gyöngyös (Hungary). The areas are mowed regularly by the Bükk National Park and mechanical shrub control was done as well. The effects of these habitat management techniques were investigated on grasslands of different degradation levels. Coenological studies were made between May and June in 2013, 2014 with 2x2 m relevés (Braun-Blanquet, 1964). The study areas were characterised according to nature conservation value categories by Simon (1988) and life forms (Raunkiaer 1934, Pignatti 2005) and social behaviour types by Borhidi. Our results showed that the above mentioned management techniques had positive effects on the diversity of grasslands. On the managed grasslands the abundance of woody species decreased, while the abundance of annual and perennial grass species and dicotyledonous herbaceous species increased. The highest species number (58-78) was recorded in the case of control areas. The number of species was high (47-49) in the areas managed by mowing and mechanical shrub control. The lowest species number (43) was recorded in the areas which were not mowed after mechanical shrub control. According to the nature conservation value categories the number of protected species was the highest in the control areas. Our results approved that regular mowing is needed after mechanical shrub control to sustain the diversity of abandoned grasslands in the long run. This project supported by a grant from Switzerland through the Swiss

Contribution: „Sustainable Nature conversation on Hungarian Natura 2000 sites“, and by Research Centre of Excellence – 8526-5/2014/TUDPOL.

AMPHIBIAN DIVERSITY IN AGROFORESTRY SYSTEMS PRACTICED IN NORTHEAST INDIA - A BIODIVERSITY HOTSPOT

Yashmita Ulman

NERIST

Madhu SHARMA, NERIST ; Awadhesh KUMAR, NERIST

The Northeast Indian biodiversity hotspot faces severe threats from conversion of forests into commercial plantations, 'jhum' cultivation, encroachment of forest lands, grazing, habitat destruction, human-wildlife conflict etc. endangering the survival of several taxa. Many of these northeastern states of India have traditional agroforestry systems in practice for their livelihood. The contribution of agroforestry systems in conserving flora and fauna in this part of India is less explored. Present study attempts to compare amphibian species diversity in three different agroforestry systems namely homegardens, tea plantations and agrisilvicultural systems during rainy season in Sonitpur district of Assam. A total of 13 species of amphibians were found belonging to 5 families with the most dominant species being *Duttaphrynus melanostictus* in homegardens (25.45%) and tea plantations (29.71%) and *Euphlyctis cyanophytis* (31.89%) in agrisilvicultural systems. A total of 3005 individuals were recorded. The highest number of individuals, diversity and species richness was found in homegardens ($n=1308$, $H=2.16$, $S=13$), followed by tea plantations ($n=1070$, $H=1.98$, $S=9$). The least number of individuals, diversity and species richness was found in agrisilvicultural systems ($n=627$, $H=1.65$, $S=6$). Homegardens with their multilayered canopy structure similar to forest have better potential to conserve amphibians as compared to that of tea plantations and agrisilvicultural systems. Tea plantations which have shaded trees prove to be a better contender as compared to that of agrisilvicultural systems. The agrisilvicultural systems might not be very suitable habitat as it is moist only during certain months in a year therefore might be showing lowest amphibian diversity. Overall, it may be concluded that in the era of decreasing forest area, agroforestry systems might be an option for conserving species in these biodiversity hotspots.

ESENIAS-TOOLS: REGIONAL INITIATIVE TO CONSERVE BIODIVERSITY

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A number of tools and strategies are being developed at either the national, regional and global level to face biological invasions which are among of the main threats to biodiversity alongside climate changes and habitat destruction. Lack of expertise and relevant knowledge are among the key factors affecting a proper response to the problem in some countries and regions. A dedicated network - ESENIAS (East and South European Network for Invasive Alien Species) - was established at the regional level in 2011 to overcome this problem. ESENIAS has been organising yearly workshops aimed at promoting capacity building initiatives and increasing knowledge toward the issue within all countries in the region. A new project has been just launched: "East and South European Network for Invasive Alien Species – a tool to support the management of alien species in Bulgaria (ESENIAS-TOOLS)". This initiative, funded under the Programme BG03 "Biodiversity and Ecosystem Services" within the EEA FM (2009-2014), will result in networking and development of IAS tools within the framework of ESENIAS. The objective is to support the management of alien species in Bulgaria and in the overall region in order to contribute to the conservation of native species and natural ecosystems. These tools will include internet portal, IAS database, early warning tool and common methodologies for collection and analysis of data. One of the aims of the project is to establish connections and collaboration with regional and international groups/ organisations. Eleven institutions from Bulgaria, Croatia, Iceland, Greece, R. Macedonia, Romania, Serbia, and Turkey will take part in the project. We expect the project will provide comprehensive information to improve efficiently the conservation decision making in the ESENIAS region, possibly in view of a dedicated regional strategy. Acknowledgements: The study and participation has been supported by the ESENIAS-TOOLS project.

WHOSE COMMONS, WHEN AND FOR WHAT?

Hita Unnikrishnan

Ashoka Trust for Research in Ecology and the Environment (ATREE)

Harini NAGENDRA, Professor, School of Development, Azim Premji University

Urban expansion is a global phenomenon, and one that occurs by often engulfing and embracing the rural. At this time many common spaces, often with complex histories of governance and stewardships become redefined within the prevailing notions of urbanity. However, such commons often pose challenges that result in conflict with respect to their use, management and ownership. These challenges

are often manifested in the ecosystem services they provide and decisions that revolve around the governance of these resources. In this paper, we use the example of a transformed lake in the South Indian megapolis of Bengaluru to look at different changing notions of urban commons pictured against a backdrop of rapid urbanizations, migrations and landscape change. The period of time we have chosen for this study is from 1885 to the modern day. We look at conflicts at each period of change and argue that many of these have shaped the landscape of today and perhaps may be responsible for current notions of ownership associated with the landscape. We combine landscape level change analysis through geospatial means along with official archival records and oral narratives to weave a story of change and its impacts on urban commons and the ecosystem services derived from them. We then pose that knowledge of historical contexts of ecosystem services, conflict and the mechanisms of conflict resolution around urban commons can help understand the trends in contemporary management of commons and help shape more equitable and ecologically robust policy frameworks with respect to the management of commons.

WILD BEE SPECIES CAN BE ENHANCED BY LEAVING UNCUT REFUGES WITHIN LOWLAND AES GRASSLANDS

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University of Bern

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Pollination services provided by wild bees are nowadays threatened by agriculture intensification. However, positive effects from agri-environment schemes (AES) aimed at protecting farmland biodiversity have only exhibited moderate levels of invertebrate population-level responses. Furthermore, evidence that local populations of invertebrate taxa increase over time are still absent. In Switzerland, a study conducted in 2011 (Buri, Humbert & Arlettaz 2014) has established that wild bees are promoted by spatial-temporal modification of mowing regimes within AES extensively managed meadows. Specifically, it was shown that wild bee abundance and species richness significantly increased in meadows where uncut refuges remained (i.e. at each cut 10-20% of area was left uncut and first cut not before 15 June) in comparison to control meadows without refuges with a first cut not before 15 June. An immediate positive effect of delayed mowing (meadows with first cut not before 15 July) was also observed. In 2014, the same meadows were resampled to see whether the applied alternative mowing regimes had stronger effects on wild pollinators' species richness and abundance after four years (in 2014) in comparison to after one year (in 2011) of implementation. We also expected that by adding a sampling year to the data set, it would allow us to



detect effects that would have otherwise stayed statistically undetected. No stronger effect could be observed in 2014 compared to 2011, i.e. population-level responses, however, our study shows the importance of leaving uncut refuges for wild bee species richness and diversity. Our results enhance the importance of sampling bio-indicator groups over several years before implementing scientifically sound management recommendations.

62. THE ECOLOGICAL BASIS OF SOCIAL VALUES

Ayse Uskul

University of Kent

Conservation professionals would benefit from findings that social-environmental contexts not only shape what individuals think, but how they think. This talk discusses the role of social interdependence shaped by livelihood requirements for a) cognitive tendencies among three livelihood groups (fishermen, herders, farmers) and b) responses to social exclusion experiences among children in two livelihood communities (farmers, herders). We examined how livelihood activity shapes cognitive tendencies by comparing herders, farmers, and fishermen on attention, categorization, and reasoning tasks. Compared to herders, fishermen and farmers focused more on the object in relation to its context, attended more holistically to relationships and similarities among objects, and used rule-based reasoning more than similarity-based reasoning. This suggests that farmers and fishermen who rely heavily on collaboration and emphasize harmonious relationships exhibited greater holistic tendencies than members of herding communities, which emphasize individual decision-making and foster social independence. In line with previous work showing that the strong social bonds associated with interdependence values serves as a protective buffer against the pain of being socially excluded, we also showed that children of interdependent farming communities reported ostracism to be less painful than did children from independent herding communities. Moreover, parents' level of social interdependence predicted their children's responses to the ostracism situation. Finally, we observed that farmers' children punished an individual who ostracized someone else less harshly. This provides evidence that livelihood, shaped by environment, is associated with important differences in human psychology. This could have important implications for conservation professionals interested in introducing collaborative processes for the management of commons resources, particularly in developing countries.

USING BENTHIC MACROINVERTEBRATE COMMUNITIES AS INDICATORS OF SUSTAINABLE RICE CROPPING IN A TROPICAL WETLAND

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Wetlands play an important role in regulation of both the quantity and quality of downstream water resources. However, most Rwandan wetlands are threatened by agriculture, with rice farming being the most dominant crop. An adaptive model was developed for sustainable rice cropping meant to maintain wetland health and ecological function including water filtering and storage. This model consists of alternation of rice parcels with uncultivated parcels left in fallow. The main objective of the study was to evaluate the effectiveness of this innovative new model by assessing the richness of benthic macroinvertebrates as biological indicators. This was coupled with examining physicochemical variables as well as sediment retention, chemical recycling and filtering function capacity. Over a one year period, stratified methods for data collection were used across different treatment types. Soil and water chemical analyses were conducted in the laboratory to test nutrient and heavy metal concentrations in fallow and rice in old and young treatments. Results showed that the new habitats created with the new model of rice cropping contributed significantly to an increase richness of macroinvertebrates at the family level, as well as declines of some heavy metal concentrations. This was an interesting result from an integrated wetland landscape created to provide much more habitat heterogeneity favorable to wetland species. Soil properties and composition displayed high similarities between different treatment types which excludes the role of soil type in variation of benthic biological and physicochemical findings. This innovative rice system management model contributed to the maintenance of healthier ecological function while increasing the long term ecological processes of Ndobogo wetland, hence the sustainability of this wetland agricultural system.

MACROINVERTEBRATE DIVERSITY AND COMMUNITY STRUCTURE IN WOODLAND POOLS AND DITCHES AND THEIR RESPONSE TO ARTIFICIAL DRAINAGE IN ESTONIA

Maarja Vaikre

Tartu University

Liina REMM, Tartu University ; Riinu RANNAP, Tartu University

Since the 20th century freshwater ecosystems have been extensively drained for agricultural and forestry purposes. Despite the magnitude of artificial drainage, its impact on



freshwater biodiversity, especially in small forest waterbodies, is still poorly known. We examined macroinvertebrate species richness and assemblages in forests, comparing (i) temporary waterbodies situated in drained plots, (ii) in natural plots, (iii) ditches, and (iv) wheel rut pools. Our aim was to determine macroinvertebrates characteristic to certain type of waterbodies, the impact of forest drainage on macroinvertebrates and the possible functioning of ditches as an alternative habitat. We surveyed 181 waterbodies within six landscape regions and identified 171 macroinvertebrate taxa. We did not detect any strong uniform forest drainage effect on species richness and assemblages and found only few indicator taxa. The ordering of waterbody types by richness differed between landscape regions. Invertebrate assemblages were relatively similar across waterbody types within landscape regions but differed between regions. Therefore it seems that macroinvertebrates are largely dependent on landscape characteristics and drainage do not reduce species richness at waterbody level. However, taxa accumulation curves pooling all regions indicated, that natural waterbodies situated in drained plots harbour less invertebrate taxa than those in natural plots, ditches and wheel rut pools. Thus drainage may have effect at regional scale. As drainage caused the replacement of natural waterbodies with ditches, it is important to ensure that ditches can provide refuge. Since assemblages and species richness in natural temporary waterbodies and drainage ditches were not significantly different, ditches can be suitable habitat for macroinvertebrates of temporary waterbodies at least in semi-naturally managed forests.

DESERT-ADAPTED SPECIES ARE VULNERABLE TO CLIMATE CHANGE: INSIGHTS FROM THE WARMEST REGION ON EARTH

Cândida G. Vale

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Climate change is eroding biodiversity and conservation efforts have been focusing on species' potential responses to these changes. Functional traits associated with adaptive and dispersal capacities may contribute in identifying species' vulnerability levels to climate change. Desert-adapted species could be sensitive to climate change as they may live already in their physiological limits, as in the case of the Sahara-Sahel ecoregions. The identification and spatial location of functional groups of Sahara-Sahel endemics and how they might be affected by the predicted magnitude and velocity of climate change are crucial for biodiversity conservation of the region. We collated trait data for all Sahara-Sahel endemics and summarize the functional strategy of each species into functional groups with different adaptations and dispersal

capacities. Future climate scenarios were classified to identify areas where predicted temperature and precipitation approach the physiological limits of each group, i.e. areas where each functional group is potentially more vulnerable to climate change. Seven functional groups with different distribution patterns were identified. Groups were distinctly threatened by specific magnitudes and velocities of temperature and precipitation changes according to their range. Generally, the magnitude and velocity of precipitation changes contributed to more vulnerability in comparison to temperature changes. While some functional groups with high dispersal abilities may colonize distinct areas, other groups with low adaptive and dispersal capacity may be highly vulnerable to climate change. Different traits contributed to the extent to which species are exposed to climate change and apparently the desert-adapted species are the most vulnerable ones. The identification of vulnerable functional groups in the Sahara-Sahel provides indications on vulnerability to climate change in other warm deserts of the world.

210 ARE ROADLESS AREAS IN THE AMAZON OVERESTIMATED?

Mariana Vale

Federal University of Rio de Janeiro
Pierre IBISCH, Eberswalde University for Sustainable Development ; Monika HOFFMANN, Eberswalde University for Sustainable Development ; Simone FREITAS, Universidade Federal do ABC

Hoffmann et al. (this symposium) present a global map of roadless areas, based on the OpenStreetMap dataset, and defining "roadless areas" as terrestrial areas whose boundaries are within at least 1 km to the nearest road. The analysis found considerably large roadless blocks in the tropics, particularly in the Amazon. The Brazilian Institute for Geography and Statistics (IBGE) road data is slightly more complete, showing ca. 157,000 km of roads in the Brazilian Amazon, as opposed to ca. 114,000 km from OpenStreetMap. Using the 1-km buffer and the IBGE dataset, we find that 94% of the Brazilian Amazon is roadless. The 1-km buffer, however, just reflects the direct impacts of roads on ecosystems. In the Amazon, roads especially have an indirect, contagious impact: they trigger uncontrolled colonization, illegal logging and deforestation. Studies show that from 1985 to 2000, there was an average of about 30% forest loss within 0 to 10-km distance from both roads and highways in the Brazilian Amazon. Using the 10-km buffer and the IBGE road dataset, we find that only 62% of the Brazilian Amazon is roadless. Still, > 85% of the area of the region's indigenous reserves and protected areas are roadless. This may be a conservative estimate, because we do not differentiate roads from highways, although from 1985 to 2000 highways' were reported to cause forest loss up to 50-km distance. It is also important to highlight that rivers are a main transportation



way in the Amazon, facilitating manifold types of natural resource use and extraction. They have not been considered in the definition of 'roadless areas' applied here.

THE LANDSCAPE OF ANTHROPOGENIC MORTALITY RISK FOR LIONS: DETERMINANTS, USE, AND CONSEQUENCES FOR LIONS, PARTICULARLY FOR YOUNG INDIVIDUALS.

Marion Valeix

CNRS

Nicholas ELLIOT, University of Oxford ; David MACDONALD, University of Oxford ; Andrew LOVERIDGE, University of Oxford

The expansion of human populations and activities creates new environments that are hostile to many wild species and underlies many declines and extinctions currently occurring worldwide. In this study, we assess the impact of anthropogenic mortality (trophy hunting, conflict, accidental snaring, and vehicle related mortality) on the African lion population of Hwange National Park, Zimbabwe. This ecosystem is one of the ten lion strongholds left in Africa. We used 206 events of lion mortality due to anthropogenic causes recorded between 1999 and 2012 to identify the variables associated with each anthropogenic mortality source. We then used data from 87 GPS-collared lions since 2002 to calculate cause-specific mortality rates for each sex. We combined these results to create a landscape of anthropogenic mortality risk for each sex. Areas of high mortality risk were located at the periphery of protected areas, with areas of very high mortality located in trophy hunting areas for males and areas of high female mortality distributed more widely across land-use types reflecting the importance of differing sources of mortality. However, even lions whose home range barycentre was inside the protected area (up to 20km inside) had sometimes significant portions of their home range in risky areas, illustrating the extent to which 'edge effects' have the potential to impact this lion population. We further revealed that the proportion of risky areas in the home range was higher for young individuals, particularly males, than experienced adults. For young individuals, we also found that all males that dispersed before 31 months died during transience and the dispersal coincided, regardless of age or body condition, with the arrival of unfamiliar adult males; an instability caused by the high mortality of adult males in trophy hunting areas. These results are crucial to fully grasp the impact of edge effects on wild populations living in isolated protected areas.

ECOLOGICAL AND SOCIAL DIMENSIONS OF TREE DIVERSITY CONSERVATION IN COFFEE AGROFORESTRY SYSTEMS

Vivian Valencia

Columbia University

Luis GARCIA-BARRIOS, El Colegio de la Frontera Sur ; Paige WEST, Columbia University ; Eleanor STERLING, Center for Biodiversity and Conservation, American Museum of Natural History ; Shahid NAEEM, Columbia University

Agroforestry is considered a promising alternative to conventional agriculture that can both conserve biodiversity and support local livelihoods. Coffee agroforestry may be particularly important for sustaining trees of conservation concern and late-successional stage, but this possibility remains unclear. Here, we examined whether coffee agroforestry systems can serve as conservation reservoirs of tree species native to nearby forests. We compared tree diversity, composition and structure between coffee agroforests and forests in La Sepultura Biosphere Reserve in Chiapas, Mexico. We found that, although at the landscape level the full set of coffee agroforests appears to conserve comparable tree species richness to nearby native forests, the species composition that is being conserved is different. Coffee agroforests had a lower proportion of trees of conservation concern, a higher proportion of pioneer trees, were dominated by *Inga* spp., harbored lower tree species diversity at the plot level, and were composed of different tree species compared to native forests. We suggest that conservation practitioners and policy makers seeking to promote coffee agroforestry as a conservation strategy should consider how such agroforestry systems differ in species diversity and composition from the native forests of conservation interest. Further, promoting different coffee agroforest management strategies, such as discouraging the replacement of diverse agroforest canopies with *Inga*-dominated canopies, would help improve the conservation value of coffee agroforests through more sustainable practice.

PRESCRIBED FIRE AS AN ALTERNATIVE MEASURE FOR THE CONSERVATION OF GRASSLANDS

Orsolya Valkó

University of Debrecen

Balázs DEÁK, MTA-DE Biodiversity and Ecosystem Services Research Group ; Péter TÖRÖK, University of Debrecen ; Zsolt VÉGVÁRI, Department of Conservation Zoology, University of Debrecen-Hortobágy National Park Directorate ; Béla TÓTHMÉRÉSZ, MTA-DE Biodiversity and Ecosystem Services Research Group

Traditional fire use was an important part of the landscape management for millennia. Nowadays the majority of human-ignited fires are uncontrolled, often having serious negative impacts on human life, property and biodiversity. The impacts of fire on grassland biodiversity are scarcely documented and there are contrasting opinions on the perspectives of prescribed burning management in European grasslands. One hand, prescribed burning can be a cost-effective method



for the management of open landscapes, the reduction of accumulated litter and for decreasing wildfire risk. On the other hand burning can lead to the encroachment of competitor and invasive species and can threaten endangered plant and animal species; thus, inappropriate burning can result in a loss of biodiversity. We reviewed the publications on the application of prescribed burning in European grasslands and also from North-America to identify findings which can be adapted to the European grassland conservation strategy. We found that not only the application of fire management is scarce in Europe but there is also a lack of published studies on this topic. European studies, contrary to the North-American practice, usually used yearly dormant-season burning, and concluded that this burning type solely is not feasible to preserve species-rich grasslands. In North-America, application of burning has a stronger historical, practical and scientific background; it is fine-tuned in terms of timing, frequency and generally combined with other measures, such as grazing, seed sowing or herbicide application. By this complex approach several nature conservation goals can be fulfilled like increasing landscape-scale heterogeneity and invasion control. For establishing fine-tuned prescribed burning management plans for European grasslands the general findings of carefully designed case-studies should be combined with the practical knowledge of conservation managers.

TO DRINK OR NOT TO DRINK? ELEPHANT MOVEMENT STRATEGIES AS SURFACE WATER AVAILABILITY DECLINES IN A SEMI-ARID SAVANNA.

Hugo Valls Fox
C.N.R.S

Hervé FRITZ, C.N.R.S; Michel DE GARINE-WICHATITSKY, CIRAD; Edwin T MAKUWE, Zimbabwe Parks and Wildlife Management Authority; Simon CHAMAILLÉ-JAMMES, C.N.R.S

Water provision for wildlife is a common practice in semi-arid savannas. Sometimes, the viability of populations in protected areas is increased by, or even depends on, this provision. In these cases the distribution in space of perennial water sources is likely crucial, but so far little is known about the water-driven movement strategies of animals: as water sources dwindle and forage depletion occurs, should individuals make long trips far away from water to obtain better foraging prospects or short trips close to water to guarantee drinking opportunities? This affects where animals will impact their environment. We analyzed GPS relocation data of elephant breeding herds during the 2013 dry season in Hwange National Park, Zimbabwe. Elephants prefer drinking at periodic time intervals every 24h, 48h and 72h. The average number of visits to water doubled from June to October due to the addition of short (about 4h) commuting trips between waterholes. As of September, 72h-trips disappeared, however the number of 48h-trips, reaching 5-8 km from water, remained constant. The

number of 24h-trips increased and they were made at higher speed. As a result, during those trips, maximum distance to water increased from 2.5 to 4km, suggesting the avoidance of depleted foraging sites located close to water. Our study confirms that there is a threshold distance beyond which elephants cannot use the landscape during the dry season, but more importantly it reveals that below this distance elephants are able to adjust their use of the environment to foraging constraints.

95 - MITIGATING THE NEGATIVE EFFECTS OF ROADS AND TRAFFIC ON WILDLIFE: HOW EFFECTIVE ARE OUR STRATEGIES?

Edgar Alexander Van Der Grift

Alterra, Wageningen UR

Marcel Pieter HUIJSER, Montana State University, Western Transportation Institute; Carme ROSELL, Minuartia / Universitat de Barcelona

Roads may result in habitat loss, movement barriers and direct mortality. In some cases wildlife population viability may be affected. Several measures are available to help reduce wildlife-vehicle collisions and restore wildlife connectivity across roads: wildlife fences, wildlife crossing structures, and warning signs activated by wildlife detection systems. However, the effectiveness of such measures is not well studied. Although some sort of monitoring is usually carried out, in many cases the methods are not optimal and they may not allow for a proper evaluation of the effectiveness of the measures. Partially based on the SAFEROAD project (www.saferoad-cedr.org), financed by CEDR, we synthesized the effectiveness of mitigation measures through literature review. We selected studies in which the mitigation measures were clearly described and that included quantitative response variables based on study designs that included a before-after comparison and/or a comparison between treatment and control sites. We deduced guidelines for monitoring based on research principles that allow for maximizing inferential strength of study designs. We present the results of our review and formulated guidelines for evaluating the effectiveness of road mitigation measures. Selected key issues in the guidelines will be illustrated through three case studies: (1) roe deer mortality before and after the construction of a wildlife overpass, showing the importance of proper selection of impact and control sites; (2) large mammal mortality at a road section with an animal detection system, showing the effect of length of the mitigated road section and the spatial precision of crash and carcass data; (3) ungulate-vehicle collisions monitoring, showing the importance of establishing proper procedures and indicators for measuring effects of mitigation and managing the conflict.



95 - THE ROAD AHEAD - THE FUTURE OF ROAD ECOLOGY IN A RAPIDLY CHANGING WORLD.

Rodney Van Der Ree

Australian Research Centre for Urban Ecology

There are currently in excess of 64 million km of roads on Earth – enough for 83 round-trips to the moon. Even some of the most important regions for biodiversity have extensive road networks – the Amazon contains ~100,000 km of road. The construction of new roads continues apace, especially in developing countries. China's highway network exceeds that of the USA, but was constructed in less than half the time. The ecological and environmental impacts of roads, railways, utility easements and vehicles and trains are diverse, numerous and mostly deleterious. In this presentation, I attempt to synthesise the presentations within this symposium and provide some directions for the future of road ecology. These directions are derived from this symposium, a recent survey of ~600 practitioners globally, as well as insights gleaned from editing the "Handbook of Road Ecology", to be published in mid 2015 by Wiley publishers. This handbook contains 62 chapters, written by over 100 authors from 25 countries. The recommendations focus on: (i) ensuring the important areas for biodiversity are spared from road construction, including through more strategic landscape-scale planning; (ii) applying offsets only after genuinely attempting to avoid, minimise and mitigate impacts; (iii) achieving greater collaboration among countries, agencies and projects to pool funding and sites for more reliable investigations; (iv) improving the study designs of monitoring programs; (v) adopting a more experimental approach to planning, implementing and evaluating road impacts and mitigation measures; and (vi) ensuring research data is made widely available and conducting meta-analyses of such data. The next few decades will see the construction of 25 million lane-km of road, 90% of which will be in developing countries. The opportunity to build a more-sustainable global road network and implement effective evaluation of mitigation is now.

MODELING DIRECT AND INDIRECT CLIMATE CHANGE IMPACTS ON KEY HABITAT OF GRASSLAND BIRDS: A CASE STUDY ON BREEDING HABITAT OF DUTCH MEADOW BIRDS.

Jerry Van Dijk

Utrecht University

Roland VAN DER VLIET, Utrecht University ; Harm DE JONG, District water control board De Stichtse Rijnlanden ; Maarten ZEYLMANS VAN EMMICHOVEN, Utrecht University ; Henk VAN HARDEVELD, District water control board De Stichtse

Rijnlanden ; Stefan DEKKER, Utrecht University ; Martin WASSEN, Utrecht University

Climate change can directly affect habitat quality, but may also indirectly affect that quality by inducing land use change. Such indirect effects are often ignored in projections of climate change impact on species, but are potentially more detrimental than direct climate effects. The objective of this study was to determine the relative impact of direct and indirect effects of climate change on breeding habitat of four meadow bird species (Black-tailed godwit, Common redshank, Eurasian oystercatcher and Northern lapwing) in the Netherlands. Habitat models were developed that link meadow bird breeding densities to three habitat characteristics that are sensitive to environmental change: landscape openness, land use and groundwater level. These models were used to assess the impact of scenarios of landscape change with and without climate change on meadow bird breeding habitat quality for a case study area in the peat meadow district of the Netherlands. Land use change was modelled in response to changes in groundwater level and soil subsidence. All scenarios led to significantly reduced habitat quality for all species, mainly as a result of conversion of grassland to bioenergy crops, which reduces landscape openness. Direct effects of climate change on habitat quality were largely absent, indicating that human adaptation to climate change rather than direct effects of climate change itself was decisive for the degradation of habitat quality for breeding meadow birds. We therefore conclude that scenario studies exploring impacts of climate change should not only incorporate direct effects of climate change on habitat quality, but also land use change resulting from human responses to climate change to accurately assess the impact of climate change on species.

CONSERVING BUTTERFLIES IN PLANTATION FOREST LANDSCAPES: ROLE OF LOCAL AND LANDSCAPE FACTORS

Inge Van Halder

INRA

Luc BARBARO, INRA ; Hervé JACTEL, INRA

The area of plantation forests is increasing worldwide, but their contribution to biodiversity conservation remains controversial. We present the results of several studies on butterfly diversity in the Landes de Gascogne Forest in southwest France, the largest plantation forest of Europe with almost 1 million hectares of pure maritime pine stands. Within this region we sampled butterflies in different successional stages of pine stands and in two semi-natural habitats, herbaceous firebreaks and deciduous woodlands either present as isolated patches or as riparian forests. Butterflies were simultaneously sampled inside the plots and at their edges. The most important factors determining butterfly community composition were the



composition of understorey vegetation at the local scale and the presence of semi-natural habitats at the landscape scale. Species richness in firebreaks was twice that of other habitat types and both firebreaks and deciduous woodlands had butterfly species not found in pine stands. Riparian forests had a higher forest species richness and hosted more habitat specialists, with higher sensitivity to temperature extremes, than deciduous woodland patches. For deciduous patches forest species richness and community composition did not vary with patch area or isolation; however habitat quality, especially host plant composition, had a significant effect. Edge habitats had a higher species richness and a different community composition than plot interiors, but some species preferred plot interiors. Many species were found in several edge and interior habitat types, including pine stand interiors, and the use of supplementary and complementary resources in different habitats is probably a key process in these dynamic, mosaic landscapes for butterfly conservation.

99-NATURAL NEIGHBOURHOODS FOR CITY CHILDREN

Yolanda Van Heezik

University of Otago

Kate HAND, University of Otago ; Claire FREEMAN, University of Otago ; Aviva STEIN, University of Otago ; Mariano RECIO, University of Otago ; Philip SEDDON, University of Otago

That children need nature for health and well-being is widely accepted, but what type of nature? The assumption that children must interact with wild pristine nature has justified recognition of a "nature deficit disorder" when such contact is lacking. We have evaluated children's reported nature interactions during independent movements, and biodiversity within self-defined neighbourhood nature maps in three cities in New Zealand, to explore nature contact from a child's perspective, in an urban context. In this presentation we address the questions: (1) is biodiversity available and accessible to children living in cities? (2) are children choosing to be in the most bio-diverse areas available to them?; and (3) what social factors support or limit contact with nature? Most children in these cities had access to bio-diverse areas, although availability was limited when independent home range size was small and in higher deprivation areas. When outside the home, children preferred to remain in their own gardens, and often did not use bio-diverse areas available to them. The often restricted independent home ranges emphasizes the importance of gardens as biodiverse areas.

