

Abbott, Rachael, *Victoria University of Wellington*; **Ben Bell**, *Victoria University of Wellington*; **Nicky Nelson**, *Victoria University of Wellington*

Improving conservation management of New Zealand's rarest kiwi (*Apteryx rowi*): An integrated approach identifies optimal release group size.

To increase the effectiveness of restocking for conservation, it is necessary to identify any elements of the release protocol which affect post release survival, and modify the procedure accordingly. Rowi are critically endangered flightless ratites which form monogamous, highly territorial pairs. Restocking of the sole remaining rowi population has been underway for over 16 years. To reflect the adult social organisation, releases traditionally took place in pairs or small groups. However, preliminary data analysis led us to hypothesize that individuals in larger groups may have higher survival rate than those in small release groups. We tested this by experimentally manipulating release group size over 3 years, followed by intensive post release monitoring. Modelling reveals that of all variables tested, group size was the only factor with significant influence on post release survival ($n=67$, $p=0.036$). Kaplan Meier analysis showed cumulative survival at 90 days post release of small groups (ϕ 0.545, $n=22$) was significantly lower than that of large groups (ϕ 0.911, $n=45$). This finding has led to a change in release protocol, and also has important theoretical implications for the interpretation of behavioral ecology, life history and demography, and their application to reintroduction biology and restocking as a conservation tool.

Abrams, Jesse, *Leibniz Center Tropical Marine Ecol*

The Carbon Cycle: Where does SCB's habitat trading fit in?

We need carbon but the need for carbon is also associated with one of the biggest problems of today: global warming. Carbon is exchanged between different reservoirs in what is known as the carbon cycle. The carbon cycle has both fast and slow components, which help regulate the Earth's temperature on both short and long time scales. Certain components could act as either positive or negative feedbacks on the system. There are certain phases of the global carbon cycle that offer opportunities for reduction of future greenhouse gas impacts, such as preserving and restoring habitats that sequester carbon dioxide. A combination of potential sequestration strategies could help mitigate the problem of rising carbon dioxide levels and the secondary problems, such as ocean acidification, associated with it. Amongst these strategies are improved land management and restoration of degraded lands and cultivated organic soils. Here I will identify where SCB's habitat trading fits into the climate change mitigation picture.

Acevedo, Aldemar, *Ecology and Biogeography Research Group, Universidad de Pamplona*; **Rosmary Franco**, *Ecology and Biogeography Research Group, Universidad de Pamplona*; **Karen Silva**, *Ecology and Biogeography Research Group, Universidad de Pamplona*

Diversity and Conservation Status of Andean Amphibians from the Tama National Natural Park - Colombia

Anthropogenic disturbances in habitats have led to changes in composition, diversity and abundance patterns of amphibian species, as well as adverse effects on the conservation of these in the Neotropics. To evaluate these processes and determine the amphibian diversity, from August 2010 to April 2011 samplings were made in the Tama park (Colombia) in four Andean mountain areas, between 2000 to 3200 m.a.s.l. In order to determine the impact of threats; we applied the technique of formal concept analysis (AFC) to evaluate the different degrees of threat (habitat fragmentation, animal husbandry, human presence and infection with *Batrachochytrium dendrobatidis*). We recorded 538 individuals of 17 species of amphibians. 95 samples were analyzed for the diagnosis of chytrid fungus through the conventional PCR technique, 45 were positive in 12 amphibians species, being one of the most alarming registers of infection in the Colombian country. In the AFC results, six of 17 species recorded faced the five threats. This study led to the discovery of a new species (*Bolitoglossa tamanese*), plus five new records were reported, three new for Colombia: *P. gryllus*, *P. melanoproctus* and *P. mondolfii* and two species to the department of Norte de Santander: *Dendropsophus pelidna* and *P. frater*. Finally, we suggest further explorations to the areas of the Massif El Tamá, and evaluate other aspects of threats to which could be subjected amphibian species of high mountain areas.

Ackerly, David, *University of California, Berkeley*

Topoclimates and climate change impacts on vegetation in Mediterranean ecosystems of South Africa and California

Species distribution models have played a central role in projections of climate change impacts on biodiversity. I present two studies examining the influences of topography on climatic heterogeneity and plant distributions at fine spatial scales, to evaluate the potential for species to persist in heterogeneous landscapes with limited dispersal. In the San Francisco Bay Area, summer and winter temperatures are inversely correlated in relation to distance from the coast. Vegetation types that are most responsive to summer temperature are projected to shift downhill and as a result they expand their potential range in lower elevation areas. Vegetation that is more sensitive to winter temperatures shifts uphill, leading to range restrictions as high elevations cover

less area. On Table Mt (Cape Town, South Africa) topographic heterogeneity generates up to 3°C variation in minimum and maximum temperatures at a local scale, due to cold air pooling and solar insolation, respectively. For one high elevation fynbos species, this fine-scale variation provides a buffer of an additional 1°C rise in regional temperature before it goes extinct. The two studies together highlight the importance of enhanced spatial resolution in both climate and biodiversity modeling, and the potential importance of landscape heterogeneity for biodiversity conservation in the face of climate change.

Adams, Vanessa, *Charles Darwin University*

Planning for conservation and development: can a regional strategic plan link to on ground local actions?

We present a regional planning exercise currently being undertaken in the Daly river catchment, Northern Territory, Australia and the potential opportunities and barriers to implementation. Although the Daly catchment currently has relatively little clearing, there is interest in future development projects including intensifying agricultural and pastoral uses. Therefore, a concurrent development and conservation planning process is being undertaken to allow for objectives to be formulated and trade-offs to be considered explicitly. Both development and conservation of natural resources in the catchment will affect human wellbeing and the long-term provisioning of ecosystem services; therefore the engagement process with residents has focused on quantifying the importance of key factors to their wellbeing. The engagement process uniquely links these factors to spatial features in the catchment and we compare the factors identified as being most important to wellbeing and the plan priorities (objectives) set by the catchment management authority. We discuss how alignment the plan priorities to factors important to resident wellbeing might contribute to the overall acceptance of the plan. Lastly, we discuss the potential for the regional plan to be implemented both at a regional scale as well as linking to local actions.

Agaldo, Jennifer, *A.P. Leventis Ornithological Research Institute. University of Jos Nigeria*

Plight of the Nigeria-Cameroon Chimpanzee in Oban division Forest; a reflection of the state of one of Nigeria's most important Biodiversity hotspot

Little is known about the endangered/endemic Nigeria-Cameroon Chimpanzee in Oban division forest of Cross River National Park. As Nigeria's most important remaining forest blocks, lack of recent research on the status of this forest and its species is ironic. This study aimed to provide data for informed conservation decisions for the protection and conservation of the Chimpanzee from local/global

extinction as well as providing recent account on status of the biodiversity rich Oban forest. Guided-reconnaissance walks were used in a stratified random manner where all chimpanzee signs encountered were identified and noted. All signs of anthropogenic activities encountered were also recorded. Interaction with local communities around the area was also carried out aimed at assessing local perspective of the chimpanzees and the Oban Forest. This study confirmed the presence of chimpanzees at very low densities in the Oban forest as no chimpanzee was sighted except nest and calls heard. Hunting, logging and farming were also identified as the greatest of 13 threat identified to the chimpanzees and the forest. It demonstrates the need for urgent steps to eliminate anthropogenic activities which affect the chimpanzees as well as other species of conservation importance in the habitat. It provides data in line with a recent regional IUCN action plan to conserve the Nigeria-Cameroon Chimpanzee.

Aguirre, Alonso, *George Mason University*

Conservation Medicine: bridging the gaps to face transdisciplinary challenges and integrative research in ecological health

Conservation Medicine has emphasized the need to bridge disciplines, thereby linking human health, animal health, and ecosystem health under the paradigm that "health connects all species in the planet" with the urgent need to address the rapid deterioration of the world. The recent convergence of global problems including climate change, biodiversity loss, habitat fragmentation, globalization, and infectious disease emergence demanded integrative approaches breaching disciplinary boundaries. This integration requires commitment not only from government agencies, universities and other organizations but eventually will attempt to generate new international structures. Conservation Medicine needs to orient itself toward research that accounts for these global changes and contextualize it in terms of human development. The challenges faced today and how to overcome them at a pivotal time in the environmental history of humanity require true regionalization of ecological health. Perhaps most importantly, not only research needs expansion to all sciences but also needs to be truly geographically and culturally participatory. The strategies of Conservation Medicine include long-term monitoring, health assessment, and interventions to protect species, ecosystems and humans at risk. We are grappling with finding solutions for today's most compelling challenges: conserving fragmented ecosystems, addressing threats to biodiversity from climate change, understanding emerging infectious diseases and ecosystem health. Consistent with this philosophy and goals, we need to strive to ensure lasting local conservation impacts with global health solutions with every project by training community leaders, volunteers and school children, in addition to professional, in-country experts. These groups comprise the next generation of planetary doctors.

Ahmadia, Gabby N., *World Wildlife Fund*

Making the most of the data: challenges of collaborative NGO data management and analysis for impact evaluation in a remote MPA network in Indonesia

Extensive collaborative efforts have resulted in a network of MPAs in the vast Bird's Head Seascape (BHS), Indonesia, which covers over 13,000 square miles. To understand the effectiveness of these conservation interventions, a comprehensive impact evaluation needs to be conducted. Three separate NGOs have been conducting ecological monitoring, which presents three major challenges in synthesizing the data and setting the framework for impact evaluation. First, to address biological and technical issues associated with the current coral reef monitoring protocol we analyzed the variability in the data to select short term and long term ecological indicators for coral reef health. Second, we made several efforts to improve data management, including creation of a database for the BHS, creation of an online storage database, and exploration into using mobile phones as a means of data collection. Finally, we addressed a lack of control sites outside of the MPAs by recently conducting an expedition to monitor potential control reef sites. We further analyzed these data in order to develop criteria for matching control sites with MPAs based on similarity of certain reef attributes. This has ultimately led to baseline ecological data to use in combination with social data for future impact evaluation in the BHS.

Aikens, Ellen, *Smithsonian Conservation Biology Institute*; **Kate Jenks**, *Minnesota Zoo*; **Naris Bhumpakphan**, *Kasetsart University*; **Nucharin Songsasen**, *Smithsonian Conservation Biology Institute*; **Sawai Wanghongsa**, *Thailand Department of National Parks, Wildlife and Plant Conservation*; **Budsabong Kanchanasaka**, *Thailand Department of National Parks, Wildlife and Plant Conservation*; **Peter Leimgruber**, *Smithsonian Conservation Biology Institute*

People and Wild Canids - Lessons Learnt from Comparative Studies of Dhole and Jackal Movements

We integrated social-science interviews on people's perceptions of wild canids with comparative ecological research on canid movement behavior to better understand how canid ecology influences perception by local people. Villagers living in proximity of Thailand's protected areas generally see wild canids as pests threatening their livestock. However, in interview surveys they frequently confuse photographs of endangered dholes (*Cuon alpinus*) with sympatric golden jackals (*Canis aureus*). We used GPS tracking and advanced statistical tools to analyze the movement ecology of both species to assess how they use habitats in and around protected areas, and to determine how

frequently they may come into contact with local people. Our research demonstrates that dholes are forest specialists with relatively restricted territories and home ranges, while golden jackals are habitat generalists living mostly in agricultural landscape mosaics with occasional forays into forests. Based on habitat choice and movement characteristics, jackal are more likely to be encountered by people and probably also represent a greater threat to livestock. Data from this research is being used for environmental education to raise awareness for dhole conservation in and around Thailand's protected areas.

Akasaka, Munemitsu, *Tokyo University of Agriculture and Technolgy*; **Taku Kadoya**, *National Institute for Environmental Studies*; **Fumiko Ishihama**, *National Institute for Environmental Studies*; **Taku Fujita**, *The nature conservation society of Japan*

Reinforcing need for conserving narrow-range species: positive feedback of being gap species and high local extinction rate in non-conserved areas

Whether a species' distribution is included in protected areas (PAs) is an important criterion for species prioritization. Particularly, species of which distribution area is not conserved (gap species) often receives high priority when planning new PAs. The gap between distribution of PAs and that of species can be minimized when PAs are allocated based on complementarity analysis. However, due to practical limitations, such allocation is often unavailable, and PAs are located rather randomly regarding areas that should be conserved. In such case, narrow-range species might become gap species easily than wide-range species. Using distribution records of 1889 red-listed vascular plant taxa in Japan, we empirically examined whether conservation priority should be set to narrow-range species. Narrow-range species were more likely to become gap species than wide-range species. Furthermore, proportion of species of which red-list category had deteriorated between 2007 and 2012 was twice as high as in the gap species than conserved ones. This trend is supported by double in the rate of local extinction in non-conserved mesh than in conserved mesh. Our results suggest a positive feedback -that is, narrow range species is prone to become gap species, which accelerates the local extinction of the species, and which further narrows the range of the species. Therefore these species should be conserved preferentially.

Akeredolu, Excellence, *Department of zoology Faculty of Science, University of Lagos, Nigeria*; **Omopeluola Akinfeleye**, *Department of zoology Faculty of Science, University of Lagos, Nigeria*; **Fela Akinse**, *University of Lagos, Department of Zoology*

Swimming crab (*Callinectes amnicola*): An ecological indicator of heavy metal pollution in the western side of Lagos Lagoon, Nigeria

Heavy metal pollution from the industrial sector constitutes a threat to aquatic biodiversity in the western side of Lagos Lagoon in the south western Nigeria. A survey was carried out at three stations: UNILAG front, Iddo and Oko Baba on the Lagoon between the wet and dry season of 2011 to determine heavy metal pollution using the crab *Callinectes amnicola* (De Rochebourne) as a bioindicator. Five priority heavy metals namely Nickel (Ni), Chromium (Cr), Copper (Cu), Lead (Pb) and Zinc (Zn) were analysed in water and crab tissues (muscle and hepatopancreas). The mean concentration of heavy metals (mg/kg) in water and crab tissues varied significantly ($p \text{ Pb} > \text{Cr} > \text{Zn} > \text{Cu}$) across the study sites. The metal level in water samples from these stations also increased in the order $\text{Ni} > \text{Cr} > \text{Pb} > \text{Cu} > \text{Zn}$. The study concluded that western side of Lagos lagoon is highly polluted with these heavy metals, thus recommending ways by which further pollution can be averted. Keywords: Heavy metals, bio-accumulation, bio-concentration, swimming crab

Alamu, Olabisi, *National Centre for Genetic Resources and Biotechnology*; **Olusegun Olajide Kupoluyi**, *Department of Agronomy*

Evaluation of Sweetpotato (*Ipomoea batatas*) conservation status and genetic diversity in Nigeria

Sweetpotato is an economic and food security crop in Nigeria. Non availability of healthy and high yielding planting materials at the beginning of the growing season has been noted to be major constraints to cultivation of the crop by many household in Nigeria with the consequence of genetic erosion of landraces and cultivars. Germplasm collection of the sweetpotato vines and roots were carried across the production zones of the Nigeria, with the county divided into six zones. Vines cuttings of 164 accessions were transferred to the Research Plot of NACGRAB Ibadan (7° 22'N, 3° 05'E) and planted on ridges at 3m x 1 m, 3 replicate per accession. Roots were harvested at the age of 5-6 months. Morphological data and yield data were taken and analyzed appropriately. There was high variability in the yield and vegetative data thus indicating genetic diversity of the crop in Nigeria. There was increase in the number of accession conserved and it also arrest the genetic erosion of the crop in Nigeria. The study recommends increase in the accessibility of farmers to materials of important traits eg. high yielding, pro-vitamin A contents, disease and pest resistance. While information and knowledge sharing through interactions among farmers and Scientists should be sustained towards conservation of plant genetic resources

Albright, Whitney, *California Department of Fish and Game*; **Natalie Dubois**, *Defenders of Wildlife*; **Judy Boshoven**, *Founders of Success*; **Amber Pairis**, *California Department of Fish and Wildlife*; **Armand Gonzales**, *California Department and Fish and Wildlife*

Incorporating Climate Change into the California Wildlife Action Plan

The California Department of Fish and Wildlife (CDFW) has begun the process of revising the California Wildlife Action Plan with a goal of better integrating the impacts of climate change. The CDFW recognizes that climate change is a major challenge to the conservation of California's natural resources and is taking an active role in planning for and responding to the challenges posed by a changing climate. As part of this effort, CDFW worked with partners to develop a methodology that explicitly integrates climate change into the threat assessment and ratings described in the Open Standards for the Practice of Conservation and will be using this framework to update the California Wildlife Action Plan. This integrated threat assessment provides a basis for identifying climate adaptation strategies that minimize the impacts of climate change on wildlife and habitat. The process has been conducted by teams at the ecoregional level and will be rolled up into a state-wide strategy. A separate climate stakeholder group was convened to help gather the necessary climate data for this exercise and to support the ecoregional teams as they worked through this process. Stakeholder involvement will be discussed in addition to describing how the Open Standards integrated threat assessment is being utilized in the context of the California State Wildlife Action Plan revision.

Alexander, Michael, *NOAA ESRL*

Uncertainty in Climate Change Projections: Myths, Misconceptions and Malleable Guidelines

Concern about climate change and its implications for human and natural systems have motivated many efforts to assess climate impacts and develop conservation and adaptation strategies. Scientists, resource managers and decision makers are increasingly expected to use climate information in assessment and planning, but may struggle with the uncertainty associated with this information. Much of the uncertainty stems from how to best use output from global climate models. There are three major sources of uncertainty in climate projections: i) model error, ii) how anthropogenic greenhouse gas emissions will change in the future, often addressed by different "scenarios" and iii) natural variability. The latter, as identified by a large ensemble of simulations with slightly different initial conditions, can have a surprisingly large impact on short term variability and long-term trends on physical quantities, including temperature, precipitation and winds. Here, we identify and address a number of common misperceptions about the ability of

climate models to project future conditions relevant to ecological systems. We focus on how natural climate variability can complicate using climate projections in understanding and projecting changes in marine ecosystems. We discuss how climate projections can be useful in ecological applications including providing strategic management advice despite these uncertainties.

Aluri, Jacob Solomon, *Andhra University*; **RANGAIAH KONE**, *Andhra University*

Reproductive ecology of *Boswellia ovalifoliolata* (Burseraceae), an endemic and endangered keystone medicinal tree species in the Southern Eastern Ghat

Boswellia ovalifoliolata Bal. & Henry (Burseraceae) occurring in the Southern Eastern Ghats Forest Ecosystem of Andhra Pradesh, India, is a narrow endemic and globally endangered deciduous tree species. The tree is a source of gum and resin; it is used for treating different human ailments such as ulcers, scorpion sting, amoebic dysentery, hydrocele and rheumatic pains. It is a prominent dry season bloomer and provides forage to an array of animals. The flowers are small, bisexual, mildly odoriferous and strictly self-incompatible. Insects and sunbirds use the flowers for forage during which they effect pollination. Bud and flower feeding by a weevil and flower and fruit feeding by the Palm Squirrel greatly affect the success of sexual reproduction. The garden lizard is a predator of pollinating insects. Fruit set in open-pollination is

Alves, Maria Alice, *Universidade do Estado do Rio de Janeiro*; **Mariana Zannon**, *Pós-Graduação em Ecologia e Evolução, IBRAG, UERJ. Rua São Francisco Xavier 524*; **Mariana Vale**, *Pós-Graduação em Ecologia e Evolução, IBRAG, UERJ. Rua São Francisco Xavier 524*

Missing for the last twenty years: the case of the southernmost populations of the Tropical Mockingbird, *Mimus gilvus*, in Rio de Janeiro, Brazil

The Tropical Mockingbird (*Mimus gilvus*) ranges from Mexico to Brazil. The Brazilian populations, however, only occur on restinga (an open shrubby vegetation in sandy coastal plains, associated to the Atlantic forest). These populations likely belong to an undescribed species that is regionally threatened by habitat loss and capture of nestlings for illegal trade. We conducted field surveys in 21 restinga remnants in Rio de Janeiro State, the southernmost portion of the species' range. The bird has already disappeared in most of them. We estimated a current Area of Occupancy (AOO) of 256 km², which combined with the estimated average population density (52 individuals km⁻²) and occurrence probability (20%), translated into an estimated population size from 2,662 to 13,312 individuals in Rio de Janeiro. From the original AOO (652 km²), we estimated an

original population size of 33,904 individuals in Rio de Janeiro, and a population reduction of 61% to 92% in the last 20 years. The species, therefore, is regionally "Endangered" under IUCN Criteria. The Tropical Mockingbird needs a taxonomic review in order to confirm whether the Brazilian populations belong to a different species. We also recommend the enforcement of the Brazilian Forest Code, that formally protects restingas, together with environmental education that could reduce illegal trade, in order to mitigate the pressures over the species and avoid more local extinctions.

Amick, Kari, *University of Saskatchewan*; **Douglas Clark**, *University of Saskatchewan*; **Ryan Brook**, *University of Saskatchewan*

Stakeholder perspectives on Chronic Wasting Disease

Chronic wasting disease (CWD) is an emergent prion disease of cervids and a burgeoning wildlife management issue in the North American west. Past management efforts have incorporated hunter participation; however, this has not been effective in the long term, apparently due to lack of hunter and stakeholder interest. This research looks at community perspectives on CWD management in the Canadian provinces of Saskatchewan and Manitoba. The goal of this project is to understand how stakeholders frame CWD as a risk, what their preferences for management are, and whether adaptive governance can be used for wildlife disease management. A mixed methods approach incorporating Q-methodology to identify participants' perspectives was used to survey hunters, First Nations, landowners, wildlife managers and other stakeholders. Preliminary results indicate that the knowledge of CWD varies between individuals, and personal understanding of CWD as a risk can impact preferences for management. These results are considered in relation to Canada's current national CWD management plan, as well as to assess the future viability of adaptive governance in addressing CWD and other emergent wildlife diseases.

Anderson, Mark, *The Nature Conservancy*

Conserving all the stages: using a geophysical approach to identify a network of climate-resilient sites

Conservationists need a method to conserve the maximum amount of biological diversity while allowing species and communities to rearrange in response to a continually changing climate. Here, we develop and test such an approach for northeastern North America. First we identified the geophysical factors most correlated with species diversity patterns and subdivided the region into 30 distinct geophysical settings. Next, within each geophysical setting we located sites that were connected by natural cover, and that had complex topography and large elevation ranges increasing

their micro-climatic buffering. We hypothesized that these sites had the highest resilience to climate change. We compared these against the current network of secured lands, and against sites identified for their high quality biodiversity features. Results showed a robust correspondence between the biodiversity sites and the high scoring geophysical sites; with universally high average resilience scores across every natural community and species group. Troublingly, low elevation areas on calcareous bedrock or surficial substrates scored markedly low for estimated resilience and securement, and had higher densities of rare species than other geophysical settings. We identified sites for each geophysical setting that are likely to have the highest possible resilience, revealing and correcting for substantial bias in current conservation.

Anwana, EnoAbasi, *Regional Institute for Population Studies, University of Ghana*; **Samuel Codjoe**, *Regional Institute for Population Studies, University of Ghana*

Life on the Edge: Livelihoods, Impact and Adaptation to Climate Change in Urban Coastal Areas in Ghana

Urbanisation in Ghana is upward trending, with a quarter of current population living along the coast; where global climate changes are expected to cause various socio-economic impacts. Yet, the country still lacks a comprehensive communication framework to address knowledge gaps on climate compatible planning for coastal environments. Using Focus Group Discussions and In-Depth interviews in consonance with a livelihood framework tool, we assessed the impact and coping strategies to sea level rise, flooding amongst three dominant economic groups (i.e. fishermen, fishmongers and non-fish traders) within six communities in Greater Accra Region. Results obtained show negative impacts on natural ecosystem goods and services. Importantly is the effect on fisheries and other aquatic biodiversity; deemed important for the dominant fishery occupation and tourism of the area. Differentiated impacts amongst socioeconomic groups have far-reaching implications for their collective responses to the effects of climate change. Thus, building resilience amongst and within groups will demand an integrative coastal zone management (ICZM), which takes cognizance of current climate change vulnerabilities of the coastal area and bridging gaps in climate change knowledge within the area. Such ICZM should be reflective of local ecological knowledge and equally embrace the adaptive strategies of the people to future climate change scenarios.

Arengo, Felicity, *American Museum of Natural History*; **Juan Cornejo**, *Wildlife Conservation Society*

Population status and threats to Chilean Flamingos in known areas of their distribution in South America

Three species of flamingo are found in southern South America. The Chilean Flamingo (*Phoenicopterus chilensis*) has the broadest distribution from the Pacific coast of Peru and Chile, lakes in the Central Dry Puna, to lowland and coastal lakes in Paraguay, Argentina, Uruguay, and Brazil. The Puna (*P. jamesi*) and Andean Flamingos (*P. andinus*) are primarily in the altiplano, although they use lowland wetlands of central Argentina, particularly in winter. The population status of Puna and Andean Flamingos is known and conservation strategies are being implemented. However, less is known about the population and conservation status of Chilean Flamingos. During a workshop with experts from the region, we identified breeding and non-breeding wetlands, threats at these sites, and knowledge gaps. The global population of Chilean Flamingos was estimated at 290,000. Priority sites holding 1% or more of the population or where breeding activity had been recorded were identified, generating a list of 8 priority sites in lowland wetlands and 13 in the high Andes. Excluding the global threat of climate change, top threats in lowland wetlands were water extraction for commercial agriculture and contamination with agrochemicals. In Andean wetlands top threats were habitat loss and degradation due to mining, road development and domestic contamination. We also identified information gaps and evaluated areas of overlap between priority areas for conservation for the 3 flamingo species.

Armstrong, Paul, *University of Tennessee*; **Szvetlana Acs**, *European Commission - Joint Research Center*; **Martin Dallimer**, *University of Copenhagen*; **Kevin Gaston**, *University of Exeter*; **Nick Hanley**, *University of Stirling*; **Paul Wilson**, *University of Nottingham*

Designing Cost Effective Conservation Payment Programs

Incentive payment programs to private landowners provide a center-piece of conservation strategies in many parts of the world. We examine how payment programs can be designed to provide cost effective improvements in biodiversity, using 44 extensive livestock farms in northern England as a case study and bird species as an indicator of biodiversity. We first estimate the "true" supply price to farmers of producing improvements in different biodiversity targets. We then derive the optimal (i.e. most cost effective) program design for each target. This provides a benchmark against which to compare the cost effectiveness of simpler, more readily implemented, payment programs. Existing payment schemes appear cost ineffective and primarily act to subsidize farm profits. The optimal policy exploits variation in costs of producing biodiversity enhancements within and among farms. However such a policy would be prohibitively complex to administer. By comparing alternative, simpler policies to the optimal policy, we show that common simplifications in payment scheme design can result in 49-100% of promised biodiversity gains being given up. Moreover, we are able to

identify which policy simplifications are most problematic. Spatially differentiating pricing for biodiversity improvements is critical to the success of such programs, a finding that is robust to idiosyncratic responses of different biodiversity targets to management actions.

Arowosoge, Oluwayemisi, *Ekiti State University*; **Folaranmi Babalola**, *University of Pretoria*

Strategies for Integrating Private Stakeholders in Plantation Forest and Conservation: Public and Private Forest Practices in Ekiti State, Nigeria.

Increasing pressure on forest with rapid decrease in biological diversities justifies the need for integrating private stakeholders in restoration and conservation strategies. This study therefore evaluates integrated approach of private stakeholders in plantation forest and biodiversity conservation in Ekiti State, Nigeria. Primary data were collected through administration of structured questionnaire and interview of 49 private tree growers. Secondary data were obtained from classified documents of the State Forestry Department. Data were analyzed using descriptive statistics. The study reveals that between 2007 and 2012, wood cut in the public forest within the State ranged from 42,216m³ to 88,642m³. Out of the 581 ha of plantations established within the five years' period, only 160 ha of *Tectona grandis* and *Gmelina arborea* was established by the State while the private tree growers established 421 ha (72.5%) on their owned lands. Top three constraints to increasing private plantation size include non-availability of land, lack of incentives and lack of technical advice. Identified strategies for effective integration approach of private stakeholders include transfer of degraded public forest to private stakeholders, stakeholders' empowerment for the sales of carbon credits and planting of mixed species. Participation of private tree growers in public forest plantation and conservation of biological diversities in the State is crucial.

Artelle, Kyle, *Simon Fraser University and Raincoast Conservation Foundation*; **Sean Anderson**, *Simon Fraser University*; **Andrew Cooper**, *Simon Fraser University*; **Paul Paquet**, *Raincoast Conservation Foundation*; **John Reynolds**, *Simon Fraser University*; **Chris Darimont**, *University of Victoria and Raincoast Conservation Foundation*

Confronting uncertainty in wildlife management: performance of grizzly bear management in British Columbia, Canada

Addressing uncertainty is an important element of effective wildlife management. Failure to properly account for uncertainty in some systems has been implicated in management errors with disastrous consequences. We used the hunt management of grizzly bears (*Ursus arctos horribilis*)

in British Columbia, Canada, as a model system to empirically assess potential impacts of uncertainty on management. In particular, we examined outcome uncertainty (the discrepancy between expected and actual mortality levels) and components of biological uncertainty. We found that unaddressed uncertainty compromised management performance repeatedly, and throughout the province, from 2001-2011. Outcome uncertainty alone led to excess mortality in 19% of cases (population-years) examined. Accounting for uncertainty around estimated biological parameters revealed excess mortality might have occurred in up to 70% of cases. We describe a method that uses empirical assessments of uncertainty to identify targets that maintain the probability of exceeding mortality limits below specified thresholds. At thresholds of 25% and 5%, this method identifies average target mortality reductions of 47% and 81%, respectively. Application of our transparent and generalizable framework to this or other systems could improve management performance in the face of uncertainty.

Aslan, Clare, *Arizona-Sonora Desert Museum*; **Erika Zavaleta**, *University of California, Santa Cruz*; **Bernie Tershy**, *University of California, Santa Cruz*; **Don Croll**, *University of California, Santa Cruz*

Large flower size may facilitate pollination disruption in Hawaiian lobeliads

Large flower size may be a specialization for large-bodied pollinators. By excluding some potential pollinators, such specialization could create risk of mutualism disruption. We examined ongoing pollination and conservation status of species in the genus *Clermontia*, a taxon of bird-pollinated Hawaiian lobeliads varying widely in flower size. We employed a combination of field observations, pollination treatments, and museum specimen measurements. Field results indicated that small and mid-sized flowers are now pollinated largely by an introduced bird species, while large flowers receive no evident pollination. A comparison of museum specimen floral tube lengths and conservation threat rate revealed that larger-flowered species in the genus are more likely to be threatened with extinction than are smaller-flowered species (ANOVA; $p = 0.047$). We speculate that pollination disruption may be one factor contributing to this pattern: not only are large-bodied native pollinators largely extinct, but introduced bird pollinators are generalist, small-bodied species. Pollination disruption carries risks of inbreeding and decreased reproductive output. Conservation threats to both large-bodied animals and large-seeded plants are broadly recognized, but the vulnerability of large-flowered plants to pollination disruption has not been widely discussed in conservation circles.

Asmyhr, Maria Gulbrandsen, *Macquarie University*

Conserving poorly described ecosystems by integrating Phylogenetic Diversity (PD) into systematic conservation planning.

Complementarity-based algorithms are increasingly being used for selecting and prioritizing nature reserve networks. However these methods require taxonomic and distributional information- data currently missing for the majority of the world's taxa. Phylogenetic diversity (PD) is a measure of biodiversity that incorporates information on evolutionary divergences between taxa by summing the branch lengths of a phylogenetic tree. The tips on the tree can be species, populations, individual organisms or genetic sequences making PD suitable for estimating biodiversity in poorly known ecosystems.

Australian subterranean fauna potentially represent a vast amount of the continent's biodiversity, with > 80 % as yet undescribed. We used molecular methods to estimate PD for stygofauna from New South Wales. Designating the branches of the phylogenetic tree as conservation features weighted by their length, we evaluated the conservation value of different sites using endemism and complementarity-based algorithms including Rebelo and the software MARXAN. The different approaches resulted in similar ranking of sites however MARXAN incorporates the cost and shape of the final reserve system resulting in slightly different conservation priorities. We demonstrate that by using molecular methods and PD, largely unknown ecosystems can be effectively included in conservation planning. Future work will focus on identifying environmental surrogates for predicting phylogenetic β -diversity.

Auerbach, Nancy, *University of Queensland*; **Ayesha Tulloch**, *University of Queensland*; **Hugh Possingham**, *University of Queensland*

Where should I do what to cost-effectively manage threats to species?

When conservation funding is constrained, natural resource managers need simple, transparent, and logical decision-support for choosing between multiple management actions to abate threats to multiple species. We show how cost-effectiveness directs efficient investment in conservation action. Our case study examines the relationship between the benefits and costs of abating two threats (habitat degradation from cattle grazing and predation by foxes, an invasive, introduced species) to priority species in a biodiverse region of Eastern Australia. We demonstrate that benefits to species are four times higher if we use cost-effectiveness to select for threat management in species-rich sites than if we randomly invest \$10M. If we also prioritize restricted habitats in species-rich areas, the contrast between arbitrary and cost-effective management is even greater. Our research further determines that for the same amount of money, it is almost twice as effective to simultaneously manage two threats as

compared to treating each threat separately. Importantly, we find that the return on investment in threat abatement diminishes rapidly. Greater than 50% of the total possible benefit of managing two threats can be delivered with \$5M, but doubling the budget results in a benefit increase of only 12%. Our analysis shows how to accountably locate where to efficiently use limited resources to act on abating multiple threats to multiple species by delivering great benefit for little cost.

Austen, Douglas J., *USFWS, Landscape Conserv. Coops.*

A national structure for collaborative science and conservation planning at the landscape scale - the Landscape Conservation Cooperatives

The need for intensively collaborative approaches to address conservation challenges has never been greater and will be increasingly necessary in the future. Clearly, successful approaches exist but have been focused on species groups or geographically limited areas. In 2010, a wide variety of conservation partners established the Landscape Conservation Cooperatives (LCC). The existing network of 22 LCC's, includes all diverse set of federal agencies, state fish and wildlife agencies, non-governmental organizations, tribes and tribal groups and others entities. The LCC's are a conservation-science partnership that: (1) develop and provide integrated science-based information about the implications of climate change and other stressors; (2) develop shared, landscape-level, conservation objectives and inform conservation strategies that are based on a shared scientific understanding about the landscape, including the implications of current and future environmental stressors; (3) Facilitate the exchange of applied science in the implementation of conservation strategies and products developed by the Cooperative or their partners; (4) Monitor and evaluate the effectiveness of LCC conservation strategies in meeting shared objectives; and (5) Develop appropriate linkages that connect LCCs to ensure an effective network. The role, function, governance, and limitation of LCC's will be discussed and explored in light the challenges facing our conservation community.

Backs, Janet, *University of Illinois at Chicago*; **Mary Ashley**, *University of Illinois at Chicago*

The story of a tough little West Texas oak, the threatened *Quercus hinckleyi* C.H. Mull.

Quercus hinckleyi C.H. Mull. is listed as a threatened species under the U.S. Endangered Species Act and by the state of Texas and is identified as 'critically threatened' on the IUCN Red List. Its known range in the United States is limited to one county in West Texas. Among immediate threats are low number of populations combined with few individuals,

asexual reproduction, wildlife herbivory and insect predation, and possible hybridization with other oak species. We used DNA microsatellite analysis of eight loci to assess the genetic status of *Q. hinckleyi*. Our findings are based on examination of over 200 samples from three separated locations. To assess the threat of hybrid swamping, we analyzed over 40 samples of putative hybridizing species. Within *Q. hinckleyi* samples analyzed from the three known locations in Texas, clonal reproduction was prevalent; among 70 ramets genotyped from two of the locations only ten genets existed and genets were not shared across these sites. While we did find a relatively high level of genetic diversity there is limited gene flow between the locations. The high level of asexual reproduction combined with the low levels of gene flow and evidence of hybridization make long-term survival a challenge. Extreme conservation strategies, including hand pollination, translocation of genets among remaining populations, and ex-situ methods such as in vitro propagation and cryopreservation may be necessary if this species is to be conserved.

Bailey, Megan, *Wageningen University and Research Centre*;
Simon Bush, *Wageningen University and Research Centre*;
Paul van Zwieten, *Wageningen University and Research Centre*;
Arthur Mol, *Wageningen University and Research Centre*

Connecting the dots through information innovation: The case of western and central Pacific tuna

Rising consumer demand for fish and seafood, coupled with improvements in gear efficiency has led to increasing pressure on the ocean's resources. Nowhere is this truer than in the western and central Pacific Ocean (WCPO), home to the world's largest tuna supplies. Conservation concerns over two species particularly, yellowfin and bigeye, have been voiced by a range of stakeholders, such as nature conservation groups, national management bodies, domestic and foreign businesses and international regulatory groups. Barriers to effective tuna governance in the WCPO include the quality of national-level data and reporting, and the limited flow of information between stakeholders. In this study, we investigate innovative information platforms, and discuss in what ways such innovations can improve governance regimes for WCPO tuna. Existing data systems, innovative smart phone applications, and real-time information platforms are analyzed. Our work suggests that information innovation, often led by private actors, can improve state-based management. These improvements are often local, however, and the flow of information across stakeholders can be limited, even when innovation exists. Linking existing information platforms, connecting investors with local businesses and communities, and increasing the availability of private data to public entities are all ways to connect stakeholders and contribute to effective conservation of WCPO tuna.

Bain, Raoul, *Div Vert Zool (Herpetology) and Center for Biodiversity and Conservation, AMNH*; **Martha Hurley**, *Center for Biodiversity and Conservation, AMNH and Global Wildlife Conservation*; **Eleanor Sterling**, *Center for Biodiversity and Conservation, American Museum of Natural History*

Conservation Biogeography of Vietnam: Insights from Novel Biodiversity

Clear demarcation of biogeographic patterns of endemism and species richness, including detecting novel biodiversity, is required to incorporate evolutionary processes into conservation planning. Key to this is the reliable identification of inventoried species and phylogeographic analyses, both of which are increasingly reliant on molecular techniques. We use results from multi-taxa inventories in Vietnam (Indo-Burma Biodiversity Hotspot), 1999-2004, to examine the relevance of specimen collections to delineating evolutionary patterns and prioritizing areas of evolutionary novelty for conservation. Results from surveys at six sites for small mammals, birds, amphibians, and reptiles include 17 new taxa described based on morphology and eight new country records and a minimum of 40 published phylogenetic analyses using vouchered tissue samples. Results support: (1) regional trends for high levels of new species descriptions over new country records; (2) importance of novel species in providing evolutionary insights; and (3) deep divergence among morphologically similar species in areas of known endemism. All depend on referenced collections to support accurate field identifications and provide comparative data for continued phylogeographic research refining ecological and evolutionary patterns. Lag in reporting survey result results from the process of species description and publication; however, tissues collected will continue to be used in molecular analyses.