126 HOW ECONOMIC SECTORS CAN CONTRIBUTE TO SUSTAINABLE USE AND CONSERVATION OF BIODIVERSITY

Mark Van Oorschot

PBL Netherlands Environmental Assessment Agency
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Addressing the underlying causes of biodiversity loss requires rethinking how food systems operate, how wood and energy are extracted and produced, and how fresh waters and oceans are managed. Land-use is regarded as the main drivers of global terrestrial biodiversity loss. Developments in sectors such as agriculture, forestry, water management and fisheries are responsible for the main drivers of future biodiversity loss. Vice versa, economic sectors depend on biodiversity and ecosystems in various ways to provide them with the resources they need for the world's growing human population. Within sectors a large potential exists of more 'biodiversity-friendly production methods' and 'nature-based solutions'. In agriculture via a combination of agricultural practices to enhance productivity, more sustainable production methods, reducing food losses, and alternative diets. Sustainable forest management should be combined with reduced wood consumption, to ensure that forests are no longer converted. Reducing fishery efforts can halt fish stock depletion, while keeping catches stable. Better land use practices will improve freshwater biodiversity and reduce pollution. Combining such options in scenario analyses shows that it is possible to reduce global terrestrial biodiversity loss and expand protected areas, and at the same time eradicate poverty and hunger, provide access to safe drinking water and modern energy sources, and limiting temperature rise to two degrees. Dependency on natural resources, cost-effectiveness of nature based solutions and also social responsibility are reasons to take up biodiversity in business policies decisions. To speed-up the integration of biodiversity within sector policies effectively, 4 strategies are suggested: (1) integrated water and landscape management (2) promote biodiversity criteria in voluntary market standards; (3) strengthen consumer awareness of biodiversity; and (4) mobilise finance for sectoral solutions.

GENETIC RESCUE OF CRITICALLY ENDANGERED PLANT SPECIES AS A TOOL FOR GRASSLAND RESTORATION

Fabienne Van Rossum

Botanic Garden Meise

Sarah LE PAJOLEC, Botanic Garden Meise ; Olivier RASPÉ, Botanic Garden Meise ; Sandrine GODEFROID, Botanic Garden Meise

Habitat fragmentation and degradation of grassland habitats have been so severe in Western Europe that many of their typical plant species only remain as a few, often small and isolated, populations. These populations are susceptible to genetic, environmental and demographic stochasticity and



are likely to express low reproductive success, reduced gene flow, inbreeding depression, and genetic erosion, threatening their long-term persistence. The usual ecological management practices that aim at restoring habitat quality may not be sufficient for ensuring sustainable population persistence, especially in the absence of a persistent soil seed bank and when they are already too rare for producing enough seeds for conventional hay transfer. Their restoration must therefore go through genetic rescue (e.g. allo- or auto-reinforcements, restoration of connectivity by corridors). In the frame of the EU LIFE project "Herbages" (<http://www.life-herbages.eu>) that aims at improving the conservation status of priority grasslands in Southern Belgium, genetic rescue experiments have been started in autumn 2013 for several grassland species that are critically endangered in Belgium, e.g. *Arnica montana*, *Dianthus deltoides* and *Helichrysum arenarium*. The aim is to increase the effective size of remaining populations (reinforcement) and restore extinct populations (reintroduction) in order to improve connectivity in the landscape. Here we present (i) the experimental design applied, which comprises an estimation of the quality of target and source populations (including genetic diversity and structure), and an assessment of soil seed bank composition of the target sites, and (ii) the first results of the demographic survey (e.g. survival, floral production, reproductive success) aiming at estimating the viability of the transplanted populations, and of the experimental estimation of fitness of the progeny, in order to test for inbreeding or outbreeding depression.

65. WHEN DO OCCUPANCY MODELS PRODUCE RELIABLE INFERENCES FROM OPPORTUNISTIC DATA?

Arco Van Strien

Statistics Netherlands

Chris VAN SWAAY, Dutch Butterfly Conservation ; Tim TERMAAT, Dutch Butterfly Conservation

Opportunistic citizen science data are considered to be a potential valuable source of information on biodiversity. But opportunistic data suffer from all sorts of biases, especially those caused by temporal variation of observation effort and by incomplete reporting of sightings. Occupancy models are able to control for biases encountered with opportunistic data, but it is not always clear whether inferences derived from a particular dataset are indeed reliable. To learn under which conditions we may achieve reliable inferences we examined a number of parameters derived from several opportunistic datasets. We applied occupancy models to estimate trends per region, trends per site, colonisation and extinction, trends in flight period and species richness per site. All results were validated using standardized monitoring data from the same sites. We conclude that validation is important to learn when occupancy models produce reliable inferences.

TOWARDS A GLOBAL BUTTERFLY INDEX

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Insects dominate terrestrial biodiversity in terms of species numbers and biomass and are integral to ecosystem function. Yet there is a dearth of information on their conservation status and trends in populations - in particular at the global scale. We are working towards the production of a Global Butterfly Index as one of the global indicators to monitor biodiversity change. Butterflies, being the most popular group of insects, have proven to be useful indicators in the temperate zone, for example as headline indicator by the European Environment Agency to follow changes in biodiversity over the European Union or as community indicators for climate change. However, developing a global insect indicator has many challenges. For example, the standard butterfly monitoring protocol in temperate regions ('Pollard walks') is not suitable for tropical rainforests. Yet it is essential to monitor population trends in these global hotspots. In this paper we present additional methods such as fruit baiting and time counts that can also be used in citizen science projects to extend butterfly monitoring to these parts of the world. We show how these diverse protocols can be brought together and developed into a single Global Butterfly Index. And we present our next steps towards the development of the first global insect indicator.

HALTING THE LOSS OF EUROPEAN BIODIVERSITY AND ECOSYSTEM SERVICES? QUANTIFYING GAINS, LOSSES AND TRADE-OFFS DUE TO LAND USE CHANGE UNDER A RANGE OF EU POLICY SCENARIOS.

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In 2010, the European Commission (EC) committed to “Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020 (...)”. While the EC has e.g. set a 15% restoration target and studied policy options under a No Net Loss initiative, further action is urgent. To be able to prioritise conservation and restoration actions, it is important to understand past trends of the current state of biodiversity and ecosystem services (ES) and future threats such as land use change and climate change. Until 2020, land use changes are the most direct threat. The understanding of these threats also assists in prioritizing climate change adaptation options. We simulated land use change at 1km resolution up to 2020 for the EU under four policy scenarios that are considered by the EC. The impacts of land use change are next quantified using ten indicators representing biodiversity and a range of ES. Scenarios include: (1) Business as Usual, as a counterfactual scenario; (2) Avoidance; stricter regulations on land conversion and land use intensity; (3) Reduce, as (2) but with additional measures to prevent and compensate impacts; (4) Offset, as (3) but with mandatory requirements to restore habitat to offset unavoidable land take. The results show where in Europe pressures and impacts on land are strongest, and which kind of biodiversity and ES are most at risk. Trends are analysed per landscape type on a range from natural to urban. This allows in-depth inference of land use change impacts and policy effectiveness. We demonstrate what trade-offs exist between alternate land uses and how these may alleviate or worsen as a result of policy interventions. Our results quantitatively indicate that while full implementation of current EU legislation is of prime importance, additional measures in the wider environment, addressing key drivers of land use change, are urgently needed to address widespread losses of biodiversity and ES.

INNOVATIVE MONITORING METHODS IN THE CONTEXT OF ADAPTIVE MANAGEMENT OF HUNTING IN THE AMAZON, COLOMBIA

Nathalie Van Vliet

CIFOR

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Managing complex hunting socio-ecological systems within a context of uncertainty requires setting up efficient ways to monitor changes in the system and inform decision making in

an adaptive management process. In such context, building trust through collaboration, institutional development, and social learning enhances efforts to foster ecosystem co-management. This approach draws explicit attention to the learning and collaboration functions necessary to improve our understanding of, and ability to respond to, complex social-ecological systems. Monitoring methods can generate observations over long time periods, incorporate large sample sizes, are relatively inexpensive and invite the participation of harvesters as researchers. We tested a combination of role playing games, traditional knowledge, technological innovations (camera traps and KoBoCollect) to co-develop a monitoring system for wildlife resources and hunting efforts in an indigenous hunting territory in the Amazon Colombia where hunters have organized themselves to develop an adaptive management approach to their hunting activities. The methods involve the active participation of hunters in data collection and an automatic tool for data analysis that allows users to visualize outputs instantaneously (e.g. map of offtakes per species, graph with number of prey per species per month). The information generated is directly usable by hunters for management decisions. We demonstrate the importance of such participatory monitoring models for building institutional trust between stakeholders (indigenous communities, governmental institutions in charge of wildlife management and civil society) as well as provide tools that are directly usable by local decision makers.

ID#7. INFLUENCE OF BELIEFS AND TABOOS ON HUNTING AND WILDMEAT HANDLING PRACTICES IN AN INDIGENOUS RESERVE FROM AMAZONAS, COLOMBIA: IMPLICATIONS ON HUMAN HEALTH AND CONSERVATION

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While there is increased knowledge about the links between wildlife consumption and zoonosis in tropical areas, few studies have approached the topic from the perspective of the users, exploring how local knowledge on human health and conservation (often transmitted through beliefs and taboos) influence practices from hunting to the handling of wildmeat and cooking of the meat. Our mixed-method data analysis was set out to explore the beliefs and taboos associated with hunting and wildmeat consumption and the relationship with human health, well-being and conservation in Ticuna indigenous communities from Amazonas, Colombia. This involved qualitative ethnographic data collected at different gender and age groups, on the myths around wildlife taboos



including accounts of symptoms associated with braking taboos, and incentives for abiding by taboos. We then gathered information on how local knowledge on wildlife use influenced practices at all levels from hunting, handling the carcasses, distribution and cooking the meat. We also used quantitative information on wildmeat consumption to understand the linkages between taboos and consumption patterns. We provide evidence that the conservation value of taboos may be limited but that the social value of taboos may be rooted in concerted attempts to preserve a physical, spiritual, moral and cultural integrity. Furthermore, we found that, despite rapid socio cultural transformations, there is a sophisticated traditional ecological and epidemiological knowledge that is likely to protect local people from zoonotic disease and unhealthy diets.

APPLICATION OF A THRESHOLD TO DETERMINE BONTEBOK PURITY: DETRIMENTAL OR BENEFICIAL?

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Human-mediated hybridization poses a serious threat to the genetic integrity of threatened interfertile species or sub-species, such as the bontebok (*Damaliscus pygargus pygargus*) and blesbok (*Damaliscus pygargus phillipsi*). The identification of pure parental and admixed populations is mandatory to design sound conservation strategies. Whenever identifications based of morphological traits are difficult, molecular analyses is needed to identify hybrids or introgressed individuals. In this study our objective was to determine an acceptable threshold of bontebok purity that would not result in further loss of genetic diversity. The study was based on 12 microsatellite loci. NEWHYBRID was used to simulate a population with up to four generations of coexistence between bontebok and blesbok, F1 hybrids, F2 hybrids, backcrosses to each parental species and double backcrosses to each parental species. For individual coefficient of membership the Bayesian model-based clustering program STRUCTURE was used. Thresholds of 0.85 to 1.00 were tested to determine where most hybrids would be detected and removed while the least amount of pure animals would be misclassified as hybrids. A threshold of 90%

was identified as being optimal and can successfully identify all pure blesbok, F1 and F2 hybrids as well as backcrosses and double backcrosses to blesbok. Approximately 3% of the backcrosses to bontebok and 40% of the double backcrosses to bontebok would be misclassified as pure bontebok and 1% of pure bontebok would be misclassified as hybrids. Overall a threshold of 90% would identify and remove 94% of hybrid animals successfully while a threshold greater than 95% would remove 8% pure bontebok and 98% hybrids animals. Due to widespread hybridization between bontebok and blesbok conservation plans should be enforced to preserve the integrity of their gene pools and the persistence of pure populations that are genetically unique must remain paramount.

HABITAT FRAGMENTATION AS SURROGATE OF POPULATION CONNECTIVITY: RESULTS FROM AN ISOLATION BY DISTANCE MODEL COUPLED WITH OCEANOGRAPHIC AND GENETIC DATA

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Connectivity between populations is the foundation of meta-population dynamic and requires to be accurately characterized for efficient management planning. In the marine realm, seascape genetic attempts to relate patterns of genetic connectivity with environmental forcing, including habitat spatial distribution. This can shed new lights on weak and chaotic genetic patterns. The simplest of this approach related population structure with geographical distance; a model termed as Isolation By Distance (IBD). Beyond geographic distance, it has been shown in the terrestrial literature that habitat patchiness can also strongly impact demographic and genetic connectivity patterns, but similar demonstration is still lacking in the marine realm. In particular for some species with a pelagic life cycle stage, the relationship between habitat patchiness and genetic connectivity is blurred by biological and physical processes influencing the dispersal kernel, such as oceanic currents pathways or pelagic larvae duration (PLD). Here, we first developed a stepping stone gene flow model coupled with biophysical information on larval dispersal to evaluate the extent by which habitat patchiness could explain patterns of measured genetic connectivity between several South West Pacific Islands. The model was applied to the sessile giant clam *Tridacna maxima*, listed on the annexe II of CITES



Washington convention, and remains relevant for any species with similar PLD (≈ 10 days). The model is used to devise the best conservation strategy to maintain the existing giant clam's meta-population.

218 TOWARDS A MULTI-PERSPECTIVE APPROACH IN NATURE POLICY

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In the last decennia, EU policy has matured and has become the bedrock for nature conservation in Europe. The Birds and Habitats Directives are the central pillars of this policy, but have been complemented with other policies, such as promoting green infrastructure and ecosystem services. In implementing this policy and turning it into practice, the challenge is how to 'make people click', how to involve citizens and businesses. The key is to understand their motives to engage with nature and what they perceive as nature. As people have different visions, they will prefer different future states of nature and biodiversity. In the Nature Outlook, PBL Netherlands Environmental Assessment Agency structures the various existing visions of organizations and citizens in the EU into various 'perspectives' to nature. By doing so the study aims to provide inspiration for strategic discussions on EU policy for nature and biodiversity. The objective is twofold. Firstly, the project structures the debate, by presenting the existing visions to nature into a set of perspectives on the state of nature in 2050, roles of actors and possible actions. The perspectives are elaborated in storylines, images, maps and figures. Secondly, a range of policy options with regard to nature and related sectors, will be discussed in the light of the perspectives. Suggestions will be provided for (new) actions and coalitions that could help to integrate biodiversity more in other sectors and to involve civil society. The Nature Outlook uses mixed methods: participatory research with stakeholders, literature analysis of narratives of frames, a survey among citizens about images of nature, and modelling of biodiversity and ecosystem services. At the Natura 2000 symposium in Montpellier, the preliminary results will be presented. Final results will be published in the first half of 2016, during the Dutch presidency of the EU Council.

A FLEXIBLE AND EFFICIENT MODELLING APPROACH TO TARGET ROAD FRAGMENTATION MITIGATION AT THE IMPACT ASSESSMENT PHASE

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Environmental impact assessments (EIAs) are mandatory in most countries prior to large infrastructure projects such as roads. Although animal movement and distribution data could guide mitigation of impacts of fragmentation and vehicle collision, the scale of EIAs is often inadequate to collect this information. In our study area in Gabon (Central Africa), we used field data collected over less than 10 weeks to demonstrate a new modelling approach to prioritize mitigation efforts to reduce the effects of fragmentation. We used stratified random transect surveys conducted in two seasons to model the distribution of African forest elephant (*Loxodonta cyclotis*), forest buffalo (*Syncerus caffer nanus*), and sitatunga (*Tragelaphus spekii*) in a mosaic landscape along an unpaved road scheduled for paving. Using a validation dataset of recorded crossing locations, we evaluated the performance in predicting actual road crossings of three types of models of animal movements with explicit species- and season-specific hypotheses. We developed a unique and flexible scoring method for prioritizing 30 m sections of the road for the implementation of fragmentation mitigation measures, allowing managers to adjust thresholds based on budgets and management goals. In addition, the method is flexible enough to incorporate other potential movement models and scoring criteria, allowing for its wider use in other linear infrastructure projects. Incorporating our method in the EIAs of large infrastructure projects could contribute to limit the costs of fragmentation mitigation measures and increase the number of roads with connectivity management plans. We advocate for increased collaboration and partnerships between environmental consultants and road engineers from the private sector and conservation professionals to incorporate fragmentation mitigation measures in road projects, starting at the preconstruction stage, and thus improve operational standards.

IN PURSUIT OF THE COMMON UNDERSTANDING OF FOREST GRAZING: THE CHANGING VIEWS OF HUNGARIAN FORESTERS AND CONSERVATIONISTS

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Forest grazing is a traditional land use system disappeared in many parts of Europe including Hungary as a result of total ban on livestock grazing in forests in the past decades. However, international experience has recently implied the economic and conservation benefits of such (properly applied) multiple-use systems. Re-introduction requires finding the common ground between stakeholders such as forest managers and conservationists. As the first step in bridging the gap, the views of these groups are revealed. The content of some selected national journals, the key discussion forums of practitioners were analysed with qualitative and quantitative methods. Journal selection was based on the first publication date (to recognise changes in views in the altering legal environment regulating forest grazing). Also, professional quality and general acceptance were regarded, based on ten expert interviews. The Hungarian forester literature has been focusing on forest grazing since the beginning (1862). There was no conclusion about its harms or benefits in the first 100 years: forest grazing was banned in some regions to protect seedlings and soils; but deliberately used to boost forest regeneration in others. As an important source of non-timber forest product income it was subjected to forest management planning until 1961. Since then, views have been mostly negative, with occasional acknowledgements of potential benefits. Until recently, conservationists typically did not focus on forest grazing, or it was regarded only from a landscape history or botanical perspective. Based on field experience, forest grazing has been re-introduced in some protected areas, but there is no sign of it in the national conservation literature. Considering the EU support of agroforestry systems it is crucial to positively influence the views of foresters' (and legislators). To do so, the availability of practical conservation experience as published case studies could be a useful input.

GAP CHARACTERISTICS FROM LIDAR REMOTE SENSING DATA IN AN ALLUVIAL FOREST

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Due to severe threatening of biodiversity, the monitoring and reporting on the state of nature has become more and more important in the last decades. Especially the spreading of invasive species requires up-to-date monitoring and reporting for conservation and management efforts. One of the most

endangered ecosystems are alluvial forests, since their high stand dynamics opens many niches for invasive species. However, to monitor natural and close-to-natural stands can be difficult using only field measurements, mainly over extended areas. Especially, canopy gaps are difficult to survey from the ground, but LiDAR data are a powerful tool to acquire synoptic 3D data from the sites. Therefore we used LiDAR data in conjunction with field measurements to analyze the conservation status of an alluvial forest. Two airborne LiDAR datasets were collected during leaf-off (March) and leaf-on (July) condition. The objective of our study is to investigate and quantify the gaps and their characteristics since the spatial properties of gaps have a large influence on the species composition and dynamics of the forest. The investigated alluvial forest associated with the Tisza Lake (Hungary) is endangered by invasive species. The most frequently occurring invasive species are *Acer negundo*, *Fraxinus pennsylvanica* and *Amorpha fruticosa*, which are found in the study area mainly in old and unmanaged gaps. The gaps were formed by management activities and large fallen trees. Gap size, connectivity, shape complexity, vegetation height and vertical structure in the gaps were mapped and analyzed from the LiDAR data. We investigated whether the horizontal and vertical structure complexity of the forest and canopy could indicate the presence of plant invasion in the investigated area. Analysis of canopy gap characteristics allows a more accurate and spatially explicit survey of understory status with respect to establishment of invasive species in order to implement early combatting measures.

HOW GREEN ARE LARGE SCALE WIND FARM DEVELOPMENT PROJECTS? A WIN-WIN SPATIAL PLANNING ALLOWING GREEN INVESTMENTS AND CONSERVING CINEREOUS VULTURES (AEGYPIUS MONACHUS)

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Wind industry is among fastest evolving green sectors of renewable energy production, contributing on one hand to gas emission reduction, but negatively affecting on the other hand species that are prone to collision with wind turbine



blades. This paper attempts to resolve the conflict between wind energy investments and conservation. We used telemetry data for an endangered vulture in Thrace NE Greece (19 tagged birds), in order to predict vulture accumulated collision mortality stemming from operating and proposed wind farms, by combining species spatial distribution modelling with a collision risk model. We present a nine-zone species-specific sensitivity map that consists of four zones in the population core area (39% population home range), four zones in the non-core area and a periphery zone, in terms of the population relative spatial use. The annual predicted collision mortality for the thirteen operating wind farms was from 12 to 3 deaths under collisions risk model's avoidance rates from 98% to 99.5%, respectively. In all cases, wind-farm mortality occurred mainly in the population core area and would increase by 11 fold in the future, in case that all current and proposed wind-farms will operate. We proved that the national Strategic Environmental Assessment failed to produce win-win solution for vulture conservation and wind-farm development, as the population is expected to rapidly decline in the future. Our zoning system offered a spatially explicit solution to the problem. We showed that core areas should be excluded from further wind farm development, and any investment should be planned on the basis of the species sensitivity map starting from the periphery towards the non-core areas. The combination of spatial modelling with collision risk models offers a tool for rapid and well-informed conservation decisions when large scale development projects are evaluated on the basis of target species movement ecology.

USE OF SPECIES RICHNESS IN GLOBAL CONSERVATION PLANNING LEADS TO LARGE LOSSES IN SPECIES COVERAGE

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In an effort to halt the global decline of biodiversity and expand the current protected area network, interest in identifying global priority areas for conservation action has increased. Several studies suggest identifying conservation priority areas with species richness, particularly richness of small range and/or threatened species. We currently lack evidence detailing the potential loss of species representation if priority areas for conservation are identified using species richness only. Here we compare the average species representation from two spatial conservation prioritization assessments. In the first assessment, priority areas were identified from 12 species richness maps of all and small range amphibians, birds, and mammals and all and small range critically endangered, endangered, and vulnerable species.

In the second assessment, priority areas for conservation were based on the global range maps for 21,671 terrestrial vertebrate species listed by the International Union for the Conservation of Nature (IUCN). Our results show that identifying priority areas for conservation using species richness alone reduces average species representation compared to priority areas identified using species range maps. As methods and software currently exist for processing large numbers of individual species distribution maps in spatial prioritization, the use of species richness appears to be an unnecessary simplification of biodiversity pattern.

ALONG A GRADIENT FROM FOREST TO OIL PALM PLANTATION: INFLUENCE OF HABITAT MODIFICATION ON AFROTROPICAL BIRDS

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The rising demand for palm oil makes West and Central Africa ever more interesting for oil palm investors, triggering the conversion of rainforests into agro-industrial monocultures. However, studies on the biodiversity and conservation value of such plantations are still very rare. In this study, we examined 6,946 bird encounters from 432 sampling points distributed over 48 one-km² blocks around twelve villages, situated either in Korup National Park, unprotected agroforestry landscape and industrial oil palm plantation, respectively. We applied MARS (multiple additive regression splines) to model species richness of different bird guilds in relation to a disturbance index based on the proportion of natural forest per sample block. In total, we recorded 198 bird species. At the scale of one-km² blocks, overall bird species richness ranged from a minimum of 23 (first-order Jackknife richness estimator: 29.22 ± 1.78 SD) in the oil palm plantation up to 84 (118.67 ± 5.96) in the agroforestry matrix. On average, bird species richness was 3.81% lower in the national park and fell by 34.95% in the oil palm plantation compared to the unprotected agroforestry landscape. Specialized feeders (ant follower/terrestrial insectivores), forest specialists and Guineo-Congolian-forest biome restricted species were negatively affected by the transformation of natural forest, while widespread (sub-Saharan, tropical African) and open-land species increased with disturbance, as shown by MARS. This study documents for the first time in Africa how industrial oil palm plantations impoverish the bird fauna, and highlights the conservation value of forest matrix landscapes created through land use practices by smallholders.



USING PROXIES OF MARINE PROTECTED AREA BOUNDARIES FOR MEASURING CONSERVATION TARGETS IN THE CORAL TRIANGLE

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As international collaborative conservation initiatives becomes more common, it is increasingly important to measure their success not only for quantifying how much biodiversity they protect, but also to justify the time and resources invested in them. A common approach to quantify success of marine protected areas (MPAs) is to measure the area of habitat or number of species protected within their borders. This is often achieved using Geographic Information Systems by overlaying the boundaries of the protected area with a map of habitats or species distribution. However, this can be challenging due to missing official MPA boundary layers. A widely used approach to solve this problem is to create a proxy of these boundaries. This is done by creating a circular polygon by buffering a known point inside the MPA, which area matches the official area reported for the respective protected area by a national authority. The Coral Triangle Atlas provides the opportunity to measure the errors from such methods at the Coral Triangle region's scale. We converted 612 existing MPA boundaries into point data at their centroids and created circular polygons of equal areas to the original MPA. This approach allowed us to compare the area of protected coral reef using the buffered proxies and the real boundaries. At both the level of the Coral Triangle region and of individual countries, we found that the buffered proxies resulted in an underestimation of protected reef area. The size of MPAs does not have a significant effect on the error except when the MPAs are larger than 100 km². Therefore, using buffers at a national scale for small MPAs could resolve the problem of missing boundaries and be more cost effective than collecting the real boundaries. However, this is true only if the real size of the MPA is known.

191 HOW EFFECTIVE ARE CONSERVATION INTERVENTIONS AT ACHIEVING BEHAVIOUR CHANGE?

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Human behavior is a key driver of all major threats to biodiversity. As such, to conserve biodiversity we must be able to influence human behavior. To this end a number of conservation outreach efforts, including environmental education and social marketing, have been undertaken.

However, these efforts have historically suffered from a lack of evaluation, leading some to question their real impact in terms of mitigating threats to biodiversity. To understand if efforts to influence behaviour are being effective we conducted a systematic review of peer-reviewed and grey literature. We documented what indicators are being used to evaluate behaviour change, what experimental designs are being used to link interventions and conservation outcomes and and if cost-benefit trade-offs were taken into account. Our preliminary results show that conservation interventions that aim to influence behaviour are generally poorly evaluated. Information regarding outputs (eg. number of schools visited or posters printed) is still frequently used as a measure of success and changes in knowledge and attitudes are often used as proxies for behaviour. Furthermore, evaluation does focus on actual behaviour, the experimental designs used largely do not allow for causal links between the conservation effort and the change in behaviour to be determined. Lastly cost-benefits relationships are rarely used to determine what interventions should be carried out. If we are to seriously attempt to influence human behaviour conservationists need to ensure evaluation is included as part of any intervention and not merely seen as an optional add-on. Furthermore, conservation can turn to disciplines such as public health or development which have for decades implemented robust evaluations of their interventions.

DEMONSTRATING COMMITMENT: THE CASE OF WETLAND CONSERVATION IN TAMIL NADU, SOUTH INDIA

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GoTN

The paper discusses the policy and programme interventions for wetland conservation in the south Indian state of Tamil Nadu from the perspective of a stakeholder group that is often side-lined in conservation dialogues viz. the administrators. Tamilnadu has a coastline of 1076 kms and is drained by a number of perennial streams that originate in the Western Ghats. The state's agrarian tradition has a recorded history of over 1000 years. These factors have contributed to the creation of wetland complexes, whose design and function is closely tailored to the local agro-ecological conditions. Some of these complexes have evolved to become heronries, and stand testimony to the symbiotic association with local communities. In view of the rather significant wetland heritage, the state has in recent times dedicated its effort to evolve a consultative mechanism for wetland conservation, which includes the development of strategy and management plans for the fourteen wetland sanctuaries of the state, identification of additional, lesser known wetlands into the ambit of protection and constituting a dedicated authority for



the protection and conservation of marshes in the capital city of Chennai. Simultaneously, the state policy on wetlands is also being evolved that is ingrained on the principle of wise use of wetlands. The paper outlines, on a time line, the processes and outcomes of the state's efforts in conserving wetlands.

LOSS AND CONSERVATION OF PHYLOGENETIC DIVERSITY IN THE MEDITERRANEAN BASIN

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Protected areas are mainly designed to maintain species richness and/or rare, vulnerable species. Yet these criteria may not be sufficient to conserve the diverse facets of biodiversity, especially phylogenetic diversity and the functions it provides. Protecting the evolutionary history shared by species has been argued to be highly valuable to conserve biodiversity quality. Phylogenetic diversity has an intrinsic interest as protecting it means protecting the building blocks of the diversity of life. Moreover there is increasing evidence that evolutionary history captures rare features and biodiversity « options values ». However, Earth evolutionary history is poorly protected by conservation actions and protected areas in particular in areas of high species richness. Here we are interested in the conservation of phylogenetic diversity (PD) and evolutionary distinctiveness (ED) in the Mediterranean Basin, the second largest hotspot of Biodiversity. The basin presents high rates of endemism and several branches of the Tree of Life may not be encountered anywhere else. We have evaluated whether the IUCN Red List, the main prioritization tool at the Mediterranean scale, better prioritize amphibians, mammals and reptiles PD and ED than if species were distributed randomly in the List. We showed that basing conservation actions on the IUCN Red List may not protect the Mediterranean evolutionary history. Moreover, for those three groups, we have identified areas where evolutionary history is particularly vulnerable and areas that shelter branches of the Tree of Life that are found nowhere else on Earth. We have highlighted that the protection of those areas is low and that the degree of protection varies between groups. As a result, we support the call of numerous scientists to better consider Earth evolutionary history when designing conservation actions.

133-FINDING COMMON GROUND FOR THE PROTECTION, CONSERVATION AND REVITALISATION OF INDIGENOUS SACRED NATURAL SITES

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Sacred natural sites are hotspots of biocultural diversity and often subject to a diversity of often competing claims. Different meanings and values are attributed to sacred natural sites by different indigenous peoples. We look at these ontological differences between indigenous peoples and contemporary protected area management. We provide an overview of indigenous initiatives that illustrate a call for recognition of self-determination in their efforts to protect sacred natural sites. We then identify opportunities for protected area management, governance, and conservation to include the cultural and spiritual significance of nature in protected areas while focussing on sacred natural sites. We provide examples of the cultural, historic, social, spiritual, and aesthetic significance that natural features and landscapes in protected areas have for people in diverse societies and cultures, both traditional and modern. We identify opportunities for involving mainstream religions and members of the general public in the conservation of sacred natural sites of indigenous peoples.

ALL SNAKES ARE CREATED EQUAL, BUT SOME ARE MORE EQUAL THAN OTHERS: EXAMINING INTER-INDIVIDUAL HETEROGENEITY IN THERMAL PERFORMANCE

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Dispersal is central to numerous eco-evolutionary processes, including population maintenance, dynamics, and species range expansion. For ectotherms, many dispersal behaviours are thermally dependent via a reaction norm called the thermal performance curve (TPC). Interestingly, not all individuals of a species are equal regarding dispersal. This inter-individual heterogeneity (IIH) in dispersal can be caused by condition (behavioural type, body shape, genetic lineage), or context (density of conspecifics, or quality and distribution of resources) but has been little investigated. We document strong IIH in the TPC for juvenile snakes, *Natrix natrix*, finding that absolute performance is not conserved: simply put, some snakes are born better than others. We also find mixed levels of support for classic hypotheses such as the specialist-generalist trade off. We use our understanding of the TPC to ask whether this heterogeneous landscape inhabited by small terrestrial ectotherms has an equalising effect on absolute performance in terms of dispersal characteristics. We discuss the implications of subsetting a population to generate a species-average TPC, and examine predicted dispersal performance under climate change scenarios. The latent variability in TPC within and between clutches at birth may hold the key to species persistence without invoking further adaptation or acclimation.



MANAGEMENT OF SALTMARSH AT SAINT NIKOLAJ, NORTHERN ADRIATIC, SLOVENIA

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Saltmarsh Saint Nikolaj is a small wetland (2ha surface) situated on small patch of unspoiled coastal land between the port of Koper and campsite of Ankaran. It covers 2 ha of surface and is designated as Natura 2000 site (SAC) due to the priority habitat types 1410 Mediterranean salt meadows (*Juncetalia maritimi*) and 1140 Mudflats and sandflats not covered by seawater at low tide. The halophyte plant communities are enriched with two rare plant species thriving only in this place, *Linum marittimum* and *Centaurium spicatum*. The area faces some conservation issues since it was neglected and used as a football place in the past. In that way the land was eroded and many invasive alien species invaded the area. The presentation describes some management approaches to restore and maintain the area. A wooden path above the area was first built in 2006 to prevent the negative impact of walking over the sensitive plant community. In order to eradicate and control the invasive flora several manual and machine interventions have been carried out since then. Some specific methods to increase a number of the two rarest plant species was experimented. The results of the almost ten years of field work in the area supported with monitoring researches should be translated to a management model to be used for small natural sites.

MODELLING BIODIVERSITY SCENARIOS IN MADAGASCAR UNDER BOTH THE EFFECTS OF CLIMATE CHANGE AND ANTHROPOGENIC DEFORESTATION

Ghislain Vieilledent

Cirad

Mario MUNIZ-TAGLIARI, Cirad ; Margaux CHARRA, Cirad ; Clovis GRINAND, ETC Terra ; Tom F. ALLNUTT, Wildlife Conservation Society ; Dimby RAZAFIMPAHANANA, Wildlife Conservation Society ; Miguel PEDRONO, Cirad ; Jean-Roger RAKOTOARIJONA, Office National de l'Environnement

Madagascar is widely known for its exceptional biodiversity which is, for the terrestrial part, mainly concentrated in tropical forests. This biodiversity is severely threatened by both climate change and deforestation. The FRB (Fondation pour la Recherche sur la Biodiversité) project named BioSceneMada (<http://bioscenemada.net>) aims at modelling the biodiversity scenarios in Madagascar under both the effects of climate change and anthropogenic deforestation. In this study we present the first results of the project. We used presence data for more than 5000 species and bioclimatic envelope

models to forecast species distribution under the effects of climate change. Species distribution maps were used to identify potential refugia for biodiversity. Combining these results to the projections of a deforestation model, we also identified the potential biodiversity hotspots under a high risk of deforestation. Project results should help define efficient strategies for conserving Madagascan biodiversity. In particular, we promote the inclusion of top priority areas for biodiversity conservation into the current Madagascar protected areas system.

AREAS OF ENDEMISM ON REGIONAL SCALE REFLECT INFLUENCES OF ADJACENT PHYTOGEOGRAPHIC DOMAINS. A CASE STUDY ON WOODY FLORA OF THE NORTHEASTERN CERRADO OF BRAZIL

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Area of endemism (AOE) is a particular area that contains species restricted to it and it can be hierarchical in organization, thus a large AOE may contain smaller areas of endemism. Brazilian cerrado is the third largest hotspots of the world but with almost none information about specific AOE, although it is well know that northeastern (NE) cerrado has a woody flora different from cerrado core. We searched for local AOE within the NE cerrado, which, in its turn, is a regional AOE of the huge Cerrado. We investigated whether AOE would reflect the influences of adjacent phytogeographic domains. We recorded 6,962 individuals of 936 woody species gathered from 160 surveys and distributed in 48 grid-cells of 1° latitude-longitude. For each grid-cell we compute indices for species richness and endemism which were tested by spatial autocorrelation analysis (SAC). Additionally we performed a parsimony analysis of endemism (PAE) to discover relationships among areas of endemism. Species richness indices were not spatially autocorrelated in contrast to endemism indices. Thus, there are hotspots for endemism but not to richness. The PAE indicated seven AOE. Considering indices of endemism and PAE, we indicated five areas of endemism in the NE cerrado: the coastal cerrados; Araripe plateau; Diamantina plateau; the northern Piauí; and the southwestern NE cerrado. Out of total species, 611 species were restricted to only one AOE whereas 170 species were widespread. Each AOE had different floristic influences from adjacent phytogeographic domains corroborating our hypothesis. The AOE indicated deserve special attention from conservation policies



HABITAT AMOUNT VS. CONFIGURATION: A TEST WITH SMALL MAMMALS OF THE ATLANTIC FOREST OF BRAZIL

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Habitat loss and fragmentation are generally associated, as an end result of land use by human activities. Resulting consequences for biodiversity have been studied based on a framework involving patch size and isolation, the configuration of the landscape. However, the amount of habitat remaining may be a simpler and more important proxy of effects on biodiversity, the habitat amount hypothesis. In this study we contrast the two hypotheses, habitat amount vs. configuration, to explain species richness of small mammals in a landscape of the Atlantic Forest of Brazil. Study sites were located in the Macacu river watershed, Rio de Janeiro State. Small mammals were surveyed in 27 sites from 1999 to 2008 using a standard protocol and constant sampling effort. Species richness estimate was the response variable in two sets of general linear models: one with measurements of fragment size and isolation as response variables, and the other with estimates of habitat amount around sampling points of small mammals. These variables were measured within two buffer zones whose width corresponds to mean and maximum estimates of interpatch movements of small mammals. The highest support was for the models with habitat amount at the largest buffer as explanatory variable (Akaike $w = 0.49$) compared to models with fragment isolation metrics ($w = 0.05$), but patch size was important in the best model for habitat amount. Small mammal assemblages seem to respond to habitat amount surrounding the existing populations more than distance between habitat patches. Habitat amount may be more important for biodiversity depending on matrix permeability and movement abilities of the organisms involved. Movements of small mammals in current Atlantic Forest landscapes may be more frequent than previously thought.

163 ADAPTING THE POLICY LANDSCAPE FOR EBA

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CATIE

Tahia DEVISSCHERR, Stockholm Environment Institute- Oxford; Marco OTAROLA, CATIE

Ecosystem-based Adaptation is increasingly recognized as a robust response to the degradation of ecosystem services spurred by the combined pressure of climate change and development paths. While ecosystems are recognized to play an important role many initiatives around the world hardly move from the study and analysis mode to the transformative action in the field. Many site-specific factors can cause limited move from problem-identification to actions. Here, we argue that inter-related process variables and obstacles cross-scale and knowledge systems governance play a key role in moving along the cycle from identification of problems to design implementation, monitoring and adjustment of adequate and efficient EbA responses at the landscape scale. More specifically, moving along this cycle can require the combination of different types of knowledge, the use of flexible and effective communication mechanisms within governance systems and the building of trust among key stakeholders to maintain action-momentum. In this presentation we highlight the results of cross-scale governance analysis, present experiences and provide examples from research in Latin America regarding agricultural governance systems relevant to promote EbA for smallholders in Central America and water adaptation planning in South America. We present the relevance of different types of boundary organizations which can provide the enabling environment for EbA planning and implementation. We show that, depending on the natural resource prioritized, different types of resources from both top-down and bottom-up are needed to ensure long-term commitment/investment required to promote EbA responses.

LINKING THEORY AND PRACTICE: HOW CAN EDGE EFFECTS RESEARCH INFORM CONSERVATION STRATEGIES IN LANDSCAPES UNDER URBAN DEVELOPMENT?

Nelida Villasenor

The Australian National University
Don DRISCOLL, The Australian National University; Philip GIBBONS, The Australian National University; David LINDENMAYER, The Australian National University

With accelerating rates of urbanization worldwide, a better understanding of ecological processes at wildland-urban interfaces is needed to conserve biodiversity. Edge effects theory suggests that the influence of urban boundaries on ecological responses varies with kinds of urban development, but lack of empirical evidence limits conservation strategies. To help guide management and urban planning, we studied mammal responses across 12 urban-forest edges (six high and six low-housing density edges) and six forest controls in southeastern Australia. We first investigated arboreal



marsupials, a forest-dwelling group. We found low-density housing development provided suitable habitat for most arboreal marsupials. In contrast, high-density housing developments had negative effects on species richness and the abundance of most individual species, probably because of low mature-tree cover in these areas. Most arboreal marsupials exhibited no response to the proximity of urban boundaries, but spilled over from forests into urban areas to differing extents. However, urban impacts extended beyond 300 m into adjacent forest for a core-area species (*Petaurus australis*). Our findings suggest (1) mitigate negative impacts of high-density housing developments by providing key habitat structures (trees) and (2) avoid forest core-area loss when planning urban areas. Second, we compared the influence on ground-dwelling mammal occurrence of variables related to urban planning (edge variables: housing density and distance to urban boundary) with those related to local habitat structure. We found edge variables had effects on most species occurrences, but local habitat structure outweighed the impacts of edge effects. Thus, (3) local-scale management of habitat will help mitigate urban impact. Our edge studies suggest residents, managers and land planners can contribute to conserve mammals in Australia and provide insights for biodiversity conservation in an urbanizing world.

RECORDING SMALL, MEDIUM AND LARGE TERRESTRIAL MAMMALS WITH VERTICALLY-ORIENTED CAMERAS TO GUIDE MANAGEMENT STRATEGIES ACROSS URBAN-FOREST EDGES IN AUSTRALIA

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Camera trapping is a non-invasive technique used in ecological research, but its usefulness to record small terrestrial mammals is limited due to a lack of focus and a small proportion of images capturing the full animal profile when cameras aim horizontally. Vertically-oriented cameras (facing to the ground) is a novel technique that can overcome this limitation and record animals of different sizes. For the first time, we used vertically-oriented cameras aimed to a contrasting wooden platform with a measured scale to: (1) aid with species identification and (2) use the results from this technique to guide management strategies for mammals across urban-forest interfaces. We investigated whether edge variables (eg. distance to an urban boundary) or local habitat structure best explained mammal occurrence across forest-urban edges. We deployed cameras at -300, -100, 0 (boundary), 100 and 300m across 12 urban-forest edges, placed three cameras

in six forest interiors (>500m from an urban boundary) and measured habitat structure at each location. We obtained 4,419 images containing animals over 462 camera-trap nights (77 stations x 6 nights). Most images recorded mammals (90% of images). Images had good quality and contrast, allowing us to identify 12 species from 98% of images containing a mammal. Species included a variety of sizes, such as small (*Antechinus stuartii*, *Mus musculus*, *Rattus fuscipes*), medium (*Perameles nasuta*) and large mammals (*Macropus giganteus*). Statistical analyses showed the occurrence of most native and non-native mammals was best predicted by local habitat structure rather than by edge variables, suggesting that local-scale management of habitat (eg. increased understory cover) can help mitigate urban impacts. Our study demonstrates the usefulness of vertically-oriented cameras to record mammals and guide management strategies in Australia, and suggests this technique can be extended to other regions and ecological research.

TRAIT-DEPENDENT RESPONSES OF BUTTERFLIES TO THE CONNECTIVITY OF SEMI-NATURAL ELEMENTS IN AGRICULTURAL LANDSCAPES

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In intensively managed agricultural landscapes, remaining semi-natural habitats are fragmented and partly composed of small linear features. A better conservation of farmland biodiversity may be achieved by improving the connectivity of both patchy and linear elements. However, the respective effects of these elements have rarely been tested. Butterflies form a suitable model group for this purpose since they have suffered a major decline over the last decades and are sensitive to landscape connectivity. In 18 landscapes of 5-x-5 km located in 3 contrasted French regions (6 landscapes/region), we sampled 286 transects in patches of grasslands and linear grassy elements along grassland connectivity gradients. We evaluated the response of butterfly diversity to grassland and woody habitat connectivity using a variety of metrics. Connectivity had stronger effects for grassland specialists and species with low dispersal ability. Woody habitat in vicinity to grassland had a positive effect: an increase in cover from 0 to 10% increased butterflies species richness from 4 to 7 and doubled their abundance. Butterflies may indeed benefit from multiple habitat usage through supplementation, complementation or spillover processes. Within grasslands, grassland connectivity had no effect on biodiversity and this may be related to the moderate extent of the gradient within studied landscapes. Butterfly richness and abundance were much lower (-27 and -52%) in linear elements than in grasslands and specialized and sedentary species suffered



most from isolation to grasslands, suggesting a source-sink functioning. Although linear elements may play an important role in butterfly dispersal in agricultural landscapes, they may not be sufficient to preserve specialist and sedentary species. To protect these target species in moderately fragmented contexts, conserving a mosaic of high quality grasslands and woody habitats appears more crucial than enhancing their connectivity.

BEYOND PROTECTED AREAS: CO-BENEFITS OF CARBON STOCKS FOR CLIMATE, GREAT APES AND SYMPATRIC BIODIVERSITY

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Global strategies to mitigate climate change aim at maintaining natural carbon stocks. However, decision makers must simultaneously consider synergies with other environmental issues such as biodiversity conservation and protected areas management. In this study, we evaluate the co-benefits of carbon stocks in tropical Africa and Asia for great apes as the best-known umbrella species for the highly diverse sympatric biodiversity. Thinking beyond the concept of protected areas which provide formal protection for only about 30% of great ape habitat, we show that another 45% of great ape habitat is covered by resource management areas classified as weakly protected or corridors. In such areas, great apes and sympatric biodiversity overlap with enormous natural carbon stocks, but also face varying degrees of human threat. If implemented these climate-biodiversity co-benefit areas would turn the commonly isolated protected areas into a real spatial network allowing continued species dispersal. The spatial congruence of carbon stocks, tropical biodiversity and human impact suggest an exceptional "win win" conservation strategy to reduce biodiversity loss and climate change.

ONLINE CONSERVATION - UPDATED SPATIAL INFORMATION ON THREATENED PLANT SPECIES IN ISRAEL

Gal Vine

Israel Nature and Parks Authority

Merav LEBEL, Israel Nature and Parks Authority ; Margareta WALCZAK, Israel Nature and Parks Authority ; Udi ORON, Israel Nature and Parks Authority ; Or DAVID, Israel Nature and Parks Authority ; Ofer Steinitz, Israel Nature and Parks Authority

Effective biodiversity conservation requires updated knowledge on threatened species. Over 400 types of wild plants are documented in the Red Book of Israeli Plants as being in danger of extinction in Israel. As part of a campaign to minimize extinction danger and to protect threatened species, the Israel Nature and Parks Authority established a

web-based database of threatened plant species. The new website (<http://redlist.parks.org.il>) aims to provide easy access to updated professional knowledge and to increase awareness of the issue among decision makers, conservationists and the general public. The website is developed in the open source Django platform, which allows flexibility and dynamic development. In the current website, each threatened species has its own page with detailed information from the Red Book of Israeli Plants, including a dynamic distribution map and conservation status. The GIS-based observation system provides easy query options for species and sites with graphical and tabular views of plant observations. The system allows users to report from a smartphone or PC on field observations of populations of threatened species including photos. The new records are processed through a validation system supervised by a botanist committee. The new records will be used for updating the distribution maps of plant species and thereby their conservation status. An updated and publically available database for local threatened species is important for improving conservation planning, allocation of conservation efforts and evaluation of management effectiveness over a national level. An important added value of such a database is the involvement of the general public, including naturalists and botany experts, in the identification of knowledge gaps and in ongoing reporting on distribution of species in danger of extinction across the country.

LINKING CONSERVATION KNOWLEDGE AND POLICY - A SPATIALLY INTEGRATED DATA APPLICATION FOR CONSERVATION MANAGEMENT

Gal Vine

Israel Nature and Parks Authority

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Conservation management involves frequent decision making, supported by various data types, spatial data often as pivot dimension. The Israel Nature and Parks Authority (INPA) protect 400+ nature reserves and national parks and conducts active management of habitats and species, including reintroduction projects, habitat restoration, anti-poaching program and more. Knowledge has been gathered for over 50 years of activity, yet it was not formalized in a database system that allowed online, straightforward access to the information, advanced analysis and simple reporting over the abundance of management actions and biodiversity data of the INPA parks and reserves. The data collection, validation, standardization and GIS work were conducted manually per report and on demand only. A generic web-applications-system was characterized and implemented by the Scientific Division in INPA. The different elements of conservation work were formalized into (a) policy and theoretical knowledge, (b) management action plans and spatial reporting of management, (c) spatial datasets



including biodiversity data. The system is based on a flexible yet robust spatial database that allows keeping complex data in flexible schemas yet analyze and report it in a generic way. The system also connects to CyberTracker software used for observation collection by rangers and ecologists. The system allows definition of complex GIS-driven queries and reports, thus allows live dynamic push of reports to relevant personnel. The system allows online collaboration according to user permissions and workflows defined. The system is based on Django framework extended by other state of the art, open-source technologies, allowing quick and efficient custom made development and adaptation of the system. Having all the data in one online data warehouse with advanced applications over it, allows a better link between decision making, knowledge and data found in the organization, and thus better conservation.

TRYPANOSOMIASIS AND LEISHMANIASIS IN BATS: EVALUATING THE ENVIRONMENTAL DISTURBANCE INFLUENCE IN THE GREATER LACANDONA ECOSYSTEM

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Habitat loss and forest fragmentation have proven to be two major threats to bats in the tropics, as fragmentation increases, the diversity decreases. The dilution hypothesis states that as the species richness decreases due to habitat loss or disturbance, the incidence of parasites becomes higher. Since bats are known reservoirs of *Trypanosoma* and *Leishmania*, two pervasive zoonotic parasites, the primary objective of our study was to determine the prevalence of *Trypanosoma* sp. and *Leishmania* sp. in bats on conserved and disturbed conditions in the Lacandona forest in southern México. The disturbed area is dotted by human communities extracting forest resources and causing fragmentation and deforestation. Our hypothesis is that in conserved ecosystems bats will have a lower prevalence of the parasites due to the dilution effect. We worked with 2 common tropical rain forest species (*Carollia sowelli* and *Sturnira lilium*). Bats were captured using mist nets in 6 sites (3 under conserved conditions and 3 within the agricultural matrix of the surrounding areas) and tissue samples (heart and spleen) were taken. We obtained the prevalence of both pathogens through direct detection by PCR. We found several positive individuals for both parasites with an overall prevalence of 8.87% for *Leishmania* and 1.60% for *Trypanosoma*. We also found preliminary evidence that *Leishmania* prevalence decreased as the number of bats

species in the site increased. Results of this study are crucial to secure conservation efforts and keep low incidences of pathogens through forest conservation for the benefit of neighboring human communities.

HABITAT MODELLING PREDICTIONS : A TOOL FOR EFFECTIVENESS ASSESSMENT OF MPAS NETWORK

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According to European Union (EU) Habitats Directive and Birds Directive, EU Member States must extend the Natura 2000 network to marine ecosystems, through the designation of marine protected areas. However, the initial state of cetacean and seabird communities across European waters is often poorly known. It is assumed that a Natura 2000 site is justified where at least 1% of the 'national population' of a species is present during at least part of its biological cycle. The aim of the present work was to provide new information about the distributions of cetaceans and seabirds and evaluate the network of existing Natura 2000 sites and proposed offshore new MPAs. These results would serve as a scientific basis for the negotiation process involved in the designation of these new offshore MPAs. Extensive aerial surveys were conducted during the winter 2011-2012 and the summer 2012 across the Channel, Bay of Biscay and northwest Mediterranean (560,000 km²). Habitat modelling was conducted by using a GAM methodology, with a combination of physiographic and oceanographic variables. For each area, a ratio between species relative abundance predicted within its boundaries and the total relative abundance predicted across the whole French exclusive economic zone was computed and compared to the 1% threshold. This evaluation also included a seasonal component, giving additional information to improve protected areas conservation plans. Our results showed that the existing network was justified for most of coastal seabird species, but a clear lack was identified for offshore seabird species and cetaceans. Moreover, the size of MPA appeared to be a crucial element, with larger MPA having higher responsibilities. Finally, we showed that proposed large offshore MPA would be of great interest, especially for cetaceans, for example less than 1% of fin whales population was included within existing network, while the proposed MPAs would concern 50.5% of the French population.



HOME RANGE AND HABITAT SELECTION OF THE LESSER KESTREL (*FALCO NAUMANNI*) IN THESSALY, GREECE: A FIRST STEP TOWARDS CONCRETE CONSERVATION MEASURES

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The knowledge of the habitat preferences of a bird species is crucial for the implementation of concrete conservation measures. The agricultural landscape of the study area includes different crop types. We studied the habitat selection of the Lesser Kestrel (*Falco naumanni*) using GPS dataloggers attached on ten individuals from five colonies of the Thessaly plain, Central Greece, during the nestling period, from mid May to mid June. In order to assess the habitat selection of the species we used the compositional analysis method. Additionally, we compared the composition of the available habitats within the home range of the species against the preferred ones, based on Aebischer's method. Using GIS software we calculated the Euclidian distance from the nesting sites to the foraging grounds, as well as the home ranges using the minimum convex polygon method. Our results illustrated an obvious preference of Lesser Kestrels mainly towards cereal crops, probably due to their higher prey abundance, and secondary to cotton, a pattern followed by both sexes. The maximum distance from the nests to the foraging patches was 4.1 km in average for the males and 4.03 km for the females, translated to a home range of 13 km² and 14.5 km² respectively. The home range size showed moderate variation between the five studied colonies, attributed to fluctuations of prey abundance of the surrounding areas due to different crop types. Understanding the mechanisms that determine Lesser Kestrels foraging grounds is essential in order to proceed to concrete conservation measures regarding the improvement of their foraging habitat quality through friendly agricultural practices.

FIRST STANDARDIZED LARGE-SCALE GENETIC WILDCAT CENSUS IN GERMANY

Burkhard Vogel

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European wildcats (*Felis silvestris*) are considered important target and umbrella species for nature-near, rich-structured forests in Germany and other European countries. But wildcat distribution is heavily scattered due to former human persecution and habitat fragmentation in Europe and especially in Germany. Currently, the large-scale conservation project "Safety Net for the European Wildcat" aims at reconnecting isolated wildcat populations and provide migration corridors of 20,000 kilometers length for forest communities. Here we present data from the first large-scale genetic wildcat census, the "Wildkatzensprung", aiming at investigating the connectivity among wildcat populations across Germany. Supported by more than 600 volunteers 800 valerian lure sticks as hair traps are inspected weekly during the mating season over three consecutive years. We present results of the three sampling season 2012 to 2014. Microsatellite analysis of 1670 samples resulted in 1561 wildcat detections representing 519 individual genotypes. The study provides estimates on populations sizes and changes in population composition over the years. Furthermore, an open database with the wildcat DNA samples has been established, to characterize the population structure and migration patterns of individuals throughout Germany.

AN AUSTRALIA-WIDE CONSERVATION GENETIC STUDY OF LITTLE PENGUINS (*EUDYPTULA MINOR*): AUGMENTING POPULATION GENETICS AT NEUTRAL LOCI WITH AN ADAPTIVE IMMUNE GENE, MHC

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Genetic diversity of threatened species is frequently quantified using neutral genetic markers, or genes not directly targeted by selection, to provide the basis for management plans. However, patterns of variation and divergence in adaptive traits that are affected by selective processes, such as immune competence, are not always correlated with variation in neutral markers. The validity of approaches relying exclusively on neutral markers for development of conservation strategies is therefore questionable. The present study of conservation genetics and demography in the Little Penguin (*Eudyptula minor*) assesses connectivity among penguin colonies along the southern coast of Australia. A fine-scale analysis of genetic structure was conducted to determine the extent of dispersal between colonies and compare their genetic variability. In



addition to using classical genetic markers (microsatellites and mitochondrial DNA), we present the first study of non-neutral genetic diversity in Little Penguins. Next-generation sequencing of an immune gene of the major histocompatibility complex (MHC) revealed high allelic diversity at the functionally relevant peptide binding groove of an MHC class 2 molecule. Population structuring at the MHC marker is shown to be stronger than structure derived from microsatellites. Correlations with parasite load furthermore indicate that intermediate levels of intra-individual MHC diversity optimise parasite resistance. Together with recent demographic estimates based on methods of minimal invasiveness, genetic data will be used to refine management strategies for E. minor with a particular focus on population viability and resilience to pathogenic threats. This study demonstrates the MHC gene's diversity and suitability to resolve population structure, which make it an ideal marker to use in conservation genetic studies.

DECLINE AND RANGE CHANGE OF ORCHIDS IN WESTERN EUROPE (FRANCE, BELGIUM AND LUXEMBOURG) OVER 20 YEARS

Hélène Vogt Schilb

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In recent decades, many studies have documented local declines of orchid species due to environmental changes. However, few data are available about the changes of orchid species distributions at large spatial and temporal scales. We aimed to characterize the recent dynamics of orchid distribution patterns in Western Europe, in regard to (i) land cover changes in the same period and (ii) species' ecology. We analyzed data from a large-scale participatory survey of 134 orchid species recorded over 20 years in France, Belgium and Luxembourg. We designed null models to assess the nature and significance of recorded changes within each administrative unit (i.e. départements, regions and country for France, Belgium and Luxembourg, respectively) and for each orchid species. We found sharp declines of orchids in the northern part of the study area (i.e. northern France, Belgium, Luxembourg), in relation to strong urbanization pressure in those regions, resulting in an overall shift to the Mediterranean area in the south. Western European orchids are thus affected and threatened by both climatic and land cover changes. Moreover, orchid species of wetlands and humid grasslands tended to decline more than species from closed forest and shrubland habitats. From a methodological point of view, we advocate the design of null models to account for spatial heterogeneity in large datasets. This use of null models opens promising perspectives for addressing critical issues on species

ecology and biodiversity conservation at large spatial and temporal scales.

TEMPORAL SHIFTS IN COMMUNITIES OF ORCHIDS IN CORSICA: ROLE OF VEGETATION CHANGES IN A 27-YEAR LONG INTERVAL USING BAYESIAN MULTISPECIES SITE-OCCUPANCY MODEL

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Shifts in biodiversity distribution patterns are of immediate concern in Mediterranean regions. Long-term diachronic surveys are requested to monitor these temporal dynamics of communities and to address their underlying factors. Here we used this method to specifically investigate the effect of land use changes on the distribution of orchid species in Corsica. Using two field surveys carried out on a 27 year-long interval in the same 45 sites in Corsica, we (i) estimated the detectability, the colonization and the survival probabilities of 37 orchid species, (ii) evaluated the impact of changes in ligneous species cover (LSC) on the dynamics of orchid communities at the local scale and (iii) predicted orchid diversity at the regional scale (i.e. for all sites). Our analysis was performed using a Bayesian multispecies site-occupancy model that took into account imperfect detection of species. Our study showed that detectability markedly differed amongst orchid species ranging from 0.81 to 0.96, and was positively related to population density. Between 1982 and 2011, LSC changed in 82.2% of sites (increase, 75.5%; decrease, 6.7%). Colonization probability of orchids was both significantly lower than survival probability, and negatively related to LSC increase. At regional scale, no significant differences were observed in terms of species richness and composition amongst sites and in regard to LSC increase. Asynchronous vegetation dynamics may drive marked and contrasted changes in orchid communities at the local scale, which in turn makes possible the maintenance of the diversity at larger scale. Practically, site-occupancy models are promising tools to take into account biases due to intrinsic variation in detectability among species in diachronic analyses.

HOW DOES HABITAT CHANGE AT LANDSCAPE SCALE AFFECT FUNCTIONALITY OF SPECIES INTERACTIONS?

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Biodiversity is necessary to secure most of the ecosystem services needed by humanity, such as global food production. Yet, biodiversity has hardly ever been so threatened as today. In fact, scientists generally agree that a sixth global mass extinction is occurring at the present. Multiple anthropogenic drivers contribute to this biodiversity crisis, but of these, habitat loss and fragmentation are considered to be the most significant. The vulnerability of species to habitat change and fragmentation depends substantially on their traits, which in turn affect how they interact with other species and thus their functional role within interaction networks. Consequently, non-random loss of species and their interactions based on their traits can drive consistent changes in species interaction networks following habitat fragmentation. In addition to species diversity and phylogenetic diversity, also functional diversity may decline. These different components of biodiversity do not necessarily respond equally to environmental change nor do they predict future community composition in the same way. Understanding and maintaining species functional roles within diverse communities is a future objective in both applied nature conservation and conservation science, and this challenge can be addressed using network approach. We formulated a spatially explicit, agent based model to investigate how habitat diversity and different spatial patterning of habitat types in the landscape along a fragmentation gradient affect the persistence of species interaction in meta-networks. Meta-network ecology is based on meta-community and meta-population concepts, where several distinctive networks are connected through interactions or dispersal.

THE DEVIL IS IN THE DETAIL: DISENTANGLING THE MECHANISMS AND DRIVERS OF DECLINE OF THE ALPINE IBEX POPULATION IN THE GRAN PARADISO NATIONAL PARK (ITALY)

Achaz Von Hardenberg

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The Alpine ibex population in Gran Paradiso National Park (Northwestern Italian Alps) has suffered a dramatic decline over the last 20 years. Previous models, based on total count data available since 1956, identified density dependence and winter snow cover as the main drivers of the population dynamics until it reached its peak in 1993, but were unable to predict the subsequent decline. The population fall-off is associated with a strong decline in kid survival which passed from an average of 0.58 (rate of kids which reach the yearling stage in 1981-1990) to an average of 0.35 in the last 10 years. Two main hypotheses have been proposed to explain this decline: i) Ageing of the population: in ungulates older females are known to have lower fertility and produce less viable kids; ii) Mismatch between trophic and breeding phenology due to climate change. Here we use an integrated population modelling approach to explore the temporal variability in demographic parameters and modifications in the age structure in this population. We combine a state-space model of total population counts with capture-mark-resight, kid survival, and fecundity data collected over the last 25 years on individually tagged Alpine ibex. Crude protein content in alpine pastures, estimated from NDVI (Normalised Difference Vegetation Index) data, appears to have a positive effect on kid survival improving the fit of the integrated population model and confirming previous suggestions that changes in vegetation due to climate change have driven the decline in kid survival in the last 20 years. Changes in age structure appear instead to affect significantly female productivity. The integrated population modelling approach permitted us to reconstruct age specific survival trajectories for years for which we have only count data available, get more accurate estimates of vital rates and contribute to disentangling the possible causes of the population decline.