Baker, Arielle, *Rutgers, the State University of New Jersey*;
Patricia Pinto da Silva, *Northeast Fisheries Science Center Social Science Branch*; **George Lapointe**, *George LaPointe Consulting*

Measuring success of Regional Fisheries Management Goals and Objectives: A Retrospective Analysis

In the United States most of the regional Fishery Management Councils (FMC) have not yet crafted a clear vision—or set of objectives—for measuring management success in their regions. A clear vision is an important step towards forming a coherent fisheries management policy. To inform these emerging processes and to illustrate the main stated goals of each FMC, we conducted a retrospective analysis of the principal regulatory documents of each Council since 1977 when the Magnuson-Stevens Act was

implemented. For each of the eight management councils, we identified all of their fishery management plans [FMPs] and associated amendments and coded and analyzed the goals and objectives in selected fisheries for each region with particular emphasis on social and economic goals and objectives. Key fisheries in each region were selected based on the number of participants and ex-vessel revenue and selected through a series of informal interviews with Council staffs, NOAA science and policy personnel, and other experts. Using Atlas Ti qualitative data analysis software, we created hierarchical trees of each fishery to enable analysis and comparison. Our initial results indicate that a core set of goals exist throughout the US. These include: preventing overfishing, rebuilding stocks, controlling effort and participation in the fishery, and ensuring economic stability. However, in many cases, fisheries goals and objectives conflict both within and among fisheries in the region.

Baker, Sandra, *University of Oxford*

Humane wildlife management; an integrated approach

People and wildlife often come into conflict in residential or leisure areas. To combat such conflict, people have devised various wildlife management methods, often involving culling. However, even where a desire exists to manage conflict humanely, little information is available on the humaneness of methods. Using moles as a case study, we applied a matrix-based model (devised by Australian Government scientists with input from animal welfare, veterinary and pest control organisations), to examine the relative humaneness of mole management methods. The model uses published scientific information from a range of disciplines, together with informed judgement, to produce a score reflecting the welfare impact of each method. Of all the methods, the overall welfare impact (excluding suffering specifically associated with the killing part of lethal methods) was greatest for live-trapping and relocation of moles, followed by harrowing and rolling molehills, phosphine gassing, spring trapping and removing molehills by hand. The killing aspects of both lethal methods were also associated with potentially severe suffering. In addition, the model allowed identification of specific gaps in scientific knowledge regarding mole control methods. This integrated approach potentially provides a tool for: reaching consensus among stakeholders regarding the relative humaneness of wildlife management methods; improving the humaneness of management methods; and influencing policy and practice.

Baldi, Andras, *MTA Centre for Ecological Research*; **Julie Shapiro**

The need for accurate locations for conservation studies

One of the basic principles of conducting sound science is that experiments and observations be repeatable. Because of this, published studies should include all the details necessary for someone to repeat their experiment. Location is a key detail in ecology and conservation biology, e.g. to find earlier sampling sites, to repeat sampling in monitoring or restoration programs, etc. In spite of this, many papers do not provide accurate location information. This is partly due to difficulties in giving exact coordinates for hundreds of field sites or for irregular or patchy areas etc. However, emerging technologies now provide free and easy tools for providing accurate location information. For example, using Google Earth, point, transect or polygon sample areas can be stored in KML format, and used by others. In this way, studies are repeatable and readers can gain more information on landscape context or even landscape views from uploaded photos. We argue that providing KML location information should be requested from papers reporting field studies, except if protection or other reasons prohibit the open access of data.

Barker, Jennifer, *FHI 360*; **Roberto Martin**, *FHI 360*;
Patrick Christie, *University of Washington*; **Barbara Best**,
USAID

Global FISH Alliance: Progress toward sustainable harvest of spiny lobster in Honduras

Implemented by FHI 360 and funded by the U.S. Government (USAID), Global FISH Alliance (G-FISH) brings together government, private sector, and civil society to promote sustainable fisheries and aquaculture around the world. The spiny lobster (*Panulirus argus*) fishery of Honduras has long been environmentally unsustainable and dangerous for lobster divers, who dive with compressed air to depths beyond safe diving limits. More than 5,000 lobster divers work in this fishery and approximately 1,800 Honduran divers have been injured from unsafe diving practices in pursuit of spiny lobster on the Caribbean coast. G-FISH, with partners including The Nature Conservancy, the Honduran government, fishermen associations, and Darden Restaurants, Inc., has employed a social change process based on increased interaction and communication among system stakeholders, regular system-wide events, targeted social ecological monitoring of the fisheries system, and policy advocacy. Interview results and social network analysis of hundreds of informants demonstrate that connections between key stakeholder groups have been strengthened and that policy makers and resource users are willing to make profound policy changes improve lobster fishery sustainability when all key actors agree to common goals, act in synchrony and create mutually beneficial outcomes.

Barrett, Heather, *Belize Foundation for Research and Environmental Education (BFREE)*; **James Rotenberg**, *University of North Carolina Wilmington*; **Jacob Marlin**, *Belize Foundation for Research and Environmental Education (BFREE)*

Integrated Community-Based Avian Conservation Program

Significant conservation challenges in Belize include the absence of a research culture and infrastructure to support in-country scholarship. Historically, foreign scientists have conducted research on flora and fauna while locals participate as guides or field hands. Much of the research carried out is unavailable to community stakeholders, leaving local conservation practitioners without data to make sound, science-based management decisions. Community members remain largely unaware of and unconcerned by conservation efforts because they do not equate conservation with income generation and a secure livelihood. The result is a dearth in long-term studies and disconnect between conservation initiatives and the local people. BFREE and UNC Wilmington have sought to address these challenges by offering Parabiologist training to local people from buffer-zone villages surrounding the Bladen Nature Reserve protected area, and within close proximity to the BFREE field station. Eleven trainees have graduated from this program and three individuals are currently in training. Three graduates are employed by BFREE and are now highly trained avian field technicians dedicated to their work and to providing environmental education to their communities. These technicians are considered avian and conservation experts in their country and are receiving opportunities and recognition abroad. Their success is shifting the existing paradigm and serves as a model for other countries.

Bart, David, *University of Wisconsin-Madison*; **Austin Yantes**, *University of Wisconsin-Madison*; **Tara Davenport**, *University of Wisconsin-Madison*; **Quentin Carpenter**, *University of Wisconsin-Madison*

Interacting Legacies and Stress Predict Rare-Species Occurrence in Wisconsin Fens

Land-use legacy influence on rare- or indicator-plants is understudied. We argue that in high stress systems these plants will be less likely found when legacies remove them from the pool or alleviate stress. We used the occurrence of a land-use legacy (a history of plowing), two non-resource stresses (waterlogging (as measured through root-zone volumetric water content) and high conductivity) and a resource stress (low nutrient availability (as measured through plant-available Nitrogen and Phosphorus)) to predict: 1) rare- and indicator-species richness and, 2) individual species frequency in 11 calcareous fens. Partial Least Squares Regression (PLS) revealed that regardless of stress, no study species were found in plowed fens. In never-plowed fens rare-

and indicator-species richness increased with conductivity and waterlogging stress and decreased with nutrient availability. The richness model was highly predictive. PLS models of frequency counts were less predictive of individual species, but invariably showed that no history of plowing, high conductivity, high waterlogging stress, and low nutrient availability were important predictors. We suggest that plowing removed most fen specialists and rare species from the local pool, and lack of dispersal to these fens limits recovery of these species. However, efforts to return these species to fens may meet limited success if abiotic stress is low.

Bateman, Brooke, *University of Wisconsin-Madison*; **Jessica Gorzo**, *University of Wisconsin-Madison*; **Anna Pidgeon**, *University of Wisconsin-Madison*; **Volker Radeloff**, *University of Wisconsin-Madison*; **H. Akcakaya**, *Stony Brook University*; **Curtis Flather**, *USDA, Forest Service*; **Thomas Albright**, *University of Nevada, Reno*; **Stephen Vavrus**, *Center for Climatic Research*; **Wayne Thogmartin**, *United States Geological Survey*; **Patricia Heglund**, *United States Fish and Wildlife Service*

Identifying drivers of abundance of an irruptive species, the Dickcissel (*Spiza americana*)

Increasing pressure from anthropogenic and climatic change will make it more difficult to identify and maintain key habitats for species. This may be particularly so for species that naturally exhibit high variability in abundance and distribution like the Dickcissel (*Spiza americana*), a grassland bird. It is thought that the irruptive nature of the Dickcissel is linked with drought conditions within the core breeding range, causing populations to move in search of more suitable conditions. We aim to identify the effect that weather has on regulating the spatial abundance of this species. We generated a temporally-fine-scale species distribution model for the Dickcissel using weather data (1950-2011). To examine the effect of extreme weather on Dickcissels, we used remote sensing products to quantify droughts and heat waves (2001-2011). We found that the Dickcissel habitat, as determined by weather, varied greatly through time, although the core of its range had the most consistent weather across all years. Our results show that low weather suitability is always accompanied by low Dickcissel abundance, suggesting that weather plays a role in limiting its distribution. When weather is unsuitable at one location this species moves to more suitable areas, which may be well outside of its core distribution. In a changing climate with weather becoming more erratic how will we ensure adequate conservation strategies for such weather-sensitive species?

Beard, Karen, *Utah State University*; **Rodrigo Ferreira**, *Utah State University*

Matrix-habitat and edge effects on amphibian communities in the Brazilian Atlantic rainforest

Brazil's Atlantic rainforest has been reduced to 10% of its historical range but still harbors a tremendous amount of endemism and diversity. This is particularly true for amphibians, which are represented by over 300 endemic species. As primary forest is lost and replaced with plantations, the effects of these new matrix types on amphibians are critical to understand. We investigated the effects of the dominant matrix types (coffee plantations, Eucalyptus plantation, and secondary forests) and their edge effects on bromeligenous and leaf litter frogs along a reserve in the mountainous regions of Espírito Santo in southeastern Brazil. Both species diversity and the total abundance of frogs were lower in coffee plantations, Eucalyptus plantations, and secondary forests than in the interior of the reserve. In addition, species diversity in edge habitats was lower than in interior forest for coffee plantations and Eucalyptus plantations matrix types. All bromeliad-dwelling frogs were found only in the forest interior. Results suggest that, in general, 1) species prefer primary forest, 2) matrix habitat types will only be used by some species, and 3) edge effects are greater for matrix types that represent the largest contrast with primary forest. We will discuss the role of the local community in habitat loss and bromeliad collections. We will also discuss our involvement in the local community, including interviews, discussions and education programs.

Bednarczyk, Daria, *School for Field Studies*; **Ellen Splain**, *The School for Field Studies*; **Edward Hind**, *The School for Field Studies*

The devil is not in the detail: Using rapid social science assessments to identify socioeconomic baselines in 'data-poor' conservation situations

Rather than seeing 'data-poor' environmental management problems as a barrier to good conservation this paper explains a scenario where the use of an easy to administer field methodology can prevent the policy stagnation that has traditionally been associated with such problems. Environmental managers are increasingly recognizing that it can be impossible to collect the detailed data which they desire to inform their decision making. Indeed, where long time series of ecological data are absent both academics and bureaucrats are now advocating data-poor decision making in line with the precautionary principle, and even data-less management. However, few have suggested a similar approach in cases where the data that is 'poor' is socioeconomic in nature. This paper, using the case-study of fisheries management in the Turks and Caicos Islands, shows that quick and simple applied social science techniques can be used to discover wide ranging socioeconomic baselines, identify complex stakeholder networks, and map out potential policies for successful conservation management.

Stakeholder feedback for this study was almost uniformly positive with little of the data or findings being questioned. These social science techniques, accessible to all, can be adopted in any environmental management situation where there are human stakeholders and are especially useful in cases where there is little existing information.

Beier, Paul, *Northern Arizona University*

SCB's Carbon Sequestration/Offset projects: a review

In 2007 SCB became the first professional organization related to natural resources to take responsibility for greenhouse gas emissions from its meetings, publications, and other activities. Our effort has 4 steps (which should be used by any responsible individual, industry, or nation): (1) Estimate emissions. SCB's annual ecological footprint assessments show that > 95% of our emissions derive from jet fuel burned to take people to our Congresses. (2) Reduce emissions. SCB cut emissions 40% by changing from annual to biennial International Congresses. (3) Replace dirty energy sources with cleaner ones. By itself, SCB cannot replace jet fuel with a cleaner fuel. (4) Offset remaining emissions by storing an equivalent amount of carbon. SCB has invested in 2 projects that have offset about 90% of our impacts since 2007. Moreover, these projects directly benefit biodiversity (by restoring native ecosystems) and improve human livelihoods in the project area. But the direct impact of our efforts is small. Real progress requires global action to reduce emissions and replace polluting energy sources, because no offset project stores carbon as securely as leaving fossil fuels in the ground. Climate change policy is at the top of SCB's policy agenda. For example, SCB promotes cap-and-trade legislation and opposes development of tar sands which emit more carbon per unit energy than other fuels.

Beier, Paul, *Northern Arizona University*; **Malcolm L. Hunter**, *University of Maine*

Conserving the stage: using geophysical units as coarse-filter targets in conservation planning for climate change

A land facet is a recurring landscape unit defined by topographic, soil, and other abiotic attributes. A reserve design that conserves the stage (diversity of land facets) should also conserve biodiversity (defined as species plus the eco-evolutionary processes that maintain & generate biodiversity), and should do so under any climate regime. The other talks in this symposium articulate the assumptions and evidence for the land-facet approach, and illustrate its use in conservation planning. In this talk we argue that (1) This coarse-filter approach is grounded in the state-factor model of ecosystems. (2) Broader acceptance of the land facet approach depends crucially on demonstrating that a reserve design based on land facets represents biodiversity under at least

some facet classification schemes (where a scheme is a combination of abiotic variables, pixel size, and algorithm), and does so better than an equal-sized reserve area composed of randomly-selected units. (3) This demonstration (that land facets are good surrogates) has not occurred because (a) we lack "truth" (accurate maps of biodiversity), (b) there are countless facet classification schemes, and (c) each analysis of surrogacy is specific to one study region and classification scheme and thus cannot support a general inference about surrogacy. (4) The alternative to a land facet approach (designing a climate-robust reserve based on focal species) is fraught with even more uncertainty.

Bekoff, Marc, *University of Colorado, Boulder*

Compassionate Conservation as a Unifying and Integrative Movement: Who Lives, Who Lives, and Why

The principles and goals of the relatively new and rapidly growing interdisciplinary field called Compassionate Conservation fit in nicely with the theme of this SCB gathering, namely, "Connecting Systems, Disciplines, and Stakeholders". Compassionate conservation asks us to consider seriously the well-being of individual animals as we make decisions about the health and integrity of larger entities including species, populations, and ecosystems in our attempts to slow and reverse wide-ranging losses of biodiversity. It also asks us to consider the well-being of human as well as nonhuman stakeholders. Almost daily we are forced to make very difficult decisions about "who lives and who dies" and because of limited time, money, person-power, and ever-growing problems, we may have to choose not to pursue certain projects and "let some species or habitats go" or to terminate those programs that are not producing useful results. Some conservation scientists already agree with these possibilities. These sorts of decisions are singularly daunting, but it is clear we cannot continue redecorating nature without paying the price for our unrelenting and destructive ways that result in significant and often irreversible damage. At best we can make decisions that have positive effects on as many nonhuman and human animals as possible and their homes, but it is naive to think that we can actually re-store or re-create ecosystems as they were in the past. Compassionate conservation demands that we no longer ignore nature and that we rewild our hearts and pay close attention to what we have done and where we need to head in the future. We also need to focus on what has worked and not less pessimism and negativity get us down. A guiding principle with which we might choose to begin is "first do no harm".

Bellemare, Jesse, *Smith College*; **Jessamine Finch**, *Smith College*; **David Moeller**, *University of Minnesota*

Climate change and assisted colonization: A 5-year, 1000 km experiment with a southern Appalachian endemic forest plant, *Diphylleia cymosa*

Climate change will be a top threat to biodiversity in coming decades. Species with small ranges, i.e. endemics, may be at increased risk of extinction, as unsuitable conditions may develop rapidly across their ranges. Human-assisted colonization has been proposed as one option to avoid extinctions by facilitating species in tracking suitable conditions poleward. This experiment explored the viability of this novel conservation approach for *Diphylleia cymosa*, a forest herb endemic to the southern Appalachian Mountains of the Southeast USA. In Fall 2008, we established a ~1000 km transect of seed sowing sites from 3 locations within the species range to 5 apparently suitable, but unoccupied, sites outside the range in the Northeast USA. Germination in 2009 was relatively high overall (44%) and did not differ significantly within vs. beyond the species range (40% vs. 46%). Survival from the seedling to juvenile stage (2009-2010) was significantly higher inside vs. outside the range (63% vs. 30%), possibly due to increased herbivory beyond the range. However, 2010-12 survival rates have been comparable inside vs. outside the range as juveniles have become established. Growth rates of experimental plants outside the range have been higher than those within the range, despite increased herbivory, and sexual reproduction is possible in 2013. These results suggest assisted colonization may be a viable option for some endemic species.

Benitez-Malvido, Julieta, *UNAM-Centro de Inv en Ecosistemas*

Fungal diseases in disturbed Neotropical forests

All plant structures at all stages of the life cycle, are subject to be colonized by microorganisms that may modify or interrupt their vital functions. In general terms a "disease" in plant pathology includes a series of microorganisms that disturb plant metabolism such as growth (hypotrophy and/or hyperplasia) in a portion of or throughout an entire plant causing even its death. Infectious agents could be fungi, nematodes, viroids, viruses, bacteria or even other flowering plants (e.g. the parasitic plant *Epifagus virginiana*). Fungi (sensu lato, i.e. including Oomycetes) are however, the major causal agents of plant diseases (i.e., ca. 75% of all plant diseases are caused by fungi) and jointly with insects comprise the major threat to wild and cultivated plant species worldwide. Fungal infection can cause local or extensive necrosis or abnormal growth in the different structures of plants. Several types of human disturbances in the Neotropics have shown to affect the interaction of plants with their fungal pathogens in natural ecosystems. Disturbance increased the levels of pathogen damage on plants. The observations are limited to foliar pathogens because of their ubiquity in tropical plant communities. Firstly, leaf diseases in tropical plants are described; secondly the physical and

biological factors involved in disease development and transmission; thirdly, the impact of anthropogenic disturbance in facilitating leaf fungal infection; then the potential consequences of disease spread, and finally, the implications of such disease induced changes in tropical rain forests function and conservation.

Berg, Joe, *Biohabitats, Inc.*

Stormwater and Aquatic Resources: Integrating Conservation and Restoration

Society's management of runoff from developed watersheds with discharge to receiving streams results in degradation of aquatic resources. The integration of water resource engineers, ecologists, landscape architects, watershed scientists, and activists has resulted in a noteworthy change in the future management of these resources. Until the very recent past, emphasis was placed on conservation of dollars; now the focus is on conservation of remaining high value resources and restoration of degraded resources. This presentation will describe an integrated approach to stormwater collection and conveyance, eroded outfall repair, restoration of incised stream channels, and disconnected floodplains. The regenerative design approach increases storage and biological processing along the flowpath, optimizes floodplain/riparian zone reconnection, incorporates the elements of the material processing stream, and has been documented to provide significant benefits relative to other restoration approaches and to reference stream conditions, including peak attenuation, increased time of concentration, wetland and aquatic system benefits, and improved cultural elements (e.g., property values, reduced O&M costs, etc.). Perhaps more importantly, the regeneration of habitat provides for better fish and wildlife communities, and significant increases in public stewardship of the resource, which has translated into increased funding support for the conservation and restoration of habitat.

Beston, Julie, *University of Delaware*; **Theodore Nichols**, *New Jersey Division of Fish and Wildlife*; **Paul Castelli**, *US FWS*; **Christopher Williams**, *University of Delaware*

Management of Resident Canada Geese in the Atlantic Flyway

Resident Canada geese have become a nuisance throughout much of the Atlantic Flyway due to their propensity to congregate in urban areas. Managers have implemented a variety of strategies - including egg depredation, September hunting seasons, and summer culling - in an effort to reduce the resident population while protecting migratory geese. We used banding data to estimate survival of resident geese in New Jersey. We found lower survival in rural areas where geese are more likely to be harvested, and we also found a

decline in survival in more recent years corresponding with expanded culling operations in New Jersey. We explored the relative effectiveness of management activities by producing a population model and manipulating survival and reproductive rates. Culling was the most efficient strategy to reduce abundance because it acted on survival, which had the highest sensitivity, and could target geese in urban areas. Because urban geese are not available for harvest, the liberalization of September seasons would be relatively ineffective at reducing the population. Likewise, the insensitivity of population growth rate to reproductive parameters meant that large egg depredation efforts resulted in relatively small changes in population growth rate. Although public perception often deters managers from pursuing culling operations, they provide the most efficient way to reduce the resident population below the goal level while conserving the migratory population.

Bhattacharyya, Silanjan, *West Bengal State University*; **ARIJIT CHATTERJEE**, *WEST BENGAL STATE UNIVERSITY*; **SOUMYA SARKAR**, *WEST BENGAL STATE UNIVERSITY*

Traditions of Wild Biodiversity Conservation within Village Ecosystems in South West Bengal, India

Existing conservation strategies overlook the wild biodiversity within villages. In this study, we explore the traditional co-existence of human populations with wild vertebrates in villages of south West Bengal, India. Intensive field surveys in 24 sample villages scattered over the region yielded data on occurrences and abundances of wild species along with information like people's perceptions etc. 389 species of wild vertebrates (41 mammals, 235 birds, 52 reptiles, 15 amphibians and 46 freshwater fishes) are found to live within villages in the region. Many are scheduled in the India's Wildlife Act (253 species) and the IUCN (24 species). Species richness per village ranges from 239 to 288. A village is a mosaic of 8-11 distinct habitats, each sustains some wild species. Majority inhabit small patches of wild bushes and tree groves (17.09-47.25% of village area). Despite a decreasing trend, their population sizes are still significant in these villages (e.g. 77-335 *Varanus salvator*, 15-80 *hyanman langur*/km²). Villagers accept these wild fauna as natural cohabitants. They assign sacred (e.g. langur, Cobras) or functional values (e.g. Monitors for eating snakes) and give special protections. Such pro-conservative tradition is now facing challenges from the increasing land demands from urbanization and cultural onslaught by it. Emergent conservation strategies must take into account this wealth of wild biodiversity and their conservation traditions remaining in villages.

Bishop, Phil, *Amphibian Survival Alliance*

Review of the global amphibian crisis and an introduction to the symposium

The IUCN Amphibian Conservation Action Plan (ACAP) is a unique example of a multi-disciplinary response to the global amphibian crisis. While there is a solid understanding of threats and a diverse academic constituency, compared to other vertebrate taxa there is only a limited global capacity to implement on the ground actions for amphibians. The ACAP prompted stakeholders from around the world to leverage some initial funding to implement real conservation actions that cross disciplines and benefit amphibians world-wide. The Amphibian Survival Alliance (ASA) acts as a global partnership for amphibian conservation and is working to mobilize a motivated and effective consortium of organizations to stem the rapid losses of amphibian populations and species worldwide. The purpose of this symposium is to convene some of the implementers of cutting-edge examples of amphibian conservation actions ranging from land acquisition to species management, law enforcement and policy, education and capacity building actions that cross a variety of disciplines. We believe that this session will be sufficiently novel to warrant the drafting of a white paper "The Global Amphibian Conservation Action Plan: Connecting systems, disciplines and stakeholders to save amphibians worldwide" and we will work with participants to ensure that it is published in an appropriate outlet.

Blackie, Helen, *Lincoln University and Connovation Ltd*; **Ian Woodhead**, *Lincoln Agritech Ltd*; **Duncan MacMorran**, *Connovation Ltd*; **Charles Eason**, *Cawthron Institute*; **Shane Inder**, *Auckland University of Technology*; **Jamie MacKay**, *University of Auckland*; **Brent Barrett**, *Centre for Wildlife Management and Conservation*

Advancements in wildlife recognition, monitoring and targeted control tools

Recent research within our multi-disciplinary team involving ecologists, engineers and designers has focused on three novel developments 1) automatic species recognition and detection tools, 2) advanced population monitoring devices and 3) species-specific long-life control tools for invasive pests. This research demonstrates the success of an integrative approach to achieve practical solutions for conservation problems. Examples of these developments and their applications will be provided, including the use of these technologies to detect and then control a reinvading Norway rat (*Rattus norvegicus*) on a pest-free New Zealand Island. These technologies have been designed to offer cost-effective alternatives to current methods for monitoring and controlling animal populations, and have widespread applications in wildlife management and conservation scenarios.

Blake, Stephen, *Max Planck Inst. for Ornithology*

Importance of roadless wilderness to African forest megavertebrates

Habitat loss and degradation, over-exploitation of resources, invasive species, pollution, disease, and climate change are conservation priorities. Road proliferation facilitates all of these, yet how many conservation organisations have a Roads Coordinator? In tropical forests road impacts can be catastrophic. In central Africa, large mammals are hunted out along new roads with areas closest to roads being the hardest hit. Megavertebrates such as forest elephants are impacted by roads even in the most remote forests. Elephant abundance declines dramatically near to roads, and home range size increases with roadless wilderness size because elephants are afraid to cross roads. Each new road built into the forest will bring not just industrial exploitation, but also settlement and access to illegal harvest of wildlife and commercial markets, yet conservationists have little impact on road development and management. Most roads are built with the goal of evacuating natural resources to markets as cheaply as possible, but the cheapest route is often the most ecologically destructive and least socially beneficial. Development agencies see roads as the skeleton on which to build economic growth, and aggressively promote road expansion, yet seldom consider the negative ecological and social impacts. Conservationists must make a last ditch effort to develop and force implementation of a "least bad" regional roads blueprint if functional forests and their megafauna are to survive.

Blank, Sara, *University of California-Santa Cruz*

Bags and Tags: An empirical evaluation of policy change for reducing illegal recreational fishing of red abalone (*Haliotis rufescens*) in Northern Cali

Illegal fishing has detrimental environmental and social impacts, but these effects are difficult to mitigate without reliable estimates of fisher non-compliance. This research applies the randomized response technique (RRT) to directly estimate non-compliance in the Northern California recreational red abalone (*Haliotis rufescens*) fishery before and after the introduction of new fishing regulations and marine protected areas (MPA's). Anonymous paper-based compliance and sociodemographic surveys were conducted of recreational fishers in Sonoma and Mendocino Counties in August of 2007 and 2011. The 2011 survey found slight reductions in illegal take across most violation types. The sociodemographic information collected in 2011 reconfirmed higher non-compliance rates among visitors than local fishers; particularly within the newly designated MPA's. Ignorance of rule change was the most common explanation provided by respondents for non-compliance, and the 2011 survey reflected declines in fisher knowledge of regulations. Promisingly, since the introduction of on-animal tagging regulations the proportional daily take limit violation among

local residents was found to have decreased from 72% to 43%. These rule-specific violation estimates confirm some non-compliance reductions have been achieved, but also point to opportunities for improving managerial communication and enforcement.

Blossey, Bernd, *Cornell University*; **Brian Greene**, *Cornell University*

Bioindicators to assess the importance of different stressors threatening plant species of conservation concern

Correctly ranking the importance of different stressors that threaten species of conservation concern is an essential step in developing successful management strategies. For example, teasing apart threats of introduced earthworms, land-use change, nutrient deposition, acid rain or deer herbivory may require elaborate experiments and development of demographic models. We developed potential alternatives using plant indicators to assess effects of introduced plants, introduced earthworms, deer herbivory and urbanization on native biota. By planting native species into riparian areas affected by rapid urbanization we were able to determine that privet invasion is a larger conservation concern than changes in hydrologic regimes. Planting species into earthworm invaded and uninvaded areas, or areas occupied by different introduced plant species while simultaneously manipulating deer herbivory showed overwhelming effects of deer with little effect of earthworms and invasive plants. We also used indicator species to assess effectiveness of deer sterilization and hunting on ecological goals in suburban deer management. Our results suggest that the single largest threat to conservation in eastern North America are overabundant deer. The planting of bioindicators appears a powerful and easy to use tool to directly assess threats by different stressors as well as habitat suitability for species of conservation concerns.

Boag, Angela, *University of British Columbia*; **Peter Arcese**, *University of British Columbia*

Comparing biodiversity modelling approaches in a high human impact landscape in British Columbia, Canada

Predictive biodiversity models provide critical information for the study and management of threatened ecosystems. They can also be used to facilitate conflict resolution and improve communication among stakeholders involved in conservation planning. However, model developers rarely collect the robust data necessary to validate their predictions due to expense and effort, making it difficult to compare the on-the-ground utility of alternative models. This is especially important in high human impact areas where threats to biodiversity are complex. We developed a spatially explicit species distribution model for threatened herbaceous meadow plants

in an area of intense human development using a GIS framework and existing survey data. We also modeled biodiversity in our study area using the InVEST Biodiversity model, which uses habitat quality and rarity as proxies for biodiversity. We sampled species richness in sites predicted by each model to have high and low plant diversity and compared accuracy between approaches. Field validation can expose key additional variables to include in predictive models, reveal trade-offs between alternative models, and should be a central priority for practitioners developing conservation planning tools.

Boesch, Don, *UMD Center for Environmental Sci*

Chesapeake Futures, 10 years later

The Chesapeake Futures Report was a collaborative effort of natural and social scientists in 2003 to describe the future condition of the Bay in 2030 given three scenarios of environmental decision-making - status quo, 2003-stated policy commitments, and feasible but ambitious alternatives. Using land-use, nutrient, and ecosystem modeling to visualize the downstream effects of a given course of action, the "Futures" authors gave meaning to decisions being made at the time on land-use, resource use, and conservation. In the status quo scenario, modeling predicted population increases, 10 to 15% increase in nutrient loads, loss of open space, and continued degradation of water quality and fishery resources. Models of the second scenario, with implementation of the Chesapeake 2000 commitment to nutrient load reductions, predicted modest gains in water quality and fishery resources. The feasible alternatives scenario, which included nutrient reductions and green land use planning, would have provided marked improvements in air and water quality and ecosystem benefits. Now, 10 years after the report was published, which course of action have we pursued? Did the report influence policy-makers, and which Chesapeake 2030 are we moving towards? This talk, culminating this symposium addressing the current state of the Bay and continued positive direction of environmental stewardship, will initiate a constructive discussion of Chesapeake Bay environmental issues.

Bond, Mark, *Stony Brook University*; **Demian Chapman**, *Stony Brook University*; **Elizabeth Babcock**, *Rosenstiel School of Marine and Atmospheric Sciences*

Differences in elasmobranch assemblages between marine reserves and fished reefs on the Mesoamerican Barrier Reef

Our previous research has shown that Caribbean reef sharks are significantly more abundant inside marine reserves when compared to similar fished reefs on the Mesoamerican Barrier Reef. We now pose the question: what effect have marine reserves had on the abundance of other elasmobranchs, such

as batoids? Rays are not commercially targeted in Belize therefore our null hypothesis is that reserves have no effect on the relative abundance of these species. Baited Remote Underwater Video (BRUV) surveys were conducted on the forereef at four sites along the barrier reef in Belize, at two reserves and two fished reefs (N=50 per site). Of the combined 100 deployments at the reserve sites 13 batoids were observed compared to 58 observed at the fished sites. We constructed a generalized linear model (GLM) to explain the presence of batoids on BRUVs, which included "marine reserve", "location nested within reserve", habitat characteristics and environmental variables as potential factors. The GLM found that the factor "marine reserve" had a significant negative effect on the presence of batoids, while none of the habitat or environmental variables had a significant influence. We discuss ongoing research aimed at explaining this pattern, including potential mechanisms such as (1) mesopredator release due to reduced predation from reef sharks, (2) altered batoid behavior due to intimidation by sharks inside reserves and (3) increased competition for prey inside reserves.

Boone, Michelle, *Miami University of Ohio*; **Jason Rohr**, *University of South Florida*; **Catherine Propper**, *Northern Arizona University*; **Christine Bishop**, *Environment Canada*

The Influence of Industry: How Conflicts of Interest Compromise Pesticide Regulation

Human and environmental health relies partly on federal agencies that set regulatory standards for pesticide use and registration. Decisions based on the best available data benefits regulators, the public, and natural world. However, current assessments for registering or reregistration pesticides can eliminate much to most of the research in the published, peer-reviewed literature allowing regulatory decisions to be based on only a few studies that are often conducted or directly funded by the pesticide manufacturer who is unambiguously impacted by the conclusions reached in these studies, thereby representing a clear case of conflict of interest. Our objectives are to 1) highlight how conflicts of interest can compromise regulation using the herbicide atrazine as a case study, particularly given its effects reported in the literature for amphibians and other vertebrates; 2) compare conclusions reached by regulators or stake holders versus independent scientists; 3) examine why studies are included or excluded in regulatory decision-making; and 4) offer recommendations for improving the regulatory process. We all have an interest in ensuring that regulatory decisions are based on all available research with sound experimental designs lacking conflicts of interest. Although current practices fall short in the US and other countries, a regulatory process that removes conflicts of interest is both plausible and

essential to protect and manage human and environmental health.

Borker, Abraham, *University of California - Santa Cruz*; **Matthew McKown**, *McKown*; **Donald Croll**, *University of California - Santa Cruz*; **Portia Halbert**, *California State Park*; **Bernie Tershy**, *University of California - Santa Cruz*; **Cody Sullivan**, *University of California - Santa Cruz*

Automated acoustic sensors for inland monitoring of endangered Marbled Murrelets (*Brachyramphus marmoratus*)

For rare and elusive wildlife, the scale of monitoring efforts is often limited by expensive methodologies, sampling inconsistencies and the logistics of large spatial and temporal scales. Detection of rare events at scale is particularly limited by variable detection biases and limited sampling efforts. For vocalizing wildlife, automated acoustic sensors are one way to greatly expand sampling effort and reduce biases. We illustrate the limits and costs of current approaches to monitor the endangered Marbled Murrelet (*Brachyramphus marmoratus*), comparing traditional human audio-visual surveys with automated acoustic sensors combined with a semi-automated analysis approach. We selected seven long term monitoring sites in the Santa Cruz Mountains, California, where Marbled Murrelets are at low abundance. Automated sensors and analysis on average detected more murrelets at each site ($t(df=6)=1.34$, $p=0.11$), and measured relative activity at similar levels ($R^2=0.85$, $p=$

Borkhataria, Rena, *Everglades Research and Education Center, University of Florida*; **Peter Frederick**, *University of Florida*; **Colin Saunders**; **James Beerens**, *Florida Atlantic University*; **Jaime Collazo**, *North Carolina Cooperative Fish and Wildlife Research Unit*; **Lawrence Bryan**, *Savannah River Ecological Laboratory*

Modeling the influence of Everglades hydrology on population dynamics of endangered wood storks in the southeastern U.S.

The southeastern U.S. population of wood storks (*Mycteria americana*) was declared endangered in 1984 following declines in the Florida Everglades. Their range and population have since increased and a change in status from endangered to threatened is likely. Despite increases elsewhere, wood storks still do poorly in the Everglades. We combined a habitat suitability index (HSI) with a spatially explicit population model to explore how Everglades restoration may influence Everglades nesting and population dynamics for the larger population. Using satellite telemetry data from 2004-2011, we compared vegetation and daily hydrological characteristics at used and random locations in

the Everglades using a proportional hazards model. Resulting HSI values were used as a covariate in a multistate state model to evaluate the probability of birds leaving the Everglades. HSI-dependent transition probabilities were then incorporated into a demographic model to explore how increasing habitat quality in the Everglades influenced the persistence of birds during the nesting season. Preliminary results indicate that persistence increased with habitat suitability. Increasing HSI by 50% more than doubled the number of chicks produced in the Everglades and increased the size of the SE US population by roughly 8%, indicating that despite shifts in nesting away from the Everglades over the past 40 years, restoration should have positive effects on the population as a whole.

Borneman, Tracy, *North Carolina Cooperative Fish and Wildlife Research Unit, NC State University*; **Theodore Simons**, *USGS, NC Cooperative Fish and Wildlife Research Unit, NC State University*

Effects of human activity on American Oystercatchers (*Haematopus palliatus*) breeding at Cape Lookout National Seashore, North Carolina

American Oystercatchers, a species whose population is of conservation and management concern, nest on coastal beaches where they are subject to anthropogenic disturbance. Therefore, we assessed the effects of a variety of human activities occurring at Cape Lookout National Seashore, North Carolina on nesting American Oystercatchers by looking for changes in behavior, physiology, and reproductive success. We expanded on-going monitoring of oystercatchers at Cape Lookout by supplementing visual observations with continuous video, audio, and heart rate recording at nests. Oystercatchers were equally likely to be on their nests before and during aircraft fly-overs, but were on their nests less often during off-road vehicle and pedestrian events than before those events occurred. Low-altitude military flights were the only human activity to significantly increase heart rate of incubating oystercatchers. Reproductive success during study seasons was comparable to or higher than past seasons. The number of daily off-road vehicle events was correlated to decreased daily survival rates and success of nests. Current levels of aircraft overflights are unlikely to affect nesting success during the incubation period. In contrast, off-road vehicles appear to affect both the incubation behavior and nest hatching success of American Oystercatchers.