CITIZEN SCIENCE PROJECTS IN ENVIRONMENTAL NGOS - BRIDGING THE GAP BETWEEN SCIENTIFIC STANDARDS AND CIVIL ENGAGEMENT

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Citizen science has become a new buzz word in nature and biodiversity conversation projects. In the majority of cases, the debate about "proper" citizen science in Germany is dominated by the scientific community, putting an emphasis on the scientific quality of the data generated from public input. In addition, concern has been voiced out that academic approaches limit public participation to that of cheap



field assistants. NABU, Germany's largest member-based environmental NGO, has been engaged in citizen science projects mostly in the field of ornithology – sometimes for decades before the term even became popular. Aside from the value of the data for monitoring purposes, NABU sees an important benefit from intrinsically motivated, publicly-driven citizen science projects in the empowerment of participation, the creation of environmental awareness and a potential to solve pressing “real-world” matters that are often of lesser priority in academia. As an important success factor, we see the mutual respect for the scientific community and the general public. The presentation will focus on the opportunities and limits of citizen science projects and data, using data from NABU's winter (since 2011) and spring (since 2005) backyard bird counts to illustrate where this data meets scientific criteria of reliability and validity, and can be used to reflect population trends on a broader level. The two campaigns attract between 60 and 90,000 participants each event on an annual basis. The data has been analyzed for statistical significance by e.g. analysis of variance and the results have been compared to other scientific ornithological censuses. In addition, it discusses the implications for the further development of citizen science from an NGO perspective while keeping the balance between scientific matters, civil engagement and volunteerism; and the potential contribution to improve the monitoring of biodiversity objectives.

QUIET AREAS IN EUROPE

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Global environmental concern is recently focused on biodiversity conservation by the implementation of innovative conceptual multidisciplinary schemes regarding protected areas and their surroundings. Special attention has also been given to Quiet Areas (QAs), recognizing health, biodiversity, economic, aesthetic and educational benefits, thus composing an alternative ecosystem service. In the present study QAs of the European Union (EU) are spatially identified, focusing on country, environmental and altitudinal level. The next step comprises the investigation of the spatial overlap of QAs and Natura 2000 network with view to proposing environmental policy improvements. We adopt a distance-based methodological approach. Human-induced noise sources are detected and buffered until the Quietness threshold, resulting in a map of Noisy Areas. Extracting Noisy Areas from a EU map determines the potential EU's QAs. We then identify QAs which overlap with Natura 2000 sites. Finally, we investigate some abiotic factors of QAs concerning the environmental zones and the relief topology. A particular pattern regarding the Quietness in the EU is revealed. Central Europe demonstrates lower percentages of Quietness while

the “edges” of the EU (Mediterranean and Scandinavian sites) contain higher percentages of Quietness. According to our findings QAs are driven by many different factors and not only, by human activities, emerging the complexity of soundscape composition, even when examined at a coarse scale. European environmental policy demands a mutual framework as far as the designing approaches of each Member State are concerned. QAs could contribute and justify such strategies by integrating other protection networks with the network of Quietness.

MANAGING AGRICULTURAL LANDSCAPES FOR CONSERVATION: WHAT DO MENTAL MODELS OF FARMERS AND SCIENTISTS TEACH US?

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After decades of public policies aimed at intensifying agricultural production in Europe, short-term maximization of yields has led to the simplification of agricultural landscapes and subsequent biodiversity loss. In this context, the interdisciplinary programme “FamLand BiodivERsA ERA-Net” currently studies the links between farmland biodiversity and cropped area heterogeneity at the landscape scale. It aims at providing results to help elaborate new policy that integrates biodiversity conservation in agricultural landscape management. In this programme, to understand the world views of the actors involved, we study individual stakeholders' representations (i.e. mental models, MMs) of the socio-ecological systems and attempt to shed light on the gaps between the MMs of “policy implementers” and “policy thinkers”. Using concept mapping methods we elicited the MMs of the functioning of the agricultural landscape for conservation scientists and farmers working in agricultural landscapes in four different regions of France. These study sites were characterized by different degrees of intensive farming and biodiversity conservation. We compared 140 MMs using qualitative and quantitative analysis based on graph theory indicators. MMs showed that biodiversity components are poorly connected to the farmlands with very few feedbacks. Within a study site, farmers and scientists identified the same components but interactions are different. These results confirmed a sectorial vision of the functioning of the landscape where biodiversity is of marginal significance and the general approach to conservation is one of land sparing. Moreover the lack of consensus on social-ecological interdependencies may contribute to a lack of cooperation and could be the main barrier to the implementation of more efficient integrated policies. We conclude with an invitation to acknowledge the role of scientists as conservation stakeholders and to question our own mental models of farmlands.



ENCROACHMENT OF AN HERBACEOUS LEGUME AFFECTS CARRYING CAPACITY OF ARID GRASSLANDS

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The encroachment called shift of arid grasslands, from grass dominated to shrub dominated communities is associated with serious implications for ecosystem functions and services that often resemble those of plant invasion by non-native species. Especially its mostly negative consequences for forage grasses and pastoral production have been subject to intensive discussion and led to a common negative connotation of this process. However, encroachment is usually solely associated with woody species or shrubs. Within the last decade, a native, annual herbaceous legume, *Crotalaria podocarpa*, has exhibited an extensive spread in arid grasslands in Namibia's great escarpment and apparently repressed the formerly aspect building local grasses in large areas. To quantify the short and long term effects of the proliferation of *C. podocarpa* on the dominant perennial tussock forming forage grass *Stipagrostis ciliata* we studied *Crotalaria* and *Stipagrostis* abundance and biomass production on long-term observation plots since 2009 and investigated possible facilitation of *C. podocarpa* by *S. ciliata*. We found competition with *Crotalaria* to reduce biomass production of *Stipagrostis* individuals by 30% and to weaken the ability of *Stipagrostis* tussocks to recover after drought. *Crotalaria podocarpa* was facilitated by *Stipagrostis* tussocks and caused an ontogenetic shift, resulting in a continuous decrease of grass tussocks in affected areas. Our study demonstrates, that the massive spread of a native annual plant, similar to woody encroachers and invasive species can severely affect arid grassland productivity, reduce its carrying capacity and may also affect biodiversity.

ENHANCED COASTAL FISHERIES IN BANGLADESH (ECOFISH): BIODIVERSITY CONSERVATION AND IMPROVED LIVELIHOODS IN THE PADMA-MEGHNA RIVER ESTUARY

M. A. Wahab

WorldFish Bangladesh

Nathan SAGE, USAID/Bangladesh ; Sarah PARK, WorldFish

Bangladesh comprises hundreds of rivers and tributaries--habitats capable of supporting rich aquatic biodiversity. About 1.3 million fishers rely on these aquatic resources for livelihood and nutritional needs. Overfishing, industrial effluents, and a controversial barrage are associated with decreases in fish catch yields, ultimately threatening these livelihoods. Policy interventions aimed to address these concerns, including the Bangladesh National Report to the Convention on Biological

Diversity and the Hilsa Fisheries Management Action Plan (HFMAP) have had limited impact. The HFMAP (2003) recommends: an 11-day fish trade ban to protect fecund migratory Hilsa; seasonal fish bans in five riverine sanctuaries (each 20-100 km in length) to protect juveniles; fisher ID card registration; fisheries enforcement; and a fishers' compensation scheme for lost earnings during ban periods. Regulations prohibiting the manufacture and use of monofilament fishing nets also support these measures. Improved management of Hilsa shad (*Tenualosa ilisha*) fisheries through these initiatives has the potential to increase the abundance of other, non-target aquatic species. However, limited funds to implement these measures have resulted in few conservation benefits. In order to strengthen Hilsa conservation initiatives, the U.S. Agency for International Development (USAID) developed a partnership with the Department of Fisheries and WorldFish in 2014 to improve the resilience of the Padma-Meghna River estuarine ecosystem and livelihoods that depend upon it. The Enhanced Coastal Fisheries project (ECOFISHBD) has developed a participatory research collaboration to build the capacity of government, non-governmental partners, and fisher communities to strengthen enforcement in sanctuaries; establish fisheries co-management; and support the resilience of women's livelihoods. ECOFISHBD demonstrates collaborative design and adaptive management in a vast, poverty-stricken waterscape.

24 - THE CHALLENGE OF NETWORKED GOVERNANCE FOR LARGE LANDSCAPES AND NATURAL RESOURCE CONSERVATION

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Large-scale conservation requires coordinated, networked action that addresses multiple management objectives across interconnected, complex, and dynamic systems. In contrast, traditional resource governance approaches were often designed to address single species or single resource challenges and be managed by an agency unilaterally. In this paper, we argue that with the widespread recognition of the importance of broader participation, network governance represents an increasingly used approach to collaboration and public engagement with its own set of historical, economic, organizational and behavioral barriers. Through the lens of three contemporary, large-scale examples, we illustrate how these specific challenges require a different set of cultural, organizational, strategic and structural capacities to promote norms for legitimate, effective and resilient networks for large landscapes.



TIPPING POINTS IN THE COLLAPSE OF ECOSYSTEM FUNCTION FOLLOWING PRIMARY FOREST DEGRADATION

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Primary tropical forests form a critically important and highly threatened component of terrestrial ecosystems. As public opinion turned against deforestation, exploitation techniques such as selective logging, which appear to leave a largely intact but slightly “degraded” primary forest, have increased rapidly. Degraded forests have nearly the same species richness, carbon stocks and functional diversity as intact forests, and so the four million km² of primary tropical forests affected by degradation (equivalent to about three complete Congo Basin rainforests) currently provoke little concern among conservation or climate change parties. However, to sustain primary forests beyond the current generation of trees, key ecological processes such as seed dispersal and nutrient cycling also need to be maintained, and little is known about how degradation affects these ecosystem functions. Here, we measure changes in inferred seed dispersal down a gradient of forest degradation, across 31 large landscapes (watersheds) in the eastern Amazon forest, by studying changes in abundance for the entire avian frugivore community. In particular, we examine how the impacts of degradation vary across different size classes of disperser beaks, which in turn are associated with the size of fruit dispersed. We show that at ~20% degradation (the average value for the Amazon), the level of seed dispersal service suddenly collapses for all but the smallest beak sizes, even though species richness remains largely unchanged. Small fruits generally produce small trees, and so the clear implication of this seed dispersal collapse is that within a generation, these “primary” forests could be reduced to largely homogeneous assemblages of small tree species, with extensive losses in biodiversity and a substantial release of carbon into the atmosphere. We therefore recommend that firm policy controls on degradation be urgently implemented, pending further research on its functional consequences.

UNDERSTANDING VARIATION AND COSTS OF HUMAN-WILDLIFE CONFLICT AT ECOSYSTEM LEVEL: LESSONS FROM NORTH LUANGWA, ZAMBIA

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Conflict between subsistence communities and wildlife increasingly undermines conservation efforts. Lethal methods are often used to protect crops or livestock, wildlife may kill or injure humans, food security and livelihoods are compromised, and tolerance of wildlife is reduced. Understanding the patterns and costs of conflict is crucial to developing solutions. Research on human-wildlife conflict has historically focused on community-level interactions without an ecosystem-scale perspective, often masking important variation in experience between connected communities. Similarly, interventions to address conflict typically focus on evident direct costs to humans without accounting for hidden socio-economic impacts. Our study examined human-wildlife conflict in game management areas of the North Luangwa ecosystem, northern Zambia. Data were obtained from observations, semi-structured interviews, focus groups, and key informants. Our results show that patterns and experience of conflict, especially crop and livestock losses, can differ considerably between villages. Results also indicated hidden costs can exceed or exacerbate more-visible direct costs and should not be overlooked or discounted. Although crop loss to wildlife was extensive, crops damaged and main species responsible were site-specific. Elephants followed consistent patterns when targeting crops, whereas livestock losses or injuries to humans by predators were highly variable. Direct costs were mainly loss of food or income, from minor to debilitating. Key indirect or hidden costs were foregone income opportunities, school absenteeism, restricted social movement, and poor health. Farmers guarding crop fields at night had a greater incidence of malaria. We demonstrate that human-wildlife conflict can vary markedly within an ecosystem, which must be understood to address the costs of conflict and promote conservation. Mitigation strategies therefore need to be tailored – one size will not fit all.

INVESTING IN COMMUNITIES: PARTNERSHIPS PROMOTING RESEARCH AND CONSERVATION IN SERENGETI, TANZANIA

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Tanzania’s Serengeti ecosystem extends from the Loliondo-Ngorongoro Highlands to Lake Victoria, includes iconic Serengeti National Park, and has high biodiversity and conservation value. Human communities adjacent to protected areas are integral to the system; however, rapidly-growing populations are increasing pressure on natural resources at



an alarming rate, threatening system functionality. Focusing on community-conservation partnerships established by Frankfurt Zoological Society, our results confirm it is essential to account for anthropogenic factors and engage communities in order to understand ecosystem processes and develop effective conservation interventions. Importantly, our results go further to demonstrate the value of actively involving local communities in research and supporting them to drive conservation actions. A series of applied research and intervention projects across the ecosystem has facilitated partnerships between communities, local leaders, government agencies, and NGOs, building community-level management capacity while promoting conservation agendas. We show that community conservation microfinance groups have extended livelihood options, improved resilience to socio-economic shocks, and reduced reliance on natural resources for income across many Serengeti villages. Community health workers have disseminated family planning and environmental information to enable sustainable resource-use decisions at household level. Community scouts have been empowered to monitor and protect forest resources while also coaching about sustainable forestry practices. Community research has provided insights about communication flows and optimal methods for distributing conservation messages, and enhanced understanding of contested-resource and land-use issues. Such outcomes highlight large returns from investing in partnerships with communities across key biodiversity landscapes, to better understand conservation issues and address them effectively.

91-USING SCIENTIFIC EVIDENCE IN CONSERVATION MANAGEMENT: WHAT ARE THE BARRIERS AND SOLUTIONS?

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Evidence-based conservation seeks to improve the effectiveness and transparency of conservation management and policy decisions by integrating systematically collated and appraised scientific research with practical experience and the local context. While reasons for the conservation science-implementation gap are well known, a thorough inventory of these barriers and effective solutions does not exist. We developed a framework to categorise the enablers, barriers and solutions of applying science to practice by reviewing the environmental and medical literature and interviewing 35 conservation practitioners from government and non-government organisations in the United Kingdom and South Africa. The use of scientific evidence is influenced by a complex array of factors, including the nature of the evidence, the

context of the decision, and characteristics of the researchers, practitioners, organisations and the link between research and practice. Most practitioners recognised the need to use scientific evidence to inform their decisions, which was facilitated by generally positive attitudes, collaborations with research institutes and other organisations, having scientists and advisors embedded within the organisation and processes that ensured collective decision making. The main barriers limiting the practitioners' use of scientific evidence were that the research was rarely presented in an accessible format (as they typically have limited access to scientific papers and little time to read them), external research was often not applicable or irrelevant, and the management organisations lacked sufficient funding for science. We collated over 100 possible solutions to overcome the barriers, with many practitioners suggesting the need for better dissemination of tailored research summaries. Future priorities for implementing evidence-based conservation are to evaluate which solutions have the highest potential for improving the uptake of science in practice.

IN SEARCH OF SNAKES: CONSERVATION AND DISTRIBUTIONAL MODELLING OF A DECLINING ISLAND POPULATION OF GRASS SNAKES (NATRIX NATRIX)

Robert Ward

University of Kent

Within Europe a fifth of reptile species are thought to be threatened with extinction, however evidence of snake declines is poor due to several life history traits and limited study. Snakes are linked with their environment at varying spatial scales and typically exhibit negative responses to anthropogenic habitat change, serving as indicators of ecosystem health. The grass snake (*Natrix natrix*) is found across much of Europe. Although relatively common in Britain, they are thought to be undergoing declines in some areas due to a dependence on landscape-level features such as oviposition sites. Within the Channel Islands grass snakes are only found in Jersey where they have declined, with little known about the causes and the population's subsequent distribution and status. Furthermore they are undoubtedly the rarest of the island's four reptile species. Earlier research has found grass snakes to be abundant in the north-west and south-west of Jersey, and historically the species occurred throughout the remainder of the island at a low density. Further declines are likely, and so to assess the population a combination of directed transect walks utilising both visual and refugia survey methods took place in 2014 at 19 sites. An intensive survey effort revealed low detection with the species occurring at 58% of study sites even though suitable habitat was available. A citizen science project encouraging public recording provided



further sightings. The resulting distributional data suggests the population is largely restricted to the west and south-west of the island. A Maxent species distribution model based upon these data highlights a lack of suitable habitat throughout much of the island, with poor connectivity between quality habitat. Furthermore, localities with south-westerly aspects, ponds, scrub and bush, grassland, gardens, coniferous woodland, a close proximity to prey populations, and lower elevations had greater likelihood of species presence.

AN ICONIC ISLAND WITH ICONIC VALUES: CONSERVATION PLANNING FOR K'GARI-FRASER ISLAND THAT INTEGRATES SOCIAL WITH BIOPHYSICAL VALUES.

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University of the Sunshine Coast

Yoko SHIMIZU, University of the Sunshine Coast ; Gabriel

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K'gari-Fraser Island in SE Queensland is the largest sand island in the world and this significance is recognised internationally through world heritage listing. The unique characteristics that define this island as iconic enable conservation of iconic fauna and natural systems, as well as engagement with nature. The values that define this iconic status and the dynamic ecosystems processes have been impacted both by climate change and changing social values with potentially far-reaching consequences. Values were identified through a range of processes including expert panel consultation eliciting values relating to use, planning, management and research. These values were overlaid within the biophysical context using advanced spatial science techniques. Spatial identification of social values in conjunction with biophysical values was a means of identifying conflicting values with implications for future use and management. This research identified socio-cultural values allocated in iconic national parks through innovative processes of social engagement within a virtual landscape context. The process gave real meaning to engagement with concrete outcomes for conservation.

27 BIODIVERSITY CONSERVATION THREATS IN MEDITERRANEAN-TYPE ECOSYSTEMS OF THE WORLD

Grant Wardell-Johnson

Curtin University

Ben Miller, Botanic Gardens and Parks Authority ; Jasper SLINGSBY, University of Cape Town ; Margarita ARIANOUTSOU, University of Athens ; Peggy FIEDLER, University of California ;

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Simply by sharing their defining feature of climate, the world's five Mediterranean type ecosystem (MTE) regions share sensitivity to a number of significant threats. These link with other global and local processes to create a palette of biodiversity threats that combine the general and the unique within each region. Jurisdictional differences in policies and responses layer over these to enhance the diversity of issues. While MTEs are recognized as among the world's biomes most threatened by climate change, the complexity of predicted and observed threats are only now beginning to be elucidated and documented. In particular, climate change impacts interact with Mediterranean flavors of processes such as changed fire regimes, urbanization, habitat destruction, overexploitation of resources, invasive species and decreased landscape connectivity with important consequences for biodiversity conservation. Here we synthesize findings on threats to biodiversity across the five MTE regions from the '100 priority questions for biodiversity conservation in Mediterranean-type regions of the world' project. We identify the common features and regional singularities of these threats, prioritize their relative importance, and illustrate with new data on key threats.

INTEGRATING CLIMATE-READY REHABILITATION AND RESTORATION IN OLD STABLE LANDSCAPES FOR A MORE SUSTAINABLE FOREST FUTURE: AN EXAMPLE FROM THE JARRAH FOREST, SOUTH-WESTERN AUSTRALIA

Grant Wardell-Johnson

Curtin University

Michael CALVER, Murdoch University ; Neil BURROWS, Department of Parks and Wildlife ; James CROTON, Water & Environmental Consultants ; Giovanni DI VIRGILIO, Curtin University

Old, stable landscapes (OSLs) are vulnerable to interactions between the consequences of resource exploitation and climate disruption, often leading to transformation of ecosystems. We outline an exemplar to integrate rehabilitation and restoration to enhance the resilience of the northern jarrah *Eucalyptus marginata* Donn ex Sm. forest of Mediterranean-climate, south-western Australia. Hererainfall has declined for over 40 years, with projections for further decline. Since European settlement (1829), this forest has also been structurally transformed by land clearing and resource extraction, including logging and mining. A new hydrological regime foreshadows drying of the regolith, with a disrupted climate leading to fire regimes of higher frequency and greater intensity. Substantive areas of this forest are mined for bauxite, requiring the complete restoration of vegetation post-mining. The forest dilemma intensifies despite state-of-



the-science restoration techniques. However, the integration of restoration following mining with subsidisation of restoration of the surrounds offers a new future for these ecosystems, despite inevitable change. We demonstrate the integration of climate-ready rehabilitation with restoration of the surrounds based on a social mandate for continued high value extractive resource industries of the NJF region. This approach enables retention of important components of the forest structure for a more sustainable future environment for venerable OSLs, and offers hope for rehabilitating, restoring and conserving a semblance of the former forest grandeur.

WHERE ARE THE MAJOR ELEPHANT POACHING HOTSPOTS IN AFRICA AND WHAT SHOULD WE DO ABOUT THEM?

Samuel Wasser

University of Washington

The African elephant is the world's largest terrestrial mammal, a keystone species, and likely to be poached to extinction over most of Africa within the next decade. Targeted law enforcement is the only certain way to urgently stop the killing. However, many factors, including politics, corruption and the sheer size of Africa, make these efforts a formidable task. My laboratory has been genetically assigning geographic origin to large ivory seizures (≥ 0.5 tons) made between 1995-2014 in attempt to identify the number and locations of the major elephant poaching hotspots in Africa. Results show that the major poaching hotspots in Africa are currently concentrated in as few as two areas and that our methods have the required accuracy to locate them. We describe strategies to focus law enforcement on these two hotspots, curtail future elephant losses and disrupt this major transnational organized crime.

A TRAVIS COUNTY ALMANAC: USING NATURE BLOGS TO CONNECT UNDERGRADUATE STUDENTS TO THEIR LOCAL ENVIRONMENT

Michael Wasserman

St. Edward's University

Increased interactions between human populations living in urban areas and local biodiversity inhabiting green space (e.g., city parks, urban nature preserves) provide a number of benefits, including promotion of sustainability and conservation practices among the general public, as well as improved human health. Further, many universities either own or are located near green space that is easily accessible to students. To increase the amount of time undergraduate students from across disciplines spend interacting with their local biodiversity and to improve student understanding of and appreciation for natural ecosystems and how human activity alters ecosystem functioning, I have designed a nature blog

experience inspired by Aldo Leopold's A Sand County Almanac. In this semester-long assignment, students read this classic text, then spend at least one hour each week in a local green space around Austin, Texas, documenting their observations of biodiversity in an informal journal. To enhance their experience, they use smartphones to learn about local species (e.g., Leafsnap, Merlin Bird ID, iNaturalist), record their location, and take photographs or record videos. To examine the effects of this experience on their own health, the students also record perceived stress levels. Using all of this information, at the end of each month, they construct a public blog entry on the A Travis County Almanac website (<https://academic.stedwards.edu/ensp2324/>). Each semester, students produce four to five entries. This website takes a citizen science approach as it continually builds a database of observations and media across space and time. Beginning in September 2013, I have used this assignment in eight classes, involving 159 students sharing a total of 397 posts. Such assignments can be easily incorporated into any environmental science or ecology course, and they have lasting effects on students' concern for biodiversity at local and global levels.

SYMPOSIUM ID_181_MAPPING VULNERABILITY AND CONSERVATION ADAPTATION STRATEGIES UNDER CLIMATE CHANGE ACROSS GLOBAL TERRESTRIAL ECOSYSTEMS

James Watson

Wildlife Conservation Society

The identification of spatial gradients in ecosystem vulnerability to global climate change and local stressors is an important step in the formulation and implementation of appropriate countermeasures. However, there are at least three shortcomings in many current conservation-oriented climate change assessments, regardless of their spatial scale. The first concerns vulnerability assessments, which until recently have been focused solely on the system's 'exposure' to future climate change, without considering that vulnerability to climate change is influenced by the system's sensitivity and adaptive capacity, as well as exposure. The second is that the vast majority of climate change assessments has been conducted on species-specific responses, and therefore been largely unable to inform conservation actions in terms of ecosystem-based adaptation. The third shortcoming is that few species or ecosystem assessments have attempted to identify (and map) the specific adaptation action needed to overcome the threats posed by climate change, especially as related to land use and land use change, the other significant driver of ecosystem change. Here I build on recent work to map ecoregional exposure to future climate, using an envelope-based gauge of future climate stability, and incorporate this with an assessment of each ecoregion's adaptive capacity,



based on the proportion of intact natural vegetation. The relationship between intactness (adaptive capacity) and stability (exposure) varies widely across ecoregions, with some of the most vulnerable, according to this measure, located in southern and south eastern Asia, western and central Europe, eastern south America and southern Australia. To ensure the applicability of these findings to conservation, I provide a matrix that highlights the potential implications of this vulnerability assessment for adaptation planning and offers a spatially-explicit management guide.

91-WHAT RESEARCH DO PRACTITIONERS HAVE ACCESS TO AND HOW CAN ACCESS BE IMPROVED?

James Watson

Wildlife Conservation Society

Richard FULLER, University of Queensland; Jasmine LEE, University of Queensland

Conservation science is a crisis discipline in which the results of scientific enquiry must be made available quickly to those implementing management. We assessed the extent to which scientific research published since the year 2000 in 20 conservation science journals is publicly available. Of the 19,207 papers published, 1,667 (8.68%) are freely downloadable from an official repository. Moreover, only 694 papers (3.61%) meet the standard definition of open access in which material can be freely re-used providing attribution to the authors is given. This compares poorly with a comparable set of 20 evolutionary biology journals, where 31.93% of papers are freely downloadable and 7.49% are open access. Seventeen of the 20 conservation journals offer an open access option, but fewer than 5% of the papers are available through open access. The cost of accessing the full body of conservation science runs into tens of thousands of dollars per year for institutional subscribers, and many conservation practitioners cannot access pay-per-view science through their workplace. However, important initiatives such as Research4Life are making science available to organisations in developing countries. We urge authors of conservation science to pay for open access on a per-article basis or to choose publication in open access journals, taking care to ensure the license allows re-use for any purpose providing attribution is given. Currently, it would cost \$51 million to make all conservation science published since 2000 freely available by paying the open access fees currently levied to authors. Publishers of conservation journals might consider more cost effective models for open access and conservation-oriented organizations running journals could consider a broader range of options for open access to non-members such as sponsorship of open access via membership fees.

130-CHANGES IN THE GLOBAL HUMAN FOOTPRINT WITH POPULATION AND ECONOMIC GROWTH

James Watson

Wildlife Conservation Society

Oscar VENTER, University of Queensland

As the global human population and per-capita consumption increases, humanity's influence on the environment is generally considered to increase apace. With most of Earth's natural systems precariously close to unprecedented change, and world population likely reach 10 – 12 billion this century, there is a need to elucidate the relationship between socio-economic growth and environmental influences. The lack of a comprehensive, temporally consistent and spatially explicit measure of human influence on the environment has limited such analyses. Recent data series enabled us to construct a globally-standardized measure of human influence on the terrestrial environment at 1 km² resolution and compare it with trends in population size, economic growth, and urbanization over the 1993 to 2009 period. We show that by 2009, at least 75% of the planet's surface and 97% of agriculturally suitable areas had been influenced by humans. Over the 1993 to 2009 period, the human footprint grew by around 12%, a rate which was outstripped by human population growth at 23% and economic output at 153%. The highest-income countries and urban centers appear to have experienced some decreases in human footprint, while peri-urban areas across all national income brackets saw the greatest increases. We discover divergent environmental pathways for expanding economies, with countries having decreasing human footprint characterized by high control of corruption and urbanization. Moreover, these countries do not appear to be simply exporting their demands for food and raw material to less developed nations. The human footprint on Earth is changing, but in ways that wealth and governance appear to differentially shape. We should be encouraged and informed by examples of rapid economic growth decoupled from environmental influences.

THE EFFECTS OF SHIFTING TEMPORAL PATTERNS OF LAND-USE CHANGE ON BIODIVERSITY

Simon Joseph Watson

La Trobe University

Human land-uses dominate a large portion of the earth's terrestrial surface area. The negative effects of major land-use transformations (e.g. from 'natural' ecosystems to agricultural land-uses) on biotic communities have been well documented. However, human land-uses are not static or uniform. For example, around the world, crops in agricultural areas regularly change, with consequent (positive and negative) shifts in biodiversity and changes to ecological communities.



Globalised markets and increased mechanisation of human land-uses has resulted in a greater frequency of land-cover change in many human dominated ecosystems. The effect of varying temporal patterns of land-cover change on biotic communities is largely unknown, but it is likely that the patterns will play a key role in processes such as biotic homogenization. Here I use case studies from around the world to present evidence on the effects of different production types on biodiversity, and highlight how the magnitude and temporal patterns of land-cover changes can affect the contemporary biotic community. Variations in the temporal patterns of land-cover change are set to continue in the future and it will be critical to incorporate knowledge of their effects on biota into strategies for conservation of biodiversity.

CLIMATE CHANGE COULD TRUNCATE THE WORLD'S MAJOR MIGRATION FLYWAYS

Hannah Wauchope

University of Queensland

Justine SHAW, Australian Antarctic Division ; Øystein VARPE, University Centre in Svalbard ; Elena LAPPO, Russian Academy of Sciences ; David BOERTMANN, Aarhus University ; Pavel TOMKOVICH, Lomonosov Moscow State University ; Richard Fuller, University of Queensland

Millions of migratory birds breed during the short but highly productive Arctic summer before flying south to overwinter at lower latitudes. The potential impacts of climate change are particularly severe in the Arctic, where the rate of warming is projected to be more than twice the global average. Moreover, shifts in suitable climatic conditions for breeding in migratory species might not be reflected at lower latitudes along other parts of species' flyways, causing migration routes to be disrupted. Here we use ecological niche modelling to estimate the future distribution of climatically suitable breeding habitat for all 24 migratory shorebird species breeding exclusively in the high Arctic. Depending on the climate change scenario used in the models, between 16 and 17 species will lose more than 50% of their current climatically suitable breeding habitat by 2070. Climatically suitable habitat will contract to small refugia on Russian Arctic islands and the Canadian Arctic Archipelago, and flyways not currently connected to these regions, most notably in eastern Asia and Alaska, could experience significant declines. Indeed, the Pacific and East Asian-Australasian flyways are projected to lose up to 38% of their species. Encouragingly, protected area coverage is comparatively good for all species currently, and for 18-20 species in future scenarios, although of course protection from habitat loss is insufficient for species' survival if no climatically suitable breeding habitat remains. Mitigation of climate change seems essential to the conservation of Arctic migratory species and, in the interim, international collaboration to protect climate refugia is urgently needed.