Bossart, Janice, *Southeastern Louisiana University*; **Josephine Antwi**, *Texas A & M University*

Small sacred forest groves retain the preponderance of biodiversity found in much larger forest reserves

Habitat fragmentation is one of the most pervasive threats to global biodiversity because it isolates populations into small, discrete habitat patches, which promotes loss of species and

genetic diversity via local population extinctions, inbreeding, and genetic drift. We conducted a year-long systematic survey of the fruit-feeding butterfly communities of two large forest reserves and five small sacred forest groves in Ghana, West Africa. Few ecosystems of the world are considered as critically imperiled, or fragmented as these Upper Guinean forests. Overall we found species richness to be higher in the larger forest reserves. Nonetheless, in all but one case, the small sacred groves retained 84-93% of this species diversity despite accounting for less than 1-10% of the total area of the forest reserves. We also compared the patterns of mtDNA CO1 variation of three representative focal butterfly species that differ with respect to their predicted dispersibilities, e.g. based on their size, habitat specificity, and flight patterns. Patterns of genetic differentiation across species were broadly coincident with our predicted hierarchy of relative species dispersibility. But as before, there was limited evidence of biodiversity (genetic) erosion from the sacred groves, even of the species most impacted by fragmentation. These small community-based, indigenous conservation reserves are clearly currently functioning as valuable repositories of genetic and species diversity.

Boudreaux, Karol, *USAID*

Challenges and opportunities for land tenure: agriculture, food security and gender

Not Provided

Bowne, David, *Elizabethtown College*; **Candace Grand Pre**, *Franklin and Marshall College*; **Jeffrey Hartranft**, *PA Department of Environmental Protection*; **William Hilgartner**, *Johns Hopkins University & Friends School of Baltimore*; **Dorothy Merritts**, *Franklin and Marshall College*; **Aleah Miller**, *Elizabethtown College*; **Michael Rahnis**, *Franklin and Marshall College*; **Robert Walter**, *Franklin and Marshall College*

Is bog turtle (*Glyptemys muhlenbergii*) habitat buried under 250 year-old sediment? Re-evaluating conventional wisdom concerning habitat loss

The bog turtle (*Glyptemys muhlenbergii*) is federally listed as threatened under the United States Endangered Species Act and as critically endangered on the IUCN Red List. The primary cause of its endangerment is usually cited as habitat loss due to wetland draining. We argue that this mechanism of habitat loss is not correct. Based on recent re-evaluation of valley bottom geomorphology in the Piedmont of eastern North America, we propose that bog turtle habitat is virtually absent in the modern environment due to the construction of milldams during the 17th to 19th centuries. These dams flooded, and then buried with slack-water sediment, widespread Holocene valley bottom wet meadows, which

likely were ideal bog turtle habitat. As these milldams breach, deeply incised single-threaded channels evolve. This stream morphology is the most common fluvial system across the mid-Atlantic Piedmont today, but does not create suitable bog turtle habitat. Historical records document the ubiquitous presence of milldams within the historic range of bog turtles. The clear mechanism by which these extremely common dams could impact bog turtle habitat is compelling evidence to re-evaluate their habitat loss. Realization that bog turtle habitat was buried not drained may yield a more successful approach for the restoration of its habitat. Correct identification of the causes of a species' habitat loss and consequent population decline is essential to plan appropriate conservation action.

Boynton, Walt, *Chesapeake Biological Lab*; **C.L.S. Hodgkins**, ; **C. O'Leary**, ; **E.M. Bailey**, ; **A.R. Bayard**, ; **L.A. Wainger**,

Multi-decade responses of a tidal creek system to nutrient load reductions: Mattawoman Creek, Maryland USA

We synthesized diverse monitoring and modeling data for Mattawoman Creek, Maryland, to examine responses of this tidal freshwater tributary of the Potomac River estuary to a sharp reduction in nutrient loading. Oligotrophication of these systems is not well understood; questions on recovery pathways, threshold responses, and lag times remain. Prior to load reductions Mattawoman Creek was eutrophic with poor water clarity (Secchi depth <0.5 m), no submerged aquatic vegetation (SAV) and large algal stocks (50-100 $\mu\text{g l}^{-1}$ chlorophyll-a). A substantial modification to a waste water treatment plant reduced annual average nitrogen (N) loads from 30 g N m⁻² yr⁻¹ to 12 g N m⁻² yr⁻¹ and phosphorus (P) loads from 3.7 g P m⁻² yr⁻¹ to 1.6 g P m⁻² yr⁻¹. Following nutrient load reduction, NO₂ + NO₃, and chlorophyll-a decreased and Secchi depth and SAV coverage and density increased with variable initial response lag times. A N budget indicated: diffuse sources now dominate N inputs, estimates of long-term burial and denitrification were not large enough to balance the budget, sediment recycling of NH₄ was the single largest term in the budget, SAV uptake of N from sediments and water provided a seasonal N sink, and the creek system acts as a N sink for imported Potomac River nitrogen. Finally, strong relationships were found between N loading and algal biomass and between algal biomass and water clarity, key water quality variables used as indices of restoration in Chesapeake Bay.

Bradshaw, Corey, *The University of Adelaide*; **Thomas Prowse**, *The University of Adelaide*; **Barry Brook**, *The University of Adelaide*; **Christopher Johnson**, *University of Tasmania*

Human impact and carnivore extinction in the disrupted ecosystem of prehistoric Australia: the dingo absolved

The extinctions of megafauna in human prehistory are generally ascribed either to overharvesting or intense climate shifts. In contrast, the disappearance of two medium-sized marsupial carnivores, the thylacine and devil, from mainland Australia during the late Holocene, has been attributed to the human-assisted invasion of a competing predator, the dingo. This popular wisdom potentially neglects the simultaneous effects of human 'intensification' (population growth and technological advances) and climate change (particularly, increased ENSO variability). We developed a dynamic model system capable of simulating the complex interactions between the main predators (humans, thylacines, devils, dingoes), their marsupial prey (macropods), human population growth and climate change in late-Holocene Australia. Using detailed scenario testing and sensitivity analysis, we identify human intensification as the most probable extinction driver. We conclude that the prehistoric impact of humans on Australian mammals was not limited to the late Pleistocene (i.e., megafaunal extinctions) but extended into the Holocene.

Breckheimer, Ian, *University of Washington*; **Meade Krosby**, *University of Washington*; **Peter Singleton**, *USDA Forest Service Pacific Northwest Research Station*; **John Pierce**, *Washington Department of Fish and Wildlife*; **Brad McRae**, *The Nature Conservancy*; **Joanne Schuett-Hames**, *Washington Wildlife Habitat Connectivity Working Group*; **Sonia Hall**, *The Nature Conservancy*; **Brian Cosentino**, *Washington Department of Fish and Wildlife*; **Karl Halupka**, *US Fish and Wildlife Service*; **William Gaines**, *Washington Conservation Science Institute*; **Robert Long**, *Western Transportation Institute, Montana State University*

Do connectivity models based on "naturalness" capture important habitat linkages for focal species? A case-study from the Pacific Northwest

Conservation planners typically use one of two strategies to reduce biological complexity in large-scale analyses: (1) limiting their taxonomic scope to a small number of species (the "focal species" or FS approach) and (2) evaluating conservation value based on the degree of human modification (the "landscape integrity", or LI approach). Currently we have little basis for determining which approach is most appropriate, particularly for assessments of habitat connectivity in data-poor environments. Here we use information from a data-rich region, the Pacific Northwest of North America, to evaluate both approaches to identifying lands important for vertebrate habitat connectivity. We compared expert-based least-cost-corridor dispersal models for 23 focal vertebrate species to a set of generic least-cost-corridor models based on human modification of the landscape. We found substantial spatial agreement between dispersal corridors identified using the FS and LI approaches

but also key differences, especially in agricultural landscapes. We also identify some of the common traits of focal species that are well- and poorly represented by the LI approach. We contend that a combination of FS and LI approaches can overcome some of the pitfalls of using either in isolation.

Breitschwerdt, Edward, *North Carolina State University*

The changing ecology of bartonellosis

Bartonella species comprise a genus of Gram-negative, fastidious, intracellular bacteria that are being increasingly implicated in association with a spectrum of disease manifestations in animals and human patients. Prior to 1990, bartonellosis was a disease, caused by *Bartonella bacilliformis* that was geographically limited to the Peruvian Andes. In North America, infection with *Bartonella quintana* and *Bartonella henselae* was first recognized in 1990 in immunocompromised individuals infected with the AIDS virus. Subsequently, over thirty *Bartonella* species and sub-species have been characterized and named. Globally, these vector-borne (biting flies, fleas, keds, lice, sandflies and ticks) bacteria reside in diverse ecological niches throughout the world, where they cause persistent intravascular infection in various mammalian reservoir host species (cats, cattle, coyotes, deer, and numerous rodents and other small mammals) and opportunistic infections in non-reservoir hosts (dogs, dolphins, human beings, whales and others). Bartonellosis, now caused by at least 17 *Bartonella* sp., is a global emerging infectious disease of animals and humans that can be acquired throughout much of the inhabited planet. From an ecological perspective, numerous domestic and wild animals have co-evolved with various blood-borne *Bartonella* sp. and with the respective vectors that transmit these bacteria among animal populations throughout the world. Inadvertent human infection can result in a persistent bacteremia, potentially lasting decades. People with frequent vector exposure and extensive animal contact (transmission by bites and scratches) are at increased risk of acquiring bartonellosis.

Bridges, Andrew, *Institute for Wildlife Studies*; **Daniel Biteman**, *Institute for Wildlife Studies*; **David Garcelon**, *Institute for Wildlife Studies*; **Melissa Booker**, *United States Navy*; **Jessica Sanchez**, *Institute for Wildlife Studies*

Know thy enemy: Research towards understanding an invasive carnivore population and mitigating its impacts on threatened island endemics

Because invasive species pose tangible and often immediate threats to native biota, we as conservation biologists may focus on control or eradication without understanding their ecology or functional roles in their adopted ecosystems. On San Clemente Island, California, feral cat (*Felis catus*) control

has occurred for >20 years, but only recently have we formally investigated their ecology. A long-term dietary analysis revealed a strong preference for native rodents, transition to native reptilian and avian prey when rodents decline, and substantial cumulative impacts on the vertebrate prey base. We used GPS collars to determine home-range, habitat use, overlap with native species, and to evaluate population control efficacy. Cementum annuli age estimates and population reconstruction analyses revealed a relatively stable population with some individuals living >15 years. In addition to direct effects through predation, we found cats likely compete for resources in both time and space with endemic island foxes (*Urocyon littoralis*) and endangered San Clemente loggerhead shrikes (*Lanius ludovicianus mearnsi*). They are more robust to removal techniques than was previously thought, and individuals may persist for many years despite the seemingly harsh environment and intensive control program. Our findings provide insight into interactions with native species, allow us to evaluate the feasibility and possible cascade effects of eradication, and inform future conservation efforts.

Brooks, Jeremy, *The Ohio State University*; **Kerry Waylen**, *James Hutton Institute*

Exploring Synergies and Tradeoffs in Outcomes of Community-Based Conservation Projects

Community-based conservation (CBC) projects have been heavily promoted since the 1980s but they have been neither consistently successful nor free of controversy. One area of controversy is whether and in which contexts CBC produces win-win solutions or trade-offs among multiple desired outcomes. The prevailing opinion is that synergies are rare. Since the goal of CBC is to provide ecological, economic, and social benefits, it is important to understand when CBC succeeds in producing synergies. While numerous studies have explored the factors associated with individual outcomes (ecological success), far fewer have examined the factors associated with synergies between outcomes (ecological and economic success). Here, we use a comparative database of 136 CBC projects in 40 countries identified by systematic review to evaluate synergies in pairs of outcomes from four domains (attitudinal, behavioral, ecological, economic). We find that synergies are most common between behavioral and ecological outcomes and economic and ecological outcomes. Using logistic regression we also suggest that factors like capacity building, local participation, and social capital are associated with synergies between different pairs of outcomes. These results could help improve the design of CBC projects to increase the likelihood of synergies, but we caution scholars and practitioners to be aware of the spatial and temporal dynamics of synergies and trade-offs that are not captured in our study.

Brotcorne, Fany, *University of Liège*; **Nengah Wandia**, *Universitas Udayana*; **Roseline Beudels-Jamar**, *Royal Belgian Institute of Natural Sciences*; **Marie-Claude Huynen**, *University of Liège*

Demographic trends and Streptococcus outbreaks in a synanthropic population of macaques (*Macaca fascicularis*), Bali (Indonesia)

The sympatric relationship between humans and primates is a contemporary widespread phenomenon. Several primate species are capable for exploiting human-modified habitats in association with people, but the most successful species in South-east Asia is probably the long-tailed macaque (*M. fascicularis*). The low predation pressures in zones of interface and the inclusion of human food in macaques' diet can lead to local overpopulations. On the other hand, the risk of epidemic disease is simultaneously increased by the high primate density and the proximity with human vectors. Data presented here represent 25 years-population dynamics of a long term commensal-living population of macaques in Ubud Monkey Forest (Indonesia). This population experienced a dramatic growth with an 11% annual increase rate. In June 2012, we counted 615 individuals divided in 5 groups with a very high density of 61 macaques per hectare. However, two Streptococcus outbreaks have also been reported over the same 25 years period, temporarily limiting the steep positive demographic trend of this population. The last epidemic event in July 2012 resulted in a 14% mortality affecting 3 out of 5 groups of the population. Besides the anthropic factors promoting population growth, epidemic diseases play a significant role in shaping the dynamics of this synanthropic population and could have important implications in the future both in terms of local management and local conservation status.

Browne, David, *Canadian Wildlife Federation*; **Matt Carlson**, *ALCES Group*

Conservation planning in Canada's western boreal forest: Modeling and communicating cumulative effects of large scale resource development

Planning for regional wildlife conservation in an area of intensive industrial development requires a strategic understanding of ecological and socioeconomic trade-offs associated with alternative land use options and effective methods for engaging the public in large-scale land use decisions. A stock and flow, spatially stratified model (ALCES) was used to conduct a scenario analysis of cumulative effects for a 693,345 km² region in the Boreal and Taiga Plains ecozones of western Canada. This area contains the world's second largest oil deposit, nationally significant conventional and shale gas deposits, and an annual allowable timber harvest of over 26 million m³. The project

assessed the long-term (50 year) implications of a range of land use scenarios to ecological and socioeconomic indicators. Scenarios assessed the influence of development rate and conservation strategies on indicators such as total anthropogenic footprint, moose habitat suitability, fisher habitat suitability, native fish population integrity, employment by resource sector, and gross domestic product. Results indicate both positive and negative impacts on wildlife from habitat alteration and loss, pollution, and human population increase and demonstrate the types of trade-offs that would be required to achieve wildlife conservation in the region. An online education tool is being developed to translate model results into a mechanism for engaging students and the public in conservation planning.

Bryer, Mark, *The Nature Conservancy*; **Paula Jasinski**, *Chesapeake Environmental Communications, Inc.*

Getting more for our money: integrating habitat restoration priorities in Chesapeake Bay

Tidal and sub-tidal habitats in Chesapeake Bay provide numerous benefits to people and nature, including fisheries production, water quality improvement, and shoreline protection. Yet, collective efforts that maximize the benefits from restoration of critical habitats are lacking. The National Oceanic and Atmospheric Administration and The Nature Conservancy, in partnership with the states of Maryland and Virginia and other federal agencies, are undertaking an effort to identify the most important habitats for protection and restoration in the waters of Chesapeake Bay. We are focusing on distinct habitat types - including benthic habitats, tidal wetlands, shorelines, and oyster reefs - and are using existing and novel GIS analyses, statistical analysis, and expert input to develop a common spatial framework and clear prioritization of protection and restoration projects throughout the Bay. This integration will help identify areas of overlap, allowing multiple restoration and conservation efforts to be consolidated, and provide larger ecological benefits for the same investment. In addition, it will identify areas of the Bay where permit reviews may be more or less complex due to the distribution of Essential Fish Habitat.

Burgess, Emma, *University of Queensland*; **Martine Maron**, *University of Queensland*; **Patrick Moss**, *University of Queensland*; **Murray Haseler**, *Bush Heritage Australia*

Pyrodiversity versus biodiversity: the influence of mosaic burning on bird species richness across multiple spatial scales

Wildfires and altered fire regimes continue to threaten global biodiversity. This has stimulated much research into the ecological impacts of fire and effective means of burning to

maintain biodiversity focused on the broadly accepted paradigm that 'pyrodiversity begets biodiversity'. Much work has been carried out at the alpha diversity level in relation to the fire event. Uncertainty, however, remains regarding the relationship between beta diversity and the fire regime mosaic. Controlled burning for biodiversity conservation thus remains a controversial topic. We assessed the alpha and beta diversity of woody plants and birds in the sub-tropical woodlands of Australia. A systematic, nested hierarchical approach to sampling has been adopted in 28 study landscapes, selected to represent gradients in fire history. Preliminary results suggest a significant relationship between species richness of birds and the fire history at the site or alpha diversity level. Species richness at the landscape or beta diversity level was not significantly influenced by fire-mediated heterogeneity. Increasing habitat heterogeneity was associated with landscape level species richness of birds. Further analysis will allow insight into the relationship between fire-mediated heterogeneity and bird community composition. These findings will provide an understanding of the operational minimum level of spatial diversity, at appropriate spatial resolution for effective ecological fire management.

Burns, Catherine, *San Francisco Bay Bird Observatory*; **Vanessa Tobias**, *University of California, Davis*; **Cheryl Strong**, *U.S. Fish & Wildlife Service*; **John Takekawa**, *USGS Western Ecological Research Center*; **Emilio Laca**, *University of California, Davis*; **Christina Donehower**, *San Francisco Bay Bird Observatory*; **Josh Scullen**, *San Francisco Bay Bird Observatory*

Conserving San Francisco Bay's waterbirds: three decades in a rapidly changing landscape

The San Francisco Bay estuary provides critical habitat for over one million waterbirds annually. Although the landscape has been altered for well over a century by increasing levels of urbanization, and by the historic establishment of evaporator ponds for salt production, it remains heavily used by waterbirds. The area also hosts the west coast's largest tidal wetlands restoration project; the South Bay Salt Pond Restoration Project is implementing a plan to convert thousands of acres of salt ponds into tidal and managed wetland habitat. While the restoration to tidal marsh will increase habitat for many species, it also will reduce the overall habitat available for waterbirds. Through adaptive management, the Project is committed to maintaining historic levels of waterbirds in this landscape. To inform these efforts, the USFWS, San Francisco Bay Bird Observatory, USGS and UC Davis have partnered to assess changes in bird population levels and community composition for nine waterbird guilds. Data collected during the early 1980s were compared with current data to identify significant changes that have occurred over 30 years. We identified significant increases in populations for some guilds, such as gulls, and

declines at all or some locations for other guilds such as divers, terns and grebes. We provide recommendations for the Project's development and for future adaptive management to ensure abundant and diverse waterbird communities.

Buttrick, Steve, *The Nature Conservancy*

Conserving the stage: using geophysical units as coarse-filter targets in conservation planning for climate change

In a project funded by the Doris Duke Charitable Foundation, The Nature Conservancy is evaluating the use of land facets to inform our traditional biodiversity based conservation priorities over 4 ecoregions (66.7M ha.) in the Northwest. We initiated this work asking: Which geophysical factors and what categorical breaks within factors best describe the distribution of ecological systems in the Pacific Northwest? Does the category selection influence how well existing biodiversity-based portfolios capture the diversity of land facets? Starting with the land facet classifications created by Schloss et al. we evaluated 9 geology vs. 9 soil categories; 3 vs. 4 slope breaks vs. a 5 category combination of slope and aspect; and 10 300m vs. 5 600m elevation breaks. Soil outperformed geology. The 3 slope and 2 elevation combinations performed equally well. A consideration when creating land facets using different classes is the number of potential facets. 3 slope breaks x 5 600m elevation breaks x 9 soil categories creates 135 possible land facets. 5 slope/aspect breaks x 10 300m elevation breaks x 9 soil categories defines 450 land facets. To evaluate whether the choice of slope and elevation breaks influences the ability of a biodiversity based portfolio to capture land facet diversity we created land facet maps using multiple combinations of slope, elevation and soil and looked at how well land facets are captured within the Conservancy's biodiversity based ecoregion portfolios.

Calabrese, Justin, *Smithsonian Conservation Biology Institute*; **Chris Fleming**, *Smithsonian Conservation Biology Institute*; **Thomas Mueller**, *University of Maryland*; **Kirk Olson**, *Smithsonian Conservation Biology Institute*; **Peter Leimgruber**, *Smithsonian Conservation Biology Institute*; **William Fagan**, *University of Maryland*

A novel semi-variance approach to extracting multiple movement modes from animal relocation data

Understanding the factors governing animal movement has long been a fundamental problem in ecology and conservation biology, and technological advances make it possible to explore this problem in ever more detail. Relocation data often consist of a complex mixture of different movement behaviors, and decomposing this mix into its component parts is a key challenge in movement ecology. Composite random walk models have been the main tools employed in analyses of multiple movement behaviors

or "modes". They can, however, be difficult to fit to data, are often parameter rich, and they require that the timescale(s) governing the movement process is (are) reasonably close to the data sampling rate. Here, we show how the semi-variance function (SVF) of a stochastic movement process offers both an alternative approach to identifying multiple movement modes, and a solution to the sampling rate problem. We describe how a family of continuous-space, continuous-time stochastic movement models, representing a wide range of behaviors, can be expressed in terms of their SVFs. We then connect these SVFs to relocation data via variogram regression and compare them using standard model selection techniques. We illustrate our approach using Mongolian gazelle relocation data, and show that gazelle movement is characterized by a slow, ballistic foraging mode with a 10 hour timescale, a fast, diffusive patch search mode with a 2 month timescale, and an asymptotic diffusion mode on longer timescales.

Campbell, Donna, *University of Central Florida*; **Denise Delorme**, *University of Central Florida*; **Linda Walters**, *University of Central Florida*

Ecosystem Protection in the Indian River Lagoon Using a Community-Based Social Marketing Plan

The Indian River Lagoon (IRL) system on the east coast of central Florida, one of the most biologically diverse estuaries in North America, is being impacted by growing urbanization and human behaviors. In particular, recreational motorized boating activity is threatening the habitat and its biodiversity. Keystone species (oysters, seagrasses, marsh grasses, and mangroves) in the area have been negatively impacted by boat propeller scars, boat strikes, eroded shorelines, and boat wake induced dead oyster reefs. Through collaboration with social scientists, we hope that a community-based social marketing (CBSM) program with innovative approaches to increase voluntary Ecologically Responsible Recreational Boating (ERRB) will help protect these habitats. Eco-sensitive zones in Mosquito Lagoon (northernmost IRL) warranting better protection have been identified using GIS and field reconnaissance, and will be used to create a smart phone navigational application to assist recreational boaters in identifying these zones. We are recording boating activity and shoreline erosion at highly impacted and ecologically-stable control sites before and after the CBSM program. We will analyze any changes in boater activity, erosion, reef death, or prop scarring following the CBSM program to determine its effectiveness in protecting the estuary from negative human impacts.

Canessa, Stefano, *ARC Centre of Excellence for Environmental Decisions*; **David Hunter**, *New South Wales Office of Environment and Heritage*; **Michael McFadden**,

Herpetofauna Division, Taronga Zoo; **Gerry Marantelli**, *Amphibian Research Centre*; **Michael McCarthy**, *ARC Centre of Excellence for Environmental Decisions*

Optimal release strategies for reintroductions: cost-effective wild and captive populations

Within reintroduction programs for endangered species, releases of different life stages can influence both management costs and program success. We assessed the trade-offs between releasing eggs or sub-adults in the ongoing captive breeding program for the critically endangered Southern Corroboree frog *Pseudophryne corroboree* in Australia. We used population models and numerical optimization to identify the release strategies that would maximize the wild population whilst meeting budget constraints and accounting for parametric uncertainty and demographic stochasticity. We measured success as the number of individuals in the wild after ten years. We compared optimal strategies with fixed plans in which only either eggs or sub-adults were released at constant rates. The optimal strategies identified were predicted to provide outcomes similar to the best fixed plans for sub-adult releases, but were up to 75% cheaper, and to yield up to 500% more wild adults than the best fixed plans for egg releases for only a 72% average increase in cost. Releasing early life stages might represent a viable option for risk-seeking managers with strict budget constraints, whereas releasing later stages may maximize the probability of establishing a viable population but increase management costs. Simple optimization of release strategies can help managers address this trade-off, improving outcomes, decreasing costs and explicitly accounting for uncertainty and constraints.

Carlson, Anne, *The Wilderness Society*; **Travis Belote**, *The Wilderness Society*

How is restoration different in an era of shifting climate? Lessons learned from a large-landscape, collaborative project in Montana.

Ecological restoration (defined as the return of an ecosystem to its former or historic condition) presents many significant challenges to managers and conservation practitioners as the climate continues to shift and change across the globe, creating a need for substantial revision of working conceptual models, planning, strategies, tools, datasets, and monitoring paradigms if these projects are to succeed. Here, we review: (a) the types of challenges that managers and stakeholders are likely to face as they endeavor to address climate change and restoration simultaneously in large landscapes, and (b) examples of the ways in which integrated, multi-disciplinary approaches to conservation and management across geospatial scales can provide innovative solutions to these challenges. Our discussion stems from lessons learned during the first three years of work on a ten-year, collaborative restoration project across 1.5 million acres of the Crown of the

Continent in Montana. We have found that: (a) efforts to incorporate climate change principles, datasets, and tools into restoration projects become most feasible when focusing on specific restoration priorities and objectives within a project; (b) incorporation of climate change scenarios into existing management tools is critically important in facilitating planning for restoration treatments; and (c) significant changes to all aspects of monitoring programs are necessary to create information feedback loops for managers.

Carretero-Pinzon, Xyomara, *Colombian Primatological Association*; **Thomas Defler**, *Universidad Nacional de Colombia*; **Manuel Ruiz-Garcia**, *Pontificia Universidad Javeriana*

How does the Colombian squirrel monkey cope with habitat fragmentation?

Fragmentation and habitat loss are the main threats of primates worldwide. Primate species with restricted diet and/or higher spatial requirements have more risk of local extinction due to fragmentation and habitat loss. The Colombian squirrel monkey (*Saimiri sciureus albigena*) is a small endemic primate species that is endangered due to its high space requirements and small distribution area. Home range and diet data for one group of this species was collected using slow scan sampling in a fragmented area in Colombian Llanos. Home range of squirrel monkeys in fragmented areas was less than half of the reported home ranges in continuous areas. However, their diet was similar when compared to data from continuous areas. Fence-rows (tree-lines used to separate adjoining pastures) connecting fragments were being used as part of their home range and as a food resource in months of less fruit productivity of the forest fragments. Therefore, these corridors were seen to be essential for the species survival as they help cope with the high spatial requirements in fragmented landscapes.

Carter, Eleanor, *RARE*

Building capacity and constituency to achieve conservation results: Protecting near-shore fisheries for people and biodiversity in the Philippines and Indonesia

Fishing communities throughout the world now face the imminent threat of fisheries collapse. Although marine protected areas have demonstrated positive biological impacts, the acceptance, adherence, and enforcement of these areas are a socio-economic challenge. Rare is tackling this challenge by training local leaders and partners to use social marketing coupled with a strong conservation research framework in near-shore fishing communities across the Philippines and Indonesia. The impact of each campaign on the knowledge, attitudes, and support for marine conservation as well as key metrics associated with behavior change, enforcement, and

reef health are monitored before, during, and after each campaign. Preliminary analysis of sites in the Philippines found 7/12 campaign sites with significant changes in knowledge, attitudes, behavior, and enforcement along with a mean 38.8% increase in fish biomass. Results from Indonesia demonstrate similar progress with mean increases in knowledge and attitudes greater than 20 percentage points post-campaign, significant changes in behavior and biophysical response at 5/10 sites. This analysis provides support for the role of community leaders and behavior change in developing appropriate fisheries management highlights the critical intersection of science, communication, and management needed for effective conservation.

Cattarino, Lorenzo, *Griffith University*

Systematic planning beyond conservation: a multi-objective, multi-action framework for freshwater biodiversity conservation.

Despite their high biodiversity value and role in providing important services to different stakeholders, freshwaters are among the most threatened and modified environments on the planet, and require immediate conservation action. As threats to freshwater systems are diverse and spatially heterogeneous - while resources for conservation are finite - it is critical to identify priority management actions, as well as where these should be implemented, especially dealing with financial and socio-economic constraints. Unfortunately, traditional conservation planning does not identify the specific actions required to meet a particular conservation target, and rarely considers the cost and socio-economic impacts of multiple actions. We developed a framework for prioritizing different management actions, while minimizing costs and socio-economic impacts. We implemented the framework by combining distribution models for a suite of freshwater dependent species (fishes, turtles and water birds) with optimization techniques based on the functional response of species to different management actions. We applied the prototype framework within the Daly River catchment, in the Northern Territory, Australia. The framework allows the spatial allocation of different management actions, by including both ecological and socio-economic objectives. It therefore represents a novel approach that will greatly improve the effectiveness of freshwater biodiversity management and conservation.

Cawthorn, Michelle, *Georgia Southern University*; **Eleanor Sterling**, *Center for Biodiversity and Conservation*; **Ana Luz Porzecanski**, *Center for Biodiversity and Conservation*; **Adriana Bravo**, *Center for Biodiversity and Conservation*; **Nora Bynum**, *Nicholas School for the Environment*; **Laurie Freeman**, *Fulton-Montgomery Community College*; **Stuart Ketcham**, *Division of Science and Mathematics*; **Tim Leslie**,

Long Island University; John Mull, Weber State University; Theresa Theodose, University of Southern Maine; Donna Vogler, State University of New York at Oneonta

Student Interpretation of Conservation Data: Does their Reach Exceed their Grasp?

This study examined how well undergraduate students can develop data analysis skills relevant to conservation biology over the course of a single semester. Students completed two conservation data analysis exercises, pre and post self-assessments of confidence in data analysis skills, a classroom discussion, and pre/post content assessments. Between the first and second exercises, a data analysis teaching intervention was administered in all classes. Instructional and assessment materials were created and validated by 24 conservation educators led by the Center for Biodiversity and Conservation at AMNH. Results from one semester (100+ students) show that students scored significantly higher on post-content assessments for both exercises. We also found significant increases in student self-assessment of confidence in data analysis skills. However, when evaluated at the level of different skill dimensions, students' ability to represent and interpret data improved between exercises, but ability to complete calculations and draw conclusions was significantly worse on the second exercise. While our study demonstrates that direct instruction in data analysis does improve student performance overall, there is a disconnect between student self-assessment of their data analysis skills and their actual ability. This indicates that some aspects of data analysis may require different teaching intervention approaches.

Cervený, Kassandra, *Coastal States Organization*

Wishing for Sessile Whales - Policy Considerations for Real World Marine Mammal Conservation

When coastal and marine issues cross geo-political boundaries, effective management relies on conservation tools that are also multi-sector and cross-jurisdictional. As the conservation efforts for wide-ranging species are fundamentally different than that of other marine resources, so must the management efforts. Whether working across local, state and/or federal governments, inclusion of non-traditional conservation sectors and interests will only strengthen the success of management efforts. Multi-stakeholder involvement can bring disparate, and even disinterested, constituencies to the table to address management needs to find a compromise that meets the needs of all interested resource users while protecting the actual marine resource (e.g. marine mammals). Recent regional collaborations led by state governors specifically to address cross-jurisdictional coastal and marine issues provide a convening authority to bring stakeholders and multiple levels of government together. This ultimately results in benefitting both the economy and the resource base upon which it is built. These partnerships demonstrate the efficacy and

efficiency of collaboration between stakeholders and federal, state, local and tribal governments.

Chan, Fang-Tse, *Endemic Species Research Institute*,

Wildlife Release and Life Education Programs of Wildlife First Aid Station

The Wildlife First Aid Station started to cooperate with the Bliss and Wisdom Buddhist Foundation in wildlife release program since October 2011. Before releasing the fully recovered wildlife, votaries participated in the interpretation of wildlife rescue and rehabilitation, the rescue story, and scientific information about the animal. We also provided a life education program for the votaries and their families. Through the end of 2012, we held 66 activities in which 4174 persons participated. According to the feedback received, they learned the correct way of respecting life and how our station treated wildlife.

Charles, Kerry, *Center for Biodiversity & Restoration Ecology, Victoria University of Wellington; Wayne Linklater, Center for Biodiversity & Restoration Ecology, Victoria University of Wellington*

Tolerating, and planting for birds: Avian-human conflict in New Zealand

Human-wildlife conflicts are increasing worldwide yet their management is critical to maintain public support for conservation, particularly in urban areas where residents have limited opportunity for positive wildlife interactions. Since more negative attitudes to wildlife may lead to reduced support for biodiversity conservation, it is important to understand the relationship between city dwellers' attitudes to wildlife and their experience of wildlife problems. In Wellington City, New Zealand, human-wildlife conflict is emerging due to damage caused by North Island kaka, a threatened endemic parrot. We conducted a household survey of Wellington residents and used an Information-Theoretic approach to multi-model selection and inference to investigate the relationship between residents' biodiversity awareness and wildlife engagement and their attitude to birds and bird-related problems. Planting trees to attract birds was the only predictor to provide substantial inference for attitude ($\omega_i = 0.873$) and engaging with birds by planting moderated the negative relationship between experiencing a problem and attitude towards birds. Hence attitude to birds and tolerance to problems may be most closely associated with a person's experience and engagement with birds rather than negative experiences. Management of human-wildlife conflicts should integrate social behaviour change with more traditional ecological approaches to wildlife conflict management.

Chassot, Olivier, *Tropical Science Center*; **Guisselle Monge Arias**, *Tropical Science Center*

Bird conservation across borders in the El Castillo-San Juan-La Selva Biological Corridor, Nicaragua-Costa Rica

In Mesoamerica, the endangered Great Green Macaw (*Ara ambiguus*) highly depends on *Dipteryx panamensis* for feeding and nesting, and on adequate, intact forest habitat. As migrating species are not limited by borders, the successful establishment of the El Castillo-San Juan-La Selva Bi-national Biological Corridor between Nicaragua and Costa Rica has been and remains essential for the conservation of the Great Green Macaw: it is the center piece of an altitudinal north-south gradient that contributes to mitigate the climate change effects on ecosystems. The Tropical Science Center and Fundación del Río took a leading role in the consolidation and implementation of cross-border alliances and nature conservation activities through a campaign that focuses on promoting the awareness of the ecology and conservation of the Great Green Macaw in the lowlands of the San Juan River. The main results to date have been the understanding and concern of stakeholders regarding the challenges faced by the Great Green Macaw, and a positive shift in land use change dynamics at the landscape level. In 2006, The Agua & Paz Biosphere Reserve was created in Northern Costa Rica, with the ultimate aim at establishing a transboundary Biosphere Reserve. Data from a 2009-2010 census show that the population of Great Green Macaws has increased along the conservation actions that have been undertaken since 1994 in order to protect the habitat of the Great Green Macaw.

Chaudhary, Anand, *SUNY College of Environmental Science and Forestry*; **Khadananda Paudel**, *Bird Conservation Nepal*; **Richard Cuthbert**, *Royal Society for the Protection of Birds*; **Bhupal Nepali**, *Bird Conservation Nepal*; **Ishwari Chaudhary**, *Bird Conservation Nepal*; **Hirulal Dangaura**, *Bird Conservation Nepal*; **Krishna Bhusal**, *Bird Conservation Nepal*

Piloting Vulture Safe Zone in Nepal as an integrated approach to conserving Asia's critically endangered vultures

Since the early 1990s South Asian vultures have declined dramatically and four species are listed as critically endangered in the IUCN BirdLife Red List. The primary cause of decline has been identified as the veterinary drug diclofenac. In Nepal, Vulture Safe Zone has been created covering 39,212 square kilometers as an integrated approach to vulture conservation involving advocacy, sensitization, exchange of diclofenac with vulture safe drug meloxicam, provision of safe food and collection of pledge from veterinarians through community based approach. This approach is being supplemented through captive breeding, monitoring vulture colonies, vulture arrival at safe feeding

sites and, knowledge and drug use practice of veterinary community. We recommend that Vulture Safe Zone approach is the way forward for in-situ conservation of these critically endangered raptor species.

Che-Castaldo, Judy, *National Socio-Environmental Synthesis Center*; **Maile Neel**, *University of Maryland, College Park*

Predicting population extinction risk based on biological traits and anthropogenic threats

The rapid growth of human populations and the resulting increase in human activities have led to an accelerated rate of biodiversity loss. However, contributions of specific anthropogenic activities (e.g., urban development, pollution) to the rate of species extinction have been difficult to determine, in part due to lack of a standardized system for classifying anthropogenic threats. I developed a hierarchical threat classification scheme by combining and modifying existing schemes to categorize actual threats for all plant and animal species listed under the U.S. Endangered Species Act. I then tested this scheme on a set of plant species for which there are published demographic data, and estimated population growth and extinction risk for these species. Using tree-based statistical analyses, I found that particular threats, such as non-native species and harvesting for resource use, were associated with lower population growth rates than other threats. Biological traits such as life form and small population size also affected demographic rates. However, high within-species variation resulted in relatively low model accuracy, and relationships depended on the level of specificity of threat classification. Implementation of the threat classification scheme will allow more standardized reporting of threats in recovery plans, and quantifying relationships between threats and extinction risk will help inform management goals for species facing particular threats.

Cheng, Li-Yi, *Bliss & Wisdom Group, Taiwan*

Life Conservation, Mind Cultivation

The Bliss & Wisdom Group is a Buddhist community in Taiwan that promotes organic cultivation and implements the empathy-and-appreciation concept for farmers and consumers through collect-and-sell organic produce. Being organic can be the solution for conserving endangered species, habitats, catchment of soil, and water. The Group releases life-threatened animals in a ritual that protects them from harm and applies the teachings of Buddha that underscore compassion for sentient beings. To avoid adverse impacts that occur when animals are released inappropriately, the Group partners with various conservation institutions including the Wildlife First Aid Station of Endemic Species Research Center and the National Museum of Marine Biology and Aquarium.