VACCINATION AS A MANAGEMENT STRATEGY FOR CHLAMYDIA IN THE KOALA (PHASCOLARCTOS CINEREUS)

Courtney Waugh

The University of the Sunshine Coast

Adam POLKINGHORNE, The University of the Sunshine Coast ; Kenneth BEAGLEY, Queensland University of Technology ; Jon HANGER, Endeavour Veterinary Ecology ; Jo LOADER, Endeavour Veterinary Ecology ; Peter TIMMS, The University of the Sunshine Coast

The koala (*Phascolarctos cinereus*) is declining across much of its natural range. A myriad of threats are placed on the koala, including motor vehicle accidents, dog attacks, habitat fragmentation and disease. *Chlamydia pecorum* is the most devastating disease in mainland koala populations and accounts for significant morbidity and mortality. Localised population extinctions are predicted to occur within 10 years due to disease in some populations. However, modelling has shown that a five-year vaccination program could halt chlamydial disease related declines, and further modelling has shown that if declines due to disease could be decreased by even 50% then populations would remain stable even with continued anthropomorphic pressures. The development of an anti-chlamydial vaccine is underway with promising results. Here, we present the results from the first and largest field based vaccine study to date. We propose that a vaccination schedule can provide a key tool for management and conservation of this iconic species.

CHLAMYDIA PECORUM IDENTIFIED IN UROGENITAL AND OCULAR REGIONS OF SEXUALLY INACTIVE JUVENILE KOALAS (PHASCOLARCTOS CINEREUS)

Courtney Waugh

The University of the Sunshine Coast

Isabelle RUSSELL, The University of the Sunshine Coast ; Peter TIMMS, The University of the Sunshine Coast ; Amber GILLETT, Australia Zoo Wildlife Hospital

Chlamydia pecorum, a major pathogen of the koala (*Phascolarctos cinereus*), is considered an important factor to the threat of localised extinctions facing koala populations. *Chlamydia pecorum* is primarily considered a sexually transmitted infection, yet recent observations have identified that sexually immature koala joeys are exhibiting clinical symptoms of *C. pecorum*. Urogenital (UGT) and ocular (OC) samples, obtained from mother-joeys pairs and orphaned koala joeys, were analysed for *C. pecorum* DNA using quantitative polymerase chain reaction. This confirmed the presence of *C. pecorum* in koala joey UGT and OC regions suggesting that *C. pecorum* is able to transmit vertically as well as sexually. No correlation could be found between koala mothers exhibiting



C. pecorum infections and joeys exhibiting infections. This suggests that, although vertical transmission may be occurring between mother and joey, it is a less prevalent method of transmission than sexual transmission. Further, the recently developed koala anti-chlamydial vaccination appears to afford some protection to joeys with vaccinated mothers.

A STEP TOWARDS UNDERSTANDING FLUCTUATIONS IN CARRYING CAPACITY FOR AN ENDANGERED FACULTATIVE MIGRANT

Matthew Webb

Australian National University

Aleks TERAUDS, Australian National University ; Dejan STOJANOVIC, Australian National University ; Robert HEINSOHN, Australian National University

Extreme plasticity in movements of nomadic or facultative migrants, usually in response to fluctuating food availability, often results in massive shifts in range size and breeding location. Although supporting data are rare, conservation management for these species needs to extend beyond traditional approaches that consider a species' distribution as static. Using spatially explicit occupancy modelling we describe dramatic spatiotemporal variation in the endangered swift parrot over 6 years. By repeatedly sampling 1000 sites across the entire breeding range we demonstrate highly significant spatial structuring where the population shifts en masse from one location to another to breed. These shifts were driven by the distribution of *Eucalyptus* flowering events, which provide the species primary food source whilst breeding. In the context of massive and continuing habitat loss, our findings are critical to inform conservation because only a fraction of the breeding range is suitable (and occupied) in most years, and that fraction varies dramatically between years. Thus, the spatial configuration of food each year also determines the availability of nesting sites (i.e. cavities in old-growth trees). These keystone features take >150 years to develop and are extremely rare and patchy across most of the landscape. We provide an analytical framework to assess overall fluctuations in (i) area of occupancy and, (ii) the relative availability and spatial configuration of different functional habitats (ie. for foraging and nesting). This allows an assessment of where, and when, spatial or reproductive bottlenecks occur and will better inform the development of spatially explicit conservation strategies that account for plasticity in settlement patterns when breeding. Most importantly, we clearly identify areas of the breeding range that need to be managed in a way that provides enough foraging and nesting habitat for the majority of the population to breed in a given year.

INTEGRATING SOCIAL SCIENCE INTO CONSERVATION SCIENCE: EXAMINING THE LANGUAGE OF 'HUMAN-WILDLIFE CONFLICT'

Amanda Webber

Bristol Zoological Society

Catherine M HILL, Oxford Brookes University ; Alberto ACERBI, University of Bristol ; Daphne KERHOAS, Bristol Zoological Society

The need to integrate social science perspectives into conservation science is now widely acknowledged. This is particularly important for the examination of negative human-wildlife interactions; historically termed 'human-wildlife conflict' (HWC). In these scenarios, wildlife can be injured or killed and the associated economic and social costs mean local people may fail to support or actively resist environmental initiatives. However, the language of HWC implies that animals are conscious protagonists (Peterson et al, 2010) in what is often a social tension between human stakeholders (Dickman, 2010, Redpath et al, 2013). There has recently been a movement to reframe this 'conflict' and find an alternative term (e.g. 'negative interaction', 'human-wildlife coexistence'); however, there is little evidence as yet of a shift away from the 'HWC' label among researchers. We will present the analysis of full texts and metadata made available by major academic publishers which tracks the usage of HWC terms (e.g. 'human-wildlife conflict', 'crop raiding'), the uptake of alternative labels, and the affiliations of authors and of the disciplinary domains of journals. We will discuss how this study (i) is not only important to understand the adoption and diffusion of terminology within the literature but (ii) also provides a useful backdrop for exploring the integration of social science perspectives in the conservation literature.

97. USING CITIZEN-SCIENCE AND CIRCUITScape TO IDENTIFY CORRIDORS AND COLONIZATION SITES IN NEW YORK CITY AND LONG ISLAND, NY

Mark Weckel

American Museum of Natural History

Christopher NAGY, Mianus River Gorge ; Megan HENRIQUEZ, Fordham University ; Rachel ENGSTRAND, American Museum of Natural History ; Jason MUNSHI-SOUTH, Fordham University

Long Island, NY is one of last large land masses in the continental U.S. yet to support a breeding population of northeastern coyotes (*Canis latrans* var.). Predicting likely areas for colonization and potential corridors can help efforts to study the ecological and social impacts of coyotes on Long Island, pre- and post-arrival. To forecast future colonization sites on Long Island, we revisited (and reanalyzed) the results of an earlier citizen science study from nearby Westchester, NY that modeled residential human-coyote interaction (HCI)



as a function of habitat. We argue that the probability of a “backyard” coyote sighting can be a proxy for permeability of the matrix to coyote movement. Therefore, we used HCI predictions to parameterize resistance grids for subsequent Circuitscape analyses. We will present the results of these analyses and also discuss the vital role citizen data can play in tracking the establishment and growth of a Long Island coyote population.

OPERATIONALIZING ADEQUACY IN MARINE PROTECTED AREA NETWORK DESIGN

Rebecca Weeks

ARC Centre of Excellence for Coral Reef Studies

Alison GREEN, The Nature Conservancy ; Eugene JOSEPH, Conservation Society of Pohnpei ; Kevin RHODES, University of Hawaii ; Elizabeth TERK, The Nature Conservancy Micronesia ; Jeremy VANDEWAL, James Cook University

A central tenet of protected-area design is that areas must be adequate to ensure the persistence of focal species. Guidelines recommend that minimum size of protected areas be informed by species’ home ranges, because individuals that move beyond protected area boundaries might be exposed to threats, and thus only partially protected. This is especially important for species that are directly exploited, such as many coral reef-associated fishes. Rules of thumb for marine protected area (MPA) size, informed by species movement or otherwise, are frequently used in post-hoc evaluation of MPA network designs. Post-hoc approaches to considering adequacy are problematic, however, as they often require subjective alterations that reduce the complementarity and efficiency of systematic designs. Post-hoc evaluations also often fail to consider that minimum size recommendations must apply to the habitats that focal species use, rather than the total size of the protected area per se. Using a case study from Pohnpei, Micronesia, we demonstrate a novel approach to MPA network design that explicitly accounts for species’ home range requirements and habitat associations. Using raster habitat maps, MPAs are “seeded” from cells with high suitability scores, calculated as a function of the area of a species’ habitat within the neighbourhood (defined by the species’ home range), and grown until they reach minimum size. We explore the spatial overlap and functional surrogacy of MPA networks designed for different species, and conduct sensitivity analyses to uncertainty in input parameters. Analysis of existing MPAs in Pohnpei demonstrates that almost all are too small to adequately protect key fishery species. Our method complements representation-based approaches to MPA network design, and is likely to appeal to stakeholders motivated more by a desire to effectively manage populations of key fishery species than by biodiversity conservation-oriented objectives.

ANTHROPOGENICALLY ALTERED LANDSCAPES NEGATIVELY AFFECT RESTING SITES BUT CREATE FAVOURABLE FORAGING HABITAT FOR OTTERS IN THE ALPS

Irene Weinberger

University of Zurich

Stefanie MUFF, University of Zurich ; Andreas KRANZ, Alkranz Ingenieurbüro für Wildökologie und Naturschutz ; Lukas KELLER, University of Zurich ; Fabio BONTADINA, SWILD - Urban Ecology & Wildlife Research [INSTITUTE] WSL Swiss Federal Research Institute

Animals have different habitat requirements for behaviours such as foraging or sleeping. Information on specific habitat selection is particularly important for species in anthropogenically altered landscapes. The natural riparian landscape in the Alps has been one of the last pristine refuges of Europe, but is severely reduced by urban sprawl, alteration of river courses and increasing numbers of hydropower plants. The Eurasian otter *Lutra lutra* is a semi-aquatic mammal which has suffered massive declines in Europe in the last century. In recent years, the species is re-expanding its geographic distribution again, also into the Alpine arc, where it had disappeared. The aim of this study was to understand the habitat requirements of the otter in the Alps to facilitate its recovery. We radiotracked nine otters for six to 30 months at night to study foraging habitat selection and during the day to identify dens. Data was analysed using step selection function and logistic regressions. We found that the home ranges were selected along streams wider than 4m, despite these being the most affected by habitat transformations. There, they significantly selected reservoirs with widths up to 12m, but avoided residual waters of this size. However, once the reservoir was broader, selection was reversed. While foraging otters were not affected by the riparian structure, for resting they clearly selected for stretches with natural riparian vegetation and varied the type of the den depending on human disturbance. Our results exemplify a mammal with a flexible selection on foraging habitat, where it tolerates or even benefits from modifications to the rivers, but it appears to be sensitive while resting. We presume that optimal resting sites are the limiting factors for otters in human altered landscapes. These findings are encouraging for a return of the species to the Alps as long as the altered riparian landscape is interspersed with natural stretches at short intervals.

THE LIMITATIONS OF NO-TAKE MARINE RESERVES IN PROTECTING CORAL REEFS FROM REDUCED WATER QUALITY

Amelia Wenger

James Cook University



David WILLIAMSON, James Cook University; Eduardo DA SILVA, James Cook University; Daniela CECCARELLI, James Cook University; Caroline PETUS, James Cook University; Michelle DEVLIN, James Cook University

Near-shore coral reefs have adapted to periodically reduced water quality from terrestrial run-off. Their capacity to cope with and recover from such disturbances is critical for their continued persistence. Globally expanding coastal development, in combination with projected increases in the frequency of extreme weather events under climate change, may lead to the continued degradation of many vulnerable near-shore coral reefs. This paper investigates the spatial and temporal variability of water quality during moderate and major flooding events of the Fitzroy River within the Keppel Bay region of the Great Barrier Reef Marine Park from 2008-2013. We quantified the ecological impacts of the resulting flood plumes on adjacent near-shore reefs using six years of flood plume satellite imagery and long term monitoring data. We then investigated the role of no-take marine reserves (NTR) in reducing reef degradation from flooding and enhancing post-disturbance recovery. Near-shore reefs did not experience any declines in coral cover from moderate flooding in 2008-09, suggesting intrinsic resistance against reduced water quality. However, they had limited ability to cope with more extreme reductions in water quality associated with major flooding in 2010-11. Furthermore, near-shore reefs showed low resistance to subsequent moderate flooding events. The reduction in coral cover strongly correlated with duration of exposure to reduced water quality ($r = -0.89$). Importantly, the NTRs did not influence the response to or post impact recovery from major flooding, suggesting limited ability of NTRs to promote ecosystem recovery following external disturbances. The limitations of NTRs in mitigating the effects of reduced water quality on near-shore coral reefs underscore the importance of integrated management approaches that combine effective land-based management with no-take reserves.

THE USE OF HABITAT ASSOCIATION AS A PROXY FOR SPECIES DISTRIBUTION

Amelia Wenger

James Cook University

Malcolm TURNER, The Great Barrier Reef Marine Park Authority; John OLDS, Queensland Parks and Wildlife; Ian CRAIGIE, James Cook University; Jessica HOPF, James Cook University; Bob PRESSEY, James Cook University

Managers of the Great Barrier Reef's islands face difficult decisions when it comes to prioritising conservation management actions. The islands contain a wide variety of natural and cultural values, which face multiple and dynamic threats, with management constrained financially. In order to improve management decision-making on islands,

a comprehensive dataset on the distribution of priority species across the study region is required. As with most environmental datasets, there are large knowledge gaps where biological surveys have not occurred, thus necessitating alternative ways of acquiring species distribution data. To address these gaps, comprehensive habitat data for the islands, based on satellite and aerial imagery, and in situ surveys, was extracted from a larger database. Then, a series of expert elicitation workshops were conducted to estimate populations of priority species on islands and to determine their habitat associations. Overall, we collected 6,076 records for 40 priority species on 146 islands. These records were comprised of 655 survey, 1341 expert judgement, and 4359 habitat proxy records. Because of the high number of habitat proxy records, we compared the use of habitat presence and absence as proxies for species presence and absence. We found that, when comparing habitat presence to expert judgement on species presence, habitat presence predicted species presence 53% of the time. In contrast, habitat absence correctly predicted species absence 94% of the time. Our results demonstrate that, in the absence of comprehensive biological surveys, habitat absence can reliably predict species absence. Environmental managers can use species absence information to prioritise monitoring programs and to prioritise areas for management actions, while minimizing the risk of overlooking important sites for priority species.

GENETIC LANDSCAPE WITH SHARP ALLELE FREQUENCY SHIFTS IN SWEDISH MOOSE (ALCES ALCES)

Lovisa Wennerström

Stockholm University

Nils RYMAN, Stockholm University; Jean TISON, Swedish Museum of Natural History; Anna HASSLOW, Stockholm University; Love DALÉN, Swedish Museum of Natural History; Linda LAIKRE, Stockholm University

The moose (*Alces alces*) is the most intensely managed game species in Fennoscandia; approximately one third of the population, c. 16,000 animals, is harvested annually through hunting. Despite the species' biological and socio-economic importance there are knowledge gaps with respect to its intraspecific diversity and genetic structure. To delineate the spatial genetic landscape and population history of the Swedish moose we used allozyme variability from over 20,000 georeferenced moose collected all over Sweden in combination with genetic information from 12 microsatellite loci ($n > 1,200$) and mitochondrial DNA sequences. We combined individual-based and traditional statistical approaches with coalescence based simulations. The results indicate a complex history with bottlenecks and recent expansions that is consistent with historical records. The analyses show that Swedish moose are separated into 2



major genetic groups, a northern and a southern one, where the southern group is further divided into three subgroups. The 2 main subpopulations are moderately differentiated and separated by sharp allele frequency shifts occurring over a relatively narrow transition zone in central Sweden that coincides with a similar, previously reported transition zone in Norway. This differentiation is not reflected in mtDNA variation, however, where no significant divergence was observed. This suggests that the 2 major subpopulations in Sweden reflect divergence shaped after the postglacial recolonization of Scandinavia. Spatial autocorrelation assessments indicate that gene flow is relatively restricted in spite of the species potential for long distance migration with an estimated average dispersal distance of only a few km. Present day genetic patterns are most likely affected by both past and present anthropogenic actions. The current management areas largely coincide with genetic clusters, simplifying the integration of genetic information into management.

91-CONSERVATION BIOLOGY - IS THERE EVIDENCE THAT IT IS STILL A DISPLACEMENT BEHAVIOUR FOR ACADEMIA?

Tony Whitten

Fauna & Flora International

In 2001 an editorial in Conservation Biology by myself and two colleagues asserted that conservation biology was indeed a displacement behaviour. Did this discipline actually contribute to conservation outcomes on the ground. The paper caused some negative reaction from some quarters and was dismissed by some. Yet the paper is still used in university courses on conservation. Nearly 15 years on from when the paper was written the basic tenets of the argument are re-examined and the conclusions will be discussed.

CONSERVATION AND BIODIVERSITY VALUE IN REGENERATING TROPICAL FOREST

Andrew Whitworth

University of Glasgow

Roger DOWNIE, University of Glasgow ; Ross MACLEOD, University of Glasgow

Although the value of primary forest for biodiversity conservation is well known, the majority of the world's tropical forests have already had their structure and underlying functions disrupted. The potential biodiversity and conservation value of these regenerating forests remains controversial. We suggest that this is because assessments of regenerating rainforest are often dominated by young regenerating forests, forests with on-going human disturbance (from logging and hunting), few multi-taxonomic studies and a lack of comparisons between disturbance types. We assess the overall biodiversity and conservation value of a regenerating

rainforest in the globally important Manu area of the Peruvian Amazon. Potentially confounding factors were overcome and results were compared to a selection of well-studied primary forest sites and the expected gamma diversity for the region. We show that, for birds, large mammals, amphibians and reptiles, that regenerating forest held 87% (+3.47) of the alpha diversity found in comparable primary forest sites and 83%(+6.66) of primary forest gamma diversity from the region. This is significantly higher than biodiversity values presented by review studies (57%, 59% and 68%), suggesting that confounding effects are causing an underestimation of the potential value of regenerating rainforest for conservation. Further, the regenerating site held 89% (39 out of 44) of the species of high conservation concern predicted for the region, indicating that the high species richness is not simply driven by generalist species of lower conservation value. Species richness of regenerating rainforest after complete clearance was on average 15% (+6.6) lower than historically selectively logged forest. However, species richness of even these historically completely cleared areas was 16% higher than previous suggested average values (60%+-9.58).

SYMPOSIUM #20: CONSERVATION DRONES AND MONITORING OF BIODIVERSITY

Serge Wich

Liverpool John Moores University

Mapping land cover and determining species are two major tasks for conservation workers. Remote sensing technology is increasingly being used to assess changes in land cover. However, conventional satellite- and air-borne sensors can be prohibitively costly and inaccessible for researchers in developing countries. Species abundance is often determined by ground surveys or costly and risky surveys with small manned planes. In addition, ground surveys are often expensive, time consuming, and limited in their spatial coverage. In 2012, Lian Pin Koh and I co-founded the ConservationDrones.org initiative (<http://ConservationDrones.org>) to introduce drone technology to our colleagues in the conservation community for monitoring of land-cover change and species distribution and density. Conservation drones are inexpensive and autonomous unmanned aerial vehicles equipped with cameras to record high quality video and photographic images. Aerial photographs can be stitched together to produce near real-time geo-referenced land use/cover maps of surveyed areas and even 3-dimensional forest models. They can also be used to survey wildlife such as orangutans, chimpanzees, and various other species. I will talk about the various applications of conservation drones for ecological and conservation research.



ASH DIEBACK MAY INFLUENCE BIODIVERSITY OF EPIPHYTIC AND EPIXYLIC CRYPTOGRAMS IN EUROPEAN CLOSE-TO-NATURAL FOREST

Sylwia Wierzcholska

University of Warsaw

Bogdan JAROSZEWICZ, University of Warsaw ; Martin KUKWA, University of Gdansk, Department of Plant Taxonomy and Nature Conservation ; Anna LUBEK, Jan Kochanowski University in Kielce, Institute of Botany

Living and dead European ash trees (*Fraxinus excelsior*) are preferred substrata for cryptogams. The dieback of ash, caused by the fungus *Hymenoscyphus pseudoalbidus*, resulted in a decline in ash abundance in Poland and adjacent countries. In Bialowieza Forest (Poland) ash population was reduced during the last two decades by 2/3 and may put ash dwelling species in jeopardy. Therefore studies on effects of ash dieback on biodiversity became urgent. We have resurveyed 144 ha permanent plot to estimate changes in species abundance, distribution and species composition of plants and lichens. We took the opportunity to study effects of ash decline: changes in the frequency of ash-dependent cryptogam species and their substrate preferences. There were many threatened and red-listed species among cryptogams recorded on ash on the study plot (e.g. *Dicranum viride*) including some lichens recorded exclusively on ash (e.g. *Pertusaria coronata*). Many species survived fading away of their host trees and continued to grow on ash deadwood in the first stages of decomposition, the others were limited to living trees only. Some species (e.g. *Zygodon rupestris*) decreased in comparison to their abundance on the plot 25 years ago. Frequency of others, light demanding cryptogams, increased, probably due to higher light amounts reaching forest floor after canopy decline. Some ash-related cryptogams showed also tendency to increase their abundance on other tree species. The impact of ash dieback on biodiversity of cryptogams in Bialowieza Forest depended on species biology. We did not record any extinctions yet. Moss species in some cases even benefitted from increased amounts of light reaching the forest floor. In the case of lichens recorded only on ash trees, their extinction risk will increase with declining numbers of available host trees. Our results show potential trends in populations of ash associated cryptogams in European countries, where the ash dieback is not so advanced yet.

INTERNATIONAL POLICY AND PRESSURE AROUND CLIMATE-SMART AGRICULTURE

Marit Wilkerson

AAAS S&T Policy Fellowship [INSTITUTE] University of California

Is 'climate-smart agriculture' merely rebranding for good development? What does the label add to the goals of sustainable agriculture? These recurring questions have strong implications for research, policy, and international development. Without a clear understanding of how climate-smart agriculture (CSA) can take shape in the field and what the relatively new label means for policy, researchers and decision-makers cannot coherently promote the practice of CSA. Nor can they adequately identify research gaps for applied conservation and agro-ecological researchers. In this presentation, I will synthesize the global trends in CSA research and policy and detail how emerging the emerging consensus around CSA highlights both critical knowledge gaps and practical development strategies. To underline the importance of CSA to natural resource conservation and food security, I will provide an overview of its origins and detail the level and nature of current agreement around a CSA definition. The particular practices that constitute CSA have been promoted for decades but were never labeled as such until fairly recently. This issue of rebranding highlights the misunderstandings and difficulties behind defining CSA. I will then delve into the state of global climate-smart agriculture policy with particular insights from the U.S. The next necessary step, translating the science and policy of CSA into on-the-ground development projects, remains largely piecemeal and ad hoc. However, certain regions and political bodies are successfully integrating CSA into existing development programs, and the international research and policy community can learn from those successful approaches. I will present the lessons learned from those success stories, distilling them into programmatic best practices. These trends, consensus, and successes point toward the next steps forward for research and policy on integration and implementation of CSA.

210 WE MUST SAVE OUR ROADLESS WILDPLACES - THEY ARE OUR ONLY REMAINING INTACT MANUALS FOR NATURE

David Wilkie

Wildlife Conservation Society

Today 83 percent of the Earth's land surface has been altered by the actions of people. Today commodity producers are already looking for new lands to convert to food, mineral and biofuel production, and pressure to expand such production will only increase in the next decades. But plundering the 17 percent of the planet not yet bent to our will, cannot make up for our failure to sustainably manage the 90 percent of the Earth that we have already altered. Roadless wild places with intact assemblages of native plants and animals, interacting largely outside the influence of humanity, and at densities



where all fulfill their ecological roles are vital. Their complex and redundant nutrient pathways make them both resistant and resilient to environmental shocks, and thus will likely be our best arks for species conservation as the climate changes. Maybe most importantly they are our last manuals for nature. Manuals that thankfully still have all their pages, something that cannot be said for all landscapes and seascapes altered and degraded by human use. These intact, wild places are vital repositories of ecological knowledge without which we will never know how to repair what we damaged or restore what we have destroyed. This presentation will explore the value of and threats to roadless wilderness in the dense forest regions of Central Africa, and propose options for reconciling the tradeoffs between development to raise incomes of some of the poorest people on earth, with the conserve of these dwindlingly few last, intact wildplaces.

EMPLOYING RANK AGGREGATION OF LOCAL EXPERT KNOWLEDGE FOR CONSERVATION PLANNING OF THE CRITICALLY ENDANGERED SAOLA.

Nicholas Wilkinson

University of Cambridge

Nigel LEADER-WILLIAMS, University of Cambridge ; Duc LUONG VAN, Hue University of Sciences

There has been much recent interest in using local knowledge and expert opinion for conservation planning, particularly for hard-to-detect species. Because of the need to compare data collected at simple locations, surveys generally seek to extract quantitative data from informants but this may incur error through cultural misunderstanding or cognitive effects. We present a new approach which couples an intuitive Rapid Rural Appraisal survey technique with rank aggregation algorithms developed for web search by researchers at MicroSoft and Google. We apply this technique to conservation planning for the poorly known saola antelope *Pseudoryx nghetinhensis* across one conservation landscape in Central Vietnam. Using assessments of relative abundance by local people across the knowledge domain of each village, we produce a prioritization map of the area as a whole. Because direct information about the saola is so difficult to obtain, these rank aggregation results are valuable for conservation planning or the targeting of field surveys.

TRADE IN ORCHIDS FOR CHINESE MARKETS

Sophie Williams

Xishuangbanna Tropical Botanic Garden

Jiungyun GAO, Xishuangbanna Tropical Botanic Garden

The use of orchids in China has a long history, dating back to 200BC, with many species highly prized for their medicinal and horticultural value. However, the demand for wild orchids

in China is thought have increased over the last decade and over-exploitation is a now major threat. The diversity of species in trade has not yet been documented. Furthermore, the attributes of orchids desired by consumers, and therefore driving trade, are also unknown. Peoples' preference for certain species tends to lead to systematic harvesting for those species perceived more valuable. We carried out monthly surveys of six regular markets trading orchids in Xishuangbanna Autonomous Prefecture, Yunnan; an area well known for its high orchid diversity. This region borders Myanmar, Laos and Vietnam presenting opportunities for illegal trade into China. We identify over thirty species in trade and show the markets close to the Myanmar border are particularly diverse in orchid species. We are unable to determine the exact source locations of species on sale. However, interviews with collectors suggest movement of orchids across the borders occurs. To assess consumer preferences we interviewed 600 people using a choice based experiment to determine favoured attributes. We show that rarity is a desired characteristic, as are red flowers. There is no difference in preference for species cultivated compared to wild harvested for species in the ornamental trade. This suggests cultivated material could potentially supply the market demand for ornamental orchids. However cultivation as a conservation strategy has little evidence of success and we discuss the challenges of substituting wild by cultivated orchids. We conclude by highlighting which species should be conservation priorities in Xishuangbanna and across China.

WISCONSIN CHAPTER OF SCB: A CASE STUDY IN FOSTERING COLLABORATION IN CONSERVATION

Caitlin Williamson

Natural Resources Foundation of WI

The field of conservation is facing an increasing number of challenges, from growing threats such as climate change, to substantial decreases in conservation funding and support. Wisconsin, USA, in particular has recently faced specific challenges in terms of budget, governance, and legislation that have negatively impacted conservation and natural resources management in the state. In the face of such challenges, it is critical for conservation practitioners and scientists to maintain an outlook of positivity and to focus on strategies that engage the public, find ways to connect research to policy, and promote a collaborative environment where conservationists from different sectors and backgrounds can learn from one another. The newly established Wisconsin Chapter of the Society for Conservation Biology (WSCB) is filling a unique niche in Wisconsin. Its membership consists of students and faculty from universities and colleges, staff from state agencies and non-profits, as well as the private sector. WSCB is finding innovative ways for its members to become meaningfully



involved in conservation research and policy in the state. In this presentation, I detail the steps that the founding WSCB board took to establish an interdisciplinary and engaged chapter, provide examples of the projects and activities that the chapter is involved in and establishing, and identify successes and challenges the chapter faced in starting from scratch. These lessons learned will be useful for other SCB chapters and groups, as well as for other organizations wishing to have an impact on their community and beyond.

BIRDS BE SAFE: CAN A NOVEL CAT COLLAR REDUCE AVIAN MORTALITY BY DOMESTIC CATS (FELIS CATUS)?

Susan Willson

St. Lawrence University

Iyioluwa OKUNLOLA, St. Lawrence University; Jessica NOVAK, St. Lawrence University

The domestic cat (*Felis catus*) has been described as the largest anthropogenic threat to songbird populations in North America. We examined the effectiveness of a novel cat collar in reducing avian and small mammal mortality by cats. A cotton fabric collar cover is worn over a nylon quick-release cat collar, and the bright colors and patterns of the collar cover are hypothesized to warn birds of approaching cats. We conducted two seasonal trials, each lasting twelve weeks, in autumn 2013 and spring 2014. Fifty-four cats participated in the autumn trial, while a subset of 19 cats participated in the spring trial. Cats were randomly assigned to two groups, and collars were removed or put on every two weeks, to control for weather fluctuations and seasonal change. Cats wearing collar covers killed 19 times fewer birds than uncollared cats in the spring trial, and 3.4 times fewer birds in the fall. The collar covers were extremely effective at reducing predation on birds. Small mammal data were less clear, but did decrease predation by half in the fall season. There were no significant effects of location (rural versus village), sex, or age of cats. The brightly colored collar cover we tested is a highly effective device for decreasing bird predation, especially in the spring season when birds may be depredated more easily due to their territorial nature and bright feather colors, as opposed to the autumn season when drab neotropical migrants typically flock together. We suggest that these collar covers be utilized as a conservation tool by domestic cat owners, and that they also be fitted to feral cats living in maintained cat colonies.