Choudhury, Arpita, *Association of Fish and Wildlife Agencies*;
Amber Pairis, *California Department of Fish and Wildlife*

We Are All In This Together: Partnership as the Backbone of Climate Adaptation in the United States

The challenges for natural resources manager are both complex and costly ones. Increasing temperatures, rising sea levels, and increased frequency of extreme weather events as well as other impacts such as habitat fragmentation, invasive species, and disease require collaboration among conservation partners in order to leverage resources for a more informed and coordinated response. Partnership as a mechanism for conservation is not a new concept but climate change poses some unique challenges which require consolidated efforts to fill knowledge gaps and define management actions on the ground. In the United States, state fish and wildlife agencies are charged with managing fish, wildlife, and their associated habitats for the country. Assisting fish and wildlife to adapt to a changing climate is a new addition to the charge. The challenges of climate change and its associated impacts are currently being addressed by state agencies and their conservation partners through collaborative partnerships and innovative solutions that help overcome the barriers of funding, lack of capacity, and knowledge to ensure that the best available climate science is being used in adaptation efforts. The proposed presentation will highlight different aspects of state fish and wildlife adaptation activities and the need for collaboration and partnership across disciplines to help reduce the impact of climate change on fish and wildlife and their associated habitats.

Church, Don, *Global Wildlife Conservation*

Designing a global network of protected areas for threatened amphibian species

Over 800 Threatened amphibian species occur entirely outside the world's network of protected areas. Many of these species are extremely range-restricted and thereby especially vulnerable to loss of habitat. At the pinnacle of extinction risk are over 300 species that occur only within single sites. To date, there has been no initiative aimed at protecting habitat for these species but, under the new Amphibian Survival Alliance, local partnering groups will be asked to lead the development of protected area networks for amphibians within their countries and regions of operation.

Clark, J. Alan, *Fordham University*; **Christine Sheppard**, *American Bird Conservancy*; **Janet Starwood**, *Audubon Pennsylvania*

Exploring how light color affects nocturnal migrants in an urban landscape

Most passerine birds and bats migrate at night, and many migrant species show population declines. Mortality during migration is substantial, and migrants are often attracted by artificial light sources, leading to often fatal collisions with human structures. Reducing the attraction of illuminated human structures is important to migrant conservation. Recent studies with communications towers showed that switching from steady burning red or white light to strobes can substantially reduce avian collisions. A few studies have suggested that green or blue light may not attract migrating birds as strongly as white or red light. We used a set of 24 spot lights in downtown Philadelphia during fall migration to compare how night-migrating birds responded to white, green, and blue light. We counted the number of birds flying through light beams as well as their flight direction on a single night during fall migration. We documented substantially more birds in the white light than in the blue or green light. In addition, we found three times more birds either circling in the white light or flying in directions not consistent with fall migration. This small study highlights the importance of better understanding how light color affects migrants. Such information can help inform public policy to help reduce the negative effects of increasingly urban landscapes on nocturnal migrants.

Collen, Ben, *Institute of Zoology*; **Louise McRae**, *Institute of Zoology*; **Tom Hart**, *University of Oxford*

Towards monitoring global penguin population change

Monitoring wildlife in the Earth's most rapidly changing ecosystems provides insight into patterns of environmental change, from which to make informed conservation decisions. Observed and predicted changes in climate, and the expansion of fisheries in Antarctic and sub-Antarctic regions are two causes of concern, which make monitoring of species in this remote part of the world critical. No inclusive monitoring network exists for this region, one of the world's least comprehensively studied and most rapidly changing. We present an index of change in penguin population status across oceanic regions of the southern hemisphere to present an index of regional change. We show using data from 14 penguin species an overall average decline in abundance over the last 37 years. Our results also reveal contrasting fortunes for western and eastern penguin populations, which broadly mirror continental scale warming and cooling patterns. Our results suggest growing threats will continue to have unequal impacts on species, requiring regionally tailored management, and supporting the need for further research to evaluate species specific responses to climate change and other threats. Expanded monitoring is required to ensure the best possible evidence base from which to protect penguins in a changing environment. We evaluate how the current limited

monitoring network influences our findings, and use this as a means to suggest how monitoring might be expanded.

Comeros, Mia Theresa, *Old Dominion University*; **Colin Buxton**, *Institute for Marine and Antarctic Studies, University of Tasmania*; **Bruce Mann**, *Oceanographic Research Institute*; **Barry Russell**, *School of Environmental and Life Sciences, Charles Darwin University*; **Kent Carpenter**, *Old Dominion University*

Predictors, Patterns and Processes of Extinction Risk in Porgies (Family: Sparidae)

The Porgies or Seabreams (Sparidae) are widely distributed in tropical and temperate coastal waters around the world. These fishes are highly esteemed food and recreational fish and are of considerable commercial importance in many parts of the world. Intrinsic life history characteristics such as specialized reproductive modes, aggregate spawning behavior, and specific habitat preferences coupled with extrinsic threats from fishing pressure and widespread habitat destruction have lead to population declines for several species in the family. We model the correlates of threat utilizing known intrinsic and extrinsic traits that predispose these species to an elevated risk of extinction. Interactions of intrinsic rates (late maturing, long-lived, and restricted ranges) and extrinsic rates (coastal development, exploitation) are shown to be good predictors of heightened extinction risk. We also calculate the spatial overlap of areas of high diversity and threatened populations with areas of high cumulative threats to identify critical knowledge gaps and highlight priority areas for conservation. The factors that drive species to increased extinction risk are complex and highly interconnected in nature. Improved understanding of these drivers can lead to better management strategies to counter the effects of biodiversity loss in this rapidly changing world.

Conlisk, Erin, *San Diego Zoo Institute for Conservation Research*; **Sara Motheral**, *San Diego Zoo Institute for Conservation Research*; **Rosa Chung**, *San Diego Zoo Institute for Conservation Research*; **Bryan Endress**, *San Diego Zoo Institute for Conservation Research*

Modeling the optimal site for coastal cactus wren habitat restoration to mitigate threats of fragmentation and wildfire

Threats to wildlife from habitat fragmentation and increased fire frequency are common in Mediterranean ecosystems. Whereas the remaining Southern California coastal sage scrub serves as refuge for rare flora and fauna, this habitat is threatened by frequent, human-ignited wildfires. The coastal cactus wren, a California Bird of Special Concern, serves as a "canary in the coal mine" for a variety of coastal sage species (e.g., the California gnatcatcher and orange-throated

whiptail). The cactus wren depends on fire-sensitive *Opuntia* and *Cylindropuntia* species. The San Diego Zoo's Institute of Conservation Research has committed to restore 20 hectares of wren habitat. To locate sites which mitigate fragmentation and wildfire risk, we use a population model created from maps of wren abundance, cactus habitat, land use, and predicted fire probability. We forecast the relative abundance of wrens under the following management options: augment existing habitat patches, create new patches in areas with low fire risk, and create new "stepping stone" patches to connect existing patches. Wildfire risk is estimated by relating previous fire locations to a variety of demographic and environmental variables. We find that the best management strategy depends on (i) wren dispersal distance, (ii) post-fire habitat recovery, and (iii) the magnitude of edge effects on the smallest patches. Our results are being vetted by local park managers and conservation groups.

Cook, Carly, *University of Melbourne*; **Hugh Possingham**, *University of Queensland*; **Richard Fuller**, *University of Queensland*

A review of systematic reviews of conservation evidence

Systematic reviews are a comprehensive method for summarizing evidence about the effectiveness of interventions that have proven highly successful at promoting evidence-based practice in disciplines such as medicine. They can be a powerful tool for synthesizing the best available evidence about which management actions are most effective under particular circumstances, and making that information freely available to practitioners. We investigated the contribution made by this growing body of literature to conservation practice by examining all of the systematic reviews of conservation evidence that have been completed. I will describe the type of implications that systematic reviews currently have for management practice and the recommendations that review authors provide for improving the scientific evidence base so that it is more relevant and useful for decision makers. I discuss the strengths and weaknesses of how this rigorous method has been applied in conservation, highlight some of the ways their benefits could be enhanced, and describe some of the key innovations that promise to make systematic reviews a more effective tool for facilitating evidence-based conservation in the future.

Cornick, Leslie, *Alaska Pacific University*

Integrating Marine Mammal Conservation in the 21st Century - Conceptual Framework

All marine mammals are protected in the US under the Marine Mammal Protection Act, and some species have additional protection under the Endangered Species Act. However, few species exist only in the US, so conservation

mangers. We use an agent based model to show that high social or economic cost can help coordinate weed management. Social cost was only important if it was independent of weed prevalence, suggesting that early access to information, and incentives to act on that information, may be crucial in stopping a weed infesting large areas. Our results show that the behavior of individual land managers can have a large effect on a weeds extent at the landscape scale, even if each individual weed manager only had access to a small part of that landscape.

Craigie, Ian, *James Cook University*; **Robert Pressey**, *James Cook University*

The management costs of protected areas in Queensland, Australia

Protected areas are the cornerstone of global conservation efforts yet despite their importance our knowledge of the financial resources required to effectively manage them is remarkably poor. For the vast majority of protected areas we have little understanding of what is being spent, what should be spent or what factors drive costs. Here I present the results of a project to answer these questions in some of Queensland's 10 million hectares of protected estate. I present estimates of current spending broken down by separate management activities and calculations of the extra funding required to meet all stated management objectives. The results show that currently when funding is constrained managers prioritize activities which are unrelated to biodiversity such as maintenance of visitor facilities, leaving biodiversity related activities especially underfunded. Analysis using mixed effect models shows that the key factors driving variation in spending levels changes with location within Queensland, however it is clear that visitor numbers, ecosystem type and the frequency of extreme meteorological events are important drivers of costs. These new data offer the opportunity to gain a much improved understanding of the costs of managing protected areas effectively; which in turn will lead to better spatial planning and improved allocation of limited funds across protected area networks.

Crist, Patrick, *NatureServe*

A Toolkit Approach to Integrating Conservation with Land Use, Resource, and Infrastructure Planning

Conservationists have recently recognized that conservation planning does not happen in a vacuum. To effectively integrate conservation with land use, resource management, and infrastructure planning, it is necessary to engage the various sector agencies in multi-objective planning. While several difficulties must be overcome, primarily from the stove-pipe history of such planning, the development of information workflows supported by software tools can lower

the bar for such collaborative planning. The complexity of such spatial planning requires the use of a variety of specialized tools including ecological modeling tools, ecosystem process tools, sector-specific modeling tools such as urban growth modeling, and a variety of conservation assessment, optimization, and planning tools. This session will provide a methodology for visualizing the information workflow among sectors using a scenario-based planning approach and identifying and integrating tools into the workflow. The approach will be illustrated with several examples applied to integrated land-sea planning, managed area planning, land use planning, and infrastructure planning. The approach was recently published in the *Journal of Conservation Planning* and participants will be provided with links to technical guides that detail the methodology.

Cronin, Drew, *Drexel University*; **Cirilo Riaco**, *Bioko Biodiversity Protection Program*; **Gail Hearn**, *Drexel University*

Conservation monitoring on Bioko Island: Bridging the gaps between bushmeat market dynamics, primate populations, and wildlife patrols

Bioko Island, Equatorial Guinea is one of the most important places in Africa for primate conservation, but a lack of effective law enforcement has encouraged commercial bushmeat hunting, which now threatens the remaining primate populations. Since, 1997, the Bioko Biodiversity Protection Program has recorded over 41,000 primates in the market of the capital, Malabo, documenting both a "mardi gras" phenomenon in consumption patterns, and the negative effects resulting from government intervention. Nevertheless, the relationship between market dynamics and the status of wild populations is poorly understood, detracting from the efficacy of conservation efforts. To address this, surveys were conducted to assess how the relative abundance of monkey species varied spatially in relation to differing degrees of hunting intensity. Overall, primate abundance decreased as hunting intensity increased, while variation existed in species specific responses to hunting levels. Our data suggest that terrain features and a steady research presence have afforded some populations a modicum of protection; however, given current bushmeat trends, an absence of enforcement, and rapid development allowing greater access to remote areas, these modest defenses will be short lived. We conclude that in addition to institutionalized support and effective law enforcement, current monitoring efforts should be nationalized and expanded to provide economic incentives for public conservation.

Cummings, Anthony, *Syracuse University*; **Jane Read**, *Syracuse University*; - , - ; - , - , -

Modeling the Distribution of Rare Multiple-Use Plant Species in a Fragmented Northern Amazonian Landscape

Multiple-use plant species are commercially logged, provide food for wildlife, and non-timber forest products for human populations. In the neotropics the range of these species inevitably straddles a diversity of land ownership arrangements, including indigenous lands, State-owned properties, and protected areas, where different approaches to resource management persist. For rare species different management approaches could potentially push them towards extinction. The probabilistic distribution of six locally-rare and four abundant species was examined to determine how they may be impacted by gold mining on State-owned lands. Species were mapped at fourteen Southern Guyana study sites within a 50,000 km² study area and their distribution characteristics used to generate probabilistic landscape-level distribution models. All species, rare and abundant, showed probabilistic distribution on State-owned and indigenous lands and within protected areas. Distribution on State-owned lands subjects species to gold mining pressures, which are increasing with the climbing market price for gold and leading to higher demands for mining permits. Current approaches to gold mining in the neotropics involve widespread removal of trees regardless of their conservation status or ecological importance. Sustainable management of these resources therefore requires reformation of codes of practices for gold mining and inputs from all stakeholders at the landscape-level.

Cypher, Alysha, *The Center for Conservation Studies, Inc.*;
Andrew Keth, *The Center for Conservation Studies, Inc.*

The Clarion-Limestone Amphibian Research Center: A Model for Public Participation in Conservation.

With the future of funding for conservation projects and research being uncertain, it is crucial that scientists rally public support for science. The Clarion-Limestone Amphibian Research Center (CLARC) is a model for promoting science and conservation to the public on a local-scale. Located on the grounds of a public school district in Clarion, Pennsylvania, this facility brings university, high school, and elementary students together in herpetological conservation and research. Projects utilizing models like the timber rattlesnake, spotted salamander, and eastern hellbender provide students with experiences unique to CLARC. Not only are students involved in conservation research and public education, but they are directly involved in the design, construction, and day-to-day operation of the facility. The students are empowered and also gain skills across disciplines including science, the arts, management, marketing, and public relations. By linking a public school district, a state university, and community organizations and businesses, CLARC has become a successful example of community-based conservation that is largely publicly-funded. By designing this facility around student education

and professional development, we have increased public participation and support of science within the local community and beyond.

Danoff-Burg, James, *San Diego Zoo Global*; **Maggie Reinbold**, *San Diego Zoo Global*; **Robin Keith**, *San Diego Zoo Global*; **Samantha Young**, *San Diego Zoo Global*; **Corrin LaCombe**, *San Diego Zoo Global*; **Kirstie Ruppert**, *San Diego Zoo Global*

Zoo-based Teacher Professional Development - An Effective Means for Integrating Conservation Science and Advocacy into Classrooms

Most learning happens in informal settings for most people, which certainly holds true for school teachers. We were interested in exploring the value of informal science learning environments for enhancing teacher training and professional development. To this end, we quantified the short-term (months) and longer-term (years) improvements in objective content knowledge and curricular integration of an immersive, three-day teacher training workshop at the research arm of the San Diego Zoo. Middle school and high school life science teacher alumni (N=151) from across the nation were involved, as were a set of teachers (N=65) who had applied to the program but were not selected to participate, who then acted as a control group. Relative to the control group, the treatment teachers demonstrated significant gains in teaching effectiveness, conservation attitude, and ability to integrate workshop materials into existing subject matter back in their classrooms. We conclude that informal science learning environments can significantly contribute to helping teachers integrate conservation into their classrooms, and the in the process building support for in-situ conservation efforts.

Davalos, Andrea, *Cornell University*; **Victoria Nuzzo**, *Natural Area Consultants*; **Bernd Bloseeey**, *Cornell University*

Determining effects of multiple stressors to develop successful management of rare and endangered forest plants

Forest ecosystems in eastern North America face multiple threats including habitat loss and fragmentation, invasions, overabundance of native species, nutrient deposition and climate change. While each stressor may have independent detrimental effects on native biota, stressors often co-occur and are likely to have synergistic effects. We used a combination of field and common garden experiments, and matrix population models to assess the importance of deer herbivory, nutrient addition, and introduced plants and earthworms on the demography of four rare forest herbs (*Aristolochia serpentaria*, *Agrimonia rostellata*, *Carex retroflexa*, and *Trillium erectum*). After five years, individuals

of all species, except for *C. retroflexa*, responded to deer exclusion with significant increases in size and reproduction and population growth rate. Life table response analysis indicated positive contributions of deer exclusion to growth rate, mainly by increasing the probability of flowering plants to remain reproductive. The remaining studied factors had no independent or interactive effect on the demographic parameters of either species. Biodiversity conservation projects should critically consider effects of multiple stressors; however, our results emphasize the importance of deer as structural forces in forests of North America and indicate that reductions in deer populations are imperative (and may be sufficient) to restore and preserve populations of rare plant species.

Davies, Tammy, *University of St Andrews*; **Nathalie Pettorelli**, *Institute of Zoology, Zoological Society of London*; **John Ewen**, *Institute of Zoology, Zoological Society of London*; **Rohan Clarke**, *Monash University*; **Will Cresswell**, *University of St Andrews*; **Guy Cowlshaw**, *Institute of Zoology, Zoological Society of London*; **Ioan Fazey**, *University of Dundee*

Quantifying the impact of land use change on biodiversity and people: a case study from the Solomon Islands

Land use change is a major threat to biodiversity through loss of habitats and fragmentation, particularly in developing regions, where human populations are expanding and where the majority of people depend on natural resources for their livelihoods. Understanding and quantifying the impacts of land use change on both biodiversity and the local people is important in order to develop appropriate conservation management plans. Using a remote region of the Solomon Islands as a case study, we undertook a multidisciplinary approach that included assessing species richness and relative abundance of birds (line transects) and bats (acoustic monitoring) in 5 land use types (primary and secondary forest, gardens, mixed cocoa and monoculture cocoa). We also assessed how household wealth affected livelihood strategies and use of natural resources, using locally defined indicators of poverty and multi-round interviews during a 6-month period. We found wealthier households were more likely to be engaged in cash cropping activities and also found biodiversity to be lower in these areas. This suggests that the activities of the wealthiest are having a negative impact on both biodiversity and the forest-based subsistence livelihoods of the poor. Our study demonstrates the importance of understanding the socioeconomic context for large-scale habitat management to ensure equitable sharing of benefits and that the poor are not further marginalised through restriction to essential resources.

de Azua, Christine Real, *Energy and Environment Consultant*

Leveraging national accounting and cost-benefit analysis tools for the environment

The case has long been made that GDP is not a measure of welfare or progress—yet it continues to be misused as a proxy for or condition of progress. Laws and treaties are in place to protect endangered species and biological diversity, yet their implementation is often ignored or trumped on the basis that it is “too costly.” At the same time, the field of ecological and environmental economics is mature. The case for tools and measures that better value the environment is well established. Some governments or agencies are making progress using those tools and measures. To accelerate this integration, existing practical leverage points and “bridges” to decision-making need to be reinforced, and new ones identified and used. International leverage points include international organizations that issue relevant guidelines, and treaties asking parties to develop and use such measures. Leverage points at the national and state level, with a major, but not exclusive, focus on the U.S. including instances of federal policies, rulemakings, and programmatic decisions will be discussed. We will present the results from consultations and interviews with decision makers and practitioners in government and in the investment and nonprofit communities about such leverage points and how they can drive more environmentally sustainable and restorative decisions and investments.

De Bruyn, Luc, *Research Institute for Nature and Forest (INBO)*

Species in a fragmented landscape. How policy scenario's change species distributions

In highly fragmented landscapes there is not much space for nature. Therefore it is crucial to understand how policy decisions can maintain/improve biodiversity. Our study aimed to get scientifically based insight in possible evolutions of biodiversity under different policy choices within a given socio-economic context. Models should be simple and easy to understand for non-specialist policymakers. In short, we modelled 6 land use scenario's. A combination of two environmental and three nature scenario's. The business as usual scenario's continue present policy into the future. The Europe scenario puts on more resources to achieve the European environmental targets. Under the segregation scenario, the use of open space is strictly divided between nature and other uses. The intertwine scenario strives to realise good nature quality everywhere. To model the effects of changes in land use we used the LARCH model (Landscape ecological Analysis and Rules for the Configuration of Habitat). LARCH is based on metapopulation systems. It includes habitat requirement, carrying capacity and dispersal capacity of the target species to construct habitat networks. These habitats are tested whether they are viable. To generalise our findings, we used

ecoprofiles. Ecoprofiles are fictive taxa that represent a series of species with comparable ecological requirements.

Deichmann, Jessica, *Smithsonian Conservation Biology Institute*; **Reynaldo Linares-Palomino**, *Smithsonian Conservation Biology Institute*; **Alfonso Alonso**, *Smithsonian Conservation Biology Institute*

Using expert opinions to define Biologically Sensitive Microhabitats for improved biodiversity conservation during hydrocarbon exploration in Amazonia

Industrial operations in the Amazon Basin inevitably have impacts on the vast biodiversity within. These influences are likely to grow as human activity moves further into Amazonia. Working in collaboration with industry during development is an important step in identifying and avoiding potential impacts, and mitigating or restoring biodiversity post-impact. In order to strengthen biodiversity conservation during development across the complex landscape of Amazonia, we must first define which microhabitats are most important for species survival, which of these are most sensitive to changes, and to what degree they can sustain different impacts. To answer these questions, we surveyed 100 taxonomic experts representing a wide range of Amazonian fauna to develop a list of Biologically Sensitive Microhabitats (BSMs), such as natural licks for mammals and birds or phytotelmata for amphibians. BSMs were then ranked based on characteristics of BSM-dependent species (endemism, range, reproduction, etc) to create a hierarchy of sensitivity. Our next step is to identify BSMs in operation areas and test their susceptibility to a variety of impacts including seismic exploration, establishment of wells and camps, and construction of linear infrastructure. By defining and evaluating the sensitivity of BSMs essential to species' survival, we can provide specific recommendations to government and corporations on how to minimize the impacts of operations and how to restore BSAs if affected.

Dell'Apa, Andrea, *East Carolina University*; **Jeffrey Johnson**, *East Carolina University*; **David Kimmel**, *East Carolina University*; **Roger Rulifson**, *East Carolina University*

The international trade of spiny dogfish: a social network analysis for the fishery management

The spiny dogfish (*Squalus acanthias*) is a shark of significant international commercial value and there is concern over its conservation status. The major demand for its meat is from the European Union (EU) market, with the US and Canada as its two major contributors. The US has yet to support a spiny dogfish listing in the CITES Appendix II, although the US Atlantic stock is under a fishery management plan (FMP) that proved to be successful in providing a certified sustainable fishery. We employed a cumulative sum technique

to compare trade data for frozen spiny dogfish export from US and Canada to the EU in relation to the FMP adoption. We also constructed a social network to visualize changes in the European trade scenario for spiny dogfish after adoption of the FMP and to predict future trade flow potentially affecting the conservation status of regional dogfish stocks in relation to recent management measures introduced in Europe. The social network analysis revealed that the exclusion of spiny dogfish from trade regulation lists eventually will affect the conservation status of dogfish stocks in Africa, Asia, South America, and the Mediterranean and Black Seas. Our results suggest that the species listing would provide an economic benefit for the US Northwest Atlantic fishery, and will eventually foster the conservation status of other regional stocks worldwide and the search for a more sustainable global exploitation of spiny dogfish.

Dennison, William C., *Integration and Application Network, University of Maryland Center for Environmental Science*; **Heath Kelsey**, *Integration and Application Network, University of Maryland Center for Environmental Science*

Environmental report cards: A tool to integrate monitoring data, engage stakeholders and catalyze actions

Environmental report cards have emerged as a technique to integrate monitoring data and provide feedback to a wide audience. There are several reasons for employing environmental report cards including a) raising environmental awareness, b) engaging citizen scientists and c) catalyzing management actions. Management objectives need to be clearly defined and a five step process of developing report cards can be used to assess progress in achieving these objectives: 1) conceptualization, 2) choosing indicators, 3) defining thresholds, 4) calculating scores and 5) communicating results. Effectiveness of management actions can be tracked with report cards. Report card credibility relies on independent rigorous assessments by environmental scientists. Citizen scientists can also contribute to report cards, particularly at small spatial scales, provided adequate training and quality control mechanisms are in place. Report cards can take advantage of emerging sensor, information and computational technologies. There are several environmental report card examples that serve as models for other regions, for example, Chesapeake Bay, Great Barrier Reef, Mississippi River, Gulf of Mexico, Southeast Queensland waterways, Maryland Coastal Bays. These examples of report cards used at different geographic and complexity scales will be used to develop some insights as to which report card approach may be applicable in other areas. In addition, the coupling of environmental report cards with a governance model, e.g., BayStat, will be discussed.

Dhanjal-Adams, Kiran, *University of Queensland*; **Howard Wilson**, *University of Queensland*; **Bruce Kendall**, *University of California Santa Barbara*; **Colin Studds**, *University of Queensland*; **Richard Fuller**, *University of Queensland*

Distinguishing local and remote drivers of change in migratory bird populations

Recent analyses of monitoring data from Moreton Bay, Australia, have identified declines in abundance of up to 79% between 1994 and 2008 for a suite of migratory shorebirds. However, resident species that remain in Australia all year round are not declining. This suggests that declines in Moreton Bay may be being driven from impacts elsewhere in the East Asian-Australasian Flyway. Here we assess the relative importance of factors local to Moreton Bay, in addition to those reflecting threatening processes elsewhere along the migratory routes of the birds, in explaining population trends. To achieve this, we first contrast a spatial formulation of the N-mixture model with existing non-spatial models to estimate abundance of migratory shorebirds in Moreton Bay and identify how these have changed since 1994. Prior to these analyses, the spatial data collected across Moreton Bay was amalgamated into a non-spatial index of bird abundance; the average number of birds counted per site visited. In contrast, N-mixture models allow spatially variable threats to be incorporated by entering sites separately into the model. Finally, we distinguish local and remote drivers of population decline by testing the effects of a range of covariates on abundance, including: climate, habitat loss and habitat degradation at non-breeding, stopover and breeding sites. Results indicate that a combination of local effects within Moreton Bay and those acting at stopover sites in East Asia best explain the observed declines in Australia. Our work shows that data from a single point in a migratory flyway can be used to draw inference about what is driving population dynamics from elsewhere along the migratory route. Our results highlight the urgent need for broader scale analyses of shorebird abundance to identify exactly where in the flyway the drivers of decline are operating most strongly.

Di Fonzo, Martina, *University of Queensland*; **Hugh Possingham**, *University of Queensland*; **Will Probert**, *University of Queensland*; **Joseph Bennett**, *University of Queensland*; **Shaun O'Connor**, *Department of Conservation, New Zealand*; **Jodie Densem**, *Department of Conservation, New Zealand*; **Liana Joseph**, *Wildlife Conservation Society*; **Ayesha Tulloch**, *University of Queensland*; **Richard Maloney**, *Department of Conservation*

Re-evaluating persistence objectives in conservation planning: are lower thresholds or species-specific targets more cost-effective?

When planning for the management of multiple threatened species with a limited budget, wildlife managers prioritize

certain actions over others in order to conserve the most species into perpetuity based on a common persistence objective. The New Zealand Department of Conservation has developed a rigorous project prioritization protocol (PPP) to optimize resource allocation. The aim is to secure the greatest number of unique species with a 95% probability of persistence over the next 50 years by carrying out species-specific actions for multiple populations. It may be possible to fund many more species with the same budget if this high level persistence target was relaxed. We use a data-set of all 700 New Zealand threatened species projects to examine how many more species could be conserved if we reduce their probability of persistence by managing fewer populations per species. We re-evaluate the use of persistence objectives in conservation planning using two approaches: a) presenting the relationship between target persistence levels and number of species managed, and b) relaxing the PPP objective so that the cost-effectiveness of every individually-managed population is considered separately and the maximal number of species conserved is calculated without an arbitrary persistence threshold. Our findings advance the field of threatened species priority setting by offering an alternative prioritization approach that is not underpinned by a common threshold of persistence.

Diamond, Juliane, *Lincoln University*; **Victor Blanco**, *Song Saa Private Island*; **Ronlyn Duncan**, *Lincoln University*

Knowing sea turtles: local communities informing conservation in Koh Rong archipelago, Cambodia

Three globally threatened species of sea turtle have been recorded in the waters around the Koh Rong archipelago off Cambodia's southwest coast: the green turtle *Chelonia mydas*, the hawksbill *Eretmochelys imbricata* and the leatherback *Dermochelys coriacea*. In order to learn about how communities around the Koh Rong archipelago interpret and interact with these species we investigated the local human populations' relationship and use of these turtles. Our study used qualitative social science research methods including semi-structured interviews, a participatory mapping exercise with a community fisheries committee, a focus group, as well as participant observation and ethnographic note taking. The study identified four frames of reference for the sea turtle: turtles as victims, turtles as occasional food, turtles as spiritual beings, and turtles as a promise for the future. These frames of reference were expressed in all villages and amongst most demographics. Our study also identified several perceived threats to sea turtle survival around the Koh Rong archipelago. Most frequently cited were trawling boats, nets, Vietnamese fishermen, hooks, illegal fishing and overfishing. Understanding how local people interpret and interact with sea turtles and perceive threats to their survival provides important insights for the implementation of nature conservation and education programs, which our study aims to inform.

Dieng, Moussa, *Department of Forestry, Michigan State University*

LANDSCAPE CARBON MEASUREMENT IN AGROFORESTRY SYSTEMS IN SAVANNA ENVIRONMENTS OF RURAL SENEGAL Toward a model of measurement of trees outside of fores

Agro-forestry combines a multitude of benefits both in the environmental, social and economic side. As a mitigation strategy, agro-forestry derives its importance from the multitude activities which all have the potential of creating income for farmers and contribute to fix a large quantity of carbon in the biomass as well as in the soil. However, the benefits of carbon for farmers cannot be fully perceived if the carbon is not quantified accurately and the efforts to estimate carbon sequestration in agro-forestry systems are still facing a big challenge. In my study I will use techniques that combine ground and remote sensing data to measure the carbon stocks in rural farming systems under agro-forestry in landscape level. The first part of the analysis will develop the basic measurement tools for monitoring carbon stocks in systems of trees outside of forests using remote sensing, ground measurements and GIS. Regression analysis will be used to estimate the change in the tree dbh from a given change in the tree crown projected area to predict tree dbh from the given crown projected area. The second part of the study will seek to understand the degree to which local farmers and community groups can be collaborators in the carbon measurement process by assessing their ability to make measurements.

Alia Dietsch, *Colorado State University*; **Michael Manfredo**, *Colorado State University*; **Tara Teel**, *Colorado State University*

Social trust and governance: How modernization is creating a greater need for collaborative conservation

Collaborative decision-making is becoming increasingly popular in the conservation arena. This all-inclusive approach to managing common resources is in direct contrast to the expert model of decision-making, where managers are regarded as the final authority to deal out decisions to those affected. While many scientists and practitioners are applauding this surge in collaboration, few stop to consider why it is becoming so necessary. One theory suggests that modernization, indicated by urbanization and rising levels of income and education, creates an atmosphere in which people, whose basic needs are provided for, can focus on higher order values of self expression.

Modernization, therefore, would lead to distrust in traditional hierarchical forms of government and toward more politically open systems. We tested this theory in regards to its potential impact on wildlife-related thought in the western U.S. We found that mutualism, a wildlife value orientation that considers animals as deserving of rights and caring, was associated with values focused on self expression and political freedom. We additionally determined a negative relationship between mutualism and trust in state-level fish and wildlife agencies, meaning that trust declined as mutualism scores increased. Findings indicate that modernization is fostering more egalitarian beliefs within society, suggesting a need to continue, and in some cases increase, collaborative efforts to reach conservation goals.

Dixon, Adam, *World Wildlife Fund*; **Don Faber-Langendoen**, *NatureServe*; **Carmen Josse**, *NatureServe*; **John Morrison**, *World Wildlife Fund - United States*; **Colby Loucks**, *World Wildlife Fund - United States*

Distribution mapping of world grassland types for biodiversity

Ecoregions dominated by grassland ecosystems have historically provided ample goods and services to the human population. Intense land use has resulted in a vast transformation of historic grasslands into cropland and grazing lands. In temperate grassland biomes, the rates of protection compared to conversion are the lowest of all biomes. We combine the International Vegetation Classification with the Terrestrial Ecoregions of the World to provide an analysis of global grassland biodiversity capable of being integrated into global policy and management decision-making frameworks. With a combination of these two systems we can advance a systematic, detailed biodiversity measurement apparatus which can account for biodiversity in a broad sense, including not only biological information, but also the spatial ecological complexes within which species occur. We have produced an up-to-date map of grassland ecosystems supported with basic vegetation data and ecoregional distributions, which we hope will guide grassland ecosystem management efforts through our current age of global economic expansion and population growth. We suggest using our framework to develop better, more adaptive management strategies and developing governmental policy based on each hierarchal level of biodiversity, including structure, function, and composition of the ecosystem, species, and genetic makeup contained therein.

Dobrowski, Solomon, *University of Montana*

Climate refugia and scale: How complex terrain shapes the velocity of climate change

A concern for species conservation is whether or not the rate of climate change will exceed the rate at which species can adapt or move to suitable environments. At the same time there is increasing awareness that climatic heterogeneity driven by complex terrain may spatially buffer the effects of rapid climate changes. This has prompted the use of climate velocity for estimating the rate of climate change as it accounts for regional changes in climate and the ability of topographic heterogeneity to buffer biota against these changes. Here we assess the climate velocity (both climate displacement rate and direction) for minimum temperature, actual evapotranspiration, and climatic water deficit over the contiguous US during the 20th century (1916–2005). Climate velocity for these variables demonstrate complex patterns that vary spatially and temporally and are dependent on the spatial resolution of input climate data. Climate velocity estimates increase as the spatial resolution of climate data is coarsened due to the fact that coarsely grained data underestimates the heterogeneity of climate gradients in areas of complex terrain. The sensitivity of climate velocity to climate data resolution is most pronounced at fine grain sizes highlighting the importance of topoclimatic variability for assessing the capacity of organisms to keep pace with changing climate.

Dominguez Alvarez, Luisa, *Instituto Nacional de Ecología y Cambio Climático*; **Erwin Marti**, *Instituto Nacional de Ecología y Cambio Climático*; **Amanda Gonzales**, *U.S. Fish and Wildlife Service*

Bi-national Cooperation for Biodiversity Conservation: The Wildlife Without Borders - Mexico Program.

Created in 1995 by the US Fish and Wildlife Service and the Secretary of Environment and Natural Resources of Mexico, the Wildlife Without Borders - Mexico program (WWB - Mexico) represents a cooperative effort to conserve the biodiversity and the integrity of the natural wealth shared by these two nations. WWB-Mexico builds human and institutional capacity for biodiversity conservation and management through training. The program provides small grants by partnering with key stakeholders from government agencies, private sector, universities, schools, NGOs, indigenous and peasant farmers organizations. Important and valuable lessons have been learned in the last 18 years during the implementation of more than 310 projects (over \$9 million USD in funding and \$24 million USD in local counterpart contributions), that have trained more than 12,000 people while benefiting more than 104 species of international concern.

Dougherty, Dawn, *University of California Santa Barb*

Going beyond NTZs: designing TURF-Reserves for fish and fishing

Recent studies have shown that small-scale fisheries around the world are in poor condition and are following a trajectory of continued decline. The state of these small-scale, data-limited fisheries is a concern for the health of marine ecosystems, the livelihoods of those that depend on them, and global food security. While marine reserves have been successful in achieving conservation goals, they may not be enough to address livelihood and food security goals when fisheries surrounding the reserves are still subject to open access management. One possible solution to the challenge of simultaneously conserving marine ecosystems and ensuring productive and sustainable fisheries is to couple marine reserves with exclusive access to fishing grounds by local fishing communities. By having spatial property rights for fishing grounds (i.e. TURFs), local communities will reap the benefits of sustainable management practices and enforcement of marine reserves. To predict the timing and magnitude of community benefits, our team is developing models to compare alternative data-poor adaptive management methods for coupled TURF-reserve systems and the possible timing of fishery recovery and ability to achieve multiple objectives when applying these methods. We also consider the optimal spatial design of these systems to balance conservation and economic objectives.

Douglas, Leo, *American Museum of Natural History*

Parrots, bananas, and Neoliberalism: A systems view of human-wildlife conflict on the island of Dominica.

Human-wildlife conflicts are often complex non-linear issues that frequently become conjoined with or surrogates for pre-existing, broader socio-economic struggles between stakeholder groups. On the island of Dominica conflict centered the behavior, meaning and value of native threatened parrots perceived as crop pests is an emerging conservation concern. Using a grounded theory approach I demonstrate that conflict between stakeholders about parrot-induced crop losses is a complex system involving an unintended collision of State-facilitated parrot population recovery efforts, government-led post-banana agricultural diversification policies, festering grievances related to the loss of economic power, financial security, and social status among farmers living in Dominica's post-banana era. Overall crop loss attributed to parrots on Dominica has become a surrogate issue and focal point within a larger, volatile public dispute about the state of agriculture and the security of farmers. The findings suggest that, given the conflict's complexity, efforts to understand and mitigate the ongoing dispute in a traditional linear manner, as purely a wildlife-crop loss issue, will be unproductive. Furthermore, it illustrates the advantages of a multidisciplinary systems perspective both in the study and management of this and

similar conflicts towards the identification of leverage points for intervention and long-term resolution.

Dowell, Stephanie, *Fordham University*

Monitoring Monitors: Genetic Structure of the Highly Exploited Nile monitor, *Varanus niloticus*

Overexploitation is a leading cause of biodiversity loss and species extinction. Identifying genetic subdivisions in highly exploited species is necessary to minimize the loss of distinct populations and overall genetic variation. The Nile monitor, *Varanus niloticus*, is extensively harvested for the skin trade in countries throughout the Sudano-topical region of Africa, yet little is understood about the genetic structure of this species. In this investigation, polymorphic microsatellite loci were used to assess the patterns of genetic differentiation in *V. niloticus* across the Sudano-topical region. The main hypothesis was that *V. niloticus* populations would exhibit genetic isolation among the major watersheds throughout the region. Significant population genetic structure was observed, as assessed with Bayesian analysis of population structure and F-statistics. However, discrete populations were not confined to individual drainage systems. Additionally, extensive structuring was observed among sub-populations of the Lake Chad region, despite their relative close proximity. The large-scale fluctuations of Lake Chad and the surrounding hydrology within the last thousand years could account for the observed genetic structure of the *V. niloticus* populations. In addition, the genetically unique populations present in Mali could call for more stringent *V. niloticus* trade regulations to preserve the genetic diversity of the species.

Draper, Chris, *Born Free Foundation*

Compassionate Conservation: a Synthesis Between Animal Welfare and Conservation

With increasing threats to wild animal populations and increasing need for conservation interventions come associated risks to the welfare of individual animals. There is a need to fully examine the interplay between animal welfare costs and benefits within conservation problems and solutions. Conservation interventions that involve harm to animals must consider factors such as the necessity of intervention, the likelihood of success and more humane alternatives. The full extent of anthropogenic impact on wild animals and how far human responsibility extends to the welfare of free-living wild animals needs to be considered. Compassionate Conservation aims to develop and refine robust and humane frameworks that fully consider individual animals within conservation research and practice in which the focus is on species, populations, or ecosystems. There is an increasing recognition that a Compassionate Conservation approach of considering individual animal welfare within

conservation policy and practice can improve conservation effectiveness and increase acceptance and support. I will provide an introduction to the emerging Compassionate Conservation initiative, highlight areas of interaction between conservation practice and animal welfare, and examine how far animal welfare ethics and science extend “into the wild”.

Dubois, Natalie, *Defenders of Wildlife*; **Judith Boshoven**, *Foundations of Success*

Incorporating Climate Change into a Strategic Conservation Planning Framework

While many conservation practitioners have begun to recognize the threats that climate change poses to natural systems, the response in terms of planning and implementation of adaptation strategies has lagged behind, in part due to a lack of specific guidance on how to incorporate general adaptation principles into specific conservation and management efforts. Here we present a methodology developed to explicitly incorporate threats from climate change into an adaptive planning framework used by a number of major conservation organizations and a small but growing number of natural resource agencies. Our approach builds on existing efforts by explicitly integrating a climate vulnerability framework into the threat assessment and ratings steps described in the “Open Standards for the Practice of Conservation” to identify new threats resulting from climate change, interactions, and synergies with existing threats. We use this framework to identify adaptation strategies that (a) intervene on non-climate threats to reduce the effects of exposure or maintain adaptive capacity of the resource, (b) use restoration to decrease the sensitivity or increase resilience of the resource, or (c) protect/restore occurrences that are less likely to experience exposure. This process provides a systematic and transparent approach to incorporating climate change into conservation planning that is transferable across scales and can be used in a variety of contexts.

Dumoulin, Christine, *University of Tennessee Knoxville*; **Paul Armsworth**, *University of Tennessee Knoxville*

Locating conservation offices for efficient management

Under given management plans and sets of reserves, we seek to identify office locations for managers that minimize unnecessary travel. Every management plan that involves regular site maintenance incurs travel costs, which depend on the overall distance between reserves and managers' base offices. Minimizing the overall office-to-reserve distance reduces travel costs, meaning that more of an organization's operating budget can be spent directly on conservation. Travel-optimal office locations also reduce the amount of carbon dioxide equivalent (CO₂e) emitted during management. We use operations research methods to solve

this optimization problem heuristically for two real-world case studies. The Yorkshire Wildlife Trust (YWT), UK, and the Northwest Florida Water Management District (NWF), USA, differ in their organizational structure, extent and road densities. For each, we found the optimal location of all existing offices, and for an additional office when the others remain in their current locations. For both case studies, we identified office configurations that reduce travel cost relative to their current locations. In YWT, an optimally located additional office would reduce annual travel costs by £25,000. An optimal configuration of NWF's four existing offices would save \$85,602 annually. Both outcomes produce enough savings to hire an additional management officer. Each of these solutions also prevents the annual emission of 20-23, and 45-49 tons of CO₂e, respectively.

Dunstan, Piers, *CSIRO*; **Nicholas Bax**, *CSIRO*

Conservation on the High Seas -Rapid Progress in Defining Ecologically and Biologically Significant Areas (EBSAs)

The oceans cover 70% of the Earth's surface, and the majority of this area (or half the Earth's surface) is in Areas Beyond National Jurisdiction (ABNJ). The international community provided a program of action for achieving sustainable development of the oceans, coastal areas and seas at the Rio Earth Summit in 1992, however sustainable use of living resources on the high seas has been challenging and remains a major concern for the international community. In 2002, an aspirational target was set to establish marine protected areas, including representative networks by 2012. In 2008, the Conference of the Parties to the CBD adopted seven scientific criteria to identify ecologically or biologically sensitive areas (EBSAs) to enhance conservation and management measures and encouraged competent parties to conduct regional workshops. The first regional workshop, convened by the Secretariat of the Convention on Biological Diversity (SCBD) in November 2011 was to identify potential EBSAs in the western South Pacific region. Subsequent workshops have been held in the Western Atlantic, Southern Indian, Eastern Pacific, and Southeast Atlantic and North Pacific oceans. We report on the results of those workshops here, discuss their progress through the international negotiations at the 16th meeting of the CBD Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) and COP11, and look to the future.

Eakin, C. Mark, *National Oceanic and Atmospheric Administration*; **Russell Brainard**, *National Oceanic and Atmospheric Administration*; **Charles Birkeland**, *University of Hawaii at Manoa*; **Paul McElhany**, *National Oceanic and Atmospheric Administration*; **Margaret Miller**, *National Oceanic and Atmospheric Administration*; **Matt Patterson**,

National Park Service; **Gregory Piniak**, *National Oceanic and Atmospheric Administration*; **Matthew Dunlap**, *University of Hawaii at Manoa*; **Mariska Weijerman**, *University of Hawaii at Manoa*

Incorporating Climate Change and Ocean Acidification into Extinction Risk Assessments for 82 Coral Species

Ocean warming and acidification threaten many species with extinction, but species-specific impacts remain difficult to predict. Marine invertebrate species facing potential extinction are often rare, with uncertain taxonomies and poorly known life history and ecological traits. This makes determining extinction risks challenging, and is best met through integration across multiple scientific disciplines. In 2009, the U.S. National Oceanic and Atmospheric Administration (NOAA) was petitioned to list 83 tropical, reef-building coral species as endangered or threatened under the U.S. Endangered Species Act (ESA). An expert Biological Review Team (BRT) assessed the extinction potential for each species using an expert-based approach. The BRT determined that warming and ocean acidification posed two of the three most important extinction risks to corals. Species with wide geographic and habitat ranges and lower exposure or sensitivity to key threats were interpreted to be at less risk of extinction. NOAA has since proposed the listing of 12 of these species as endangered and 54 as threatened. As ocean warming and acidification are occurring globally, it has become clear that, while necessary, local management and conservation efforts alone are insufficient to conserve coral reef diversity. Efforts to address carbon dioxide emissions directly need to be implemented soon to prevent the loss of many species of corals and ecosystem services provided by coral reefs.

Ellis, Alicia, *University of Vermont*; **Taylor Ricketts**, *University of Vermont*; **Sam Myers**, *Harvard University*

Linking ecosystem services and human health: Crop pollination, nutrition, and burden of disease in developing countries

It has long been known that pollination is an important ecosystem service that improves crop yields, and recent research highlights the important nutrients derived from animal-pollinated crops. However, no studies have established an empirical relationship between pollination and actual health outcomes or identified populations that benefit most from pollination in terms of nutritional diseases. To establish these relationships, an integrated approach that links ecological and public health disciplines is needed. In this study, we ask how an incremental reduction in pollinators would affect diets, nutrient deficiency, and burden of disease in Kenya, Haiti, and Nepal, where incidence of nutritional diseases is high and access to nutrient supplements or replacement foods is limited. We use: (1) dietary consumption data, (2) ecological information on the effect of

pollination on crop yields, and (3) country-specific food composition tables to test the effects of pollination reduction on burden of disease. Pollination was important in all countries although the effect on nutritional health varied as a function of diet. Broadly, results suggest that while pollination is clearly important for food yields and security, its effects on nutritional health are location-dependent.

Elphick, Chris, *University of Connecticut*; **Michael Reed**, *Tufts University*; **Christopher Field**, *University of Connecticut*

Complex statistics and stakeholder engagement: Is a better analysis always a good idea?

Engaging stakeholders is crucial to successful conservation, but can be hampered when quantitatively complex and hard-to-explain modeling underlies scientific conclusions. Simultaneously, the use of complex analyses could improve engagement by making it easier to incorporate data that would compromise more traditional analyses. To explore the need for quantitative sophistication, we used a large 20-year data set to estimate survival rates for the Hawaiian stilt, an endangered island endemic. We used Markov chain Monte Carlo methods to fit hierarchical models and construct the complete data likelihood for both adult and sub-adult survival rates. Using data augmentation to estimate missing values and incorporate auxiliary data that were not collected during formal sampling allowed us to use all of the available data, much of which was collected via ad hoc sampling over many years by volunteers, agency biologists, and other stakeholders not initially involved in the study. We compared our results to those used in an exploratory population viability analysis, based on only two years of sampling in the 1990s. Surprisingly, we found little difference in average survival estimates, despite considerable variation in sub-adult survival among cohorts. In contrast, the ability to use all of the data in the new analyses provides much better information about variation and uncertainty. For some questions analytical complexity is clearly helpful, but it may not always be needed.

Engelhardt, Katharina, *University of Maryland Center for Environmental Science, Appalachian Lab*; **Maile Neel**, *University of Maryland College Park*; **Brittany West**, *University of Maryland College Park*; **Michael Lloyd**, *University of Maryland College Park*

The consequences of genetic and functional diversity on sustainability of *V. americana* patches

Reduced diversity of populations can have far-reaching consequences on ecosystem functioning and resilience when individuals within populations have lost the capacity to adapt or acclimate to changing environmental conditions. We focus on the effects of genetic and functional diversity on the performance and sustainability of *Vallisneria americana*, a

freshwater submersed aquatic macrophyte species that is common in the Chesapeake Bay, USA, but that has witnessed catastrophic declines. We genotyped individuals from 14 populations and cultured them to conduct greenhouse experiments that tested the effects of genotype richness on the growth, productivity and reproductive potential of individuals and populations. Individuals varied greatly in terms of allocation to lateral spread versus vertical growth and between asexual and sexual reproduction, which has implications for tradeoffs between persistence at a site versus dispersal among sites. The presence of flowers and the frequency of both sexes flowering in the same population increased with genotype diversity. The response we observed was a classic allee effect; more genotypes increase the chance that genotypes that flower more frequently are selected and that both sexes are represented. These observations have tremendous consequences for population genetic structure and sustainability because they show that the genetic and functional characteristics of populations determine whether adaptation and acclimation are possible.

Epler-Wood, Megan, *Cornell University*; **Mark Milstein**, *Cornell University*

Community Enterprise development strategies for tourism in protected area buffer zones

Efforts to improve benefits from tourism and arrest poor enterprise designs for communities living in buffer zones outside protected areas have frequently failed due to a poor understanding of tourism markets. Techniques to improve supply chains with a wide variety of local tourism products are well understood but usually not financed. Capacity building solutions cannot help communities who cannot reach the marketplace without more support from tour operators, hoteliers, or other major players due to the complexities of the international tourism marketplace. The authors will supply a variety of tested approaches to improving enterprise development in buffer zones. New approaches to connect local community products to tourism buyers could be highly successful if the existing marketplace is simply financed for the cost of performing local community enterprise development during the period of support from donors. This presentation will provide examples of how socially and environmentally responsible tourism businesses can help develop and boost local community businesses in buffer zones without massive capital infusions but rather with technical support funding for innovative procurement strategies and community development partnerships with local, regional and international tourism buyers.

Erez, Elana, *Tel Aviv University*; **Rakefet Sela-Sheffy**, *Tel Aviv University*; **Avi Bar Massada**, *University of Haifa-Oranim*; **Uri Shanas**, *University of Haifa-Oranim*

Public participation in the process of declaring a biosphere region: cultural and ecological perspectives

Megiddo Regional Council is a rural area in northwestern Israel, comprising thirteen agricultural settlements and having roughly 90% of its land as an open space. An intensive process, led by the council and involving its residents, culminated in 2011 in UNESCO's Man and Biosphere Programme declaring the region as the Ramat Menashe Biosphere Region. We aim to compare how and whether the values of the residents, as manifested in the final decisions on the location of core areas, concord with biological data. We conducted interviews with residents who took part in the process. Using discourse analysis methods, we recognize a "rural identity" which the residents value as a symbolic and a political capital. We show that this identity was the motive that pushed forward the creation of the Biosphere Region. Based on species observations within the council's area, we created species distribution models using MaxEnt for ten iconic vertebrates. We identified biodiversity hot spots by overlaying and averaging the predicted distribution maps, and found that they are not sufficiently captured by the actual core zones of the biosphere region. Using the two perspectives above, we highlight the biosphere-reserve concept: the chosen core zones, which do not best reflect the biodiversity of the region, have a major role in the residents' identity. As such they might get a better chance of being preserved over the years, but might not encompass preservation for the entire fauna and flora.

Estes, Lyndon, *Princeton University*; **Lydie-Line Paroz**, *NA*; **Bethany Bradley**, *University of Massachusetts*; **Jonathan Green**, *Princeton University*; **David Hole**, *Conservation International*; **Stephen Holness**, *Nelson Mandela Metropolitan University*; **Guy Ziv**, *Natural Capital Project*; **Michael Oppenheimer**, *Princeton University*; **David Wilcove**, *Princeton University*

Using Changes in Agricultural Potential to Quantify Future Climate-Induced Risk to Conservation

Most biodiversity-related climate change impacts research focuses on direct effects to species and ecosystems. Little attention is given to the potential ecological consequences of human climate adaptation, which may equal or exceed the direct effects on biodiversity. Agriculture adaptation may have particularly large biodiversity impacts. As farmers respond to changing climates, they may seek to convert new lands while leaving others as agricultural suitability changes. We quantified how the agro-economic potential of South African conservation areas may be altered by climate change. We

assumed that the probability of an area being farmed is linked to the economic benefits of doing so, using crop productivity as a proxy for production benefit and topographic ruggedness as a proxy for production costs. We simulated current and future maize and wheat productivity in key conservation areas using the DSSAT4.5 model and 36 crop-climate response scenarios. Most conservation areas currently have, and will continue to have, low agricultural potential because of their location in rugged terrain. We highlight several areas that may gain in agricultural value and thus face greater risk of conversion to cropland. Several areas are likely to lose agro-economic potential and may prove easier to protect from conversion. Our study provides an approximate but easily applicable method for incorporating potential human climate change adaptation responses into conservation planning.

Evans, Karl, *University of Sheffield*

Factors shaping urban bird assemblages.

Not Provided

Farnsworth, Matthew, *Conservation Science Partners, Inc.*; **Ericka Hegeman**, *Conservation Science Partners, Inc.*; **Luke Zachmann**, *Conservation Science Partners, Inc.*; **Kelly Herbinson**, *Pioneer Ecological Consulting*; **Thomas Jackson**, *Kaweah Biological Consulting*; **Brett Dickson**, *Conservation Science Partners, Inc.*

Differential space use patterns by translocated, control, and resident Mojave desert tortoise (*Gopherus agassizii*) in the Ivanpah Valley, CA, USA

The need for renewable energy sources in the U.S. has led to a dramatic growth in the development of solar energy, which frequently occurs in locations inhabited by the Mojave desert tortoise, *Gopherus agassizii*. The translocation of desert tortoises has become a common conservation tool for this federally threatened species. To understand how space use differed between approximately 400 translocated, resident, and control groups of tortoises in the Ivanpah Valley, CA, USA, location data were collected using radio tracking on an approximately weekly basis. At each encounter, information on tortoise habitat use (e.g., in burrow, cover type) was noted by field biologists. From a suite of demographic and environmental variables, we developed a candidate set of statistical models to 1) compare occurrence probabilities for each habitat type at individual and group levels, and 2) identify which environmental and demographic variables most strongly influenced those probabilities. We found that space use patterns differed for translocated tortoises when compared to the resident and control groups. Our results suggest that newly translocated tortoises spend more time above ground than resident or control groups, possibly while establishing new home ranges. As translocation activities

increase, it remains important to identify the effects of translocation on tortoise space use patterns, and, ultimately, how those patterns influence survival in a region of rapid energy development.

Fauchald, Per, *Norwegian Institute for Nature Research*; **Vera Hausner**, *University of Tromsø*

Indigenous subsistence harvest in the Arctic: a sustainable socio-ecological system?

The harvest of wildlife is an important ecosystem service in small resource dependent communities worldwide. In some regions, this harvest is also considered among the greatest threats to biodiversity. Here, we investigate how subsistence-based communities in the circumpolar Arctic tundra region fit to three distinct models of the socio-ecological system. The conservation model predicts that population growth, new hunting technology and poverty will result in increased hunting pressure, and that a biodiversity crisis only can be avoided through poverty alleviation and stronger regulations. Under the stewardship model, the hunters regulate the productivity of the system through active management. Lack of sustainability is related to poor knowledge and governance, and adaptive co-management is advocated as a solution. According to the indigenous model, hunters and wildlife have co-evolved to form resilient socio-ecological systems. The hunters do not control the resource; they adapt to the natural fluctuations, and the management authority should be transferred to the local communities. We used population statistics, harvest data, management reports and literature review to evaluate the evidence for the three models. The harvest is poorly regulated by the governments. There is little evidence that the subsistence hunting affect biodiversity and the communities have evolved a range of adaptations to a variable resource. Our study does therefore support the indigenous model.

Feaga, James, *Mississippi State University*; **Francisco Vilella**, *USGS Cooperative Fish & Wildlife Research Unit*

Winter Waterbird Use and Food Resources of Aquaculture Facilities in Mississippi

The conversion of wetlands and bottomlands to aquaculture provided alternate aquatic habitat for a variety of waterbirds. In response to the 2010 British Petroleum oil spill, the National Resource Conservation Service (NRCS) enacted the Migratory Bird Habitat Initiative (MBHI). The NRCS partnered with landowners and managers through easements to provide additional habitat for migrating waterbirds. Eligible lands included aquaculture and farm land, which provided mudflats and shallow water. In addition to easements, the NRCS sponsored research to evaluate the MBHI relative to avian response and food availability in the

Mississippi Alluvial Valley (MAV). Our study area included 12 idled and production aquaculture sites throughout the Mississippi portion of the MAV. Our objectives were to: (1) assess winter waterbird abundance and diversity in aquaculture ponds during winters of 2011-2012 and 2012-2013, (2) compare current winter waterbird use of aquaculture ponds with historical data, and (3) estimate invertebrate and seed abundances in aquaculture ponds. Production sites exhibited less dynamic fluxes in bird abundance than idled sites, with peak use in mid-December 2011. Idled sites had similar peaks in mid-December 2011 and late January 2012. While conditions provided by aquaculture are not a substitute for restoration and management of natural wetlands, our results suggest these environments provide important migration and wintering habitat for a diverse waterbird community.

Fernandez, Miriam, *Pontificia Universidad de Chile*

Large-Scale Ecosystem Analyses of the Easter Islands Archipelago: Implications for Increased Marine Protection

Currently my research projects concentrate, on one side, on studies of the latitudinal distribution of modes of development of marine invertebrates, and the consequences of the potential for dispersal of marine species for fisheries management and conservation. On the other side, we are trying to understand the evolutionary context that favored the great diversity of modes of development that we observe among marine invertebrates.

Ferrol-Schulte, Daniella, *Leibniz Centre for Tropical Marine Ecology*; **Sebastian Ferse**, *Leibniz Centre for Tropical Marine Ecology*; **Marion Glaser**, *Leibniz Centre for Tropical Marine Ecology*

Exploring drivers of natural resource overexploitation in tropical coastal communities

It is no secret that livelihoods in developing countries, including in areas of high biodiversity and endemism, often depend heavily on natural resources. Understanding not only what these livelihoods are, but their dynamism within social-ecological systems, is one of the many keys to truly effective and equitable natural resource management. This project focuses on one of the driving aspects of coastal and marine resource-dependent livelihoods in Zanzibar and Indonesia, namely patron-client systems in small-scale fishing households. Using questionnaires and interviews under the Sustainable Livelihoods Framework, we can determine what role these systems play in shaping the character and extent of natural resource dependence. We can also identify where the key drivers of exploitation originate from. In the case of Zanzibar we can see that growing tourism interacts with

patron-client systems to push fishermen into unsustainable practises. In Indonesia, patrons are found to be a crucial link between foreign markets and local fishermen, resulting in devastating sequential resource over-exploitation. The lesson for natural resource managers and conservationists is that social networks, household livelihood security and individual actors can play determining roles in local knowledge transfer, values and exploitation patterns in areas of poverty and/or high natural resource dependency.

Figel, Joe, *University of Central Florida*

The Development of the Palm Oil Industry in Mesoamerica and Potential Impacts on the Jaguar Corridor

Extending from northern Mexico to northern Argentina, the range-wide Jaguar Corridor is one of the largest working models for wildlife conservation in the world. One of the most proximate threats to the Jaguar Corridor is the burgeoning palm oil industry, advancing the development of expansive plantations at key linkages in the corridor. My study sites in the Magdalena region of Colombia and north coast of Honduras have the highest conservation priority anywhere within the Jaguar Corridor, in part due to their geographic location and projected palm oil expansion. Jaguars can cross and even use small agricultural patches but extensive acreages of oil palm mono-cropping may present a formidable barrier to movement. My ongoing study uses camera-trap and interview data on jaguars and their prey to evaluate the habitat characteristics and configurations in oil palm plantations that predict jaguar presence and could potentially support their persistence. Study results will guide the implementation of better land use planning and zoning measures, both of which are crucial for improving the connectivity value of oil palm landscapes within the Jaguar Corridor.

Findlay, C. Scott, *University of Ottawa*

Using Student Power to Assess the Status of Species Recovery Under the Endangered Species Act

Fitzgerald, John M., *SCB Policy Director*

SCB's Policy Symposium, Policy Program, Recommendations to the Obama Administration, Climate Leaders & Others

This presentation will provide an overview of the symposium and highlight key questions that will arise throughout the day. First, we will demonstrate how SCB members can participate in this Policy Symposium and in our Policy Program, how they can use SCB's "Recommendations to the

Obama Administration 2.0", become "Ambassadors of Science" in the climate debate, and take other initiatives to bring the best available science to policy makers globally, nationally and locally. We will describe some of the most powerful but underused elements of international and domestic conservation law, and some of the key terms which, if better defined in light of modern science, could become more effective tools for conservation and for helping to ensure that science drives the decision-making and regulatory processes. We will expl 牯∩濂?条淡楣徽映溪惚柿攏灸犄4 慰瑄振灑瓏溼 湮瑛故耀冷浥歡∩抽捌徽∩潤冷 浩抽 癯∩桴∩愼慮 条淡沱攔挽獫溼爾圪∩楷莖愼獬 轴灯獫∩ 馮愼灰稍捡∩桴瓏∩馮攏灭警犂漆稍捡 梯嗽撈湯敦癩瓏 溼 馮 次浩瓏∩潰榻楣徽乘 桴∩牡溪 景乘璠犂慮梯湯 汚瑛備黠∩42愼穀故獮 囿偃∩琳乃 W醅璠来備梯 柿映敲棒慷整∩挽獫獫整獫乘璠 轴瑯挽整 牡槌漆械牯 瑩敦∩馮 僅擎搖瀾∩汰馮楮柿∩吁牯敲瑤械汚燧慵梯 P 愼擎攏瑤慵械敲漆稍整瑣揚愼敲 愁慮敲獲愼敲愼莖眠 瓏犂耀徽峻捲徽淨馮条犂 w 眠敲桴犂瑛敲∩敲污穩∩豎 漠∩潮∩螢警

Fleischman, Forrest, *Dartmouth Environmental Studies*;
Claudia Rodriguez-Solorzano, *Dartmouth College*

What influences how internationally adjoining protected area managers in the Americas respond to land use change?

What influences decisions by protected area managers? In this paper we examine the responses that protected area managers make to land use change within their protected areas. Theories from public administration and political science suggest two primary types of influences: policy networks and constraints, such as political pressures or budgets. We test these alternative hypotheses utilizing a unique dataset of internationally adjoining protected area managers in North, Central, and South America. An emphasis on policy networks would lead us to predict that managers of adjoining protected areas, particularly those that have international cooperation agreements, would behave similarly. In contrast, an emphasis on constraints would lead us to predict that managers of protected areas which face similar constraints would behave similarly. Important constraints, such as political pressures and budgets are determined independently from international boundaries, by political processes internal to individual countries. We examine the responses that protected area managers make to land use change, and find that constraints play a more important role than networks. This implies that creating resources for protected area managers may be a more effective conservation tool than creating exchanges between them.

Forman, Richard, *Harvard University*

The Netway System: Recovering Lost Ground, Reconnecting the Land, and Solving Big Transportation Problems

Our massive road-vehicle transportation system, a central catalyst for society, has diced the land into fragments with ramifying ecological and human effects. Road ecology principles and solutions, barely a decade old, are producing accelerated successes. Yet worldwide, increasing rates of both road construction and vehicle use far outstrip our mitigations. Transportation also now faces huge problems (fuel, CO₂, congestion, accidents, bridges, funds). Could a significant portion of the land covered (e.g. >1% of USA) and ecologically degraded (>15% USA) by road corridors be recovered, and the rest of the land reconnected, quickly? A transportation system, based on renewable-energy electric-induction-transported pods under automated control on narrow elevated-to-sunken ways, with flexibility permitting efficient individual driving on ground-level roads, is outlined for the immediate future. No driving, no accidents, no fossil fuel use, no greenhouse gas or unhealthy pollutant emissions, more efficient relaxed travel. No roadkills, no wildlife barrier, no traffic-noise effect, new trail networks, market-gardening space, extensive recovered land, reconnected nature. The last transformation of surface transportation leaped from horsepower on dusty muddy roads in 1900 to motorized vehicles on black-top surfaces in 1925. It is time for the next 25-yr step pronto. Reverse our downward spiral, and create a multi-goal success for both nature and society.

Forrester, Tavis, *Smithsonian Institution*; **Roland Kays**, *North Carolina Museum of Natural Sciences*; **Bill McShea**, *Smithsonian Institution*; **Robert Costello**, *Smithsonian Institution*; **Megan Baker**, *Smithsonian Institution*; **Arielle Parsons**, *North Carolina Museum of Natural Sciences*

eMammal - A solution for broad-scale, long-term monitoring of wildlife populations

Nearly 20% of mammals are threatened or endangered, yet we have no long term, broad scale abundance and distribution data for these species. eMammal is a new initiative that integrates camera trap data from researchers with a growing citizen science effort to increase the spatial and temporal scale of survey data. We launched the citizen science camera trapping effort in the mid-Atlantic region of the USA. Volunteers are trained to set camera traps, receive instructions from the eMammal website, deploy cameras in protected areas, and identify and upload pictures using custom software. eMammal uses a cloud based workflow that includes a volunteer website, remote photo upload, expert review of photo ID to ensure data quality, and storage of

photos and meta-data in a Smithsonian digital repository. Around 2 million researcher camera trap images from projects around the world are being entered in the same repository, which will soon be publically accessible. In 2012, 85 volunteers deployed cameras to 750 sites in for 15,750 trap days in 12 protected areas, and collected hundreds of thousands of pictures. We are initially using this data to test hypotheses about the effect of hunting and hiking on wildlife populations. eMammal is a framework for citizen scientists and professional researchers to build publically accessible, frequently updated, landscape scale wildlife datasets to enable conservation and education in today's rapidly changing world.

Foster, Sarah, *Project Seahorse, Fisheries Centre, The University of British Columbia*

Trawler trash: recognizing the impacts of shrimp trawling on small fishes

We know next to nothing about the impacts of tropical shrimp trawlers on the vast majority species found at the bottom of their nets - the small fishes. The wide range of potential impacts makes it hard to predict how a species may respond to trawling, but the few studies that have applied data-poor approaches to fisheries assessment suggest that at least some small fishes - those with specialised life histories, or whose reproductive peak overlaps with peaks in trawl effort - show potential for overfishing. These studies call for a re-evaluation of the status of small species which have generally been considered resilient to fishing pressures. But even these methods are too data intensive to be viable for the hundreds of small fishes captured in hundreds of shrimp trawl fisheries, and too inconclusive to confirm impact. Thus, it may be necessary to apply precautionary methods to avoid potential effects of indiscriminate trawling. The perceived economic importance of shrimp fisheries in tropical countries means that lessening the problem requires pragmatic approaches that consider both socioeconomic and ecological goals. I argue that seasonal or regional closures to trawling may be the most pragmatic, practicable ways to reduce bycatch of small fish species globally. Finally, I present several research questions related to shrimp turned 'trash' fisheries that need immediate attention, lest the small fish bycatch issue become even more challenging to address.

Fox, Helen, *WWF-US*; **Robert Pomeroy**, *University of Connecticut Avery Point Campus*; **Gabby Ahmadi**, *WWF-US*; **Arun Agrawal**, *University of Michigan*; **Xavier Basurto**, *Duke University*; **Louise Glew**, *WWF-US*; **Michael Mascia**, *WWF-US*; **Nasser Olwero**, *WWF-US*; **John Parks**, *Marine Management Solutions LLC*

Solving the mystery of marine protected area (MPA) performance: linking governance, conservation, ecosystem services, and human well being

As awareness of the importance of marine ecosystem services grows, so too does the recognition that better governance of social-ecological systems (SES) is critical to sustainability. An interdisciplinary team is unpacking the links between marine protected area (MPA) governance and ecosystem structure, function, and services, drawing upon the seminal work of Elinor Ostrom and building on existing efforts. With a cross-disciplinary theoretical framework and a common analytic platform (i.e., database) we will document the social and ecological impacts of MPAs at local, regional, and global scales by synthesizing existing interdisciplinary monitoring data from many MPAs. These datasets have been collected by MPA managers and scientists, with different levels of methodological rigor, but their collective power and emergent insights for both science and policy have not yet been tapped. Moreover, we are addressing a critical but under-recognized obstacle to adaptive management: the absence of a platform to turn raw MPA monitoring data into actionable information. MPA managers often struggle to effectively store, manage, process, and analyze monitoring data - especially in developing countries. Widespread adoption of an open-source MPA monitoring database would establish a new standard for increasingly rigorous monitoring of MPAs, empowering MPA managers and fostering adaptive management.

Frascaroli, Fabrizio, *University of Zurich*

The contested link between Western Christianity and conservation: ecological and cultural values of shrines and pilgrimage sites in Central Italy

Over the last years, the relation between spiritual values and conservation has received growing attention by ecologists and practitioners. Not the least, a clear connection between sacred areas and biodiversity has been highlighted in a number of instances throughout East Asia and Africa. Such a link, however, remains vastly underexplored in Western Christian contexts, probably also due to a dominant view of Christianity as essentially anti-naturalistic and Western societies as entirely secularized. Here, I rely on first-hand ecological data to demonstrate that, on the contrary, also Catholic sites in Central Italy play an important role for the conservation of biological diversity. Further, although the sites in question are no longer crucial for the livelihoods of local populations, they remain fundamental for maintaining social cohesion, cultural traditions, and as sources of local identities.

Fujitani, Marie, *Arizona State University*; **Eli Fenichel**, *Yale School of Forestry & Environmental Studies*; **Joshua Abbott**, *Arizona State University School of Sustainability*

Using changes in recreational angler site demand to infer the cost imposed by a marine reserve in the central Gulf of California, Mexico

Marine reserves regulate people by adjusting costs and incentives to alter the behavior of human users, for example by reducing fishing visits with a fine. Understanding how a reserve alters the landscape of human use provides insight into how the reserve is functioning mechanistically and can assist passive adaptive management. I use a novel dataset that is a complete census of recreational fishing trips taken by a large recreational angling community in the Gulf of California, Mexico, over nine years. I use discrete choice models to show that the creation of the marine reserve only temporarily decreased visitation to the reserve site. I determine the actual additional travel cost (in expected enforced trespassing penalties) the anglers perceived the reserve imposed upon them. This value is very small, especially compared to the total cost of travel to the reserve site. Such a small cost increase likely had little effect on behavior, and would explain why the reserve was unable to reduce visits in the long term. I use the model to project the different "fines" that would be necessary to reduce site visitation by a given percentage. I find this relationship to be non-linear, such that eventually the fine to reduce each additional percent of site visitation skyrockets. If a small amount of reserve non-compliance is deemed acceptable to reserve goals, these results suggest for this system a data-driven level of fine that should be both effective and not undesirably high.

Gal, Adiv, *Kibbutzim College of Education, Technology & the Arts*; **Amir Arnon**, *Ramat Hanadiv Nature Park*; **Tal Gaiger**, *Kibbutzim College of Education, Technology & the Arts*; **Iris Rainer**, *Kibbutzim College of Education, Technology & the Arts*; **Liat Hadar**, *Ramat Hanadiv Nature Park*.

Identifying potential wildlife corridors to improve the connectivity between a Mediterranean nature park and its surroundings, using camera traps

Preventing habitat fragmentation is one of the means in wildlife conservation. This challenge is greater in a small country with rapid development, where conflicts between conservation and development are on decision makers' agenda daily. We examined ways to prevent isolation of a 500-hectare nature park in the Mediterranean region of Israel, extremely rich in fauna; It is monitored routinely as part of an LTER monitoring program to define the management that best conserves the local biodiversity. The park is surrounded by building, industry, railways and a quarry. The park's connectivity to nearby natural habitats is threatened by a significant widening of the road along its eastern border and the expansion of an adjacent industrial area. In order to

identify passages most used by wildlife in and out of the park, we mapped and characterized potential passages along the park's eastern border. In the 18 best ranked ones we set camera traps and monitored their use for a whole year. Data from the camera traps was related to different sections of the border and to a roadkill survey conducted along the road nearby. While the proportion distribution of crossings by animals varied between sections, one section was favored by most species. This section, through which around 70% of all crossings occurred, was also adjacent to a roadkill hotspot. We therefore recommend that to preserve viable populations, a wildlife corridor should be created at that section.

Gallo Santos, Jenny, *Fundacion Ecodiversidad Colombia*

Project Golden Frog Supatá: An Example in Conservation.

The golden frog is an amphibian Supatá which was discovered in 2007. Since this event began the project "Golden Frog Supatá" thanks to its ecology studies have concluded that one of the most ameazados amphibians to extinction in Colombia. The project's objective is to make the local community appropriates their preservation. For over five years, the foundation has implemented Colombia ecodiversity Management Plan and Conservation with various environmental activities and scientific research including community activities. The most outstanding achievements are 1.) This amphibian was declared a Natural Heritage of the municipality in 2008. 2.) Institutionalized the Golden Frog Festival which is now in its fifth version, 3.) 250 children have been trained as environmental leaders, whose overall objective is to develop a local conservation initiative that contributes to the conservation of amphibians in this county. 4.) Sustainability of the project was held in the town's first athletic career, these resources allow revegetation make a day in the habitat of this amphibian.

Game, Eddie, *The Nature Conservancy*

The death of strategic conservation?

Opportunism is a driving force in conservation spending. Failure to acknowledge the important role of opportunism in modern conservation has consigned many conservation plans to the graveyard for type III errors; good answers to the wrong question. I argue that we have entered an era where conservation will inevitably be even more opportunistic. Is it even possible to be strategic and opportunistic at the same time? I discuss the role of conservation planning in this brave new world, and how the discipline can change do to help navigate the complex terrain of opportunism. I conclude with a discussion about how the concept of opportunism can be integrated into conservation opportunity assessments.

John Gallo, *The Wilderness Society*; **Amanda Lombard**, *Nelson Mandela Metropolitan University*

LandAdvisor: A "living" decision support system supporting cost-effective and connected allocation of different management approaches on the landscape

In an increasingly dynamic and uncertain world due to climate change and other stressors, it is important to have decision support systems (DSS) that are living, flexible, transparent, and integrated. LandAdvisor DSS does this as a framework and tool to help organizations decide where to conserve, how (i.e. acquisition, stewardship, etc.), and why. It uses a "return on investment" approach to blend the objectives of NatureServe Vista, Marxan with Zones, and CorridorDesigner. A site valuation process combines with an algorithm allocating a variety of land management options in near-optimal solution sets while considering factors such as contiguity, representation, naturalness, management quality, and connectivity. The connectivity algorithm prioritizes not only paths within a linkage, but also linkages within a landscape. LandAdvisor is available as an open-access ArcGIS Toolbox. A consensus-based approach to setting some weights was a means for stakeholder collaboration. An assumptions sensitivity analysis evaluated the impact of various conservation planning assumptions made in the last two decades. Surprisingly, the biggest influence was properly valuing the contribution of private conservation areas to the conservation network. Meanwhile, assumptions affecting optimal representation had relatively low

influence. LandAdvisor is an exciting new application for conservation planning and management, and also a framework for exploring the science of conservation.

Garner, Trent, *IoZ, ZSL*

The European Threat Abatement Plan for chytridiomycosis: a work in progress

Batrachochytrium dendrobatidis is arguably the most important infectious disease posing a threat to wildlife today. Despite the ability of this fungus to cause amphibian decline and species extinction, and its listing by the OIE, national and international plans to combat the threat of chytridiomycosis are thin on the ground. In Europe, lethal chytridiomycosis was first identified in 1997 and by 2005 infection had been detected in 5 countries. In response, a consortium of institutions acquired EU funding through the BiodivERsA scheme to better determine the scope of the problem in Europe and developed the European Threat Abatement Plan (ETAP). This project (R.A.C.E.; Risk Assessment of Chytridiomycosis to Europe's amphibians) completes in 2013 and I will report some of the findings that will be incorporated into the ETAP. These include: 1) evidence in support of introduction of infection through human activities; 2) the unpredictability of temperature as a factor influencing transmission, disease and mortality, and; 3) a preliminary risk assessment of species susceptibility

Gatica, Alejandro, *University of La Serena, Institute of Ecology and Biodiversity*; **Carolina Vega**, *University of La Serena, Institute of Ecology and Biodiversity (IEB)*; **Claudia Fernández**, *University Catholic of North*; **Patricio García**, *University of La Serena, Institute of Ecology and Biodiversity (IEB)*; **Ramiro López**, *University of La Serena, Institute of Ecology and Biodiversity (IEB)*; **Lorgio Aguilera**, *University of La Serena, University Catholic of North*; **Carlos Gaymer**, *University Catholic of North, Institute of Ecology and Biodiversity (IEB)*; **Francisco Squeo**, *University of La Serena, Institute of Ecology and Biodiversity (IEB), Center of*

Impacts of human activities and conservation priority in coastal wetlands of the Chilean Atacama Desert

Wetlands are the habitats for a diversity of plants and are also zones of feeding, resting and breeding for a large numbers of birds. However, these ecosystems are being threatened by habitat loss due to human activities. In the coastal fringe of the Atacama Desert, Chile, there are an important number of wetlands which are influenced by the increase in industrial activities and urban growth. Yet, little is known about these wetlands and the scarce information is highly dispersed. Our

aims were: a) to describe the biodiversity and conservation status (IUCN) of plants and birds; b) to quantify, through photointerpretation of satellite imagery, the area impacted by human activities in the wetlands; and c) to prioritize the protection of wetlands by a habitat loss index (HLI) which considered nine variables (e.g., wetland size, road length, urbanized area). We found 611 plant species (180 native, 326 endemic, 105 alien), and 188 species of birds (53 visitors and 135 residents). The impacts of the most common human activities were construction of roads, proximity to urban centers, crops, and industrial activity. The most threatened wetlands were those which are inserted in urban zones, and we consider these as a priority sites for conservation. This type of information can provide valuable assistance to local decision makers and may allow better regulation of human activities in areas of high biodiversity.