NEW FIELD DATA ON THE ENDANGERED L. MITTERMEIERI - NORTHWEST MADAGASCAR

Leslie Wilmet

Liege University - Gembloux Agro-Bio Tec

Roseline C. BEUDELS-JAMAR, Royal Belgium Institute of Natural Sciences, Brussels, Belgium. Rue Vautier, 29. 1000 Bruxelles;

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Madagascar's extraordinary biological diversity is under increasingly severe threat from anthropogenic degradation of its forest habitats. Genus *Lepilemur* is exemplary of the mammalian fauna of the island. The genus is particularly negatively affected by deforestation and habitat fragmentation, which is reflected by the recent uplisting of many of the 26 *Lepilemur* species into one of the threatened categories of the IUCN Red List. Sportive lemurs have small distribution ranges, and fairly small total populations. Their pattern of distribution appears to have been established through vicariant speciation, probably driven by changes in the configuration of the hydrographic system. Such a pattern suggests a high level of niche conservatism. The main goals of this study is to verify the existence and extent of niche conservatism in three closely related species within genus *Lepilemur*, and to draw conclusions on the applicability of conservation protocols to a broader array of *Lepilemur* species. This study focuses on a poorly-known taxon, *L. mittermeieri*, whose distribution range is located on the Ampasindava peninsula. This species was described in 2007 but since then no investigation has been carried out. We present here our global project as well as the results of a field mission conducted from March to June 2015 in order to specifically 1) investigate habitat use of 8 radio-collared *L. mittermeieri* by the analysis of their home range, feeding ecology and sleeping sites characteristics and 2) to complete forest characterization of the home range of each radio-collared animal. This study is conducted on the Ampasindava peninsula, a priority area for Malagasy conservation.

PROVISIONING ECOSYSTEM SERVICES IN DARJEELING HIMALAYA: FUELWOOD, FORESTS, AND PEOPLE

Alexa R. Wilson

University of Massachusetts Boston

Kamal BAWA, University of Massachusetts Boston

Patterns of energy use at the household level have important implications for many aspects of economic development and landscape sustainability. In mid-montane forest regions of Darjeeling District, Eastern Himalaya, the majority of households rely on fuelwood extracted from natural forests to meet energy needs for cooking, heating, and supporting livelihoods. Fuelwood extraction has been identified as a significant driver of change in forest structure and composition and even deforestation in many developing countries. However, little is known about the impact of fuelwood extraction on forests in this region. To elucidate this impact, we conducted informal household interviews in five buffer



villages of Singalila National Park and three buffer villages in Senchal Wildlife Sanctuary to identify fuelwood extraction sites and to establish permanent monitoring plots. Three fuelwood extraction sites were selected for each village. For each extraction site, we sampled three 10 x 10 m quadrats. The parameters measured included basal area, number of cut stems, species richness, and species abundance. We measured the same parameters in control quadrats with no fuelwood extraction. The GPS coordinates of each quadrat were recorded for future re-sampling. Results indicate differences in species occurrences and differences in understory species abundance and diversity between extraction and control sites. The data generated from this ongoing research will fill the knowledge gap necessary to develop sustainable local and regional forest management strategies and is a critical component in understanding the linkages between rural energy use patterns, people, and the environment.

COMMUNICATING SCIENCE IN ADVOCACY: AN EXERCISE IN SOCIAL AWARENESS

Amber Wilson

Wyoming Outdoor Council

The environmental problems we face are urgent, complex and involve a multitude of stakeholders from many social and economic backgrounds, experiences, and expertise. Solving these problems ultimately requires diverse groups to work together. Successful collaboration requires empathy and commitment to set aside emotion and seek common goals even when they seem unlikely. Controversy surrounds the field of environmental advocacy and those of different or conflicting values and beliefs are often demonized. Environmental advocates may intentionally or unintentionally present an argument that implies poor moral or ethical standing on the part of a person/group rather than acknowledging and crediting the difference in perspectives. When this happens, the opportunity for collaboration is broken. Presentation of scientific findings in a "truth to power" format may come from altruistic intentions, but ultimately it damages the advocate's credibility with those they hope to persuade. The intended audience becomes disinclined to engage in productive collaboration when they have been accused of poor character, while they in truth and self-perception are generally of good intent. The modern environmental advocate must understand the technical science behind issues and communicate the findings in relatable terms, but most critically, they must also practice an empathy, understanding, and patience in their advocacy despite the urgent and often emotionally-charged nature of environmental issues and conflicts. Virtuosity manifests in different forms as people act in ways they believe to be virtuous in their own world-views. Advocates should base their messaging and strategy on the assumption and

acknowledgement that humankind generally strives to be virtuous. I will outline a model for bridging the science/manager/stakeholder gap through an advocacy framework that presents scientific findings on a level playing field. I will discuss examples of the model's successful implementation.

A NEW THREAT TO PENNSYLVANIA'S (USA) MOST DIVERSE STREAM: THE INVASION OF ROUND GOBIES INTO A NEW WATERSHED

Casey Wilson

Allegheny College

Jay STAUFFER, Penn State University

Round gobies, *Neogobius melanostomus*, were discovered in North America's Great Lakes in 1990 and since that time have become among the most abundant benthic fish in all five Great Lakes. In August 2014, round gobies were discovered in French Creek, which is a separate watershed from Lake Erie. This stream holds the greatest species diversity of both fishes and freshwater mussels in the state of Pennsylvania, many of which are listed as threatened or endangered. The purpose of this study was to compare diet overlap between round gobies and darters (Family Percidae). A secondary objective was looking at diet overlap between darter species in the absence of round gobies. Two streams were selected, the first being a tributary to Lake Erie (Elk Creek), where gobies are abundant, and the second in headwaters of the Ohio River drainage, where gobies have recently been discovered (French Creek). Results show that in Elk Creek, round gobies directly compete with native rainbow darters (*Etheostoma caeruleum*) and cause a dietary shift. Current studies in French Creek will continue assessing diet overlap and also habitat partitioning between round gobies and native darters in the specific stretches of French Creek where round gobies have been discovered. Information on the introduction of round gobies to lotic systems with high species richness is lacking, therefore these studies will give better a better understanding of the impacts of gobies in such systems. Nowhere else in the Northeastern United States remains as ecologically intact as French Creek. This stream has been deemed "one of America's last great places" because of its high diversity and relatively unaltered watershed. The implications of this new invasive species on the biological integrity of French Creek is currently unknown, but round gobies in stream systems have been known to dominate resources and severely impact native benthic fish populations.

CENTRAL AMAZON VÁRZEA FLOODPLAIN HYDRODYNAMICS: SEASONAL AND INTERANNUAL HYDROLOGICAL VARIABILITY

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Maria VEGA, University of the West Indies ; Bruce FORSBERG, Instituto Nacional de Pesquisas da Amazônia

Surface water flow is recognised as the key factor in the establishment and maintenance of wetland ecosystems as it helps to determine the spatial and temporal complexity of wetland habitats. However, the hydrodynamics of seasonally flooded wetlands in the Amazon basin remains poorly quantified through ground observations, satellite observations or modelling. In this research, a detailed hydrodynamic model was developed for ~850 km² of várzea floodplain at the confluence of the Solimões and Purus rivers and used to characterise the seasonal and interannual hydrological variability in the wetland system. The model was constructed using in-situ and satellite data as the main boundary conditions and validated against floodplain flow measurements collected across the area during an intensive fieldwork campaign from mid-rising, through high-water to mid-falling flood conditions. Acoustic Doppler Current Profiler (ADCP) measurements were obtained of flow rates along floodplain channels, runoff from terra firme via measurement of flows out of ria lakes, and main channel discharge. Results indicate that floodplain channels play a fundamental role in floodplain hydrodynamics, carrying the bulk of flood water into the floodplain during rising water. Once main-channel water levels are above-bankfull, overbank flow directly into the floodplain forest becomes significant. Terra firme runoff contributes a relatively small amount of flow. The hydrodynamic model was able to represent well the broad hydrodynamics through the várzea system, particularly along floodplain channels; diffusive overland flow was less well represented due to errors in topographic data caused by floodplain vegetation. The model has allowed a detailed picture of floodplain hydrodynamics to be constructed which will help to improve understanding of the hydrology of wetland ecosystems and its importance for their conservation.

GLACIAL RETREAT AND THE ROLE OF LATE PLEISTOCENE AND EARLY HOLOCENE EVENTS IN THE ORIGIN OF CONSERVATION UNITS: IMPLICATIONS FOR WOODLAND CARIBOU IN CANADA

Paul Wilson

Trent University

Cornelya KLUTSCH, Trent University ; Micheline MANSEAU, Parks Canada

Criteria for establishing Designatable Units (DUs) under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) require a threshold of "distinct" and "significant". Accurate delineation of conservation units is critical given the assessment criteria for status and the reliance on population sizes and trends defined by where these boundaries are defined. Establishing DUs for caribou in Canada is particularly

challenging given the diversity of morphology, behaviour, and the ecozones in which they inhabit. Significant attention has been given to glacial refugia as reservoirs contributing to the phylogenetic differentiation of conservation units, and evidence of admixture is often interpreted on a contemporary scale for many species, including caribou. We applied microsatellite and mitochondrial DNA markers from 1500 caribou from central Canada where admixture from northern Beringian evolved caribou with caribou lineages derived south of the Pleistocene glacial maxima was evident. Approximate Bayesian Computation (ABC) supports early introgression of Beringian derived DNA into southern evolved lineages consistent with the retreat of glaciers in central Canada, with subsequent evolution of two related contemporary ecotypes from the introgressed lineage: sedentary boreal and migratory tundra caribou. Dates of the divergence of the two ecotypes occurred within the Holocene several thousand years ago at the time of land modifications in the Hudson Bay Lowlands ecosystem. Our findings further show that delineation of current boreal caribou ecotypes is warranted given distinct phylogenetic histories with differential levels of introgressive hybridization. The role of differential lineage admixture in the formation of ecotypes is not limited to central Canada and may have contributed to a higher number of distinct and significant lineages in western and northern Canada that are not currently considered as separate DUs under COSEWIC.

156: CAMERA-TRAPPING VS. IDNA FOR WILDLIFE SURVEYS; COSTS, EFFICIENCY AND RELIABILITY

Andreas Wilting

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Camera-trapping is a very popular method to study wildlife, as camera-traps work independently of the observer, and thus can accumulate survey effort over extended areas and periods of time with comparatively little effort. Camera-traps are further known to record even the most elusive mammals. However, particularly reliable camera-traps are costly, and as camera-traps represent a highly directional and point-based sampling method, even species in the immediate vicinity of the trap will be missed if they do not pass through the camera's sensor field. Recently, a new non-invasive method to study wildlife populations has emerged; the use of invertebrate-derived DNA (iDNA) of vertebrate host species. Invertebrate parasites such as leeches, mosquitos or ticks are generally abundant and easily



collected without costly equipment or extensive training, and joint screening of multiple individuals limits lab costs. Although this method is still largely unexplored, first results indicated that it could become a powerful tool to study a wide range of wildlife species. Here, we present first iDNA sequencing results of terrestrial leeches from the Central Annamites in Vietnam. We analyzed leeches both individually and in pools up to almost thirty individuals, and compare the results in terms of costs, efficacy and reliability to detect target species. Further we compare our molecular data with camera-trap datasets from an adjacent area in Vietnam and we discuss costs, breadth of the target community sampled, and taxonomic resolution of the approaches.

NATURE IN YOUR BACKYARD - CITIZEN SCIENCE IN GARDENS

Silvia Winter

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Julia KELEMEN-FINAN, Technical office Julia Kelemen-Finan ; Kristina PLENK, University of Natural Resources and Life Sciences Vienna ; Bärbel PACHINGER, University of Natural Resources and Life Sciences Vienna

Gardens and parks represent important refugia in intensive agricultural landscapes for many formerly common species. Citizens can easily observe wildlife in their gardens or backyards in rural and urban areas, while researchers may not get access to these sites. Such wildlife observations could be entered to a single database providing a unique large-scale spatial dataset. Our project "Nature in your backyard – citizen science for schools" joins scientists, NGOs and governmental sections with 16 schools from Lower Austria and Vienna. We aim at linking the presence and relative abundance of hedgehogs, wild bees (in nesting aids), 12 bird and 8 readily identifiable butterfly species to garden structure and management as well as to the surrounding land use. Pupils use online or printed survey forms to gather information on garden size, type, management and structures as well as wildlife observations. Each school will collect data on the chosen species groups in at least 4-5 gardens per school. Identification guides, experimental protocols and hands-on training at the respective garden sites are provided by the scientists and NGOs. In addition, we expanded this science education partnership to a broader citizen science project where we want to involve all gardeners or people attached to gardens to report the presence of hedgehogs in their gardens across Austria. Analogous to the science education partnership, gardeners should report sightings of hedgehogs or footprints by using hedgehog tracking tunnels. Hedgehog citizen scientists will complete an online form on garden management and report presence or absence data of hedgehogs in their gardens in combination with scans or photographs of hedgehog footprints. The wider range and higher number of observations

will lead to better estimations of hedgehog presence in relation to garden structures and management.

163: THE FUTURE OF MARINE ECOSYSTEM SERVICES IN KIMBE BAY, PAPUA NEW GUINEA: IMPLICATIONS FOR LOCALLY MANAGED MARINE AREAS

Russell Wise

CSIRO

James BUTLER, CSIRO ; Tim SKEWES, CSIRO ; Erin BOHENSKY, CSIRO ; Nate PETERSON, The Nature Conservancy

The need to realise the co-benefits of biodiversity conservation, sustainable fisheries, climate adaptation and food security from near-shore marine ecosystems is well-documented. This provides the rationale for the Coral Triangle Initiative and more specifically Locally Managed Marine Areas (LMMAs) in the Indo-Pacific region. LMMAs are delineated near-shore marine areas where rules (e.g. no-take zones and harvest restrictions) are applied with clear ownership and management by local communities, and in many cases have achieved these co-benefits in cost-effective and culturally-sensitive ways. The LMMA network in Kimbe Bay of PNG was informed by principles of successful community-based natural resource management (CBNRM) and is cited as an exemplar of CBNRM and ecosystem-based adaptation. However, during a multi-stakeholder scenario-planning process held in 2013, concerns were raised about the long-term ability of these LMMAs to achieve these co-benefits, given 'business as usual' projections of population growth, economic development and climate change. We sought to assess the effectiveness and sustainability of this LMMA network, given their current characteristics and governance. Two lines of investigation were adopted. First, the social-ecological context of Kimbe Bay was assessed using data from the scenario-planning process and consultations with four communities with established LMMAs. This assessment considered the beneficiaries, the relative contributions to livelihoods, the threats, the trends in condition, the costs of monitoring and enforcement, and the present and future values, of the biodiversity and ecosystem services derived from the LMMAs. Second, the characteristics of the LMMA network were compared with principles for successful CBNRM. These analyses revealed many recommendations for improving the design, governance and management of the LMMAs. These will be presented and discussed.

188-THERMAL BARRIERS TO HABITAT CONNECTIVITY OF JUVENILE STEELHEAD TROUT

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Distributions of native salmonid fish in the Pacific Northwest are strongly tied to temperature conditions in their habitats. Conservation concerns arise owing to declining salmonid stocks in conjunction with warming aquatic conditions that can fragment and functionally disconnect cold-water habitats. A significant case in point is the influence of increased summer water temperatures on distributions of juvenile steelhead trout (*Oncorhynchus mykiss irideus*) in the South Umpqua River, Oregon. The Umpqua River is a major steelhead producing ecosystem on the Pacific coast of North America. The Umpqua ecosystem contains tributary streams with different elevation gradients, hydrologic and thermal regimes that provide diverse freshwater rearing habitats for juvenile steelhead and other salmonids. However, variations in summer temperature regimes can present barriers to distributions by life history type. In South Umpqua tributaries, extremes in thermal conditions influence distributions of different steelhead life history stages. A conservation paradigm is explored that uses criteria informed by available knowledge about fish distribution, habitat conditions, biological requirements and annual 7-Day maximum summer temperature regimes. This approach attempts to address direct and indirect effects of temperature, the role of unoccupied habitat and the relevance of scale. Because distributions of life history stages commonly extend beyond the boundaries of their existing or suitable habitat, the conservation paradigm points to natural temperature regimes being preserved whenever possible.

ENGAGING BUSINESS INTO BIODIVERSITY CONSERVATION: THE CASE STUDY OF THE FRENCH SNB VOLUNTARY INSTRUMENT

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Although they are subject to multiple environmental regulations, businesses have significant impacts on biodiversity through their operations and products. In response to the call of the Convention on Biological Diversity (CBD) to broaden actors' engagement into biodiversity conservation, notably regarding business, the French government has designed an original instrument that is part of its national biodiversity strategy (Stratégie nationale pour la biodiversité, SNB). This instrument aims at engaging organizations on a voluntary basis in two steps: adherence to SNB principles, concretized afterward by a peer-reviewed commitment plan. We first draw

on the concepts of corporate social responsibility (CSR) to analyze the motivations and effective outcomes for businesses that made SNB-reviewed commitments. Then, an evaluation of the contribution of these commitments to the SNB and CBD objectives is proposed. This case study combines data collected from business commitment plans, administrative documents and in-depth semi-structured interviews with managers in charge of the SNB commitments of their companies. Initial business motivations were mainly contractualist-oriented, eg. improvement of stakeholders' relations and gain of market share. In contrast, the main effective outcomes of this process for businesses are primarily institutionalist: strengthening of the internal consistency of corporate biodiversity plans, gain of internal legitimacy and better regulatory compliance (resulting from voluntary actions). If the marginal impact of this instrument seems undermined by the weak number of present actors and sectors, some commitments tackle issues not covered by regulation. Commitment plans present more procedural than substantive actions and seem to contribute heterogeneously to the SNB and CBD objectives. This is notably related to their relevance for the different business sectors relatively to their maturity, specific impacts and value creation opportunities.

„QUICK & DIRTY“ - A STANDARDIZED PROTOCOL FOR RAPID ASSESSMENT OF BAT ACTIVITY IN AGROFORESTRY SYSTEMS WITH CONSERVATION PURPOSE

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Increasing land use competition is a great challenge. Agroforestry (AF) is said to benefit many species and thus could satisfy both agricultural and conservation demands. Nevertheless bats, which are highly relevant as bioindicators and for conservation, are rarely assessed. This may be due their nocturnal activity and the large effort and knowledge required. Therefore, a method for rapid assessment of bat activity was developed to evaluate whether and how bats use agroforestry systems e.g. for commuting or foraging. Bat activity was analyzed at Scheyern research station located in the Bavarian tertiary hills in southern Germany. Agroforestry systems were established in 2009 on two organically managed fields with seven crops in rotation and two integrated managed fields with four crops in rotation. Each short-rotation coppice system comprises of three 8.25 m wide tree strips, where each



strip consists of three double rows of different trees. The first harvest was in February 2013. We used simple heterodyne detectors and a standardized protocol to record bat activity on presence/absence basis within 15 second intervals for a total of 20 minutes per plot. On 10 dates during summer 2013 and 16 dates during 2014 activity was recorded after sunset in eight randomly ordered plots. Four habitat types (AF-organic, AF-integrated, grass strip and hedgerow) were sampled with two plots each. To validate the simplified method bat calls were also recorded and analyzed in more detail using an automatic bat detector system. The simple method is much faster and cheaper than the advanced technique. However, results are similar and can thus be used for a rapid and cost efficient assessment and monitoring of bat activity. Furthermore, results suggest that agroforestry can be recommended as conservation measure to improve arable habitats for bats.

THE IMPLICATIONS OF CONSERVATION POLICIES ON MAMMAL DIVERSITY AND MOVEMENT WITHIN A COSTA RICAN BIOLOGICAL CORRIDOR

Margot Wood

Texas A&M university

Current government payments for ecosystem service (PES) policies, in place in Costa Rica since 1997, strive to protect water, biodiversity, scenic beauty and carbon. PES landholder participants that live in the SINAC (Sistema Nacional de Areas de Conservacion) designated biological corridors are given funding priority because their lands are considered essential for connecting segregated wildlife populations held within the National Parks. Eligible PES land uses include agroforestry, regeneration through tree plantation and primary forest protection. The corridor network intends to aid in conservation and ecological functioning of the existing protected areas. The purpose of the study is to assess the ecological function of the Paso de Las Nubes biological corridor. We use populations of medium and large mammals as study organisms and indicators of ecological health and movement capability. Our research objectives are to determine if (a) spatial conservation targeting increases vegetation in the Paso de las Nubes Biological Corridor and (b) if this targeting creates or maintains mammalian dispersal corridors between the two neighboring protected regions. Lastly, how (c) alterations to the PES funding, land targeting and biological corridor policies impact ecological dispersal processes. We collected species presence and absence data throughout the biological corridor using camera traps and hair traps. We collated that data with interview data to gain species lists for each PES property. We also collected vegetation data throughout the biological corridor. We will detail the diversity held in corridor and buffer regions of the parks. We will also describe the land use changes within the biological corridor occurring since the creation of

the policy, and how these changes vary from areas outside of the official conservation corridor.

21 EVALUATING THE IMPACTS OF CONSERVATION ON HUMAN WELLBEING: A CASE STUDY ON THE NORTHERN TANZANIA RANGELANDS

Emily Woodhouse

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Katherine HOMEWOOD, University College London ; J. Terrence MCCABE, University of Colorado ; E.j. MILNER-GULLAND, Imperial College London ; David WILKIE, Wildlife Conservation Society

The research demonstrates the application of a human wellbeing framework in understanding multi-dimensional impacts of conservation interventions on local people, and more broadly in considering aspects of justice. The Simanjiro plains, east of Tarangire National Park, are a key dispersal area for large mammals, and are of vital importance to Maasai livelihoods. Pastoralist livelihoods are, however, rapidly diversifying, resulting in changing needs and priorities. The recent history of the region is characterised by conservation conflict, and state control over land and wildlife revenues continues to be strengthened despite rhetoric about community-based conservation. In the broader context of these policy and landscape changes, we evaluated the impact of a payment for ecosystem services (PES) intervention which aims to prevent agriculture on the plains. A locally driven conceptualisation of wellbeing, grounded in qualitative discussions, gave priority to local knowledge and socio-cultural values. Rather than analysing average impacts, we disaggregated data by gender, age and village to understand differences in needs and aspirations, and the distribution of impacts across groups. Improving security was an overarching priority, shaping ideas and experiences of wellbeing, and was grounded in a history of land alienation, uncertainty, and a lack of control over decision-making. This suggests that interventions focused on providing land security at a community level, and attentive to procedure and trust-building will be vital in sustainable ecosystem management and human development efforts. Finally, we reflect on the justice implications of the research, both locally and globally, in terms of the resolution of trade-offs in dimensions of wellbeing between interest groups.

118 APPLYING A LOCALLY DRIVEN, 3D CONCEPT OF HUMAN WELLBEING IN CONSERVATION

Emily Woodhouse

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of Colorado ; David WILKIE, Wildlife Conservation Society ; E.j MILNER-GULLAND, Imperial College London

Understanding the social impacts of conservation interventions is vitally important to ensure conservation is at the very least not harming people, and instead aiming to support human development. These impacts are commonly measured through externally defined asset and monetary based poverty measures. We highlight how the concept of human wellbeing stands apart from standard poverty and welfare indicators to take into account the multiple dimensions of people's lives that they have reason to value. The strength of the wellbeing concept lies in its breadth, but this has also tended to result in vague conceptualisations, and superficial engagement. We present a universal framework for wellbeing, which can be adapted to locally meaningful formulations, allowing local voices to be heard and putting at the centre those people most affected by policy and environmental change. This conceptualisation combines three dimensions – objective, subjective and relational – with the thematic categories of material assets, health, social relations, security and autonomy. Drawing upon case studies in Tanzania and Cambodia, we discuss how the concept can be applied to impact evaluations on the ground, and how conservationists can navigate trade-offs between quantitative and qualitative approaches to support causal and explanatory analysis. In considering the implications of a wellbeing approach for conservation policy, the research elucidates how the use of mainstream economic measures can distort decision-making in ways that constrains sustainable development outcomes.

ENVIRONMENTAL AND SPATIAL VARIABLES INFLUENCING THE CATCH OF SMOOTH HAMMERHEAD SHARKS (SPHYRNA ZYGAENA) WITHIN THE SHARK MESHING PROGRAM OFF THE COAST OF NEW SOUTH WALES, AUSTRALIA.

Alexander Wray-Barnes

University of Newcastle
David POWTER, University of Newcastle ; Natalie MOLTSCHANIWSKYJ, University of Newcastle ; Victor PEDDEMORS, New South Wales Department of Primary Industries

Understanding the factors influencing the distribution of a vulnerable species is critical for adaptive management. This is especially necessary for data deficient species which experience potential human induced population pressures such as harvest and climate change. This study assesses the role of environmental conditions on distribution and catch of the vulnerable smooth hammerhead shark (*Sphyrna zygaena*). A long-term catch dataset from the Shark Meshing Program in New South Wales beaches, Australia, was overlaid with SST, rainfall (sea surface salinity proxy) and Chlorophyll data

obtained from satellite data extracted for net positions. A total of 1,423 *S. zygaena* were caught over the 24 year study period. Sharks ranged in size from 30-400 cm total length (TL); though 96.4% were immature (< 210 cm TL). Almost 50% of the catch of *S. zygaena* were from eight nets close to estuary mouths, indicating possible nurseries. Generalised Linear Modelling of catch occurrence against environmental parameters show catch greatest during periods of low rainfall, from nets above sandy substrates, and the period before, during and after new moon. Models suggest that increase in SST may explain the temporal decrease in catch, however, population declines may also play a role. Preliminary results indicate that Chlorophyll a may increase catch occurrence. This research highlights the importance of specific estuaries as nurseries and thus identifying possible locations for protected areas. This also highlights that remotely sensed information alongside long-term catch data can be used to further understand the distribution and environmental preferences of data deficient marine species.

118-THE EQUITY LANDSCAPE

Becky Wright

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Resource management typically requires limits on human use of natural resources to protect biodiversity and the services on which people rely. These actions often lead to differences in who pays the costs and who reaps the benefits, as well as tradeoffs among social, economic and ecological management objectives. Understanding the mechanisms and consequences of these equity concerns remains a core question for the design and evaluation of conservation actions. Here we present a new framework for how to think about equity through the lens of getting things done. First we identify different types of equity as being inputs, such as who gets to participate in management decisions, and/or as outputs, such as who gets the benefits of the conservation intervention. We define "the equity landscape" as how a given community the distribution of resources, costs, and benefits. The equity landscape then determines the equity inputs and outputs of a conservation intervention. There are hypothetical scenarios where the equity landscape favors a moderate, low or high degree of equity. Similarly, management may place a moderate, low or high value on equity objectives. This framework allows us to compare and discuss the tradeoffs of where management sets target equity values, and how different contexts might determine equity's role in conservation success. We survey the



literature and apply this framework to different conservation outcomes. In some scenarios, fitting a conservation intervention equity inputs and outputs to the existing equity landscape will lead to the highest probability of success, whereas other scenarios might require deviating from the equity landscape and changing the equity inputs and outputs.

UNDERSTANDING THE MOTIVATIONS AND SATISFACTIONS OF VOLUNTEERS TO IMPROVE THE EFFECTIVENESS OF CITIZEN SCIENCE PROGRAMS.

Dale Wright

BirdLife South Africa

Les UNDERHILL, University of Cape Town ; Matt KEENE, Environmental Protection Agency ; Andrew KNIGHT, Imperial College London

Citizen science is increasingly recognised as a useful approach for conducting scientific research and public outreach, producing multiple benefits for nature conservation and the volunteers involved. Understanding the motivations, satisfactions and other aspects of volunteers' psychology is essential for conservation scientists wishing to mobilize this resource. By employing programme evaluation in combination with psychometric assessment one can begin to understand the complex relations which exist between citizen science programmes and their volunteers. Such empirical evaluations help promote evidence-based conservation practices. We tested a psychometric instrument for assessing the motivations, satisfactions, and advocacy role of volunteers with the Second Southern African Bird Atlas Project (SABAP2), including a logic model that articulated the theory of operation of SABAP2 with regard to its volunteers. Data were collected through stakeholder and volunteer surveys, and focus groups with the programme's management. Qualitative and quantitative data analysis included content analysis, statistical tests of internal consistency and factor analysis. An inventory, the Environmental Volunteer Functions Inventory (EVFI), was tested for assessing volunteer motivations in this and other volunteer-based research programmes. Robust scales were also developed for assessing volunteer satisfaction and level of ambassadorship. These scales revealed that volunteers in SABAP2 are satisfied with the program and exhibit behaviours suggesting they act as advocates for the program. A platform for adaptive management of the SABAP2 program and further evaluations of this, and similar programs, represents a major outcome of this research. The components of an effective citizen science programme are also described.

THE IMPORTANT BIRD AND BIODIVERSITY AREAS PROGRAM IN THE WESTERN CAPE PROVINCE, SOUTH AFRICA: TRANSLATING KNOWLEDGE INTO ACTION ACROSS THE REGIONAL NETWORK.

Dale Wright

BirdLife South Africa

As the country partner to BirdLife International, BirdLife South Africa is tasked with managing South Africa's Important Bird and Biodiversity Areas (IBAs). The regional IBA work in the Western Cape Province was initiated in January 2012, with the objective to assess, monitor and conserve this network of twenty-four IBAs in the Western Cape. The initial step in this process has been to conduct comprehensive IBA Assessments for all sites, describing the status of threats, species and habitat, and conservation action at each IBA. Upon completion of the assessments these data are analysed through a rigorous prioritization exercise in order to rank IBAs for conservation intervention. The prioritization sums the threat score obtained from assessments, with an IBA species score based on the number and conservation status of the IBA trigger bird species present at the site, to determine the priority ranking of each IBA. A decision tree analysis is applied to the combined score to determine the most appropriate course of action and guide implementation at each site and across the entire network. The decision tree examines factors such as the current protection status, protected area expansion priorities, existing conservation action and opportunities for intervention. It is essential that such prioritizations are applied in conservation in order to direct limited resources to the most critical sites. The regional programme is applying a multi-faceted, evidence-based approach to conserving the network of IBAs. Tools being employed include private landowner-driven biodiversity stewardship at key sites; habitat rehabilitation at farms across the landscape; fundraising for socio-economic development projects; initiating academic research projects targeting knowledge gaps; developing Local Conservation Groups for IBA monitoring and grass roots implementation; conducting outreach and raising awareness through various platforms.

REFRAMING THE CONCEPT OF 'ALTERNATIVE LIVELIHOODS'

Juliet Helen Wright

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In developing countries, conservation programmes that aim to reduce local exploitation of natural resources frequently include livelihood-focused interventions. "Alternative livelihood projects" are one such intervention, aiming to reduce the prevalence of activities deemed to be environmentally damaging by substituting these activities with another activity which provides at least equivalent benefits. Alternative livelihood projects are very widely implemented, but the inherent assumptions fail to recognise the complexities of poor rural people's livelihood strategies. In response to a 2012 IUCN resolution calling for a critical review of alternative livelihood projects, we here consider what is meant by the term 'alternative livelihoods' and examine the associated assumptions. We present a typology of three broad categories of intervention - alternatives, compensation and incentives - and take a sustainable livelihoods perspective to conceptualise how alternative livelihood projects fit alongside other livelihood-focused interventions. Sustainable livelihoods approaches have been used in development to consider the multiple factors that influence people's livelihoods, and highlight the range of activities a household engages in as part of a dynamic livelihood strategy aimed at achieving both tangible and intangible goals. Given the diversified nature of livelihood strategies, it cannot be assumed that the benefits from an alternative will substitute, rather than supplement, the benefits that can be gained from exploiting natural resources. Interventions based on flawed or simplistic assumptions about people's needs, aspirations and the factors that influence livelihood choices are unlikely to achieve conservation objectives. It may be more appropriate to target interventions at those most vulnerable to resource access restrictions and to enhance or diversify their livelihood strategies making them more resilient to change.