Geldmann, Jonas, *Center for Macroecology, Evolution and Climate*; **Lucas Joppa**, *Microsoft Research and UNEP World Conservation Monitoring Centre*; **Neil Burgess**, *Center for Macroecology, Evolution and Climate*

The human footprint 1995-2010: Spatial and temporal changes in human threats to wild nature and impacts on protected areas

The 'Human Footprint' index, published in 2002, was a static map widely used as a surrogate for human impacts on wild nature around the world. We have developed a spatially explicit and temporal map of the human footprint that is applicable globally at a resolution of 5 km². This map is based on a comprehensive evaluation of nine different categories of threat to biodiversity and comprises the two global threat-layers which could be compared spatially and temporally. This map estimates not only accumulated global human pressure, but also shows how this has changed across geo-political regions and in protected areas. Over 15 years we find little support for the common perception of protected areas assigned less strict IUCN categories (V and VI) are always worse, and we also find great continental differences in protected area performance. These findings are discussed in relation to the effectiveness of protected areas at conserving habitat and species; the limitations of our approach are also elaborated and ways forward outlined.

Geoghegan, Claire, *University of Pretoria South Africa*

Implementing transdisciplinary and health-conservation projects in rural and under-resourced areas.

Natural resource conservation and the health of people and animals are often seen as conflicting priorities, especially in areas with increasing human populations. Using an example from South Africa, this paper illustrates the utility of combining human, animal and environmental health for the

benefit of conservation and communities in rural and under-resourced areas. We demonstrate that by recognising the links between land use, community health, livestock-based livelihoods, and the survival of protected and free-roaming wildlife populations, programmes can improve natural resource conservation while simultaneously reducing the risks of emerging disease. Using a combination of clinical, environmental and social data, we describe the process and benefits of encouraging expertise while implementing a trans-disciplinary approach to tackle emerging zoonotic and food-borne pathogens across traditionally separate health sectors, conservation services and spatial boundaries. Finally, by identifying the incentives and priorities of multiple-stakeholders, we argue that collaborative interventions may be developed to include community-led solutions as well as stimulating policy-level change for improved human, animal and ecological health.

Ghazaryan, Astghik, *Yerevan State University*; **Tigran Hayrapetyan**, *Yerevan State University*; **George Papov**, *Yerevan State University*

Unknown status of *Sicista armenica* in Armenia

There are 34 species of rodents dwelling in Armenia. Among them one is endemic species *Sicista armenica* (Armenian birch mouse) for Armenian plateau, which is listed in IUCN Red List as endangered species. According to literature data last time 3 individuals of Armenian birch mouse were captured from Hanqavan province in 1986 by Sokolov and Baskevich. We started our study this summer tried to find the Armenian birch mouse in Hanqavan. During our researches we have caught 331 animals, (mainly shrews and voles) but no Armenian Birch mouse in both Pambak and Tcaghkuntanc ridge. We find data in old literature where described places for *Sicista cacuasia*: Sevan and Zangezur. We believe that animals were coated in Zangezur and Sevan and listed in old literature as *Sicista cacuasia* actually were *Sicista armenica*. Referring to this information we are going to continue our studies in Zangezur and Sevan.

Gibbs, Samantha, *U.S. Fish and Wildlife Service*

Seeking refuge: wildlife health and conservation across a patchwork of protected lands

The National Wildlife Refuge System protects fish and wildlife habitats across a patchwork of 150 million acres of land and water. Home to 700 species of birds, 220 species of mammals, 250 reptile and amphibian species and more than 1,000 species of fish, the refuges also welcome more than 45 million human guests each year. Expanding anthropogenic activities on the surrounding landscapes are placing increasing pressure on refuges to provide recreational opportunities as well as food resources and breeding grounds for wildlife. This

draws animals in to close contact with one another, with domestic animals, and with humans, exceeding the carrying capacity of protected areas and sometimes exacerbating annual disease cycles. Mortality surveillance and disease diagnosis have been conducted on Refuge lands for over 35 years, allowing identification of areas with emerging and chronic disease issues. Armed with historical and contemporary disease diagnostic information, it is now time to place increased emphasis on adjusting wildlife management strategies to prevent disease.

Gill, Jacquelyn, *Brown University*

Rapidly changing actors on the stage: climate change, megafaunal extinctions, and novel plant communities at the Pleistocene-Holocene boundary

The transition from the last ice age to our current interglacial was a time of widespread environmental upheaval, including the arrival of humans to North America, warming temperatures punctuated by rapid climatic events, melting ice sheets, and the extinction of 34 genera of megafauna. Meanwhile, plant species underwent extensive individualistic shifts in their ranges and abundances in response to these global changes. This talk approaches “conserving the stage” (e.g., using geophysical units in conservation) from a paleoecological perspective, using a case study of the formation of widespread novel communities in the Great Lakes region from 14,500 to 12,500 BP. To test the role of the end-Pleistocene extinctions in the formation of “no-analog” plant associations, we present several lake sediment records of fossil pollen and charcoal to reconstruct vegetation and fire history. The timing of megafaunal collapse is established using spores from the dung fungus *Sporormiella* preserved in sediments. Our results show that novel climates and the loss of keystone megaherbivores ga

敲模敷响吹敌渠瓠牵污攥灸妨浩淡濠漠回桴回慰璫耀癸糙
桴瓠挠涸除楮楮徽温孺迨汜回馮 櫛慳孺迨汜回耗煥敵
璫徃槩 敲欠湯數典 汧扯污挠慨柿 a 温擊璫慨4暈档璫
懶瓠瑩溟瓠渾紫韻懶榘 榘攬 0 欵 \ 礎礎獲回传牵眠牯
欠槩猥璫 桴回敲揚璫 潤瓠摩妨欠祥璫湯回欠挽教回馮
潮敵 潤更瑩瑩教回重擱癸汶灯回潤瓠妨慶楮湯映懶敷
津歲回時械柿温濛妨溟 景膜渾慢 档馮敲回47温械敲耀
獵妨敵敲窠榘整撒槩璫来懶楮柿猥桴污渾馮条迨淡4
楮榘槩牡敵璫挠湯低汰耀冷獵槩 愨惱氣浩瑩瑩瑩懶
慣 楮榘妨教妥温械敲耀獵妨敵回牡回皖教瑩懶瓠挠湯
數癩回慨楮櫛 v 敲溟櫛敵獲璫 温擊温畢擊馮馮温擊
濛灯冷瓠溟 璫畚瓠牵回景攥灸渾瑩揚猥數楮微馮 淡慨
据回回楮榘妨教回桴桴杵回磁潰瓠漠回僅癩敲温擊温時塗回

涿敷嗽 W 捌徽悛整捌滄湯瑤備整 暈搗徽悛楷桴湮泮牡
漣凶敲數癩徽潤彌摩犸地敬撓慨茱涑敲凶敲愁漣

Glennon, Michale, *Wildlife Conservation Society*

Exurban Development and Wildlife: Lessons from the Adirondacks

The Adirondack Park is often hailed as one of the great experiments in conservation, a place that appears to contain ample habitat for both humans and wildlife. Where these habitats converge, however, impacts to ecological systems and communities can be significant. Low density exurban development is often perceived as benign. Because houses are spread out and the matrix remains in the original ecosystem type, effects to wildlife are assumed to be minimal. A growing body of work suggests the opposite. We have engaged in a number of studies to understand the impacts to wildlife from exurban development in the Adirondacks. Across various scales and taxa, we have explored the size of the ecological impact zone that surrounds exurban homes, the difference between ecological communities in subdivisions and control areas, the changes to wildlife communities that occur after a new home has been constructed, and how these impacts vary between the heavily forested Adirondack landscape and more open landscapes of the Rocky Mountain West. Our results suggest that, although the physical footprint of exurban development is small, effects to wildlife can extend up to 200m into surrounding forest, occur quite rapidly, result in similar impacts to varying taxonomic groups, and result in similar changes in disparate ecosystems. We collaborate actively with regional and local planners to translate this and other science to improve land use planning and policy in the northeast.

Goad, Erica, *Colorado State University*; **Liba Pejchar**, *Colorado State University*; **Richard Knight**, *Colorado State University*; **Sarah Reed**, *Colorado State University*

Life on the Fringe: Mammalian habitat use along a gradient of exurban housing density in Northern Colorado

Since the 1990s the American West has been one of the fastest growing regions in the United States, with "exurban" development occupying nearly five times more land than urban and suburban development combined. Few studies have addressed conservation issues associated with this widespread and rapid conversion of natural and agricultural lands to rural residential development. Understanding the effects of exurban development on biodiversity has important implications for public policy, conservation practice, connectivity, and land use planning. To assess exurban housing density impact on mammalian habitat use, wildlife

cameras were placed along a housing density gradient in a rapidly growing rural region of Colorado. Species occupancy was measured in summer and winter seasons and these data were analyzed in conjunction with a novel, acoustic-based approach to assessing human presence. Impacts of exurban housing density varied by species, with some species showing decreased activity and occupancy levels at higher housing densities, whereas others occurred more frequently in these areas. In particular, some species appear to use greenbelts in exurban areas, which suggest that the configuration of homes may be as important as density. This study demonstrates that the impacts of housing density are species -dependent and that incorporating open spaces into development projects may be critical to supporting wildlife in a region that will likely see continued exurban expansion.

Golden, Rachel, *University of Maryland*; **Roopa Krithivasan**, *World Wildlife Fund*; **Michael Mascia**, *World Wildlife Fund*; **William Fagan**, *University of Maryland*

Protected Area Downgrading, Downsizing and Degazettement (PADDD) in Yosemite National Park and the Sierra Nevadas

Traditionally, protected areas (PAs) are considered fail-safe means to conserve biodiversity and provide cultural resources. Although conservation practitioners and policy makers typically assume that PA boundaries are permanent, evidence suggests otherwise. Efforts to document 'protected area downgrading, downsizing, and degazettement' (PADDD) suggest that legal changes have been enacted since 1900 which have changed the size and strength of protected areas worldwide. We reviewed peer-reviewed and grey literature to document and analyze causes, trends, and patterns of PADDD in the United States. Over 2,000 PADDD events have been enacted or currently proposed in the United States from 1900 to the present, and have occurred in every decade across all federal agencies which manage public lands. In addition, we conducted a focused analysis of the landscape-level impacts of PADDD events on Yosemite National Park and the surrounding Sierra Nevada WWF ecoregion. Despite its high profile, Yosemite experienced two downsize events and one downgrade during its early history, the impacts of which can be measured today. In particular, these downsizes opened up 23% of the park's original area to infrastructure, forestry, and other industrial activities. Overall, the magnitude and pervasiveness of PADDD across space and time implies that even the most iconic protected areas should not be regarded as permanent fixtures on the landscape, but instead recognized as dynamic systems.

Gonçalves, Lucas, *PUCRS Brazil*; **Eduardo Eizirik**, *PUCRS Brazil*

GIS modeling of the geographic distribution of melanism in leopards (*Panthera pardus*): a baseline tool for the conservation of phenotypic diversity

Biodiversity conservation includes preserving adequate representation of existing variability and phenotypic diversity is prevalent among most life forms. Melanism is a common phenotypic polymorphism in wild felids, occurring naturally in 13 of 36 species of the group and still little is known even about its frequency, geographic distribution and environmental adaptation. In leopards (*Panthera pardus*) we have recently identified its molecular basis, induced by a mutation in the ASIP gene. To further investigate the evolution, ecology and design conservation strategies, this study focuses on its spatial distribution throughout the species' range. We analyzed 428 individuals (45 melanistic and 383 non-melanistic) obtained from captures, camera-traps and pelts, using vegetation maps and protected areas as layers in a GIS model, aiming to assess association between landscapes and the phenotype presence. Melanism was recorded in low frequencies in Africa and Iran, in high frequencies in India, Bhutan, Sri Lanka, Malay Peninsula and Java Island and was absent in the Arabian Peninsula and in far eastern Asia. If affirmed, this pattern may reveal significant association to some habitats, possibly influenced by adaptive processes. Therefore, the analysis of the geographic distribution and relative frequency of polymorphic phenotypes may be more important for biological conservation assessments and useful to setting priority areas for endangered wild cats conservation.

Gore, Meredith, *Michigan State University*

Rethinking corruption in conservation crime: insights from Madagascar

Corruption affects biodiversity conservation. Mechanisms that more effectively reform corruption and mitigate negative effects of corruption on conservation are needed, especially in biodiversity hotspots such as Madagascar. Local definitions of corrupt behavior, attitudes about reforms and motivations for noncompliance may generate deeper understanding about corruption, which in turn may advance the conservation community's thinking and invite new solutions. We conducted in-depth interviews with Malagasy residents living adjacent to the Makira/Masoala Conservation Area, querying perceptions about regional corruption, rules in use (i.e., social norms or rules in action), rule breaking and mechanisms for reform. Most participants framed noncompliance with conservation rules as a deficit/absence (e.g., lack of knowledge of rules), defined local corruption more as an omission of duty than a commission of crime, and discussed poverty, unfairness, and diverse rules in use related to corruption. Traditional framing of corruption singularly as a lack or absence of honesty and morality or as a normative phenomenon does not seem wholly accurate at reflecting, or for thinking about, the local context. Data herein allude such

inaccuracy may be most noteworthy at the level of corruption reform. Rethinking corruption in conservation crime as a blend of dimensions may liberalize the suite of reform mechanisms available to conservationists.

Gracey, Kyle, *Co-Chair SCB Treaties Task Force*

Are We Conveying the Big Picture to Decision-Makers? Implementing the Convention on Biological Diversity's Strategic Plan and other commitments

Several international efforts have, in recent years, tried to introduce expanded environmental valuation into policymaking around biodiversity use and conservation. The Convention on Biological Diversity's Strategic Plan, for example, calls on Parties in multiple ways to develop better indicators of biodiversity state, pressure, and response, adding more economic accounting of the biodiversity's value. Most parts of the plan are voluntary, however, so implementation has varied dramatically, with relatively large success in a few countries and more limited progress in many others. The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) is designed to provide an additional tool to evaluate and communicate these values to decision-makers, and outcomes from its first plenary session provide hints of the challenges and opportunities to achieve this. Efforts by the United Nations Statistics Division to harmonize environmental-economic accounting provide another opportunity, and we review progress and barriers to its implementation.

Grammer, Laura, *Stevenson University*; **Kimberly Tucker**, *Stevenson University*; **Katie Mistretta**, *Stevenson University*; **Hadassa Guttman**, *Stevenson University*

Identification of Microbial Biodiversity and Community Structure in the Baltimore Harbor

The Chesapeake Bay is the largest estuary in the United States with more than 150 rivers within its watershed, spanning across six densely populated states. Anthropogenic activity has affected the ecology of the Bay. For over a century, the Baltimore Harbor has been a major port of industry and commerce. On a macroscopic scale, it is apparent that the biodiversity has decreased over time; however, microbial communities have not been thoroughly studied in the Harbor. Studying microbial biodiversity is important when trying to understand the ecosystem as a whole, as they play important roles, contributing to nutrient cycling, population dynamics, and other processes. This research utilizes a combination of culture-independent methods to examine microbial biodiversity in the Harbor. Light microscopy is being used to observe the abundance and biodiversity of zooplankton and large phytoplankton. Epifluorescence microscopy is being used to observe the abundance of bacteria

and viruses. Finally, DNA techniques are being used to examine microbial eukaryotic, prokaryotic, and viral communities. Residents and industrial operations occupying these areas influence the overall health of the Bay, and communication with these groups is necessary. Understanding the biodiversity of the microbial communities can increase our knowledge of the species that can degrade harmful pollutants, affect the seafood population, drive evolutionary processes, and cause disease in humans and animals.

Grange, Zoe, *Massey University*; **Brett Gartrell**, *Massey University*; **Nicola Nelson**, *Victoria University of Wellington*; **Laryssa Howe**, *Massey University*; **Please Delete**, *Delete*; **Mary van Andel**, *Massey University*; **Nigel French**, *Massey University*

Investigating translocation mediated bacterial spread between isolated populations of endangered takahē, using a network approach

Human mediated relocation of vulnerable species poses the potential risk of susceptibility and transmission of disease. However, our understanding of the epidemiology of bacterial transmission within populations is limited. Since human colonization and subsequent introduction of invasive animals, New Zealand has had a high rate of species extinctions with many native fauna still vulnerable. As a consequence, intensive management and translocations have become increasingly common practice. We collated records of translocations of an endangered endemic flightless rail, the takahē (*Porphyrio hochstetteri*) and applied social network principles to describe connectivity of the movement network. Our analysis has identified locations acting as potential hubs, sinks and sources for bacterial dissemination and evolution within takahē. These locations are ideal priority targets for disease surveillance, with individuals tested from the sites likely to be representative of the population. We then collected fecal matter from over a third of the takahē population encompassing individuals from key locations and are testing each sample for the presence of common pathogens and commensals, with the intention of determining biogeographical patterns of prevalence. Translocation networks have the potential to provide epidemiological guidance to aid conservation decisions when considering a translocation and increase our knowledge of how potential pathogens could spread within a population.

Gratwicke, Brian, *Smithsonian Conservation Biology*

Building in-country capacity for ex-situ conservation in Panama

One of the major limiting factors in the global amphibian crisis is a lack of capacity in terms of full-time staff and

facilities dedicated to mitigating threats to amphibians. I will review basic methods in organizational capacity-building for conservation and explain how we are expanding facilities, infrastructure, and staff on the ground in Panama as part of the Panama Amphibian Rescue and Conservation Project. Our country-level strategic plan establishes ex-situ assurance colonies of up to 20 amphibian species threatened with extinction from chytridiomycosis and researches potential disease-management tools that will ultimately position us to re-establish populations of these species in the wild. This presentation provides a detailed glimpse behind the scenes of a single ex-situ conservation project working under the umbrella of the global Amphibian Ark program and the Amphibian Survival Alliance. These basic species management actions cannot be implemented without substantial organizational capacity-building and strong connections between disciplines, stakeholders and systems.

Green, Kevin, *Rare*; **Amielle DeWan**, *Rare*; **Nigel Asquith**, *Fundacion Natura Bolivia*; **Keith Alger**, *Rare*

Payments for watershed services as a driver of climate compatible development: What works and why?

Payments for watershed services (PWS) schemes have received considerable attention for their potential to deliver hydrological services in addition to biodiversity conservation objectives. With that success has followed additional hypotheses about co-benefits such as 'climate compatible development' (CCD), a construct designed to locate synergies between climate change mitigation, adaptation, and development. PWS has been widely popularized as a key nexus between diverse stakeholders and disciplines; however, there are many approaches to PWS that differ in structure and implementation. Locally-led reciprocal agreements seem more likely than national schemes to promote CCD. Epitomized by initiatives in Bolivia and Ecuador, these schemes (known locally as Arreglos Reciprosos por Agua, or ARAs) are locally-implemented and build on local social norms. In order to systematically evaluate contributions to climate compatible development, Rare and partners have developed a CCD index that captures the critical indicators of development, adaptation, and mitigation in the context of PWS. Initial results from an evaluation across a range of PWS types suggest that differing PWS project characteristics correspond to substantially different climate-compatible development outcomes, a key finding for stakeholders with varying objectives. We will present the CCD index methodology as a novel approach to co-benefits assessment and will discuss these initial findings from our evaluation.

Greenwald, Noah, *Center for Biological Diversity*

Forty years of implementation of the Endangered Species Act

The U.S. Endangered Species Act is one of the strongest laws for protecting biodiversity of any nation. But the effectiveness of this landmark law is ultimately dependent on implementation by the U.S. Fish and Wildlife and National Marine Fisheries Services. We compiled data on species listing, critical habitat designation and recovery plan development to assess implementation of the Endangered Species Act. A total of 1511 U.S. species are currently listed as threatened or endangered. On average, 35 species per year have been listed over the past 40 years, but there has been considerable year to year variation with both litigation and presidential administration contributing to this variation. Species have routinely experienced delays of more than 10 years in receiving protection. Existing data suggests there are roughly an additional 2,100 species in the United States that may warrant protection. Of listed species, 659 (44 percent) have critical habitat. A greater proportion (80 percent) of species listed in the last ten years have had critical habitat designated concurrently with listing. A majority of listed species have recovery plans (85 percent), but 79 percent are more than ten years old and 26 percent are more than twenty years old. In the next 40 years, adequate funding and robust implementation of the Endangered Species Act will be necessary to meet the growing challenges to species survival from climate change and an increased human footprint.

Gregory, Tremaine, *Smithsonian Conservation Biology Institute*; **Farah Carrasco Rueda**, *Smithsonian Conservation Biology Institute*; **Jessica Deichmann**, *Smithsonian Conservation Biology Institute*; **Joseph Kolowski**, *Smithsonian Conservation Biology Institute*; **Alfonso Alonso**, *Smithsonian Conservation Biology Institute*

Evaluating fragmentation mitigation effects of natural canopy bridges for arboreal tropical forest mammals in pipeline construction

Despite the increasing abundance of natural gas and oil pipeline right-of-way (RoW) clearings in tropical forests, little is known about the extent to which primates and other arboreal mammal populations are isolated by the resulting linear canopy fragmentation. In the Lower Urubamba Region of Peru, we are collaborating with Repsol Exploración Perú to study the effects of the construction of a natural gas pipeline on arboreal mammals and the effectiveness of natural canopy bridges (connections left between canopy branches which span the pipeline clearing) in reducing the pipeline's fragmentation effects. We are evaluating mammal use of the RoW and surrounding areas before, during, and after pipeline construction in areas with and without natural canopy bridges. Data from before to during construction indicate a reduction in primate encounter rates within one kilometer of the RoW. However, canopy camera traps in natural bridges have revealed over 60 individuals of 11 species of arboreal

mammals, including three primate species, utilizing the bridges in the four months since they were exposed. Results will be used to shape recommendations for industry "best practice" protocols. This study highlights the value of partnerships between conservation organizations and development industries and demonstrates that while stakeholders in corporate partnerships may ultimately have different priorities, common ground can be found and conservation goals can indeed be met.

Groom, Martha, *University of Washington Bothell*; **Eleanor Sterling**, *Center for Biodiversity Conservation, American Museum of Natural History*; **Ana Porzecanski**, *Center for Biodiversity Conservation, American Museum of Natural History*; **Adriana Bravo**, *Center for Biodiversity Conservation, American Museum of Natural History*; **Nora Bynum**, *Duke University*; **Barbara Abraham**, *Hampton University*; **John Cigliano**, *Cedar Crest College*; **Lilana Dávalos**, *Stony Brook University*; **Carole Griffiths**, *Long Island University*; **David Stokes**, *University of Washington Bothell*

Cultivating Critical Thinking Skills Among Conservation Biology Students

To be effective in conservation, students need to develop sophisticated understandings of conservation problems and problem-solving approaches, which derive from advanced critical thinking skills. Here, we present results of an experimental study aimed at fostering students' critical thinking skills and comprehension of complex conservation issues. Faculty from six institutions, led by investigators from the Center for Biodiversity and Conservation at AMNH, designed a multi-year experiment that applied novel instructional and assessment materials under two different instruction modalities, individual reflection vs. intensive classroom discussion. We found that use of the instructional materials improved student performance in two independent assessments of critical thinking (N=42-78), while also showing gains in their content knowledge (N=26-46). In particular, students improved in their abilities to select and use evidence in constructing arguments, and in understanding the influence of context and assumptions on conclusions drawn from evidence. However, we did not find that student self-confidence in their critical thinking abilities increased (N=38-42). We are currently assessing whether the intensity of the teaching intervention influenced student gains in critical thinking. Our results show that critical thinking skills can be improved within a single course through strategic instructional techniques across a wide range of institutions and classroom settings.

Groves, Craig, *The Nature Conservancy*; **Edward Game**,

Challenges and Opportunities in implementing Regional Conservation Plans on Private Lands and with the Private Sector

The Nature Conservancy (TNC) has invested heavily in Ecoregional Assessments, a form of systematic conservation planning, to help guide the geographic focus of our conservation work, especially in the United States. The systematic process and scientific analyses and information contained within these plans gives the Conservancy credibility to work with public agencies, industry sectors, and private landholders in implementing these plans. Implementation is often guided and influenced by funding sources, conservation opportunities (e.g., policy), enabling conditions, diverse stakeholder interests, and the urgency of threats to particular landscapes or seascapes. The search for conservation's silver bullet of multi-site strategies that could leverage conservation efforts over large areas is often an overriding implementation concern. Although all of these factors can represent challenges, regional conservation assessments can also provide opportunities for engaging the private sector in such diverse areas as energy development, fisheries and MPAs, and timber or range management to help insure that these activities are conducted in places and a manner that promotes biodiversity conservation and conservation-friendly industry practices. Based on TNC's success and failures, we suggest some lessons for future systematic conservation planning efforts.

Guerrero-Gonzalez, Angela, *The University of Queensland*

Social Networks and Planning for Restoration in Large-scale Corridors

Effective biodiversity conservation usually requires coordinated action between stakeholders operating across local, regional, and landscape scales. A lack of collaboration in the decision making process might result in resources being wasted or uncoordinated on-ground implementation that fail to address the full scope of the conservation problem. In large-scale corridor restoration, the social networks that enable the collaboration necessary for effective action are as important as the ecological networks requiring restoration. Through a case study in Western Australia, we illustrate the ways in which the network of collaborations formed among actors in this area can affect effective conservation. We show how connections between actors can drive coordination across diverse scales of action, and highlight the role that key actors can play depending on how they are connected to the rest of the network. Our study contributes towards understanding of the relationship between social networks and successful biodiversity conservation, and has implications for how conservation partnerships are developed on the ground to increase the likelihood of success of conservation investments.

Gupta, Kaberi Kar, *California State University, Fresno*

Which is the better green space? A comparison of traditional grass lawn and waterwise gardens in a semi-desert urban landscape

Urban residential vegetation is driven by homeowners' socioeconomic status, city government policy, and price and availability of water. Water use in a semiarid urban landscape should reflect the natural habitat of the area. Urban vegetation in the Fresno-Clovis Metropolitan Area (FCMA) in Central California, where annual rainfall is 28.5cm, however, is similar to high rainfall areas. Fresno did not have water meters until the end of 2012. With new metering and changes in water prices a few homeowners are transitioning to waterwise yards but most retain traditional grass lawns. We focus on homeowners' perception of water use, and the effect of residential water use on biodiversity in the FCMA. We mapped all non-grass yards in FCMA using Google Earth imagery. We compared plant, bird and arthropod diversity between waterwise yards and traditional grass lawns (N=20 each). We conducted focus group meetings with a random sample of homeowners in 3 socioeconomic strata (n=18), engaged community members in Audubon and Café Scientifique meetings (n=28), and surveyed parents of 5-6th grade students (n=150). Waterwise yards have more plant species than traditional grass lawns. Bird and arthropod diversities were not significantly different in Fall 2012. Homeowners were unaware of their monthly water consumption. They would change their yards if water prices go up with metering, but lack information about waterwise options. A toolkit for creating low-water yards is under construction.

Gurney, Georgina, *James Cook University*; **Robert Pressey**, *ARC Centre of Excellence for Coral Reef Studies*; **Joshua Cinner**, *ARC Centre of Excellence for Coral Reef Studies*; **Natalie Ban**, *University of Victoria*; **Richard Pollnac**, *The University of Rhode Island*

Marine protected areas: understanding social impacts through time in Indonesia

Marine protected areas (MPAs) are a principal conservation tool but their efficacy is variable. A significant factor impeding MPA success is a lack of consideration of associated human systems. Given that MPAs restrict human activity, gaining local stakeholders' support for management is integral to achieving sustainable outcomes. An understanding of the social impacts of MPAs is thus critical to their successful implementation but remains poorly understood. We address this gap by investigating the long-term impacts of MPAs on human well-being in Sulawesi, Indonesia. These MPAs were implemented during 1997-2003. Using data from more than 2,000 interviews from 1997, 2000, 2002 and 2012, we compared how several dimensions of well-being have changed over time in project and control sites. Our study - one of the first to examine social impacts of MPAs using controls and

time-series data (including an ex-post assessment) - found changes in various indicators of well-being relevant to MPA implementation (e.g. property rights, environmental knowledge, community organization). Further, we identified multiple management factors and characteristics of the political and social context, which affect MPA persistence, and lead to negative and positive social impacts of MPAs. Our research thus highlights the need for an integrated approach to MPA management, and may aid managers in designing MPAs to achieve social and biological benefits, thus engendering the support of local stakeholders.

Gwali, Samson, *Makerere University*; **John Bosco Okullo**, *Makerere University*; **Gerald Eilu**, *Makerere University*

Folk classification and characterisation of shea tree (*Vitellaria paradoxa* subsp. *nilotica*) in Uganda: Implications for its conservation and breeding

Folk classification provides a considerable opportunity for identification and selection of plus shea trees (*Vitellaria paradoxa*) for conservation and improvement. In Uganda, indigenous knowledge points to differences in morphological and organoleptic traits in shea trees and recognizes various local varieties. However, there is a dearth of scientific information on morphological, chemical and molecular variation among these folk varieties. This study was conducted in the shea tree belt of Uganda to document folk classification and management, examine morphological variation, analyze fat content and fatty acid composition, and assess molecular variation among shea tree folk varieties. Using participatory rural appraisal techniques, 44 folk varieties based on morphological and organoleptic traits were documented. Analysis of variance of quantitative morphological traits as well as chemical (fat content and fatty acid composition) data obtained by near infrared spectroscopy and wet chemistry showed no congruence with folk classification. Nuclear microsatellite analysis showed that 86.90% of molecular variation occurred within individual trees, 8.43% was found among individual trees within folk variety groupings while 4.67% was found among ethno-variety groupings. This indicates that these folk varieties are arbitrarily defined sub-groups of a single randomly mating population. Sampling for conservation/breeding of this species should therefore target the entire population.

Hadidian, John, *HSUS*

Conserving urban wildlife: the need for a bridging subdiscipline.

Although some might argue that there are far higher conservation priorities than any involving what we might call “urban” wildlife, there may be solid ground from which to challenge that notion. While it is true that the majority of

species that have adapted to living in urban environments are generalists who face no great threat of extinction, at least some may be rare enough to be of real conservation concern. The tantalizing prospect that entirely new species may be arising with specific adaptations to urban habitats ought to be considered as well. Beyond such things, however, it the human dimension of urban wildlife that is relevant to larger conservation interests. If both positive and negative feelings are generated through direct experiential contact, then the sorts of interactions urbanites have with the wild animals with whom they share their daily lives will assume considerable significance. How conflicts between people and such synanthropes are resolved will be important in shaping attitudes and approaches to conflict resolution in other contexts. Urban wildlife can be visualized as comprising a bridging subdiscipline to link conservation biology and animal protection through an ethical framework that amplifies the values espoused by both.

Hagell, Suzanne, *University of Wisconsin Madison*; **Christine Ribic**, *USGS Wisconsin Cooperative Wildlife Research Unit*

Communication styles and risk attitudes as barriers to climate change adaptation: a survey of wildlife professionals in Wisconsin

Evidence-based decision making and adaptive management are cornerstones of wildlife conservation and key to confronting climate change. However, these tools require effective integration of the producers and users of science. We conducted a survey of wildlife researchers and managers in the state of Wisconsin to elucidate how differences in communication style and risk perception could impede climate-adaptive resource management. We received surveys from 95 field managers, 54 administrators/policymakers and 75 researchers. All but one respondent agreed that climate change is occurring, but 44% of the sample and 32% of field managers were unsure if it will negatively impact wildlife. All three groups had similar opinions of strategies like translocation, rely on personal experience when deciding when to use a strategy, and agree on what is needed to make good decisions (and that these factors aren't used enough in practice). As expected, researchers primarily communicate through the literature, but managers rely on in-person communication and want information that is relevant to decision-making. Relatedly, only

Hamel, Nathalie, *Puget Sound Partnership*; **Scott Pearson**, *Washington Department of Fish and Wildlife*

Taking the pulse of Puget Sound: Developing indicators for assessing ecosystem health.

Ecosystem restoration activities in Puget Sound, a region under intense human development in Washington State, are a

complex example of deliberate efforts to integrate systems (marine and terrestrial), disciplines (natural and social sciences), and stakeholders (tribes, local, state and federal agencies, non-profits, and businesses). A significant challenge for such large-scale efforts is to develop ecologically defensible indicators to track ecosystem conditions. The process of identifying a few key indicators is complicated by many factors, including uncertainty about cause and effect relationships between ecosystem components. Here, we describe our approach to develop indicators that reflect the health of terrestrial and marine bird populations dependent on Puget Sound. We evaluated species-specific indicators that were 1) ecologically meaningful and Puget Sound-wide and 2) supported by existing time series and data with enough power to detect trends. Because several species meet our criteria, our recommendation included both individual species and functional groups that characterize specific aspects of communities (e.g., interior conifer forest). However, species within the same grouping exhibited inconsistent trends, thereby complicating our interpretation of the response to restoration activities. To be effective management tools, indicators must be matched to the scale of the activities and sufficiently sensitive to reflect short-term responses.

Hammerly, Susan, *University of North Texas*; **Jeff Johnson**, *University of North Texas*

Surviving in the wild: the role of inbreeding and immunocompetence in post-release survival of the critically endangered Attwater's Prairie-chicken

Immunocompetence has been shown to be compromised among individuals with reduced genetic diversity; however it is not known to what extent immunocompetence may influence endangered species recovery. The critically endangered Attwater's Prairie-chicken (*Tympanuchus cupido attwateri*; APC) has been managed in captivity since 1992 and the current population is based on 17 founding individuals. Each year the wild APC population is supplemented with captive bred individuals, yet survival is low (21%), which could be the result of multiple factors including inbreeding. Here we explore the consequences of inbreeding in the APC population by investigating the correlation between neutral genetic diversity and individual fitness-related traits in the captive-release breeding program, specifically focusing on immunocompetence and survival. To evaluate the role of immunocompetence and inbreeding on post-release survival, all birds were sampled at release in the fall of 2011 and 2012 (n=369) and a subset of the surviving birds were re-sampled approximately five months post-release (n=59). Individual inbreeding coefficients were calculated using 12 microsatellite loci, and immunocompetence was evaluated based on multiple techniques used to assess both innate and acquired immune response. Preliminary results using the 2011 dataset suggest inbreeding coefficient and

multiple immunocompetence measures at the time of release are both predictors of an individuals' survival post-release.

Hanna, Emily, *Australian National University*; **Marcel Cardillo**, *Australian National University*

Island mammal extinctions are determined by interactive effects of life history, island biogeography and mesopredator suppression.

Understanding extinction on islands is critical for biodiversity conservation, as islands harbour many vulnerable endemic species, and often serve as the last refuge for otherwise extinct species. But whether island extinction patterns can be explained by simple predictors, or are more complex functions of multiple processes, remains poorly tested. We use generalised linear mixed models and decision trees to show that extinction in 935 Australian island mammal populations is determined by interactions of introduced predators, island biogeography, and life history. In large mammal species (>2.7kg), distance from the mainland is the primary predictor of extinction, consistent with island biogeography theory. For small species (

Hansen, Andrew, *Montana State University*

Towards Assessing the Vulnerability of US National Parks to Land Use and Climate Change

Many protected areas are not functioning to protect biodiversity due to the influences of land use, climate change, and invasive species. The goal of this paper is to illustrate the initial steps in an assessment of vulnerability to land use and climate change across 48 US National Parks.

We defined protected area centered ecosystems (PACES) around each park based on ecological principles.

We quantified two components of vulnerability within each PACE for the period 1900-present and forecasted to 2100.

Exposure was measured as change land use, invasive plants, and climate.

Sensitivity was measured as predicted change in biome type under future climate.

We found that PACES differed in exposure and sensitivity. Multivariate clustering revealed PACES fell into five land use change classes from wildland to urban.

The proportion of nonnative plants was positively correlated with land use intensity in the PACES.

Climatic warming since 1900 was highest in wildland PACES.

A few PACEs, experienced rapid increases in land use intensification, invasion and warming. Other PACEs had low levels of change in land use, climate, or invasion. Climate niche modeling under future IPCC scenarios suggests that conditions in 2030 will favor biome shifts across more than 50% of many PACEs but no biome shifts in others. Knowledge of these differences in vulnerability based on exposure and sensitivity provide a basis for crafting PACE-specific adaptation strategies.

Hardesty, Britta, *CSIRO*; **Chris Wilcox**, *CSIRO*; **Tina Lawson**, *CSIRO*

Estimating sources of debris at a continental scale from coastal surveys

There is an exponentially increasing amount of human-associated rubbish in our oceans. This marine debris results in a wide range of issues from introduction of adsorbed PCBs into food webs to entanglement and subsequent mortality of threatened seabirds, turtles and mammals in derelict fishing gear. While there has been a major effort afoot to publicize these issues, there remains a paucity of data and scientific research to underpin solutions to the problems. We carried out a rigorous national coastal debris survey every 100km around Australia's coastline to quantify density, types, and potential sources of marine debris. Our aim was to develop a standardized measure of the density of debris along the Australian coastline, to allow comparison of input across regions. We used a statistical model to infer how local conditions such as coastal aspect, slope, and prevailing wind direction affect debris density. We also explored variables such as distance from surrounding cities to understand factors affecting debris distributions. Citizen scientists aided in data collection and results from this work are being used to inform a proposed national container deposit scheme.