218 STATE OF THE EU CONSERVATION DIRECTIVES, SUCCESSES AND FAILURES - A PERSPECTIVE FROM EUROPE'S ENVIRONMENTAL NGOS

Friedrich Wulf

Friends of the Earth Europe

The Birds and Habitats directives (BHD) are the cornerstones of the EU's efforts to conserve its biodiversity. With over 27.000 sites covering 18.36% of the EU's land area and more than 250.000 km² at sea, the Natura 2000 network installed under the directives is one of the world's largest, most sophisticated and commended protected area networks. In its article 6, the Habitats directive contains a strong tool to defend the areas against impacts that might adversely affect their integrity. The network's sites have been selected to protect certain

habitat types and species which are either threatened or for which Europe has a global responsibility. Progress towards reaching a favorable conservation of these species and habitats is reported every six years and published in the state of Nature report. The results of the most recent report, which will be published this April, and the evidence gathered during the so-called "Fitness check" of the Nature directives the EU is undertaking this year, prove that the system works in principle, that it is beneficial for both society and economy, and that there is no alternative to these directives in order to preserve the EU's biodiversity and achieve its own 2020 Biodiversity targets. Failures and lags in progress are due to wrong policy decisions in other sectors – notably the recent CAP reform, but also in land use and energy policies – and a lack of implementation, and not due to wrong legislation. There is a clear need for a better understanding of biodiversity's importance, its benefits for people and the economy, for better policy decisions in other sectors, and better implementation of the directives, including through supplying the necessary funding.

INTER-GOVERNMENTAL, MULTI-DONOR, AND ACADEMIC COORDINATION TO IMPLEMENT A TRANSPARENT NATIONAL FOREST MONITORING SYSTEM IN BANGLADESH

Karl Wurster

US Agency for International Development

Mike ROBSON, Food and Agricultural Organization (FAO) ; Md. Yunus ALI, Bangladesh Forest Department ; Sasha GOTTLIEB, US Forest Service ; Matieu HENRY, Food and Agricultural Organization (FAO) ; Imran AHMED, Bangladesh Forest Department

Planning and implementation of sustainable forestry projects requires coordination between national and international actors to maximize the effectiveness of national and local actions and ensure their sustainability. In Bangladesh, the focus on short-term projects funded by donors and development organizations frequently limits long-term planning and commitment of government budgets. In early 2014, USAID, FAO, and the Bangladesh Forest Department (BFD) began co-designing two USAID-funded projects to develop and implement a sustainable national forest inventory and monitoring system as part of the Bangladesh REDD+ MRV. These complementary projects implemented by FAO and the US SilvaCarbon program integrate recent scientific advances, new technologies, the national context, different inter-governmental, multi-donor, and academic visions, and decades of experiences in monitoring forests worldwide to build national capacity and maximize the sustainability of the Bangladesh national forest monitoring system. Additionally, the BFD is setting up new technical units within the government



to which trained officers will be posted to use a combination of remote sensing and ground-based forest inventory for monitoring the status forest and ensure long-term financial support. By training Bangladeshi counterparts on the most relevant, cost-effective, and accurate methods for forest monitoring the BFD will be able to conduct future inventories independently. The complementary four-year projects were initiated in July 2014 with a three-day multi-stakeholder planning workshop attended by over 50 Bangladeshi stakeholders from the government, environmental NGOs, and academic institutions and facilitated by FAO, USAID, and SilvaCarbon experts. Since January 2015 over 100 Bangladeshi partners have been trained, the forest inventory methods have been developed and the first national forest cover map was created. The national forest inventory will be completed in early 2018.

CAMPAIGNING FOR BIODIVERSITY CONSERVATION IN BANGLADESH

Karl Wurster

United States for International Development
Sumaiya FIROZE, United States for International Development ; Wasif HASAN, United States for International Development ; Colin HOLMES, United States for International Development ; Troy BECKMAN, United States for International Development

For over two decades USAID has worked in Bangladesh to promote biodiversity conservation and sustainable economic development. Projects have made huge strides in developing and implementing community-government protected area management and has created alternative livelihoods for poor, resource dependent people. Unfortunately, many of these conservation successes are not known or understood by the general public, particularly the youth in Bangladesh. In order to tell the story of how USAID projects are balancing biodiversity, conservation, and climate change goals with sustainable economic development, a series of communication tools are being used. Starting in 2014, USAID/Bangladesh developed a communications and outreach campaign that is focused on biodiversity. The campaign created local, national, and globally reaching outreach materials and products to communicate the importance of conserving biodiversity. USAID activities include policy dialogues on biodiversity conservation with the host government officials; involving journalists in investigative biodiversity reporting; engaging youth to increase their understanding and participation in conservation; developed outreach materials about the importance of Bangladesh's fragile ecosystems, and the importance of protecting and conserving natural environments. This presentation highlights lessons learned from this campaign and is focused on successes, challenges, and mistakes; particularly when engaging young and old journalists during trainings, and students for a film competition.

73 - SEASCAPE GENETICS FOR THE DESIGN OF A MARINE RESERVE NETWORK FOR A LONG-DURATION PELAGIC LARVA

Amanda Xuereb

University of Toronto

Janelle CURTIS, Department of Fisheries and Oceans ; Isabelle CÔTÉ, Simon Fraser University ; Frédéric GUICHARD, McGill University ; Louis BERNATCHEZ, Université Laval ; Marie-Josée FORTIN, University of Toronto

Ocean circulation plays an important role in shaping patterns of spatial genetic structure in marine organisms, particularly those with a passively dispersing larval stage. We integrate biophysical oceanographic models and genomic data to investigate the influence of ocean currents on larval dispersal and gene flow in the giant California sea cucumber (*Parastichopus californicus*) in the north-eastern Pacific Ocean. Using a biophysical model of ocean circulation developed for the Pacific coast of Canada, we simulate larval dispersal trajectories using a Lagrangian particle-tracking model and use these trajectories to generate a connectivity matrix among 18 sampled sites, spanning the west coast of Canada. We then simulate changes in allele frequencies as a function of larval dispersal probabilities from each location based on the connectivity matrix. We compare our simulation of gene flow to an empirical genomic dataset of ~4,000 variable single nucleotide polymorphism (SNP) markers from 432 sampled sea cucumbers. Furthermore, we identify potential loci under selection to examine spatial patterns of adaptive variation. Our work shows the importance of using of ocean circulation models to explain patterns of neutral and adaptive genetic structure in marine systems characterized by a long-lived dispersive stage with a high potential for gene flow.

EFFECTS AND MECHANISMS OF PROTECTED AREAS ON NATURAL CAPITAL AND HUMAN WELL-BEING IN CAMBODIA

Wu Yang

Conservation International

Madeleine BOTTRILL, Conservation International ; Will TURNER, Conservation International ; Carlos CANO, Conservation International ; Max WRIGHT, Conservation International ; Marc STEININGER, Conservation International ; Annette OLSSON, Conservation International ; Tracy FARRELL, Conservation International

Despite extensive conservation efforts and policy interventions, over the past decades the Earth's natural capital has been experiencing unprecedented degradation and decline from local to regional and global scales, posing great threats to the sustainable provision of ecosystem services for human well-being. Recently, there has been a growing



recognition of the importance of understanding and managing the linkages between natural capital and human well-being. However, so far, there is very limited understanding of how policy intervention affects natural capital and then influence human well-being. Particularly, it is due to lack of quantitative indicators of natural capital and human well-being as well as systematical causal inference of underlying mechanisms. Moreover, although spatial autocorrelation is a well-known issue, previous impact evaluation research seldom takes it into consideration. Here through an international collaborative project, we assembled remotely sensed data, geographic information, and socioeconomic data to construct indicators of natural capital and human well-being in Cambodia, Southeast Asia. We then constructed spatially explicit causal inference models to test a number of hypothesized causal mechanisms of policy intervention on natural capital and human well-being. Our results identify multiple pathways through which protected areas affect natural capital and human well-being. Our results also confirm that spatial autocorrelation significantly affects model parameters and cannot be ignored. This study laid a theoretical and methodological foundation for future research and practice on understanding and managing natural capital for human well-being.

SYMPOSIUM (ID 108) DEMONSTRATING EFFECTIVE BIODIVERSITY CONSERVATION OUTCOMES WITH THE USE OF GEO-TECHNOLOGIES IN PARAGUAY AND THE AMERICAS

A. Alberto Yanosky
Guyra Paraguay

Satellite remote sensing has been crucial in Paraguay and from Paraguay to the region, to monitor biodiversity conservation outcomes. Monitoring through remote sensing has allowed decision makers in Paraguay to advance the conservation of biodiversity from identification of key sites for conservation, evaluate their human-induced land use changes and natural changes and provides co-benefits for local people and climate change adaptation and mitigation. Among the several aspects to measure advances in biodiversity conservation, some of them are related to land use changes. Monitoring Important Bird and Biodiversity Areas, and the methods and its application has been extended beyond the boundaries of Paraguay into the Americas (for important sites for waterfowls, for mangroves, for Amazonian sites, and particular sites of conservation investments). The monthly report for the Gran Chaco, the ecoregion with the highest rates of deforestation, have been linked to strong communicational campaigns which have permitted to put in place conservation actions. Selection of sites for key environmental services, methods of identification of sites by high value conservation forests and areas, impact of climate change in ecosystem services, are

among the many information outputs which were linked to implementation of activities to conserve biodiversity. This work done by a private conservation institute (Guyra Paraguay) has been done in close cooperation with sub-national, national and international public and private institutions. It is of an unprecedented type the way of advancing biodiversity conservation using GIS through satellite data collected, the ease of access to such data, and a model of policies that have promoted free and open data in the country. This is a prominent example of the increased dialogue between the remote sensing/data providing community and conservationists.

CLIMATE-SMART GRASSLANDS MANAGEMENT: ADAPTING TO CLIMATE VARIABILITY, REDUCING VULNERABILITY OF PRODUCERS, AND CONSERVING BIODIVERSITY IN URUGUAY

A. Alberto Yanosky
Guyra Paraguay
Holger KRAY, World Bank

Uruguay is known for its grass-fed beef production on a landscape with diverse grasses and gentle hills where trees or shrubs are only seen in rocky and hilly areas. The basis for its world famous beef-production economy can be traced to the early 1600s when 100 livestock heads were introduced to Uruguay's extensive grasslands and the national herd has since grown dramatically. In this rural landscape, a convergence of different animals and plants makes Uruguay a country of globally significant biodiversity with approximately 14 million hectares of savannah—the dominant landscape where livestock have adapted. Due to now hundreds of years of extensive and increasingly intensive livestock production, the rich biodiversity found in Uruguay is becoming more and more threatened. Over the past ten years, the country has experienced extreme floods and droughts, increasing both in intensity and frequency, when compared to historical records. Repeated and severe floods and droughts have had a strong negative impact on rural livelihoods and production levels. Uruguay has sought to develop strategies and mechanisms to responsibly capitalize on its natural resources in the pursuit of market opportunities presented by increasingly aware and demanding consumers. Uruguay has successfully demonstrated improvements in NRM and climate change adaptation practices for the most vulnerable production systems of Uruguay. Uruguayan family farmers adopted economically, climate-smart and environmentally sustainable practices. These interventions have integrated soil, water, and biodiversity management through implementation of 5,300 on-farm sub-projects covering over 880,000 hectares of agricultural landscapes throughout the country (5% of Uruguay's productive area). Natural grasslands management and biodiversity mainstreaming have proven to be crucial for



reducing vulnerability and promoting adaptation strategies under a “responsible and biodiversity-friendly producer.”

SPATIAL DISTRIBUTION OF PARROTFISHES ON CORAL COMMUNITIES IN THE GULF OF THAILAND AND THE ANDAMAN SEA

Thamasak Yeemin

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Scleractinian corals are recognized as ecosystem engineers in tropical coral reef ecosystem, providing a structural complex habitat which harbors the highest biodiversity in marine ecosystem. Parrotfishes are an important group on coral reefs because of their roles on grazing and bioerosion. They can feed on macroalgae which are the most important space competitors of scleractinian corals. Some parrotfish species have been reported to feed directly on living corals. Overfishing causes significant decline of parrotfish on many coral reefs worldwide. Degradation of coral reefs, caused by coral bleaching events has been showed to affect reef fish communities. In the present study, we examined spatial distribution and abundance of parrotfish on coral communities in the Gulf of Thailand and the Andaman Sea following the severe coral bleaching event in 2010. Parrotfishes were quantitatively observed using a visual census technique in belt transects, 50 m x 5 m for each at nineteen study sites. The dominant parrotfishes were *Chlorurus capistratoides*, *C. sordidus*, *C. strongylocephalus*, *Scarus ghobban*, *S. niger*, *S. prasiognathos*, *S. quoyi*, *S. rivulatus*, *S. rubroviolaceus*, *S. scaber* and *S. tricolor*. The parrotfishes were more abundant at the study sites in the Andaman Sea, in a range of 68 – 121 individuals/250m². The densities of parrotfish in the Inner and Eastern Gulf of Thailand were very low. The present study provides important data on status of parrotfish abundance in Thai waters and highlights the importance of basic biology of parrotfishes for coral reef fisheries management.

ASSESSMENT OF THE STATUS OF FISHERIES RESOURCES WITHIN THE DAWASAMU DISTRICT QOLIQOLI IN FIJI.

David Yeeting

University of the South Pacific
Cara MILLER, University of the South Pacific ; Stacy JUPITER, Wildlife Conservation Society

Increasing population size and high levels of unemployment are some of the factors placing increased pressure on local fisheries resources in many Pacific Countries, including Fiji. In turn, important coastal ecosystems including coral reef ecosystems and near-shore habitats are coming under increasing demand to meet both subsistence needs and to supply urban markets. In response to this dilemma, strategies for sustainable management, community participation and engagement, and local livelihood support have been explored through such avenues as ecosystem-based management regimes and locally managed marine area designation. A key tool for effective implementation of such approaches however is a well-informed understanding of the marine resources within the given area of concern, identification of key habitats, an overview of current fishing practices (including relative effectiveness and specificity), as well as insight into the reliance and use of fisheries resources. This present study undertook a multi-pronged approach to assess marine resources within the Dawasamu District. In the first instance a thorough meta-analysis of all available data was undertaken to provide a baseline level of information as well as potential guidance for how to synergize the typically variable types of data that is available to review fisheries resources within local fishing grounds in Fijian waters. Secondly, a catch-per-unit effort survey undertaken, collected data on biomass, diversity, distribution and habitat of community catch. A second component of this data collection focuses on the effectiveness and specificity of different gear types and methods used. The third area of investigation of this study includes socioeconomic surveys of coastal villagers to assess the relative importance of fisheries resources within households in the Dawasamu District.

EFFECT OF FOREST PATCH ISOLATION AND FOREST PATCH SIZE ON NATURAL FOREST ARTHROPOD DIVERSITY WITHIN KWAZULU-NATAL TIMBER PRODUCTION AREAS

Inam Yekwayo

Stellenbosch University
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South African natural forests are highly fragmented naturally, surrounded by a matrix of grassland. Recent human



development has isolated these patches further and in some cases reduced them in size. Small patches are thought to be adverse for forest specialist species due to the decreased forest interior and increased edge habitat. Here we determine the impact of forest patch isolation and patch size on arthropod diversity. Forty sites were selected with ten in large (≥ 100 m) patches that are isolated (> 500 m) from other patches; ten large patches that are near (< 100 m) to other patches; ten small (≤ 50 m) patches that are isolated; and finally ten were selected that were small patches that are near other patches. Arthropods were sampled using pitfall traps, leaf litter sampling (Berlese funnels) and active searches. The only pairwise difference observed were small-isolated patches having significantly higher species richness and abundance compared to small-near patches. Assemblage composition between forest patches of different patch size revealed significant differences between all pairs. This study indicates that patch isolation does not affect arthropod diversity in large forest patches since there were no differences in species richness between large-isolated and large-near forest patches and also no differences were observed in assemblage composition between large-isolated and large-near patches. This suggests that the size of the patch is more important for natural forest arthropods than isolation. These forests have been naturally isolated for millennia and this has probably led to species evolving to this fragmented network of forest patches. In transformed landscapes this remain true, provided that the size of the natural forest patches remain large enough (and intact) to overcome anthropogenic pressures. Conserving large patches should be the conservation priority for indigenous forests in this landscape.

DEVELOPMENT AND VALIDATION OF THE TAIWAN CHILDREN'S ENVIRONMENTAL ACTION INDEX

Chiung-Fen Yen

Providence University, Taiwan

Chia-Ling CHIANG, National Dong Hwa University ; Li-Hua HOU, Providence University, Taiwan ; Tsung-Wei YAO, Providence University, Taiwan ; Chiu-Ju SU, Providence University, Taiwan ; Joel J. MINTZES, California State University

One of the principal objectives of environmental education is to encourage and support environmentally responsible behavior. In this study, we used Smith-Sebasto and Fortner's Environmental Action Internal Control Index as a framework to develop and validate a useful instrument for assessing environmental attitudes and behavior among elementary and middle school children in Taiwan. We dubbed a new instrument the Taiwan Children's Environmental Action Index (TCEAI) which addresses relevant and significant environmental issues in the Taiwanese context. This instrument was field tested and revised to insure that the instrument conformed to the reading level of test subjects. Subjects of the study were students attending elementary school, grades five ($n=65$) and

seven ($n=80$) and middle school, grade nine ($n=71$). Responses to the experimental instrument were factor analyzed that generating a principal component solution with Varimax rotation and Kaiser normalization. Our findings suggest that the TCEAI displays substantial internal consistency (Cronbach's $\alpha=.92$), moderately positive correlations with self-report measures of environmentally responsible behavior ($R = .35$ to $.46$, $p < .01$). No differences were found among students by gender or age. These findings suggest that the new instrument has substantially favorable psychometric characteristics and may be a valuable tool for use in elementary and middle school classrooms in Taiwan. Currently we are developing teaching modules that address each of the four factors identified in the rotated factor matrix. The module on conservation, for example, introduces students to the importance of habitats to the survival of plants and animals. In future work, we plan to develop revised versions of the instrument to accommodate aboriginal and tribal students in order to broaden its scope and applicability.

POTENTIAL OF RETENTION TREES IN PRESERVING LICHEN DIVERSITY IN MANAGED NORTHERN BOREAL FORESTS

Anna-Liisa Ylisirniö

University of Lapland

The role of retention trees in preserving diversity of old-growth forest lichens was studied in northern boreal spruce forests in NE Finland. Five study sites were established in each of the following categories: 1) 10-12 year old clear-cuts with few retention trees (old logging methods), 2) 7-8 year old clear-cuts with many retention trees (new logging methods), 3) old-growth forests. The occurrence of 14 old-growth forest indicator lichens was investigated from 30 deciduous trees and snags on each site. The species richness of indicator lichens was significantly higher on the old-growth forest sites than in the clear-cuts, regardless whether there were many retention trees or few ($t = 3.578$, $p = 0.013$). The number of lichen records was significantly higher on the old-growth sites compared to the clear-cuts with few retention trees ($t = 2.917$, $p = 0.035$), but the difference to the clear-cuts with many retention trees was not significant ($t = 2.222$, $p = 0.71$). The species found in clear-cuts (one *Leptogium* and two *Nephroma* species) were mainly growing on aspen (88% of the records), the rest were found on goat willow (9%) or birch (3%). On the old-growth sites the observed nine species were mostly growing on goat willow (51%) or birch (39%); only 10% occurred on aspen. All the *Chaenotheca* species which are old-growth forest indicator lichens growing on birch were lacking from clear-cuts, as were species *Lobaria pulmonaria* and *Arthonia incarnata*. The results indicate that the ability of retention trees to maintain lichen diversity is limited, especially for species which prefer closed



canopy and humid microclimate. The survival of lichen species on retention trees in the long run needs further studies, because increased desiccation and solar radiation in the clear-cuts may affect populations in delay.

SYMPOSIUM #151_CONTEXT DEPENDENT EFFECTS OF BIODIVERSITY LOSS ON DISEASE

Hillary Young

UC Santa Barbara

Large wildlife are being systematically lost across the world. These reductions lead to profound shifts in the ecology of entire communities and ecosystems, and often have major consequences for prevalence and transmission dynamics of many diseases. However, the effects of these large wildlife declines on disease likely hinges upon both underlying, and often changing, abiotic properties of these systems as well as on the types of secondary anthropogenic changes associated with wildlife loss, and the pathogens considered. This has made it difficult to predict impacts or guide management, and led to the suggestion that the relationship is idiosyncratic. Here we will present results from a regional study across East Africa, which seeks to understand how environmental and human context mediates the impact of large wildlife loss on disease. Our results find that environmental and human context is indeed critical in determining the impacts of large-wildlife decline on disease dynamics. While general relationships that ignore context may remain elusive, by incorporating context predictive power for biodiversity disease relationships can be greatly increased.

76-USING THE IUCN RED LIST INDEX TO EVALUATE THE IMPACT OF A CONSERVATION ORGANIZATION

Richard Young

Durrell Wildlife Conservation Trust

Carl JONES, Durrell Wildlife Conservation Trust ; Andrew TERRY, Durrell Wildlife Conservation Trust ; Vikash TATAYAH, Mauritian Wildlife Foundation ; Stu BUTCHART, BirdLife International

Global and project-level biodiversity indicators have received considerable attention, but indicators of the conservation actions and impacts of programmes and institutions appear to be under-developed. The IUCN Red List Index (RLI) has potential to be a useful indicator at an organisational-level to evaluate long-term impact of conservation on the extinction risk of species, thereby supporting institutional decision-making and communications. However, it has not yet been tested for its utility in tracking changes in extinction risk of a set of species targeted specifically by an individual conservation agency. In this talk, I examine the feasibility of using the RLI as one metric of the conservation impact of the Durrell Wildlife Conservation Trust, a conservation charity

which runs multi-decadal programmes on a modest number of globally threatened terrestrial vertebrate species. Of 17 target amphibian, bird and mammal species, eight underwent improvements in Red List category (reductions in extinction risk) owing to conservation. This drove a 67% increase in the value of the Red List Index between 1988 and 2012. This contrasts with a 23% decline in a counterfactual RLI showing projected trends if conservation had been withdrawn in 1988. For organisations that target sets of species with circumscribed geographic distributions and that are regularly assessed by the IUCN Red List, the RLI is a useful indicator for measuring and demonstrating long-term conservation impact to technical and non-technical audiences.

NONINVASIVE GENETIC TRACKING OF ASIATIC BLACK BEARS (URSUS THIBETANUS) AT ITS RANGE EDGE IN IRAN

Gholam Hosein Yusefi

CIBIO/InBio - Research Center for Biodiversity and Genetic Resources[INSTITUTE]Mohitban Society[INSTITUTE]Biology Education Center, Uppsala University

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The Iranian population of the Asiatic black bear, *Ursus thibetanus*, is the westernmost peripheral population of the species as well as one of the most threatened one. In the remote mountainous areas of the southeast Iran this bear suffers from critically low population size, pronounced decline and isolation. Unlike other populations in Asia, little data exist on this peripheral population in general and, in particular, its genetic status still is uninvestigated. Here we report the first genetic analysis of the Iranian black bear using mitochondrial and microsatellite markers via noninvasive samples (feces). Further, phylogenetic relationships among Asiatic black bear populations using published sequences and sequences in this study were assessed. The results reveal the absence of mtDNA variability in the studied population, yet all samples from 5 geographically separated areas had the same, unique haplotype. Also low levels of nuclear genetic diversity were found among Iranian black bears ($HE = 0.57$ across 7 microsatellite loci in overall samples), with lower levels of microsatellite differentiation ($F_{st} = 0.07$) between black bears from the 2 source areas (northern vs. southern groups). The mitochondrial phylogeny from median-joining network, neighbor-joining tree and Bayesian phylogenetic analyses revealed that Iranian black bears are highly distinct from the



other populations from East Asia. Our findings suggest that Iranian black bears represent separate Evolutionary Significant Unit (ESU), and support their designation as a separate subspecies. Although preliminary, the results bring important new information on the genetic status of Iranian black bears and also provide a baseline for future monitoring of this endangered bear.

A NOVEL APPROACH FOR ASSESSING SHIFTING CULTIVATION DYNAMICS IN A REGIONAL CONSERVATION HOTSPOT - INSIGHTS FROM NORTH-EASTERN MADAGASCAR

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The north-eastern escarpment of Madagascar has been deemed a global hotspot of biodiversity due to its high levels of endemic species being heavily threatened by accelerated deforestation rates and landscape changes. The main concern for conservation of the remaining humid primary forests is the shifting cultivation practices of local smallholder farmers for rice production. According to the mainstream narrative, human population growth leads to a shortening of crop-fallow cycles and thus to the accelerated conversion of forests to agricultural land. However, little is currently known about the dynamic changes between forest and shifting cultivation systems at the regional level. Existing land cover change analyses in this area have so far only focused on binary forest to non-forest changes and have therefore failed to account for the dynamic nature of the change processes between forest and different agriculture land use systems. This can be partly explained by the significant challenge to delineate shifting cultivation systems on land cover maps using traditional remote sensing classification approaches. To address this gap we therefore applied a novel GIS approach, that was originally developed for the assessment of shifting cultivation dynamics in Laos and has so far never been applied elsewhere, to map shifting cultivation of different crop-fallow lengths as well as permanent agriculture land use at the regional level. Change analyses of land use maps between 1995 and 2011 allowed us to comprehend the general trends of land use trajectories and their spatial variation. This more detailed understanding of land use change dynamics is key to plan for successful interventions to slow forest loss while at the same time improving local livelihoods. We further believe that this approach holds great potential for conservation monitoring in this resource-rich but poverty-prone conservation hotspot.

CONSERVATION IMPLICATIONS OF FLOODS, FOREST MANAGEMENT AND LAND USE FOR SAND LIZARD POPULATIONS

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In Slovenia the sand lizard (*Lacerta agilis*) has a distinct distribution pattern concentrated in river valleys. We have conducted an extensive field sampling using transect line visual surveys at three main rivers in the country: Sava, Drava and Mur. Our main aims were to understand the spatial and habitat use of sand lizards on river banks and their proximity, and to analyse the effects of three major factors: floods, habitat type and forest management. Transects were located inside different flood zones (exceptional, occasional and frequent flooding) and outside the flooded area. Habitat types present at all three sites were forest, forest edge and open areas. Three river sections differed in the intensity of river-bank regulations done by people in the past and in the dominant land use of areas next to the river. Results showed that floods had positive effect on the spatial distribution of the sand lizard at all three rivers. We argue that via exclusion of potential competitors and predators, floods improve the conditions for sand lizards, which seemingly have an ability to survive floods in the flooding zone. Important factor further explaining the distribution in all study sites was the habitat type. Sand lizards preferentially selected edge habitats, such as forest edge or other border habitats between different vegetation. Additionally, at Mur river, we observed a rapid population boom after forest clear-cuts were created. However, rapid population decline followed after the site was again overgrown by dense *Populus* plantation. This suggests that forest management practices can have strong short-term effects on the population dynamics of sand lizards. Long-term effects still need to be studied.

BIODIVERSITY UNDER THE LIGHT OF AGRICULTURAL LAND ABANDONMENT. INTERACTIONS, IMPLICATIONS AND THE NEED TO PRESERVE RURAL MOSAICS

Sylvia Zakkak

University of Patras

Vassiliki KATI, University of Patras

Rural depopulation and agricultural abandonment are widespread in the mountainous regions of eastern and southern Europe, directly affecting landscapes and biodiversity. Our research handles this major conservation issue, attempting to assess its impact on five taxonomical groups with different



ecological demands, namely woody vegetation, ground spiders, carabid beetles passerine birds and lizards. We selected 20 sites in Pindos Mts, Greece, well-representing a gradient of land abandonment based on forest encroachment. All groups' overall species richness and abundance, apart from lizards, were adversely affected by this process. Habitats with more than 75% woody vegetation cover were relatively poor regarding spider abundance, while forest encroachment was affecting carabid beetle community composition. Typical farmland and Mediterranean shrubland bird-species diversity was also found to be negatively affected, while birds formed five distinct ecological clusters after land abandonment. Concerning lizards, despite the non-significant effects of forest encroachment, the dominance of *P. muralis* indicated a gradual lizard community shift towards species inhabiting forested habitats. At the species level no general pattern could be drawn, due to each species different ecological requirements. Our results also provide evidence for the beneficial role of low intensity grazing for spiders, while having an overall beneficial effect hampering forest encroachment. We suggest a set of 22 indicator bird species, as well as a 50% woody vegetation cover threshold, as new tools for the cost-effective designation of High Nature Value farmland and the implementation of relevant monitoring schemes, under the Common Agricultural Policy frame in Europe. In conclusion, policies towards maintaining open heterogeneous rural landscapes and the associated biodiversity should be developed, motivating traditional farming and mild grazing or logging in abandoned fields.

WALKING IN THE SUN OR HIDING IN THE WOODS? SPIDERS MAY NOT BE SO CREEPY AFTER ALL! (A CASE STUDY ON SPIDERS' RESPONSES IN GREECE)

Sylvia Zakkak

University of Patras

Konstantina ZOGRAFOU, University of Ioannina ; Vassiliki KATI, University of Patras ; Maria CHATZAKI, Democritus University of Thrace

Although in many regions, forest conservation policies are mainly addressed to prevent deforestation, there is an increasing awareness that an excess of forest cover may be problematic for some taxa. In an attempt to understand these interactions regarding the understudied group of spiders, we assess the differences in ground spider (Gnaphosidae, Liocranidae, Miturgidae and Corrinidae) diversity between open and forested habitats, in two mountainous areas in Greece: Pindos Mts. and the Dadia-Lefkimi-Soufli Forest National Park (DNP). The study sites in Pindos Mts. were placed in non-protected areas, at 500-1000m altitude, mostly covered by young forests. On the other hand, the DNP has been a reserve since 1980, located at 20-650 m altitude and covered by older forests. Sampling took place in 2011, from

May to July, in 32 sites (420 pitfall traps), representing open and closed habitats. We identified 49 species (1,662 ind.) and 45 species (851 ind.) in each area, respectively. Regardless the differences between the two areas regarding the geographical, environmental and conservation parameters, closed habitats had a consistently negative effect on both species richness and diversity. When the datasets of the two areas were treated separately, both in Pindos Mts. and the DNP the effect of canopy cover was significant in terms of species richness ($F = 4.46, P < 0.05$ and $F = 9.86, P < 0.05$) and diversity ($F = 4.50, P < 0.05$ and $F = 10.84, P < 0.05$). When the data were merged, the effect persisted for species richness ($F = 5.14, P < 0.05$), while ground spider abundance was not affected in any case. Our results are in agreement with previous findings regarding the preference of the Gnaphosidae family for open lands. Conservation measures for ground spider diversity preservation should focus on the maintenance of open, heterogeneous landscapes, either through the promotion of traditional agricultural practices, or through the enhancement of wild ungulates.