Hardy, Mathew, *RMIT University*; **Ascelin Gordon**, *RMIT University*; **Sarah Bekessy**, *RMIT University*

The ecological consequences of out-of-kind offsetting

Globally, biodiversity offsets are becoming an increasingly utilised tool in conservation. Often, offset policies have a "like-for-like" requirement, where any permitted biodiversity loss must be offset by gains in a similar ecosystem close by. In Victoria, Australia, proposed changes to the current offset policy (in place since 2002) indicate a potential shift away from the like-for-like requirement to allow offsets that are out-of-kind and in locations based on multiple biodiversity attributes. However, little is known about the ecological consequences of out-of-kind offsets. A case study was

undertaken of Melbourne, Victoria, containing multiple vegetation communities with different threat status. We modeled 3 distinct scenarios 1) strict like-for-like offsets 2) trading-up offsets (i.e. offsets in more highly threatened vegetation communities) and 3) out-of-kind offsets, based on a regional prioritisation over all vegetation classes. Vegetation clearance was concentrated in urban growth areas, and offset sites protected from future development. We analysed how the distribution of vegetation in the different threat categories changes over time under each scenario. Our results show that out-of-kind offsets have a significant impact on the distribution of offset locations and often resulted in losses of vegetation communities. Moreover, trading-up offsets, whilst beneficial for threatened vegetation, may lead to detrimental decline of non-threatened vegetation communities.

Harkness, Mary, *NatureServe*; **Patrick Crist**, *NatureServe*; **Patrick Comer**, *NatureServe*

Wildlife Connectivity Planning: A Practitioner's On-line Guide

Maintaining and restoring wildlife connectivity has emerged as a major ecological concern for conservation and natural resource management. The science and practice of assessing habitat connectivity is a rapidly evolving field, making it challenging for conservation planners and resource managers to readily incorporate connectivity considerations into their activities. Recently, NatureServe and North Carolina State University collaborated on two new web resources for habitat connectivity practitioners. The NatureServe site (landscape.org) provides step-by-step guidance for new practitioners to approach the technical tasks of characterizing, assessing, and planning for wildlife connectivity. That guidance is integrally linked to a breadth of resources on NC State University's site (www.conservationcorridor.org), among others, which provides scientific background, library, digests, and examples around assessing connectivity. The landscape.org site also provides a robust online map service to identify connectivity projects and data within a practitioner's region of interest. Together these integrated websites provide an unparalleled resource to understand the issues, approaches, and solutions for maintaining and restoring wildlife connectivity. This presentation will provide a brief overview of the issues around habitat connectivity and will demonstrate the use of the web resources for obtaining information and guidance.

Harris, J. Berton C., *Princeton University*; **Martin Breed**, *Australian Centre for Evolutionary Biology and Biodiversity*; **Juan Freile**, *Fundacion Numashir*; **Melissa Ocana**, *Stonybrook-Millstone Watershed Association*

Failure to Account for Surface Area of Species' Ranges May Overestimate Extinction Risk of Montane Birds

Range size is one of the most important predictors of extinction risk, and it is the most often used measure for IUCN Red List evaluation of birds. Species that live on mountain slopes have ranges that are larger than what is characterized by a flat polygon, but differences between flat area and surface area of species' ranges are apparently unstudied. Given that tropical mountains are hotspots of endemism and species richness, any systematic bias in range size estimates on tropical mountains could have important conservation consequences. We compared flat and surface area of range maps for 15 species of highland *Grallaria* and *Grallaria antipittas* in Central and South America. We made these comparisons with two range characterizations: BirdLife International extent of occurrence polygons for global ranges, and minimum convex polygons made around occurrence records in Ecuador. We found that surface area ranged from 4-12% (mean of 8%) larger than flat area for our study species in both range characterization methods. Our results indicate that the size of montane *antipitta* ranges are being modestly underestimated by flat BirdLife International extent of occurrence polygons. The importance of this effect will depend on habitat quality of steep vs. flat areas, which is poorly understood in *antipittas*. We present these results in hopes of stimulating a discussion on the pros and cons of accounting for surface area when evaluating extinction risk.

Hartman, Ashley, *Nicholas School of the Environment, Duke University*; **Gerald Post**, *The Veterinary Cancer Center*; **Deborah Gallagher**, *Duke University*

Champions in the Conservation World: An interdisciplinary examination of conservation entrepreneurship

Successful conservation interventions are difficult to implement and sustain, due to the complexity of the underlying issues and the scope of the problem. However, the presence of a conservation champion may increase the chances of success. Champions are personally committed to the creation and installation of innovative ideas, and use personal activism and informal networks to ensure their success (Gallagher, 2009). This paper builds upon Gallagher's research on environmental champions and Post's evaluation of tiger conservation in India (2010). Combining the disciplinary lenses of conservation biology and public policy, we undertake a broader examination of how champions for wildlife conservation operate in practice. We surveyed members of The Society for Conservation Biology to gather evidence of champions' work in the field. The goal of the research was to inform our understanding of the phenomenon of the conservation champion more fully. Preliminary results indicate that most champions serve in organizations such as the ministry of the environment or within the context of park management. In addition, most champions utilized both a

top-down and bottom-up approach to influence conservation behavior, enforcing the idea of using various interdisciplinary approaches to find a solution. These results emphasize the need to more broadly understand the distinct role of conservation champions as interdisciplinary leaders working to diminish biodiversity loss.

Hartmann, Aaron, *Scripps Institution of Oceanography*; **Kristen Marhaver**, *University of California Merced*; **Mark Vermeij**, *CARMABI Foundation*

Healthy corals contribute disproportionately large numbers of offspring on island-wide scales

Metrics of coral reef health are important for conservation and management, yet visual measures such as live coral cover often cannot discern when systems are susceptible to or confronting degradation. With coral cover over twice the region-wide average, the undeveloped East Point area of Curaçao is one of the healthiest remaining Caribbean reefs. To examine subtle physiological differences in coral health among reefs, we measured storage lipid content and reproductive output of multiple coral species collected at three sites on East Point and on three "degraded" reefs near the urban center of the island (Willemstad). In the majority of species we studied, colonies from East Point stored greater amounts of energetic lipids and produced more offspring than their Willemstad counterparts. With higher coral cover and greater per-adult fecundity in multiple species, East Point's corals are likely a disproportionately large source of offspring for the entire island. Currently, plans to develop up to 55% of East Point are under government consideration. Given that reef degradation followed development elsewhere on Curaçao, East Point would likely meet a similar fate. By revealing that visually healthy corals can differ in their reproductive output, with undeveloped areas tending to harbor the most fecund adults, our work highlights that a major offspring source population stands to be lost, making conservation of this area critically important to the island as a whole.

Hastings, Jesse, *National University of Singapore*

A Third Way: Reconciling the community and the ecoregion in 21st century conservation

Driven by the goals of protect biodiversity and securing human livelihoods, the global conservation community has cycled through various approaches to conservation over the last forty years. These approaches differ in the scale at which they are planned and implemented, the role of science in the site selection process, and the balance between biodiversity protection and human use. There is an emerging recognition that pluralistic multi-scalar approaches are necessary in a globalized, interconnected world; however, there are few explorations of how these approaches can combine strategies

from local scale, participation-driven and large scale, science-driven conservation. This presentation illustrates the processes and outcomes of Conservation International's Marine Management Area Science program in Panama, a conservation research and policy initiative lasting from 2005 until 2010. Qualitative data about MMAS was gathered through document review, meeting observation, and semi-structured interviews with 40 key informants in the United States and Panama. Results from MMAS demonstrate that multi-scalar approaches can create a foundation for both biodiversity protection and local participation and input by building upon scalar strengths, creating horizontal and vertical linkages and partnerships, enabling cycles of learning, adaptation, and trust-building, integrating disciplines and knowledge systems, and acknowledging tradeoffs between conservation and development.

Hayden, Daniel, *Rare*; **Marcia Brown**, *Foundations of Success*

Connecting Human Wellbeing to Conservation Planning in Theory and Practice

Conservation is inevitably a social undertaking. Humans serve as conservation stewards, they depend on resources for their livelihoods and wellbeing, and they exert threats to biodiversity through unsustainable use or when they fail as stewards. Consequently, many conservation teams feel compelled to consider human wellbeing when developing their projects. To date, however, most teams have not been clear about their ultimate aim or how human wellbeing relates to biodiversity and vice-versa. Likewise, they have been inconsistent in their approaches to defining, describing, and addressing human wellbeing. With this in mind, a team of representatives from many leading conservation organizations (e.g., TNC, WCS, Rare, WCN, and FOS) developed guidelines for addressing human wellbeing in the context of the Conservation Measures Partnership's Open Standards for the Practice of Conservation. This practical guidance has become an important contribution to the Open Standards, as well as to the wider conservation community. This session will: - Outline the need for a structured approach and the importance of clarifying connections among conservation, ecosystem services, human wellbeing, and integrated approaches - Provide real-world examples of how to connect conservation to local stakeholders through this multi-disciplinary methodology - Conclude with lessons to date and suggestions of how the guidance should be updated and improved over time - Solicit feedback and suggestions

Haynes, Michelle, *U.S. Fish and Wildlife Service*; **Donna Brewer**, *U.S. Fish and Wildlife Service*; **Michael Runge**, *U.S. Geological Survey*

Decision Analysis for Conservation Practitioners: Concepts, Applications and Capacity Building

We affect our environment through choices, decisions we make about how to allocate resources. Values and science both play an integral role in determining how those decisions are made, but seldom are those distinctions apparent, including defining the roles of scientists and managers. This routinely results in conflict, miscommunication, and suboptimal management of resources. Here we share tools to decompose and overcome obstacles to the decision, avoid errors due to psychological biases, and account for the values and science that go into the decision. This enables clear documentation and increases transparency. Conservation practitioners are increasingly tasked with understanding impacts of a changing environment and making decisions before or while reducing uncertainty. We share local, state, federal, and international examples of how decision analysis has been applied across scales of decisions and degrees of complexity, from one person with one hour to multi-stakeholder, multi-disciplinary, multi-year processes. The U.S. Fish and Wildlife Service and the U.S. Geological Survey have developed a training curriculum to make better decision makers and build capacity of decision analysts. As the demand for these skills grows, the conservation community must equip international conservation practitioners at the undergraduate, graduate, and professional level to use the best available science, including the tools from decision analysis, to make important conservation choices.

Hazen, Elliott, *NOAA NMFS NWFS*

Predicted Habitat Shifts of Pacific Top Predators in a Changing Climate

It is important to identify species at risk and habitats critical for conservation in order to implement an ecosystem-based approach and to manage marine ecosystems proactively. Climate change scenarios have predicted an average sea surface temperature rise from 1-6° C by 2100 which are predicted to effect the habitat and distribution of many marine species. We used spatially explicit habitat models (generalized additive mixed models) to examine present-day distributions and foraging habitat of 15 top predator species from the Tagging of Pacific Predators (TOPP) project in the Pacific from 2001-2010 as a function of fixed bathymetric variables, sea surface temperature, wind, Ekman pumping, mixed-layer depth, and chlorophyll-a. Consequently we used 1° and monthly resolution climate models from the Geophysical Fluid Dynamics Laboratory to predict potential habitat under future scenarios. We found species winners and losers, oceanographic changes, such as the northward migration of the transition zone coincident with top predator biodiversity throughout the Pacific, while the California current remained a hotspot into the future. Adaptive management approaches may be necessary for already stressed species, as increased migration times and loss of pelagic

habitat could exacerbate population declines or inhibit recovery.

Healy, Erin, *ICF International*; **Jennifer Pierre**, *ICF International*

Contaminant Mobilization Associated with Ecosystem Restoration Projects

Typically, ecosystem restoration involves restoration of wetlands and floodplains that have been diked off for agricultural development, or filled with dredge spoils. Ecosystem restoration results in new habitat and many benefits to aquatic species. However, inundation may also result in mobilization of certain types of contaminants that are relatively immobile in uplands, but can be very mobile, bioavailable and toxic in an aquatic system. Residues of copper, arsenic, pesticides and herbicides may be present in agricultural soils. In some cases, historic contaminants that have been bound to soils, are remobilized under inundated conditions. The potential for mobilization and effects on aquatic resources is dependent on many factors including: the fate and transport characteristics of the contaminants; how they partition in the environment; feeding behavior of aquatic species; metabolic pathways that can lead to accumulation or excretion; and foodchain dynamics. This presentation provides an overview of the risk for increased bioavailability in restored aquatic systems for some of the typical contaminants. Mercury and selenium will be highlighted, based on the author's recent evaluation of contaminant dynamics associated with the Bay Delta Conservation Plan in California. Potential mitigation measures that can be taken to minimize contaminant mobilization will also be presented, with an emphasis on mercury.

Hegeman, Ericka, *Conservation Science Partners, Inc.*; **Matthew Farnsworth**, *Conservation Science Partners, Inc.*; **Luke Zachmann**, *Conservation Science Partners, Inc.*; **Thomas Jackson**, *Kaweah Biological Consulting*; **Kelly Herbinson**, *Sundance Biology*; **Brett Dickson**, *Conservation Science Partners, Inc.*

Exploratory data analysis from a translocation study of Mojave desert tortoise, *Gopherus agassizii*

The global increase in large-scale solar electric generating projects has resulted in a growing number of programs involving the translocation of sensitive species, including the Mojave desert tortoise, *Gopherus agassizii*, which is a federally threatened species. Translocation has become a common management tool for desert tortoises, yet only recently have movement and space use patterns been investigated. Here we describe results from the first year of a ten-year post-translocation monitoring project involving approximately 400 individuals in the Ivanpah Valley of southern California.

Goals of this project include determining the effectiveness of translocation as a conservation tool through a comprehensive monitoring program. Estimates of space use were derived from systematically collected radio tracking data and reflected differential patterns of habitat use among translocated, resident, and control groups. Similar to previous studies, we found differences in utilization distribution (UD) size among all groups, with translocated tortoises having larger UD's. We also found differential space use patterns in which translocated tortoises were found more often above ground than in burrows, when compared to both control and resident groups. Ongoing work includes model-based survival analysis that incorporates information on habitat features, as well as tortoise health status, to rigorously evaluate the influence of translocation on survival of this long-lived desert dweller.

Heller, Nicole, *Duke University*

Targeting the geography of climate and climatic changes to increase the resilience of protected area networks

Conservation planning must take into account climate changes to achieve conservation goals in the future. At the same time, there is great uncertainty in the rate, magnitude, and sometimes the direction of change, as well as the response of ecological communities. Given uncertainty, methods need to be developed to do adaptation planning that do not rely on best guess estimates of how the climate will change or how species will respond. Here I report on an experiment done in collaboration with TBC3.org, which targets spatial and temporal elements of climate on the landscape to improve the resilience of the Conservation Lands Network in the San Francisco Bay Area. I share results from an experiment comparing how different protected area network configurations based on climate types, resolved at the 270 meter scale, or vegetation types, resolved at the 30 meter scale, compare in the representation of climate diversity now and in the future, with the assumption that greater climatic diversity is an asset for biodiversity. Results suggest that vegetation filters function similarly to climate filters in terms of representing climatic diversity on the landscape today and in alternative futures. However differences did emerge in some regions suggesting that targeting climatic elements introduces new information that may aid in adaptation.

Heppell, Scott, *Oregon State University*; **Brice Semmens**, *Scripps Institute of Oceanography*; **Christy Pattengill-Semmens**, *Reef Environmental Education Foundation*; **Phillippe Bush**, *Cayman Islands Department of Environment*; **Croy McCoy**, *Cayman Islands Department of Environment*; **Bradley Johnson**, *Cayman Islands Department of Environment*

Behavior, hyperstability, and population declines of an aggregating marine fish

Collapses of marine fish populations are a global concern. Some collapses are attributed to hyperstability, where catch per unit effort remains stable while the population declines. Hyperstability is difficult to detect until after a population is depleted, thus nearly all such studies on the hyperstability phenomenon are retrospective. Using whole-island acoustic arrays to track an endangered, aggregating reef fish on two Caribbean islands, we demonstrate for the first time behavioral mechanisms that might lead to hyperstability. We show that: (1) every reproductive-aged fish aggregates each year, (2) older, more fecund fish aggregate longer, (3) individuals will visit multiple aggregation sites during the spawning period, yet every fish always aggregates and spawns at a single location, and (4) overfishing extends the time spent aggregating, increasing vulnerability to harvest as the population declines. This latter finding is supported by historic accounts from other aggregation sites throughout the Caribbean. Taken together, our results demonstrate that aggregation sites are a surprisingly complete and persistent geographic bottleneck for aggregating species, and this bottleneck is a feature that intensifies with depletion. Our results highlight both the extreme vulnerability of local populations to harvest but the potential for even heavily harvested aggregations to recover.

Hess, Shervin, *N/A*; **Amir Hossein Khaleghi**, *N/A*

Conservation of big cats in a politically isolated country, Iran

Conservation of wildlife in developing nations is often dependent on international funding. In politically isolated nations such as Iran, economic sanctions imposed by other nations have severely reduced the work of conservation research and management by non-governmental organizations. This study measures the conservation implications of economic sanctions are by the progressively diminished foreign financing of Persian leopard conservation efforts over a span of five years, resulting in reduced resources for research, public education and management. As progressively greater restrictions are placed on international financial transactions, foreign funding for projects has diminished. Sanctions also stifle knowledge transfer between international non-governmental organizations, academic institutions and other organizations working in conservation. Persian leopard conservation funding by foreign institutions has declined by 90% since 2007. The subsequent economic crisis has quadrupled the rate of inflation within Iran, stifling domestic funding of conservation projects. The deleterious effects of wildlife conservation as a result of political sanctions are quantifiable and must be examined in order to spark conversation about the need to shelter world wildlife heritage from political conflict.

Hilgartner, William, *Johns Hopkins University & Friends School of Baltimore*; **Dorothy Merritts**, *Franklin and Marshall College*; **Robert Walter**, *Franklin and Marshall College*; **Michael Rahnis**, *Franklin and Marshall College*; **Jeffrey Hartranft**, *Department of Environmental Protection*; **David Bowne**, *Elizabethtown College*; **Aleah Miller**, *Elizabethtown College*; **Candace Grand Pre**, *Franklin and Marshall College*; **Christopher Bernhardt**, *U.S. Geological Survey*

Millennial Stability and Post-settlement Burial of Bog Turtle (*Glyptemys muhlenbergii*) Habitat in Two Piedmont Valleys of Maryland and Pennsylvania

Paleoecological analyses of macrofossil seeds, charcoal and pollen from two river banks in the Piedmont of Maryland and Pennsylvania were combined with geomorphic data and historical land use records to provide a 5000-yr and 3000-yr history of two valley wetlands. At both sites sedge meadows dominated by *Carex stricta* (tussock sedge), *C. prasina*, *C. stipata* and *C. scoparia* persisted virtually unchanged for 3-4 millennia until the 18th century, despite major storm events, regional beaver activity, fire, and anthropogenic disturbances. Wetland hydrology consisted of gently flowing water in rivulets and saturated organic soil maintained by springs from valley margins. In the Piedmont of Maryland and Pennsylvania the sedge meadow and associated hydrology is prime habitat for the endangered bog turtle (*Glyptemys muhlenbergii*). We suggest that these Holocene sedge meadows must have supported bog turtle populations for > 4,000 years. Burial of the sedge meadows happened rapidly in the mid to late 1700s when 1- 2 m of silt and clay sediment from land clearance (legacy sediment) accumulated in mill ponds behind downstream dams. Eventual breaching of the milldams created incised, high-banked channels and upland riparian vegetation not conducive to bog turtles. This study indicates that the current disjunct distribution of the bog turtle is a result of 18th century damming, and that habitat restoration might be accomplished by removing legacy sediment to expose the buried wetland.

Hoban, Sean, *University of Ferrara*; **Scott Schlarbaum**, *University of Tennessee*

Optimal sampling of plant populations for ex-situ conservation of genetic biodiversity: spatial considerations

As habitat loss, environmental degradation, and climate change accelerate, there is a pressing need to preserve genetic diversity of plant species in ex situ conservation collections (e.g. seed banks). However, current guidelines for sampling populations to conserve genetic diversity are primarily based on decades-old probabilistic models that do not consider population genetic structure. Population structure, which is common among plants, is an important consideration because it results in alleles or traits restricted to particular populations or regions, which are of high conservation value. We propose

a methodology utilizing computer simulations of realistic genetic structure patterns to test the ability of different sampling strategies (spatial distribution) and intensities (number of samples) to capture genetic diversity (especially locally restricted alleles). We simulate three species having different levels of connectivity. We find that spatial strategies strongly differ in performance: sampling one population per region is more effective (~175% more alleles captured) than sampling all populations in one region. The effect is strongest for poorly connected species. Modest sample sizes (~20 samples per population) perform well. We use a case study in the highly threatened butternut tree to argue for sample sizes of 25 trees from 10 states. We conclude that simulations are a valuable tool to help tailor sampling strategy for threatened plants.

Hodum, Peter, *Oikonos Ecosystem Knowledge/Univ. of Puget Sound*; **Erin Hagen**, *Island Conservation*; **Valentina Colodro**, *Oikonos Ecosystem Knowledge*; **Veronica Lopez**, *Oikonos Ecosystem Knowledge*; **Christian Lopez**, *Oikonos Ecosystem Knowledge*; **Paola Gonzalez**, *Oikonos Ecosystem Knowledge*

Engaging local communities to advance conservation of endemic species: A case study from Chilean islands

The complexity of conserving endemic species can be even greater when local communities interact with focal species. Community participation in, and commitment to, conservation measures greatly enhance long-term chances of success and increase the likelihood that such initiatives will become self-sustaining. As a central part of our long-term conservation program for several endemic endangered land- and seabird species, we have led community-based conservation efforts in the Juan Fernandez Islands and Mocha Island, Chile, for 11 and 3 years, respectively. We have focused community-based efforts on two principal areas: (1) community awareness development through creative artistic and educational activities and (2) capacity building, training and hiring of local residents. For example, we have led writing, painting and drawing workshops and contests, developed active-learning modules for the environmental education programs, established conservation-themed soccer tournaments for island residents and created volunteer programs in monitoring and invasive plant control. Our second focus, local capacity building, has produced teams of local residents (>20) trained and hired to work as field technicians and local coordinators on conservation, monitoring and restoration projects. Bottom-up community-based initiatives, using a suite of activities, have tremendous potential to complement on-the-ground conservation and restoration activities focused on threatened bird species.

Hoffman, Matthew, *New York University*

Is Education the Sticking Point? Problems of Collective Action in Landscape Conservation

An effort is underway in a small Vermont town to make a comprehensive plan for the protection of biodiversity. The landscape to which the plan applies belongs to hundreds of private owners whose cooperation is necessary for its success. Supporters of the plan hope to secure landowner cooperation by means of an educational campaign about the importance of protecting biodiversity. But even if most landowners come to favor conservation in principle, it does not necessarily follow that they will actively support the plan, since the shared goals of a group are often undermined by the incentives faced by each individual member. A mail survey of all households was used to investigate whether education is the sticking point, or whether landowner commitment to conservation is undermined by problems of collective action. It was found that most landowners are already in favor of conservation and would be willing to make conservation commitments in the context of a mutually binding agreement with other landowners.

Hogue, Aaron, *Salisbury University*

Bridging the Past and Present: Archaeological, Historical, and Field Evidence for Carnivore Declines on a Mid-Atlantic Peninsula

Mammalian carnivores (carnivorans) play a key role in the functioning of many ecosystems. Therefore, preserving these species is important to maintaining the integrity of these systems. The purpose of this study was to examine changes in the carnivoran fauna since European colonization on an early colonized mid-Atlantic peninsula. We used archaeological and colonial records to reconstruct the native fauna, and contrasted this with evidence of existing species from field data, museum specimens, and other sources. Ten species were found to be native (Table 1). Of these, four are extirpated, one appears reduced to a single population, and a sixth is restricted to several isolated populations. This indicates 60% of the native carnivorans have either been extirpated or nearly so.

Honarvar, Shaya, *Drexel University*; **Gail Hearn**, *Drexel University*; **James Spotila**, *Drexel University*; **Michael O'Connor**, *Drexel University*

Tidal movement, gas exchange and conservation of sea turtle eggs

Sea turtles bury their eggs up to 70-80 cm deep and sand above the nest is an important resistance to gas exchange. Leatherback eggs have low hatching success. On Bioko Island nest hatching success is 10% and it decreases to 3% in a less productive year. Tidal movements of the water table under the nest can ventilate the nest. To make predictions about

factors that control hatching success of sea turtle eggs we measured tidal water table fluctuations in nesting beaches on Bioko Island. Large water table movements suggest that tides can ventilate nests more vigorously. The amplitude and timing of water table fluctuations varied with distance of the nest from the water, with lunar phase, and between successive tides. Amplitude of the tidal water table fluctuations was attenuated with increased distance from the water. Simulations using our measured tidal fluctuations, show the potential to decrease time averaged oxygen deficits and carbon dioxide concentrations by 25-30%. Peak predicted oxygen deficits were also ameliorated, in contrast to predictions with smaller water table fluctuations. Thus, water table movements and potential effects on respiratory gas exchange, metabolism, and developmental rates all increase in nests laid closer to the water. We will predict which beaches will be favorable for sea turtle egg incubation in the face of rising seas and warming temperatures and the effects of human alterations of sand composition on development of sea turtle embryos.

Horning, Ned, *American Museum of Natural History*

Photo mapping and monitoring using inexpensive low altitude platforms

There is great and growing potential for using portable digital imaging devices and other sensors on low altitude aerial platforms such as poles, kites, balloons and unmanned aerial vehicles (UAVs) to map and monitor landscapes. With recent hardware and software advances the conservation community and, in fact, the general public can now access the technology required to conduct sophisticated aerial mapping and monitoring projects that were impractical even a few years ago. The goal of this presentation is to raise awareness of and improve accessibility to these inexpensive photo mapping and monitoring hardware and software tools. Strengths and limitations of different systems will be discussed and an overview of important regulations pertaining to aerial platforms and other equipment will be presented. Becoming familiar with these low-cost aerial systems will provide conservation practitioners access to new tools to collect spatial data to support conservation projects.

Horwich, Robert, *Community Conservation*

Community Conservation: A Powerful Solution to Environmental Degradation and Biodiversity Loss

In a time of environmental crisis, with biodiversity loss and an ineffective conservation record, community conservation is a major solution to environmental degradation. During the past 28 years, Community Conservation (CC) catalyzed communities, in 24 projects in 14 countries, to protect private, community and public lands. CC's flexible formula, based on trust, asked communities for help and encouraged

them to form over 40 community-based organizations (CBOs) and federations that monitor and protect forests and wildlife. For example, the Community Baboon Sanctuary in Belize, begun in 1985, is community-owned, protects the black howler monkey and served as a model for 24 community-managed sanctuaries under government policy. The Golden Langur Conservation Project catalyzed a federation of 18 CBOs to protect the Manas Biosphere Reserve and the Indian golden langur population that increased from 1500 to 5600 langurs. Tigers and elephants also increased and UNESCO "in danger" label was lifted. In northern Peru, CC partners catalyzed 12 CBOs to gain conservation concessions of over 80,000 hectares of cloud forest habitat of 3 endangered endemic primates. In Papua New Guinea, CC helped clan landowners create the first Conservation Area to protect the Huon tree kangaroo. In Ghana, communities protect the last coastal forests and 3 endangered primates. When treated as equals, rural communities are powerful on-site conservation partners that will protect their forest when asked.

Hudgens, Brian, *Institute for Wildlife Studies*; **Julie Youn**, *Utah State University*; **Erin Boydston**, *USGS Western Ecological Research Center*; **Lorraine Flint**, *USGS*; **Alan Flint**, *USGS*; **Jessica Lundquist**, *University of Washington*

Incorporating climate change into habitat suitability assessments for species reintroductions.

Reintroductions into suitable sites are powerful conservation tools. While current conditions are critical to reintroduction success, future conditions in the face of global climate change also play an important role. We assess the potential of the Sierra Nevada to sustain a reintroduced wolverine population through the 21st century under differing assumptions of climate change and wolverine ecology. Wolverines were lost from California in the early 1900s, likely due to trapping and poisoning programs no longer practiced in the state. The potential suitability of the Sierra Nevada depends on how spring snowpack is impacted by ongoing climate change. We used down-scaled climate models incorporating cold-air pooling and wolverine demographic models to estimate the number of potential female home ranges available in the Sierra Nevada through the 21st century. We find that there is currently sufficient habitat to support ~170 adult female home ranges in the Sierra Nevada, declining to ~125 home ranges by mid-century and ~70 home ranges by 2100. There was a wide range of predicted changes in suitable habitat, ranging from increases to a >60% loss by mid-century with an 11% to >90% loss by 2100 depending on the climate model and female home range size assumed. While the Sierra Nevada is expected to lose wolverine habitat in the next 50-100 years, it will remain one of the largest habitat blocks and potentially important refuge for wolverines in the southern extent of their range.

Hurley, Martha, *Center for Biodiversity and Conservation, AMNH and Global Wildlife Conservation*; **Raoul Bain**, *Div Vert Zool (Herpetology) and Center for Biodiversity and Conservation, AMNH*

Conservation Biogeography of the Amphibians and Reptiles of Cambodia, Lao PDR, and Vietnam

Biogeographic analyses have the potential to guide conservation of the ecological and evolutionary processes underlying endemism and the distribution of biodiversity. We analyzed Indochina's > 600 amphibian and reptile species in a spatially explicit framework to identify ecological correlates of endemism and species richness and identify areas of unique biodiversity. Species richness is highest in amphibians and snakes and peaks in upland, forested areas. Endemic species are more ecologically restricted than non-endemic ones; however, the ecological correlates of endemism differ among amphibians, snakes, lizards, and turtles. We identify two centers of endemism: one spanning the northern Indochina-south China border and one centered on the Annamite Mountains. However, cluster analyses reveal strong divergence in the composition of the Annamitese, suggesting at least three distinct units. Southern Chinese species are an important component of northern Indochina's herpetofauna whereas few purely Sundaic species are present and likely representing relict populations. Overall, species composition reflects a unique evolutionary trajectory influenced by the region's complex geological and climatic history. Conservation priorities include: (1) protecting unique areas of evolutionary novelty; (2) incorporating lineage-specific ecological correlates of endemism into conservation planning; (3) clarifying endemic status; and (4) increasing cross-border taxonomic exchange.

Ibisch, Pierre, *Center Econs & Ecosystem Manage*

Roadless areas: working towards a comprehensive global assessment

A systematic approach to mapping and assessing the conservation status of roadless and low-traffic areas is generated by the creation of a Road Disturbance Index. This index takes into account various types of information on road fragmentation as well as traffic intensity and is designed to inform conservation planning and environmental policy making. The quality of the final mapping results is then tested against index measures for a range of proxy indicators not directly related to road data, such as population density or presence of cities. The spatial distribution of the identified roadless areas is assessed according to ecosystem functionality, biodiversity patterns, protected area coverage and selected socioeconomic parameters. Socioeconomic and environmental information, such as population, economic

growth or primary production, is used in a risk assessment describing the probability of roadless areas to be disturbed or eliminated by road development.

Innes, Larry, *Canadian Boreal Initiative*; **Daniel Oades**, *Kimberley Land Council*; **Valerie Courtois**, *Canadian Boreal Initiative*

How acknowledging Indigenous rights can help conservation: amazing results from Australia and hope for Canada

The world conservation community has become increasingly aware that their activities and actions can have major, and sometimes unforeseen, impacts on Indigenous peoples. Some conservat62i62o62n62
62o62r62g62a62n62i62z62a62t62i62o62n62s62
62a62n62d62 62g62o62v62e62r62n62m62e62n62t62s62
62h62a62v62e62 62n62o62w62
62r62e62a62l62i62z62e62d62 62t62h62a62t62
62s62u62p62o62r62t62 62o62f62
62l62n62d62i62g62e62n62o62u62s62
62r62i62g62h62t62s62 62t62o62 62m62a62n62a62g62e62
62a62n62d62 62c62o62n62t62r62o62l62 62t62h62e62
62u62s62e62 62o62f62 62t62h62e62i62r62
62l62a62n62d62s62 62i62s62 62a62 62s62o62c62i62a62l62
62a62n62d62 62e62t62h62i62c62a62l62
62i62m62p62e62r62a62t62i62v62e62.62 62N62o62t62
62s62u62r62p62r62i62s62i62n62g62l62y62,62
62c62o62n62s62e62r62v62a62t62i62o62n62
62o62u62t62c62o62m62e62s62 62t62h62a62t62
62s62t62a62r62t62 62w62i62t62h62 62t62h62e62
62a62c62k62n62o62w62l62e62d62g62e62m62e62n62t62
62o62f62 62t62h62i62s62 62p62r62e62m62i62s62e62
62o62f62t62e62n62 62g62r62e62a62t62l62y62
62e62x62c62e62d62 62t62h62e62
62o62r62i62g62i62n62a62l62
62e62x62p62e62c62t62a62t62i62o62n62s62

Islam, Md. Torikul, *Practical Academy on Wise Education and Research Foundation*; **Md. Ariful Haque Mollik**, *Practical Academy on Wise Education and Research Foundation*

Studies on microbial behaviors and physicochemical characteristics of rubber seed oils of different clones cultivated in Sylhet Hill Tracts Bangladesh

Gentle slopes, rich light soil, a congenial climate and abundant rainfall have made Sylhet Hill Tracts one of the largest rubber producing areas in the world. Rubber seed samples of three different clones viz. PRIM-600, GT-1, and PB-255 were collected from the Sylhet Hill Tracts of Bangladesh. The morphological and phonological characteristics of the seeds were studied for each clone. Oils were then extracted from the seed samples by solvent

extraction method. It was then purified by a standard method for each of the samples. The total oil contents of each of the clones were found to be 32.50% (PRIM-600), 29.80 (PB-255), and 41.90% (GT-1) respectively. Physical and chemical properties of the three rubber seed oil samples were studied and compared with those of standard oils. Fatty acid compositions of the oil samples were studied by gas liquid chromatography. Rubber seed oils of the three clones were found to contain the fatty acids viz. arachidic acid, lauric acid, linoleic acid, linolenic acid, myristic acid, oleic acid, palmitic acid, and stearic acid. The seed oil samples of PRIM-600, GT-1, and PB-255 showed the unsaturated fatty acids of 89.03%, 81.59%, and 83.91% respectively. Microbial activities of the oils were also studied against six human pathogenic bacteria and six plant pathogenic fungi.

Iuliucci, Danielle, *Towson University*; **Joel Snodgrass**, *Towson University*

Amphibian productivity in a restored wetland landscape in Maryland, USA

Wetlands provide habitat, food, and nursery areas for wildlife and have been drained historically to convert saturated soils into farmland. Restoration projects are frequently undertaken to restore the ecological functioning of destroyed or degraded wetland landscapes, but examinations of post restoration function are limited. In 2003, The Nature Conservancy (TNC) restored a 75 ha parcel of farmland within a 255 ha preserve in Caroline County, Maryland. The preserve currently supports more than 40 wetlands that differ in physical features and hydrology, thereby having the potential to support a diverse assemblage of amphibian species. We operated drift fence arrays and pitfall traps around 13 of the wetlands to estimate the relative production of amphibian metamorphosis and evaluate the degree to which the landscape of restored wetlands supported a diversity of amphibian life histories. Preliminary results indicate hydrologic variability is correlated with metamorph production. This study will provide TNC with a ten-year post-restoration amphibian inventory and evaluate the suitability of the restoration as amphibian habitat.

Izzo, Grant, *Towson University*; **Joel Snodgrass**, *Towson University*

Investigating the Potential of Adaptations in Stream Salamanders to Road Salt in Urban Watersheds: The Role of Storm-Water Management Practices.

In recent years, the application of road salt as a deicing agent has increased extensively and the impact it has on stream salamanders has yet to be investigated. Modern stormwater management practices are designed to mitigate the impacts of pollutants associated with roads on stream systems and

therefore, should affect the delivery of ions associated with road salts to aquatic systems. We used bioassays and field-deployed data loggers to investigate potential road salt toxicity to two widespread species in the eastern United States, the Northern Dusky Salamander (*Desmognathus fuscus*) and Northern Two-Lined Salamander (*Eurycea bislineata*), in streams draining watersheds with and without modern stormwater management practices (primarily stormwater management ponds). Streams draining stormwater ponds force chloride ions into the groundwater, yielding elevated conductivity levels throughout the year. Unmanaged streams did not have increased conductivity peaks during the winter. Stream salamanders were relatively tolerant of road salts, not exhibiting any lethal effects until conductivity levels exceeded 14 mS/cm and conductivity peaks in all streams did not exceed these levels during the winter of 2011-2012. Our results suggest road salts are not having acute lethal effects on salamanders in the streams we studied. However, chronic and indirect effects require further study.

Jacob, Anila, *USAID*; **Kiersten Johnson**, *ICF International*

Forest cover associated with improved health and nutrition outcomes in Malawi

Healthy forests provide human communities with a host of important ecosystem services including the provision of food, clean water, fuel, and natural medicines. Globally, about 13 million hectares of forests are lost yearly, with the biggest losses occurring in Africa and South America. As biodiversity loss and ecosystem degradation due to deforestation continue at unprecedented rates, with concomitant loss of ecosystem services, impacts on human health remain poorly understood. Using 2010 Malawi Demographic and Health Survey data and NASA's satellite remote-sensing data, we show that forest cover is associated with improved health and nutrition outcomes among children in Malawi. Children living in areas with net decadal forest cover loss experienced decreased odds of having a diverse diet and consuming vitamin A-rich foods (19% and 29% reductions, respectively). Children living in communities with higher percentages of forest cover had increased odds of consuming vitamin A-rich foods and decreased odds of experiencing diarrhea. Net gain in decadal forest cover was associated with a 34% decrease in the odds of experiencing diarrhea. These findings raise concerns about the potential short and long-term impacts of ongoing deforestation and ecosystem degradation on community health in Malawi, and support the position that preventing forest loss and maintaining the ecosystems services that forests provide are important factors in improving human health and nutrition outcomes.