90-MOVEMENT AND EGG LAYING IN MONARCH BUTTERFLIES: WHAT HAPPENS WHEN THE MATRIX IS CLEANED UP?

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Movement is the key ecological process linking individual fitness traits to the utilization of resources distributed across landscapes with population level consequences. We use various individual-based models derived from tracking of adult females to describe the host seeking behaviour over the lifetime of a "Lepidoptera" agent, which utilizes hosts both aggregated in patches and scattered across the wider landscape as a substrate for laying eggs. The models either explicitly describe movement and resources in real virtual space or simplify the process to "search and find rules". The models simulate the number of eggs laid daily and on particular patches in the landscape if movement is modeled explicitly. We examine the population consequences of different movement rules, perceptual distance (ability to find) and landscape configuration. Specifically we consider the distribution of birth to death distances and the potential population consequences of cleaning up the matrix and changing habitat configurations at a landscape scale. We relate our work to monarch butterfly (*Danaus plexippus*) population decline in agricultural landscapes, in which genetically modified crops that are resistant to herbicides ("Roundup Ready") has resulted in the decimation of milkweed (*Asclepias* sp) hosts over large areas. We make some initial (preliminary) suggestions on how monarch habitat might best be restored at a landscape scale.



LAND USE CHANGE AND THE ECONOMIC COST OF EMERGING INFECTIOUS DISEASES

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Disease emergence is driven by socioeconomic, demographic and environmental changes, which include deforestation, agricultural expansion and both habitat degradation and fragmentation. Around 60% of all emerging infectious diseases (EID) – from HIV to Ebola - have a zoonotic origin. Over the past 70 years, nearly one-fifth of all EID were linked to some type of land conversion. Land use change leads to disease emergence by increasing opportunities for contact and pathogen spillover between wildlife and humans and by perturbing host-pathogen ecological dynamics that promote cross species transmission. Intact forests thus provide a service to human society through protection against infectious diseases outbreaks. This work aims to understand the benefits of disease regulation from intact forests by estimating the value of damages that are avoided by keeping the ecosystem intact. Our working hypothesis is that the economic costs of disease control will increase with deforestation. To test this hypothesis, we conducted a literature review to get information on revenues and operation costs for industries using land in the region, ecosystem service values –including carbon sequestration and water retention-, deforestation rates and total economic cost of a case of malaria. Our preliminary simulations estimated a \$60 trillion savings over 50 years had land been managed to mitigate disease emergence and maximize ecosystem service production. Our results could be used to define optimal land use policies by governments, private sector, and civil society stakeholders.

HARNESSING GENETIC VARIABILITY OF PHILIPPINE UPLAND RICE FOR DRY AND SALINE ENVIRONMENTS

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In the upland areas of Sarangani Province in the Philippines, tribal farmers cultivate traditional rice varieties using age-old farming methods. Field surveys have unfortunately revealed losses of these premium rice varieties due to emerging environmental and socio-political realities in the uplands. This study was thus undertaken to identify varieties which can

potentially be grown in marginally dry and saline soils. While increasing PEG and NaCl concentrations caused obvious signs of injury to all rice genotypes, considerable varietal differences were noted in the nature of responses providing evidence that these genotypes possess broad intraspecific genetic variations for drought and salt tolerance. Furthermore, G_Mlato, G_Katiil and A_Kanadal were observed to thrive relatively well despite increased salt stress and are therefore recommended for saline soils while drought-resistant A_Pilit na Bisaya, A_Pilit na di Mabal-an, A_Mayaman, A_Fitam kwat and G_Larangan consistently performed well despite water-deficit conditions and can be recommended for planting in upland areas which are perennially plagued by long dry spells. Measures should therefore be instituted to conserve these priceless genetic resources so that the province's goal of food security for the indigenous peoples will be attained.

CONSEQUENCES OF FOREST MANAGEMENT ON THE METAPOPULATION DYNAMICS OF THE LESSER HORSESHOE BAT (RHINOLOPHUS HIPPOSIDEROS) AT THE NORTHERN EDGE OF ITS RANGE; CONTRIBUTION OF NON-INVASIVE GENETIC CAPTURE-MARK-RECAPTURE TO CONSERVATION MANAGEMENT.

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The lesser horseshoe bat (*Rhinolophus hipposideros*) is the Palearctic bat species which regression is best documented. During the last century, it became rare or extinct in many countries at the northern edge of its range including the Netherlands, Belgium, most of Germany and Northern France. The reasons mentioned for the decline of this forest species include pesticides, food shortage, and habitat loss. In this study, we investigated the reliability and accuracy of estimating both population size and fertility of *Rhinolophus hipposideros* by genotyping DNA from droppings collected non-invasively over two consecutive sampling sessions at twenty colonies located in a variety of managed forest habitats at the northern limit of the species distribution (Picardie, Northern France). We evaluated the strength of this non-invasive genetic



capture–mark–recapture (CMR) method by comparing the demographic data it produces to those obtained from a classical survey of these colonies realized during the same periods. We then tested for a possible effect of habitat quality, induced by different forest management strategies, on the population size and fertility of these bat colonies. Such non-invasive genetic CMR methods represent a useful tool for *Rhinolophus hipposideros* conservation since it can help to better understand the metapopulation dynamics of the species and to propose appropriate recommendations in terms of forest and land use management while maintaining ecological network between forest patches at the landscape scale.

MAPPING FOR CONSERVATION OF THE VALLEY OF THE GEYSERS (KRONOTSKY RESERVE, RUSSIA): METHODS AND CHALLENGES

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The Valley of the Geysers in Kamchatka, Russia, is one of the five largest geyser fields in the world, and the only one in Eurasia. Located in Kronotsky Nature Biosphere Reserve, it remained undisturbed and pristine example of distinctive dynamic ecosystem that contains native communities of thermal bacteria, algae, lichens, mosses, red-listed endemic vascular plants and plays an important role for local population of brown bears. Outstanding esthetic values as well as the rare biological and ecological features of the Valley's ecosystem attract thousands of tourists and scientists from all over the world. However, complexity of the Valley is not yet fully understood, as prior research has focused primarily on specific species or habitats, rather than linkages between different components of the ecosystem and spatio-temporal dynamics of natural processes. The Atlas of the Valley of the Geysers – published last year – became the first attempt to show the complexity and extreme vulnerability of the ecosystem of the Valley and to put all the collected information about the area into one set of maps, understandable and useful both for public and scientists. To create the Atlas our team collected and integrated information from different databases, archives and papers, digitized and actualized existing maps, consulted specialists and rangers, and during 2009–2014 conducted their own detailed ground studies. As a result set of more than 80 full-color maps, 3D models and charts, 100 photos as well as essays by leading researchers of the area, brings together for the first time information about relief, geology, climate, landcover, vegetation, threatened plants, soils, natural dynamics of the landscape; international significance, history of discovery and modern use; recreational durability and relationships between different components of the ecosystem. The research was supported by the Russian Foundation for

Basic Research (projects 13-05-00870, 15-04-03818, 15-05-07002).

SEA TURTLE NESTING IN PERU: USING CITIZEN SCIENCE AND PUBLIC PARTICIPATION TO REVEAL OVERLOOKED NESTING ACTIVITY IN THE NORTHERN COAST

Adriana Zavala

EcOceanica
Shaley KELEZ, EcOceanica

Until 2011, Peru was not considered a nesting site for sea turtles; since 2012 we realized Olive Ridley *Lepidochelys olivacea* and Green turtle *Chelonia mydas* are nesting here on a regular basis and in increasing numbers. There are 100 km of sandy beach to be surveyed along the coast of Piura and Tumbes. Some portions of these beaches are remote, some highly urbanized and some are projected to be developed. The challenge on the developed beaches is to find the turtle reproductive activity and protect them from human threats, such as: artificial lighting, dune removal, introduction of foreign vegetation, and obstacles (beach furniture, garbage, etc.). The challenge on the remote beaches is to find the nests, needed to get the baseline data. By inspiring hotels staff and their visitors to help us we can then do the research needed to provide recommendations to the local and central government so they can manage the beaches for these threatened species. The methodology was to contact 120 hotels of the highly urbanized beaches in Piura and Tumbes to create a citizen scientist network with staff and visitors. To inspire them to help us collect data we are providing: educational presentations, posters, brochures and a turtle conservation logo for marketing. Their reporting activity will help us record nesting. Then we can evaluate and tag nesting females, mark nests and monitor their development and success. We will record all natural and human threats to females and nests. This information on nesting density, distribution, frequency, threats, and nesting and hatching success will be incorporated into the recommendations to the government to protect the southernmost nesting habitat of sea turtles in the Eastern Pacific. Our goal is to conserve sea turtles through research and protection of their nests and nesting beaches in Peru and, in the process, to involve and inspire people in our conservation effort.

ANALYSIS OF PHENOMENON OF DESERTIFICATION BY USING SATELLITE DATA IN THE NORTH ALGERIAN STEPPE

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Centre of Spaces Techniques



The degradation of natural resources in arid and semi-arid areas was highlighted dramatically during this century due to population growth and transformation of land use systems. The Algerian steppe has undergone a regression over the past decade due to drought cycle, the extension of areas cultivated in marginal lands, population growth and overgrazing. These phenomena have led to different degradation processes, such as the destruction of vegetation, soil erosion, and deterioration of the physical environment. In this study, the work is mainly based on the criteria for classification and identification of physical parameters for spatial analysis and multi-sources to determine the vulnerability of major steppe formations and their impact on desertification. To do this, we used satellite images Alsat-1 (2009) and LANDSAT TM (2001). These cross-sectional data with exogenous information could reduce the impact of the semi arid ecological diversity of steppe formations. This longitudinal study based on the use of remote sensing data is to analyze the evolution of steppe ecosystems. The application, through specific processes, including the supervised classification was used to characterize the main steppe formations. An analysis of the vulnerability of plant communities was conducted to assign weights and identify areas most susceptible to desertification. Vegetation indices are used to characterize the forest and steppe formations to determine changes in land use. This study will map the different components of the steppe, highlighting the magnitude of the degradation pathways, which affects the steppe environment, allowing an analysis of the process of desertification in the region.

A CREDIT POINT SYSTEM FOR ASSESSING AND ENHANCING BIODIVERSITY AT THE FARM SCALE - AND BEYOND

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Simon BIRRER, Swiss Ornithological Institute ; Sibylle STOECKLI, Research Institute of Organic Agriculture FiBL ; Lukas PFIFFNER, Research Institute of Organic Agriculture FiBL

In many parts of Europe, farmland biodiversity has undergone strong declines over the last decades. In recent years, a range of agri-environmental schemes have been set up to reverse the negative trend. While scientific results have repeatedly demonstrated that single measures ('options') effectively enhance farmland biodiversity, these positive outcomes did not result in a general increase at larger geographical or national scales. Instead of analysing biodiversity patterns at the plot scale, we focused on the farm level and developed a tool which assesses on-farm biodiversity as a whole. With this tool, farmers can score credit points for a total of over 30 options know to enhance farmland biodiversity. The Credit Point

System (CPS) yields a single biodiversity score for each farm. The CPS was scientifically evaluated on 133 farms in the Swiss lowland. Biodiversity was significantly positively correlated with species richness and density of plants, grasshoppers, butterflies and birds and was thus shown to be a suitable proxy of biodiversity at the farm scale. In 2010, a farming organisation for sustainable and wildlife-friendly foods set up mandatory guidelines for the enhancement of biodiversity on their producers' farms. Since then, it has become mandatory for those farms (ca. 10 000 farms managing 25% of the Swiss agricultural land) to apply the CPS and reach a minimal biodiversity score in order to remain in the label programme. Meanwhile, biodiversity scores on those farms have markedly increased, and farmers have implemented additional habitats for biodiversity. Not only the quantity but also the ecological quality of those habitats was higher in 2012 than at the outset in 2010. The uptake of biodiversity directives and the Credit Point System as an assessment tool in a label programme for sustainable and wildlife-friendly foods have opened up new perspectives towards promoting farmland biodiversity at a large scale.

EVOLUTIONARY HISTORY OF THE ENDANGERED MEDITERRANEAN TORTOISE TESTUDO HERMANNI HERMANNI: GENETIC STRUCTURE, HISTORICAL DEMOGRAPHY AND CONSERVATION ISSUES.

Saliha Zenboudji

Biogéographie et Ecologie des vertébrés (EPHE), Centre d'Ecologie Fonctionnelle et Evolutive (UMR 5175)

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Our work focused on the genetic structure and demographic history of one of the most threatened reptile in Europe, the Hermann's tortoise *Testudo hermanni hermanni* (Gmelin, 1789). This subspecies shows a very scattered distribution in Western Europe and is classified as endangered according to the IUCN. Based on 17 microsatellite loci that were specifically developed from a pyrosequencing library, our study investigated the genetic diversity and structure of seven populations covering almost the entire subspecies range. Two major genetic groups were evidenced. The first group mainly included continental populations: Albera, Var, Italy and the northern part of the Menorca Island. The second group comprised tortoises of Corsica, Sardinia, Sicily and south of Menorca. The same dichotomy was also supported by the phylogenetic tree based on 3 mitochondrial genes (Cytb, ND4, COXI).



Temporal changes in effective population sizes as well as their demographic state revealed that all the studied populations of *T. h. hermanni* have declined. However, we observed contrasting declines in terms of time and intensity. Our work allowed to better understand the evolutionary history of the Hermann's tortoise in the occidental Mediterranean basin and to address some important issues concerning the ongoing conservation management programs. The different genetic lineages identified contribute to propose specific Evolutionarily Significant Units and Management Units. Our results have also implications concerning the restocking strategy to be adopted for the different populations of the Hermann's tortoises: is it better to preserve the genetic characteristics of the original population favoring local adaptations but thus increasing the risks of high diversity loss (especially for small and isolated populations) or to restore the genetic diversity by introducing neighboring populations (which could also include different genetic combinations)?

EVOLUTION OF SYSTEMATIC CONSERVATION PLANNING (SCP) WORK IN TURKEY - ADVANCES, ADAPTATIONS AND POSSIBLE CONTRIBUTIONS

Ugur Zeydanli

Nature Conservation Centre

Ayşe S TURAK, Nature Conservation Centre ; Didem AMBARLI, Nature Conservation Centre ; Ozge BALKIZ, Nature Conservation Centre ; Deniz OZUT, Nature Conservation Centre ; C. Can BILGIN, METU

Since its first introduction to Turkey in 2000, mainstreaming of SCP has been a slow process of overcoming impediments through an adaptive process. However, the participatory nature of the SCP processes has enabled embracing of new concepts and overcoming resistance rooted in advocates of approaches that does not involve complementarity. A recognition by the authorities of the need for more efficient conservation planning, and the effective collaboration among government bodies, university researchers and NGOs, have led to Priority Conservation Areas determined for nearly one third of Turkey. The comprehensiveness of the evaluation process has improved with each project through addition of new aspects related to persistence of biodiversity; new procedures for analysing threats and socio-economic aspects have been developed, some analyses have been adapted to local conditions due to issues on legislation, cultural, socio-economic and political characteristics, data availability and/or quality, and other limitations. As a result, the Ministry of Forestry and Water Affairs has adopted the SCP approach for determining Natura 2000 sites in Turkey. In this presentation we submit advancements in methodology, such as approach to socio-economic evaluations including conservation costs, conservation opportunities, suitability for timber production and anthropogenic threats; additional surrogates such as

ecological and evolutionary processes, wild river types, and ecosystem services; and impact of climate change. We also present details of a new procedure for analysing threats, which can be used while determining, delineating and evaluating them. The evolution of SCP in Turkey and the new tools that were developed during the process provides a model with a high potential for adoption in countries facing similar conservation constraints and opportunities.

EROSION AND DEGRADATION OF RIPARIAN FOREST CORRIDORS IN HYPER-FRAGMENTED LANDSCAPES IN THE SOUTHERN AMAZON

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Southern Amazonian forests have succumbed to high deforestation rates in the so-called 'arc of deforestation', resulting in widespread forest loss and fragmentation. Although retaining buffer strips of riparian forests is a key goal in landscape-scale management for animal conservation, the species-specific usefulness of these riparian corridors depends on a myriad of both extrinsic and intrinsic factors. Vertebrate species responses to habitat degradation are often independent from species responses to fragmentation per se, even though these processes are associated. The conservation value of corridors is therefore determined not only by their size (width, length, area), but also their habitat quality in terms of vegetation structure. Here we explore the degree to which habitat fragmentation is linked to structural degradation in quasi-linear patches of riparian forests, which are legally protected under Brazilian legislation. We obtained structural measures across 204 sampling points nested within 39 corridors located in a highly fragmented landscape of the Southern Amazon, and compared riparian corridor width with variables that describe habitat quality: tree basal area, tree density, understory density, canopy cover, and vertical stratification profile. We also conducted a supervised classification of RapidEye® imagery with a 15-m resolution, in order to quantify overall corridor vegetation integrity based on the identification of three land-cover classes: primary forest, secondary forest, and shrubby vegetation. Although habitat loss is usually accompanied by loss in structural quality of vegetation, this is not by all means a general rule. Not all wide corridors were high-quality corridors, and vice-versa. Both corridor size and quality should therefore be considered separately when assessing overall corridor value for wildlife conservation in fragmented tropical forest landscapes.



A RANGE-WIDE ANALYSIS OF HUMAN-JAGUAR CONFLICT

Alexandra Zimmermann

Chester Zoo

Conflict with livestock farmers is the most serious threat to the survival of the jaguar (*Panthera onca*) across its range of 19 countries of the Americas. I examined human-jaguar conflict at a range-wide scale by reviewing the state of knowledge on the topic, modeling the spatial risk of conflict across the range, and analysing a series of empirical field case studies. Findings from 43 published studies and 117 expert-described cases show that depletion of prey and poor husbandry are reported as the key reasons for depredation, regardless of ecological, cultural or socio-economic context, and that attitudes towards jaguars are not necessarily linked to losses. By combining spatial datasets with expert-based opinion, spatial patterns of human-jaguar conflicts are presented as a predictive risk map of hotspots. Around 85% of the total jaguar range, 72% of the total Jaguar Conservation Units total area and 90% of the Jaguar Corridor overlap with livestock, and 15% of the jaguar range has risk of conflict. Regions in which jaguars are repeatedly persecuted may become ecological traps and decimate local populations. An aggregate study of 17 case studies across seven countries showed that there are considerable differences in farmers' experiences and levels of concern with the issue, and that attitudes, tolerance, and social norms vary across and within communities. However, no situational factor could predict how farmers perceive jaguars and deal with depredation. The only pattern consistent across case studies was that tolerance of jaguars is most likely predicted by a factor of the perceived impact of livestock losses combined with the social influences of the community. In most scenarios, mitigation strategies must go beyond practical measures such as improving husbandry and consider also behaviour-change approaches and address underlying social issues that have shaped the conflict over time.

95-EVALUATING WHEN AND WHERE TO IMPLEMENT ROAD MITIGATION FOR WILDLIFE WITH ROADKILL MODELLING: THREE INTERNATIONAL CASE STUDIES

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Roads pose many threats to wildlife including mortality resulting from wildlife-vehicle collisions (WVC). Although considerable research on WVC exists, analysing and predicting risk with statistical modelling has not been fully applied in management or road planning. Models can augment these efforts by identifying or predicting high-risk areas across time and space. However, for models to be incorporated into

management practice, they must be conceptually simple, flexible to changing data, and adaptable for a range of environments or species. We present three case studies on different continents where modelling is used to describe and predict WVC risk. In Canada, road mortality is an identified threat for seven species of turtles. Two years of road mortality was documented along 100 km of highway that bisects extensive wetlands in Eastern Ontario. WVC hotspots were identified and the transportation agency is now installing permanent exclusion fencing where the highest peak of turtle mortality occurred. Subsequently, the model was extrapolated to the provincial road network and its prediction capability validated with an independent data set. In Brazil, modelling is used to identify factors related to spatial and temporal distributions of amphibian roadkill in the Atlantic Forest Biosphere Reserve. The results suggest locations and seasons for placement of mitigation. In Australia, WVC are predicted with a conceptual risk framework by modelling the magnitude of threat (vehicle presence and speed) and exposure to threat (wildlife presence) across Victoria for seven mammal species. Reported locations of WVC are used to train and validate a collision model and measure predictors influencing risk. Managers can manipulate predictor values (speed limit or traffic volume), in a simulated environment, and observe predicted collision risk on road networks. While employing different analytical mechanisms, all case studies introduce novel methods to reduce WVC.

MAPPING NATURA 2000 HABITAT CONSERVATION STATUS IN A PANNONIC SALT STEPPE WITH AIRBORNE LASER SCANNING

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Natura 2000 Habitat Conservation Status is currently evaluated based on fieldwork; however, this is proving to be unfeasible over large areas. The use of remote sensing is increasingly encouraged but covering the full range of ecological variables by such datasets and ensuring compatibility with the traditional assessment methodology has not been achieved yet. We aimed to test Airborne Laser Scanning (ALS) as a source for mapping all variables required by the local official conservation status assessment scheme and to develop an automated method that calculates Natura 2000 conservation status at 0.5 m raster resolution for 24 km² of Pannonic Salt Steppe habitat (1530). We used multi-temporal (summer and winter) ALS point clouds with full-waveform recording and a density of 20 pt/m². Some required variables were



derived from ALS product rasters, others involved vegetation classification layers calculated by machine learning and fuzzy categorization. Thresholds separating favourable and unfavourable values of each variable required by the scheme were calibrated from 10 plots where field-based assessment was carried out. Rasters representing positive and negative scores for each input variable were integrated in a ruleset that exactly follows the Hungarian Natura 2000 assessment scheme for grasslands. Accuracy was evaluated by 10 independent assessment plots to 80% (Kappa 0.615), and the numeric score for conservation status assessed in the field was predicted by the ALS-based system with an R² of 0.97 from 20 data points. We conclude that ALS is a suitable data source for Natura 2000 assessments in grasslands, and that the national grassland assessment scheme can successfully be used as a GIS processing model for conservation status, ensuring that the output is directly comparable with traditional field based assessments.

A STRATEGIC ACTION PLAN FOR CONSERVATION AND MANAGEMENT OF THE LAST SURVIVING POPULATION OF MOROCCO'S DORCAS GAZELLE, GAZELLA DORCAS MASSAESYLA (BOVIDAE: ANTILOPINAE) IN M'SABIH TALAA RESERVE, WEST CENTRAL MOROCCO

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The dorcas gazelle *Gazella dorcas* is categorized as Vulnerable on the IUCN Red List (IUCN, 2008) and is considered Endangered in Morocco (Cuzin, 2003). The species has declined precipitously throughout Morocco because of poaching and severe habitat degradation from the expansion of agriculture and increased livestock grazing pressure. Dorcas gazelles have been fully protected since 1958. In Morocco this gazelle species historically occupied the plains north of the Atlas mountains but now persists only as a remnant population, isolated within a 1,987-ha reserve established in 1952 at M'Sabih Talaa, west-central Morocco. Recent genetic analyses (Godinho et al., 2012) indicate that this population is genetically differentiated, and may be the last surviving population of Moroccan dorcas gazelle, *G. d. massaesyala*. A population viability analysis indicate that local extinction of this remnant population is imminent unless active population and habitat management are undertaken. Our recent studies established that, apart from management problems, poaching and predation by feral dogs

were the main anthropogenic factors that caused the gazelle's decline. Our researches have also shown important long-term changes in available trophic resources and the gazelle's food habits. Moreover, a fluctuating asymmetry analysis, carried out on collected skulls, was indicative of a possible environmental/genetic stress in this isolated small population. We review these findings, and based on our research results, outline a recovery strategy for the last surviving Moroccan dorcas gazelle population. So, we developed a strategic action plan for the conservation of this remnant population with a long-term vision of a viable, ecologically functional and respected population. The main goal of this plan is to improve the conservation status of this relict subspecies throughout its historical distribution range. Several well defined objectives and targets are proposed.

QUANTITY OR QUALITY, LOCAL OR LANDSCAPE SCALE - WHAT DETERMINES MULTI-TAXON SPECIES RICHNESS IN DRY GRASSLAND FRAGMENTS?

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The theory of island biogeography suggests that increasing the size and reducing the isolation of patches can benefit species survival in fragmented landscapes. By contrast, conservation practice has typically focused on patch quality. We compared the influence of size, isolation and quality on species richness in a set of 50 dry grassland fragments in agricultural landscapes of eastern Austria. We studied two plant taxa (vascular plants, bryophytes) and 11 invertebrate taxa (gastropods, spiders, springtails, grasshoppers, true bugs, leafhoppers and planthoppers, ground beetles, rove beetles, butterflies and burnets, ants and wild bees). We distinguished between (1) dry grassland specialists, (2) all grassland species and (3) all species. Using regression and hierarchical partitioning techniques, we found that total species richness (3) was highly influenced by spillover from adjacent biotopes. Grassland species richness (2) was determined mostly by landscape heterogeneity parameters. The area-isolation paradigm was applicable only for dry grassland specialists (1). When analysing specialists of all taxa together, species richness was significantly related to historical patch size but not to current patch size, indicating an extinction debt. At the landscape scale, the quality descriptor 'short-grass area' was a better predictor than the variable 'area of extensively used landscape elements'. 'Distance to mainland' was a good predictor for specialists of mobile animal taxa. Plant specialists showed a pronounced dependence on quality parameters at the patch scale and at the landscape scale, whereas animal specialists were influenced by patch size, patch quality, landscape quality and isolation measures. None of the taxa benefited from linear structures in the surroundings. In



conclusion, high patch quality and a network of high-quality areas in the surrounding landscape should be achieved to conserve species richness in fragmented landscapes.

ENDEMIC SPECIES PERILOUSLY RESTRICTED TO SMALL CLIMATE PATCHES

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Identifying patterns of endemism and their underlying causes are essential to global prioritization of conservation efforts. Why do some areas include massive numbers of endemic species across many taxa? Do these reflect historical process related to geographic isolation and speciation or contemporary environmental factors that limit species' ranges? Preliminary studies suggest that endemism depends to some degree on late-Quaternary climate change velocity. That is, areas with low rates of climate change since the Last Glacial Maximum (e.g., mountains) shelter the most endemic species. However, this pattern can reflect contemporary climate. Here, we construct global measures of endemism for mammals relative to globally-observed climate clusters based on temperature (1°C) and precipitation (100 mm) worldwide. We calculated the area of every climate bin and the number of mammal endemic species present in each to test whether the area of climatically distinct zones globally affects numbers of endemic species. We found that small patches, irrespective of climate, tend to harbor more endemic species. The number of endemic species decreases monotonically as climatically-bounded patches increase in area. Smaller patches, housing more endemic species, are concentrated in topographically complex areas. Although underlying ecological or evolutionary processes are still debated, these findings are relevant when choosing new paths for conservation, in particular in the context of climate change. Disappearing climates will eliminate small climate patches and novel climatic conditions that replace them will preferentially generate non-analog biotic communities in regions with the highest concentrations of endemic species.

THE ROLE OF LANDSCAPE CHANGES IN SHAPING ALPINE SPECIES DISTRIBUTION

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Ecosystems are deeply affected by the human activity and land use and land cover change is recognized as one of the most important causes of the alarming loss of biodiversity. In this

scenario is fundamental to identify the most endangered areas where developing conservation purposes. The Alpine regions are of particular interest because they are characterized by rare and fragile ecosystems with a high level of endemism well adapted to harsh condition and particular sensitive to changes. Taking in account that the landscape is the result of natural and human processes is fundamental to reconstruct what happened in the past, describe the present through monitoring activities and try to predict the future events. Therefore in biodiversity conservation the remote sensing images are useful to define the landscape structure and to evaluate its changes. Considering the importance of the scale-dependency of ecological processes, we propose a multi-temporal and scale approach to describe the landscape structures and their role in shaping Alpine species distribution. The study area is the Gran Paradiso National Park, and we will focus both on test areas and both at the landscape scale. During the first step we will set a low-cost procedure of UAV (Unmanned Aerial Vehicle) survey adapted to Alpine environment in order to obtain high temporal and spatial resolution images in test areas. In the second step we will focus on the interpretation of the aerial images already available to reconstruct the land cover changes during the last decades and we compare the results with the UAV images. In the last step the analysis will be extended to entire Park landscape using satellite data. This multiscale analysis of landscape changes allow us to study how the environmental patterns affect the animal distribution using both a multi-taxa approach and considering a single target species. These results are essential for an adaptive management, balanced in space and time.

ASSESSING THE EFFECTS OF TROPICAL LAND USE CHANGE: A CAMERA TRAPPING STUDY OF FELIDS AND THEIR PREY IN THE PIEDRAS REGION OF PERU

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Previous research shows that most mammals, especially felids, are reduced in fragmented forests, particularly species averse to human-modified landscapes. Since felids are elusive, sometimes nocturnal, and usually inhabit interior forest away from human activity, they can be difficult to study through in-person field observations. One effective approach to study elusive felids is through camera trapping, where the captured imagery can be used to identify individuals of certain tropical felid species by their spots and bot fly warbles. To better understand the impacts of forest fragmentation on felids, we studied the abundance and distribution of both felids and their prey species across a modified tropical forest gradient in the Las Piedras region of Madre de Dios, Peru. The goal of this study



was to compare and relate species abundance and species diversity data for captured Peruvian mammals in response to land-use changes, specifically for jaguar, puma, margay, and ocelot. We also gathered felid home range and distribution data, and examined the relationship between felid occupancy and habitat type and felid occupancy and prey densities. Results of this research indicate healthy populations of felids compared to other Amazonian studies, and support the theory that felids are using human modified areas for both movement and habitat. In addition, we found that seasonally used and minimally fragmented forests hold abundant biodiversity and act as corridors between core habitat and protected areas for larger mammals. Given the demonstrated diversity and vulnerability of the Las Piedras region, and that it represents one of the largest unprotected and largely intact tropical rainforests in Peru, this research shows both the importance of the region in supporting robust felid populations and the urgency needed to increase the protection of the region's species and forests.



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