Januchowski-Hartley, Fraser, *James Cook University*; **Nicholas Graham**, *James Cook University*; **Joshua Cinner**, *James Cook University*; **Garry Russ**, *James Cook University*

The overlooked role of fish behavior in coral reef fisheries management and conservation

Fish behavior is often overlooked when describing benefits arising from protection. Here we demonstrate benefits provided by changes in fish behavior resulting from two commonly used management tools, periodically harvested fisheries closures (PHCs) and no-take reserves (NTRs). We surveyed fish flight initiation distance (FID - how closely a fish can be approached before it flees) in a before-after-control-impact-pairs study on periodically harvested fisheries closures (PHCs) in Vanuatu and across the boundaries of permanent no-take marine reserves (NTRs) in the Philippines. In PHCs mean FID for Acanthurids was less than speargun range (suggesting they would be easy to catch), and lower than in fished areas. Post-harvest, mean FID in the PHCs increased to beyond speargun range. The proportion of Acanthuridae in the catch from PHCs was almost double that of normal fishing trips, and catch per unit effort was 96% greater. In the Philippines we found that FID of the fishery-target families (Acanthuridae and Scaridae), was lower inside NTRs, gradually increased across boundaries, and was equal to the mean FID in fished control areas approximately 140 m outside NTRs. This represents greater behavioral spillover, than spillover of fish biomass. In addition to being an important mechanism by which local fishers can benefit from protected areas, changes in fish behavior can alter the vulnerability of fish families in ways that may have ecological consequences.

Jenkins, Clinton, *North Carolina State University*; **Lucas Joppa**, *Microsoft Research*; **Stuart Pimm**, *Duke University*

Global Patterns of Terrestrial Vertebrate Diversity and Conservation

Identifying priority areas for biodiversity is essential for directing conservation resources. Fundamentally, we must know where individual species live, which ones are vulnerable, where human actions threaten them, and their levels of protection. We mapped priority areas for vertebrates using newly updated data on all mammals, amphibians, and birds. For each taxon, we identified centers of richness for all species, small-ranged species, and IUCN listed threatened species. Importantly, all analyses were at a spatial grain of 10x10km, one hundred times finer than previous assessments. Fine scale is a significant methodological improvement, for it brings mapping to scales comparable with regional decisions on where to place protected areas. We also mapped recent species discoveries, for they suggest where as-yet unknown species might be living. To assess the protection of the priority areas, we calculated the percentage of them within protected areas using the latest data from the World Database

of Protected Areas. While the priority areas do have more protection than the global average, the level of protection is still insufficient given the high importance of these areas. We also found substantial differences between our priority areas and the leading map of global conservation priorities, the biodiversity hotspots. This suggests a need to reassess the global allocation of conservation resources to reflect today's improved knowledge of biodiversity and conservation.

Jenkins, Peter T., *Center, Invasive Species Prevention*

Current Status of Federal Invasive Species Policy in the United States - and Proposed Reforms.

Invasive, non-native species are one of the three most important causes of loss of native biodiversity worldwide, together with habitat loss and global warming. They cause extensive environmental degradation, economic harm and disease outbreaks. However, U.S. Federal budget cutbacks, combined with anti-spending and anti-regulatory trends in conservative Members of Congress, and further combined with a passive, overly-cautious approach by the Obama Administration, have blocked any significant progress on invasive species prevention in the United States. U.S. NGO responses have dwindled rather than becoming stronger. Reforms have stalled and invasions by animals, weeds, plant pests, pathogens and other groups continue unabated. Global warming will exacerbate all of these threats and in some cases muddy what species should be considered native versus non-native. Numerous international examples exist, e.g., from Australia and New Zealand, of successful policy reforms to prevent further invasions resulting from the intentional import trade, both for the plant and animal trades, which the United States should emulate. This talk will address desirable outcomes and the role that committed SCB members can play with respect to specific reforms needed for both the live animal and plant import trades.

Jennings, Megan, *San Diego State University*; **Rebecca Lewison**, *San Diego State University*; **Erin Boydston**, *United States Geological Survey*; **Kevin Crooks**, *Colorado State University*; **Lisa Lyren**, *United States Geological Survey*; **Robert Fisher**, *United States Geological Survey*

Connectivity Under Fire: The Importance of Incorporating Changing Fire Dynamics into Connectivity Assessments

Landscape connectivity has been recognized as a critical component to protecting ecosystem function and species viability. In urban areas, connectivity is threatened directly by anthropogenic landscape alteration and indirectly by fragmentation-related changes to natural disturbance regimes, most notably wildfire. We used telemetry data from bobcats and coyotes to evaluate the impacts shifting fire

frequencies on connectivity in an urbanized landscape in southern California. We developed habitat models for each species to generate a connectivity assessment and found that, without incorporating data on observed and predicted change to fire-return intervals with respect to historic patterns, characterizations of landscape connectivity may be inaccurate. In particular, we found connectivity for bobcats was reduced substantially when habitat maps included these changes in fire-return interval. Given their sensitivity to habitat fragmentation, bobcats may serve as a bellwether of synergistic changes in landscape connectivity under shifting conditions. In an urbanized landscape already constrained by roads and development, increasing fire frequency may increase landscape resistance for carnivores and other species. Our results suggest that we must account for shifting disturbance dynamics in connectivity assessments to generate more accurate estimates of landscape permeability and adequate conservation planning efforts for protection of landscape connectivity.

Jirik, Katherine, *Birch Aquarium at Scripps Institution of Oceanography, UC San Diego*

Making conservation relevant: an integrative evaluation process for public engagement

To bolster public involvement in conservation, environmental organizations increasingly emphasize stewardship and behavior change in their program goals. Because many human behaviors do not favor conservation, programs are strengthened when integrative, front-end research informs engagement strategies. Leveraging knowledge from diverse fields of study helps to assess scientific evidence, decide program priorities and identify barriers to behavior change. Here, a six step front-end evaluation process is described to aid conservation practitioners in engaging public audiences and fostering sustainability. This process includes useful decision points to narrow communication priorities and to interpret emerging conservation issues, which have not yet been well-studied. Steps 1-3 use evidence-based, interdisciplinary research to guide topic selection and conduct literature reviews. Steps 4-6 explore how to align research insights with project goals and engagement strategies. The topic of marine debris is used to illustrate how synthesizing research from marine ecology, sustainability science and social psychology can help to enhance science literacy and mitigate barriers to sustainable behavior.

Johnson, Arlyne, *Foundations of Success*; **Jean-Gaël Collomb**, *Wildlife Conservation Network*; **Peter Blinston**, *Painted Dog Conservation Organisation*; **Gregory Rasmussen**, *Painted Dog Conservation Organisation*; **Forgie Wilson**, *Painted Dog Conservation Organisation*; **Wilton Nsimango**,

Painted Dog Conservation Organisation; **Gregory Gibbard**, *Painted Dog Conservation Organisation*; **Nick Salafsky**, *Foundations of Success*

Adaptive Management Improves the Effectiveness of Painted Dog (*Lycaon pictus*) Conservation in Zimbabwe

Conservation practitioners must prioritize use of limited resources and demonstrate the effectiveness of their actions to achieve biodiversity goals in order to obtain ongoing support and participation from stakeholders, partners and funders. To address this need, the Painted Dog Conservation Organisation, with support from the Wildlife Conservation Network, is using the five steps of the Open Standards for the Practice of Conservation to iteratively plan, evaluate and adapt their strategies to conserve highly endangered Painted Dog (or African Wild Dog - *Lycaon pictus*) populations in Zimbabwe. We show how the process has resulted in explicit assumptions and testable hypotheses about four prioritized strategies to reduce 11 critical threats to Painted Dogs, their ungulate prey and key habitats. The first iteration of monitoring and evaluation revealed that law enforcement, education, and species management strategies have been effective to varying degrees in achieving intermediate objectives. Major challenges still exist for reducing the threats of prey depletion and cascading ecological impacts of artificial waterholes. The results indicate that the adaptive management process is contributing to increased involvement of staff and partners in understanding and achieving the organization's objectives and goals, improved strategies and reallocation of resources to increase effectiveness, and refined monitoring and evaluation protocols to better inform future management.

Johnson, Crista, *University of Illinois Urbana-Champaign*

Border Existence: Managing people, pressures and *Papio ursinus* in Cape Town, South Africa

Managing human-wildlife conflict around the edges of a city is further complicated by the complexity of societal relations within an urban context. Over the past 10 years Cape Town has experienced an exponential increase in reports of baboon-wildlife conflict around the foothills of Table Mountain National Park. Attempts to manage the troops of Chacma baboons (*Papio ursinus*) have led to intensified intra-societal tensions amongst institutions, affected communities and the public with regards to race, space and class. In turn, these tensions have pressured authorities to produce tangible management outcomes, which have resulted in the removal of over half the male baboon population in the Cape Peninsula from 2009-2012. Although the Chacma baboon is not endangered presently, similar wildlife management practices in the past have led to regional extinctions of fauna in the Cape. This study has been conducted from 2012-2013 and investigates the dimensions of cross-racial human relations within a socially stratified urban context that has led to the

application of strong wildlife management techniques. Interviews, baboon population surveys and behavioral monitoring, and spatial analysis have been conducted to achieve a greater understanding of these social dimensions. This study purports the integral importance of addressing intra-societal divisions in order to achieve a level of collaboration that can lead to effective and sustainable baboon management.

Johnson, Laura, *Prescott College*; **Cristina Eisenberg**, *Oregon State University*

A transferable model for effective conservation communication

Models for effective conservation communication exist, but when reviewing accounts of where these models have been executed successfully, a disproportionate number come from urban, affluent areas. This study sought to design a transferable model for conservation communication that incorporates both urban and rural audiences. We conducted a case study in rural northeast Michigan where coastal communities have experienced the social and economic impacts of anthropogenic biodiversity changes in the Great Lakes. We interviewed 30 participants from three groups: natural resource managers, communication practitioners, and citizen stakeholders to investigate how differences between urban and rural communities affect stewardship motivation. We found that differences in capacity (financial and human resources), land use, and culture strongly influence stewardship motivation. As such, these community characteristics act as guiding principles in our resulting model, which steers practitioners through three phases of a conservation communication plan: research and development, messaging, and implementation. To help both urban and rural practitioners succeed, the model provides tips on how to execute each phase based on the targeted community's financial and human capacity level and their cultural relationship with local natural resources. This preliminary research strongly supports the need for a more integrated and environmentally just approach to conservation communication design.

Jones, Emily, *University of New Mexico*

Introduced grazers, human demography, and landscape impacts: environmental change in contact-era New Mexico

The 17th century brought a large number of changes to New Mexico, many of which could be expected to have left a signature on New Mexican landscapes. Old World domesticates such as sheep and cattle became well-established members of New Mexico's faunal community; indigenous populations may (or may not) have undergone radical

demographic shrinking due to new diseases; settlement patterns and strategies shifted for many indigenous groups; and a number of new ethnic groups, including the Spanish, moved into the area with their own distinct subsistence and settlement practices. Some or all these factors may have impacted New Mexican landscapes - but which ones, and how? This poster uses faunal data from both archaeological and paleontological contexts to explore human impacts - both direct and indirect - on New Mexican landscapes in the 17th century, and the legacies of those impacts on today's landscapes.

Jordan, Tom, *Smithsonian Environmental Research Center*; **Donald E. Weller**, *Smithsonian Environmental Research Center*; **David L. Correll**, *Smithsonian Environmental Research Center*; **Dennis F. Whigham**, *Smithsonian Environmental Research Center*; **Matthew E. Baker**, *University of Maryland, Baltimore County*

Nutrient overload to Chesapeake Bay: Where it comes from and ways to control it

Overload of nutrients, especially nitrogen, is one of the largest threats to the Chesapeake Bay; causing depletion of dissolved oxygen, demise of submerged vegetation, and possibly declines in some fisheries. To investigate the factors affecting nutrient discharges, we measured discharges from 500 watersheds with differing land cover in four major physiographic provinces within the Chesapeake Bay basin, and we developed budgets of anthropogenic nitrogen inputs to the watersheds. The main inputs of nitrogen to the Chesapeake watershed are fertilizer application, nitrogen fixation by crops, atmospheric deposition, and import of animal feed. Much less than half of the net nitrogen input to the land reaches the Bay and the fate of the remaining nitrogen is poorly known. Developed land contributes nitrogen to the Bay via runoff from impervious surfaces and sewage releases. Agriculture contributes the majority of the nitrogen load to Chesapeake Bay, but the amounts differ greatly among physiographic provinces. Piedmont and Appalachian croplands release more nitrogen per unit area than do Coastal Plain croplands. This reflects higher nitrogen inputs to some Piedmont croplands and greater prevalence and effectiveness of nitrogen-absorbing riparian buffers along Coastal Plain streams. There are many ways to reduce nitrogen discharges but rising populations of people and livestock and lack of knowledge of the effects of management practices may slow progress.

Kadagi, Nelly, *African Billfish Foundation*; **Tina Harris**, *African Billfish Foundation*

Take or Release? Determining the impact of capacity building activities for recreational fishermen on billfish conservation in Kenya

Despite several years of studies on billfish biology, there is still a need for more effective conservation and management methods for this group, especially in the West Indian Ocean region. The goal of our study was to carry out education and awareness activities with recreational fishermen and measure the impact of these activities on billfish conservation in Malindi, Watamu and Kilifi fishing sites. To understand catch rates, we tagged billfish and collected release and recovery data of tagged individuals. From the year 1990 to 2010, a total of 44,670 billfish had been tagged using hydroscopic plastic tags and 1,812 recaptured. Additionally, we gathered responses from 420 recreational fishermen on observed trends of billfish catches and opinions on the benefits of billfish conservation and education. We used this biogeographical data and interview responses to determine the influence of recreational fishing on billfish catches between the years 1990 and 2010. Preliminary analysis shows a positive contribution of the practices of recreational fishermen on billfish conservation efforts in Kenya. We also illustrate how capacity building activities and stakeholder collaboration through sharing of information is important in the conservation of billfish given their highly migratory status.

Kahler, Jessica, *Michigan State University*

Poaching Risks in Community-Based Natural Resource Management

Poaching can disrupt wildlife-management efforts in community-based natural resource management. Monitoring, estimating, and acquiring data on poaching is difficult. We used local stakeholder knowledge and poaching records to rank and map the risk of poaching incidents in 2 in Caprivi, Namibia. We mapped local stakeholder perceptions of the risk of poaching, risk of wildlife damage to livelihoods, and wildlife distribution and compared these maps with spatially explicit records of poaching events. Recorded poaching events and stakeholder perceptions of where poaching occurred were not spatially correlated. Locations of documented poaching events were spatially correlated with areas that stakeholders perceived wildlife as a threat to their livelihoods. Local stakeholders thought that wildlife populations were at high risk of being poached and that poaching occurred where there was abundant wildlife. Findings suggest

stakeholders were concerned about wildlife resources in their community and indicate a need for integrated and continued monitoring of poaching activities and further interventions at the wildlife-agricultural interface. Involving stakeholders in assessing poaching risks promotes participation in local conservation efforts, a central tenet of community-based management. Stakeholder-generated maps of human wildlife interactions may be a valuable enforcement and intervention support tool.

Kansky, Ruth, *University of Stellenbosch*; **Andrew Knight**, *Imperial College London, Silwood Park Campus*; **Martin Kidd**, *University of Stellenbosch*

A Meta-Analysis of Attitudes Towards Damaging Causing Mammalian Wildlife

Many populations of threatened mammals still occur outside protected areas and their survival depends on the willingness of communities to tolerate them. Thus an understanding of the attitudes and tolerance of these communities and the factors that determine these is essential. We conducted a meta analysis to determine factors found to affect attitudes to four groups of mammals. Urban residents had the most positive attitudes (80%) followed by commercial farmers (51%) and communal farmers (26%). Elephants (65%) elicited most positive attitudes followed by primates (55%), ungulates (53%) and carnivores (44%). A tolerance to damage index showed that tolerance for ungulates and primates was in proportion to damage levels while for elephants tolerance levels were higher than expected and for carnivores lower than expected. Among carnivores the most positive attitudes were for tigers, wild dog, lion, leopard, cheetah and jackal and the least were for wolverine, wolf, bear, hyaena and coyote. Multivariate analyses showed complex relationships between species group, stakeholder type and the probability of experiencing damage. We conclude that damage is not always the main factor determining tolerance while taxonomic bias may be an important additional factor. Determining what these other factors are and which ones operate at which sites for which species will be important in order to prioritize conservation investments.

Kao, Rebecca, *Denver Botanic Gardens*; **Jennifer Neale**, *Denver Botanic Gardens*; **Michelle DePrenger-Levin**, *Denver Botanic Gardens*; **Mary Goshorn**, *Denver Botanic Gardens*

Longer long-term data in rare plant monitoring is needed

We have been monitoring rare Colorado plants for up to 18 years using count-based Population Viability Analyses. While many PVA studies only use four years of data, we present data on the minimum number of years needed to estimate a stable population growth rate for plants with different life histories

and environmental variability. The native plants studied have a variety of survival mechanisms, from the ability of the succulent to withstand years of extreme drought to perennial herb strategies, including periods of dormancy (both of the seeds and adults). While we do not yet know if the lack of growth and flowering for many of our study species in 2012 will affect long-term population trends, we can analyze this year's data in the context of long-term data to better understand the magnitude of the impact of this extreme year. As expected, with continued long-term data collection, the growth rates of the populations we monitor have stabilized and variance around the growth rates have decreased. The number of years required to reach a stable growth rate depends not only on population size, but also on the dependence of population size on environmental conditions. Using a count-based PVA allows multiple agencies with different monitoring methods and goals to communicate the status of a particular species. Understanding the length needed for confidence in PVA results can help agencies allocate appropriate resources to successfully monitor plant populations.

Kappel, Carrie, *National Center for Ecological Analysis and Synthesis*

Can we avoid going over the cliff? Tipping points in marine ecosystem based management

Scientists have uncovered a growing number of examples of thresholds or tipping points in marine ecosystems. Many of these, like the phase shift from coral dominated to algal dominated reefs, have had undesirable consequences for ecosystem services and resource management. We define a tipping point as a point or zone where a small change in an environmental driver results in a rapid, nonlinear change in ecosystem conditions. Such tipping points have been associated with both reversible phase shifts and alternate stable states that may be difficult or impossible to reverse. We use meta-analysis to characterize tipping points in marine ecosystems around the world and assess factors that contribute to variation in the strength and pervasiveness of this phenomenon across different systems, ranging from the intertidal to the open ocean. We highlight examples where this knowledge has been incorporated into management, with varying levels of success. We then introduce a new four year, collaborative, interdisciplinary project aimed at linking the science of ecosystem tipping points to management via analyses, tools and a general framework that can help managers make better decisions and avoid potential negative consequences of unintentionally crossing thresholds. The project is being developed in collaboration with managers, policymakers, and case study partners to maximize its utility. This project may have benefits for conservation and resource management as well as restoration.

Kaur, Biba, *World Wide Fund for Nature-India*; **Dipankar Ghose**, *World Wide Fund for Nature-India*; **SANJAY DAS**, *Guru Gobind Singh Indraprastha University, Delhi, India*.

Assessment of Human Elephant Conflict in a Critical Wildlife Corridor within the Terai Arc Landscape, India

Asian elephants (*Elephas maximus*), are threatened by extinction. One of the identified threats to the elephants is their interaction with Humans. Although the importance of human elephant conflict management is widely recognized, it is still relatively poorly understood and often ineffective in the Indian Subcontinent. Managing such a conflict management needs to take into consideration different factors that are location specific, such as perceptions and attitudes of people, socioeconomic factors and culture, behavior of elephants, etc. A survey of attacks of Elephants was carried out in the critical corridor (Bailparao-Kotabagh Corridor) in Terai West Forest Division, Ramnagar, Uttarakhand, India. We recorded crop-raiding, property damage, attack by elephants, and fear of attack, in the area. The methods adopted to document the problem were forest trails and village surveys. We found that crop damage is a problem for nearly all families in the village due to proximity of their agricultural fields to the park border and the village location within a traditional elephant migration route. The attitude of the villagers towards elephants was depressing. The depredation by the elephant has created antagonism among the owners, which has resulted in little cooperation towards elephant conservation programs. The survey provides a set of recommendations for the mitigation of the conflict.

Keane, Aidan, *Imperial College London*

Modeling behavior to understand patterns and drivers of illegal resource use

East Africa's dryland areas are famous for their spectacular wildlife, but are also home to many poor communities. In recent years, initiatives throughout the region have increasingly sought to combine conservation with economic development. Kenya's community conservancies are a prominent example: local pastoralist households lease their land for conservation and eco-tourism, foregoing rights to grazing in return for regular payments. Conservancies are promoted as an effective means to enhance local well-being while achieving conservation goals, but their longer-term consequences are poorly understood. Focussing on the Maasai Mara area as a case study, we used a combination of household modelling, economic games and discrete choice experiments to predict what effect the creation of conservancies will have on levels of illegal grazing. Our results compare the economic conditions where conservancies will reduce a household's reliance on livestock with those where, by contrast, households will use

their conservancy payments to buy larger herds, leading to higher levels of illegal grazing.

Keeley, Annika, *Northern Arizona University*; **Paul Beier**, *Northern Arizona University*; **Tabitha Graves**, *Colorado State University*; **Brian Keeley**, *N/A*

Comparison of landscape resistance measures as estimated by habitat use, movement behavior, and dispersal

Wildlife corridors are a widely used conservation strategy. Least-cost models identify corridors that are expected to offer the least resistance to animal movement. These models rely on landscape resistance values that reflect how much landscape features impede or promote movement of a focal species. We studied kinkajous (*Potos flavus*) in a Costa Rican landscape to derive and compare 3 sets of empirical resistance estimates, namely (1) resistance estimated from analyzing habitat use data from GPS radio-tags on 10 female kinkajous, (2) resistance estimated from movement paths (from the same data), and (3) resistance estimated from 38 dispersal events (locations of 38 parent-offspring pairs inferred from 10-locus microsatellite genotypes analyzed in PARENTE software). Because conservation corridors are intended to support dispersal movements, the latter estimates are the most appropriate for corridor design, but they can be more expensive to obtain. Resistance values derived from the 3 datasets were similar, suggesting that resistance estimates from habitat use and movement paths may be reliable proxies for resistance based on parent-offspring pairs. Based on this kinkajou dataset, designers of wildlife corridors can rely on resistance maps generated from data on habitat use.

Kellar, P. Roxanne, *University of Nebraska at Omaha*; **Dakota Ahrendsen**, *University of Nebraska at Omaha*; **Shelly Drenkow**, *University of Nebraska at Omaha*; **J. Chris Pires**, *University of Missouri*; **Amanda Jones**, *University of Nebraska at Omaha*

Phylogenetic Diversity using massively parallel sequencing: Robust biodiversity metrics for conservation planners

As ecosystems change across the globe, the preservation of biodiversity will best be achieved by the conservation of evolutionary processes. A significant gap exists between the capabilities of current technologies and the biodiversity assessment tools upon which conservation decisions are made. Our research bridges that gap, demonstrating that the newest sequencing technologies lead to biodiversity assessments that: 1) provide better characterization of genetic variation present in an ecosystem and 2) better inform policy-makers. Using massively parallel sequencing to estimate phylogenies and calculate Phylogenetic Diversity (PD) of organisms in an ecosystem represents an enhancement to biodiversity

assessment for conservation planning. In this investigation, robust phylogenies of angiosperms were estimated at two prairie sites in Nebraska, and three PD metrics were calculated and compared with species richness. The questions addressed were: 1) How are PD and species richness correlated? 2) How does PD vary between angiosperm plant families? and 3) How does PD vary between ecosystems? Complete plastid genomes plus nrDNA genes were recovered for 30 species of Asteraceae and Fabaceae for phylogeny estimation. The primary conclusion is that species richness and phylogenetic diversity are not always correlated. These empirical results give scientists and conservation planners a better understanding of the genetic diversity present in an ecosystem, beyond simple species counts.

Kelly, Sarah, *La Trobe University*; **Michael Clarke**, *La Trobe University*; **Andrew Bennett**, *Deakin University*; **Rowan Mott**, *La Trobe University*; **Greg Holland**, *Deakin University*; **Anna Flanagan-Moodie**, *Deakin University*

Assessing changes in the forest bird community after experimental prescribed burns, with a little insight from the scarlet robin

The increasing demand for prescribed burning on public land will lead to more frequent use of fire in ecosystems where little is known about appropriate fire regimes, such as the box-ironbark forests in north-central Victoria. This collaborative study was set up by researchers and government land managers to investigate the impact of prescribed burning on this ecosystem. A series of experimental burns were conducted during 2011 in two different seasons (autumn, spring) and at different levels of burn cover. Bird community monitoring was undertaken to look at density and composition before and after burning. A focal species, the scarlet robin *Petroica boodang*, was selected and radio tracking used to investigate the direct impact of burning and changes in territory, habitat use and foraging behaviour following spring burns. Scarlet robins proved to be quite resilient to high coverage burning of their habitat, remaining in areas of >90% burn coverage and canopy scorch, but there was an increase in extent of habitat used post-burn and some small shifts of territories. New nests were built in the post-burn landscape and two-thirds of tagged birds were found using the same territory one year post-burn. While there was little change observed in the density and composition of the overall bird community, radio tracking provided some insight into the impacts of burning on individual birds and highlighted the importance of adjacent unburnt forest for use as refuge during the fire.

Kester, Marieke, *George Mason University*; **Thomas Huff**, *George Mason University*; **Elizabeth Freeman**, *George Mason*

University; **Thomas Goodwin**, *Hendrix College*; **Nucharin Songsasen**, *Smithsonian Conservation Biology Institute*

The Solitary Maned Wolf Uses Scent Signals to Ensure Reproductive Success

The maned wolf (*Chrysocyon brachyurus*) is unique among canids; this species is an induced ovulator (ovulation occurs only in the presence of a male), unlike most other canids that spontaneously ovulate. Because females housed next to males, but without direct contact, ovulate normally, it appears that chemical signals facilitate ovulation. It is hypothesized that these reproductive signaling chemicals exist in the males' urine. Using an integrative approach connecting chemical-ecology techniques with reproductive behavioral observations, this project's goal is to identify male signaling compounds responsible for estrus induction. Urine samples and behavioral data were collected from maned wolves housed at the Smithsonian Conservation Biology Institute. Results showed that female maned wolves interact more with male urine collected during breeding season compared with samples collected outside breeding season. Using gas chromatography-mass spectrometry, over 120 volatile compounds were identified including alkyl-pyrazines, thiols, thiophenes, ketones, and hemiterpenoids, including compounds that may be unique to males. The findings suggest that certain urinary volatile compounds may signal individual identity, sex, and reproduction among conspecifics. Results generated from this research will be applied to develop a non-invasive method of inducing estrus, easing captive breeding management while advancing assisted reproductive technologies in this threatened species.

Khadka, Madhav, *World Wildlife Fund Nepal Program*; **Hemanta Kafley**, *University of Missouri*; **Rupak Maharjan**, *Department of National Parks & Wildlife Conservation, Government of Nepal*; **Ritesh Basnet**, *Department of Forests, Government of Nepal*

Shift in Strategy for the Implementation of a Successful Wildlife Crime Control: Coordination among Stakeholders as a Key Approach

Nepal, with its rich diversity of several critically endangered species, serves both as a source and a transit for wildlife trade. Wildlife crime control strategies have been evolving in Nepal since early 19th century. However, effectiveness of the adopted strategies was never assessed. We report on effectiveness of the current wildlife crime control strategy in Nepal to fill this knowledge gap. This study is based on a synthesis of expert knowledge and opinions along with the critical examination of the wildlife crime control strategies existed at different times. Current integrated wildlife crime control strategy that mobilizes different institutions to act simultaneously for the control of wildlife related crime has been the most effective strategy till date. However, illegal trade reportedly continues threatening biodiversity of the

country. We also analyzed the preference of traders to use different available routes in the country. Location data on seizures and arrests show that routes are not chosen based on the wildlife parts being traded. Traders generally preferred safest route, which is not surprising. However, as opposed to common notion shorter routes did not have significant effect in choosing routes for trading wildlife products. The results contribute in improvising wildlife trade control strategy and the trade route analysis objectively guides the law enforcement agencies.

Khan, Md Saiful, *Lakehead University*

REDD+ site selection through systematic conservation planning using MARXAN in Tanzania

Mainstreaming conservation priorities into REDD+ decision making process is one of the biggest challenges for conservation. Adoption of systematic conservation planning principles for REDD+ site selection can be a solution. This research explores the feasibility of integrating conservation and REDD+ spatial planning at national level in Tanzania. Marxan with Zonae Cogito software was used for selection of REDD+ sites using relative land value as cost and reducing deforestation, maintaining carbon reserve, provisioning biodiversity conservation, participatory management and other socio-economic benefits as targets to achieve. Using GIS based datasets potential REDD+ sites were mapped under different decision scenario. Maps of selected REDD+ sites in Tanzania were easily interpretable and showed logical response in sensitivity analysis under different decision scenario. These sites showed congruence of conservation priorities in terms of biodiversity richness, rareness and complementarity. This selection mechanism can be used for subsequent stakeholder consultation in systematic planning process. Marxan has the potential to become key REDD+ spatial planning software with some adaptation. Successful adoption of systematic planning and use of Marxan as decision support tool for REDD+ site selection with due importance to biodiversity and its habitats can change the face of conservation efforts across prospective REDD+ countries.

Kielgast, Jos, *University of Copenhagen*

Monitoring of rare freshwater animals in Europe using environmental DNA - a valuable shortcut to crucial biodiversity data?

Freshwater ecosystems are among the most endangered habitats on Earth greatly suffering from anthropogenic impacts across the globe. Reliable monitoring of threatened freshwater species is crucial for data-driven conservation actions in this context but remains a challenge owing to non-standardized methods that depend on practical and

taxonomic expertise, which is steadily declining. Here, we show that a diversity of rare and threatened European freshwater animals - representing amphibians, fish, mammals, insects and crustaceans - can be detected and quantified based on DNA obtained directly from small water samples of lakes, ponds and streams. We successfully validate our findings in a controlled mesocosm experiment and show that DNA becomes undetectable within 2 weeks after removal of animals, indicating that DNA traces are near contemporary with species presence. We also test the comparative performance of conventional monitoring methods and environmental DNA detection in the field showing promising evidence of high sensitivity in DNA based surveys. Lastly, we demonstrate that eDNA from small water samples can be used to exhaustively detect entire assemblages of amphibians and fish by high-throughput sequencing. Our findings underpin the ubiquitous nature of DNA traces in the environment and support the use of environmental DNA as a tool for monitoring rare and threatened species across a wide range of taxonomic groups.

Klaus, Valentin, *University of Münster, Germany*; **Till Kleinebecker**, *University of Münster*; **Steffen Boch**, *University of Bern*; **Jörg Müller**, *University of Potsdam*; **Stephanie Socher**, *University of Bern*; **Daniel Prati**, *University of Bern*; **Barbara Schmitt**, *University of Bern*; **Nico Blüthgen**, *University of Darmstadt*; **Markus Fischer**, *University of Bern*; **Norbert Hölzel**, *University of Münster*

Implication for management and conservation of species-rich temperate grasslands from an interdisciplinary research project in Central Europe

Land use is a precondition for the existence of species-rich grasslands in the temperate zone, but highly intensive land use leads to a drastic drop in species richness. The Biodiversity Exploratories (www.biodiversity-exploratories.de), a broad scale research project with 300 people involved in Germany, addresses interactions between land-use intensity, biodiversity and ecosystem processes in agricultural grasslands. We assessed data on grazing, fertilization and mowing intensities, on diversity, productivity, biomass nutrients and the delta15N isotopic composition of 150 grassland plots. Productivity, nutrient concentrations and delta15N in biomass were positively related to land-use and especially fertilization intensity, while plant species richness was clearly negatively related. Highest plant species richness was found under P- or NP co-limitation. Our results showed multiple negative impacts of intensive land use on the conservation value of temperate grasslands. Analyzing a subset of organic grasslands revealed that plant species richness did not benefit from reduced land-use intensity under organic management. A seed addition experiment implied that a gap between potential and realized plant species richness exists, where former land use was highly

intensive. These results indicate that dispersal limitation is a major obstacle for species richness to benefit from reduced land-use intensity and to effectively conserve and restore grassland biodiversity.

Kleisner, Kristin, *University of British Columbia*; **Daniel Pauly**, *University of British Columbia*

Modeling potential fisheries recovery using catch reconstruction

The global fisheries crisis has been illustrated by numerous examples: catches are declining despite increasing fishing effort; otherwise unprofitable fisheries are kept afloat by government subsidies; the state of stocks - except for a few areas with prudent management - is abysmal; and biodiversity is decreasing. In the world of marine fisheries and biodiversity, it is common to attempt to mitigate this fisheries crisis in the form of a zero-sum game, where increased fisheries yields are seen as incompatible with maintaining marine biodiversity. However if depleted stocks were allowed to rebuild, they would produce more in terms of fisheries yield and contribute to increased biodiversity in their ecosystems. This win-win situation logically follows from the basic principles of both fisheries and marine conservation science: in situations where stocks are overfished, allowing them to rebuild will, after a transition period, lead to potentially higher productivity and, if managed well, more sustainable catches. We estimate the potential for catch increases in 25 major fishing countries using a data-poor assessment method that relies on a time series of landings to estimate maximum sustainable yield and compare these potential catch estimates with results from ecosystem-based models. Results suggest that some countries are experiencing strong exploitation and that reduced fishing effort would allow key species' biomass to increase, and thus their sustainable levels of yield.

Knight, Andrew, *Imperial College London*

A policy process for identifying and orientating the conservation problem in opportunity assessments

Over the past decade, conservation planners have emphasised the importance of careful scoping of the conservation problem. However, few studies have presented a systematic process for problem scoping, particularly in the areas of problem identification and problem orientation. Such processes need to be established and implemented alongside conservation opportunity assessments to ensure that important elements of the conservation context are embedded in the assessment, including key stakeholders. This presentation will present an overview of one process for identifying and orientating the conservation opportunity problem, as developed by a team of researchers and

practitioners who attended a workshop in Australia on The Development of New Tools and Processes for Assessing Conservation Opportunity (April 23-26 2013). The process links together elements of the Systematic Conservation Planning process with elements of established environmental policy and natural resource management processes. The presentation will conclude with a discussion of the strengths and weaknesses of this process in regards to the translation of conservation priorities into effective conservation actions.

Knuth, Kate, *University of Minnesota, Institute on the Environment*

Educating Graduate Students to be Environmental Leaders and World-Changers: Experiences from the Boreas Leadership Program

Finding and enacting solutions to conservation challenges requires effective, innovative and well-networked leaders. Graduate education in conservation biology and related fields prepares students in many important skills, but misses some important leadership skills. Furthermore, students have easy access to academic networks but may have some difficulty branching out into wider networks. The Boreas Leadership Program at the University of Minnesota's (UMN) Institute on the Environment (IonE) is an innovative, co-curricular, non-credit education program working to fill some of these gaps in graduate education. By offering leadership training, networking, and skills building experiences Boreas complements more traditional graduate education programs. Skills workshops focus on communications and media, integrative leadership, systems thinking and tools, and mentoring. Networking events bring students into contact with leaders in global business, state government, NGO organizing and more. In its first two years of existence Boreas has trained over 200 graduate and professional students from over ten colleges at the UMN, and the program's breadth and depth of impact continue to grow. This presentation will outline the development of the Boreas Leadership Program, offer lessons learned from two years of experience, and reflect on the need to train the next generation of conservation leaders and how to do so effectively.

Kolowski, Joseph, *Smithsonian Conservation Biology Institute*; **Alfonso Alonso**, *Smithsonian Conservation Biology Institute*; **Hadrien Vanthomme**, *Smithsonian Conservation Biology Institute*; **Lisa Korte**, *Smithsonian Conservation Biology Institute*

Distribution of a community of mammals in relation to roads and other human disturbances in a mosaic landscape of central Africa

Despite the expansion of roads and settlement in Central Africa, we have limited knowledge of how both ecological and

anthropogenic factors integrate to determine the distribution of terrestrial mammals. We present the first community-level study of the associations of both roads and other human disturbances with the distribution of mammals in Gabon. We used sign surveys, observation and camera traps along 199 line transects to document mammals in a mosaic landscape that includes an oil concession. Generalized linear mixed-effect models identified associations between ecological and anthropogenic variables and the abundance or presence of 17 species. Some types of roads and other disturbances were negatively associated with elephants, buffalos, gorillas, sitatungas, duikers, and some monkeys. Yet we also found positive associations with road presence (red river hog, some monkeys, duikers), agriculture (sitatunga, small carnivores, large rodents) and industrial activities (sitatunga, red river hog, red duikers, side-striped jackal), stressing the importance of accounting for multiple anthropogenic factors. Hunting, agriculture, and urbanization, all facilitated by roads, were key factors in determining mammal distribution, indicating that land-use planning is critical to conservation of mammal populations. This study highlights that industry partnerships can result in unique opportunities to advance conservation science and the development of impact mitigation solutions.

Kornbluth, Sarah, *Rutgers University*; **Kimberly Russell**, *New Jersey Institute of Technology*; **Gareth Russell**, *New Jersey Institute of Technology*

Native bees and large-scale organic farming: Are sufficient pollination services provided?

Pollination is a critical ecosystem service that maintains biodiversity and ecosystem function. Honeybee deaths and escalating costs of rental in the wake of Colony Collapse Disorder has demonstrated that dependence on domesticated honeybees for agricultural pollination in the future is unrealistic for many farmers. Native bees may be able to provide sufficient pollination services when their populations are encouraged, but data on the spatial distribution habits of native bees is critical to understanding the pollination services that they can provide. Research that quantifies in-field distribution and diversity is limited but is especially important as field size and distance from natural habitat increases. We found cooperative collaborators in organic farmers and chose the largest scale farm (285 acres) to maximize our chance of estimating the distance at which bee penetration might diminish. Using beds as long as 250m of bee-pollinated crops (pepper, tomato, and eggplant) with adjacent natural habitat, we trapped and observed bees to quantify the density and diversity of bee pollinators at intervals within the fields, and we performed hand pollination and pollinator exclusion in mid-field. We found over 30 species of native bee and statistical analysis of distribution corroborates the satisfactory level of pollination services provided. We find that a farm of this scale receives sufficient

pollination services from native bees living in adjacent natural habitat.

Kretser, Heidi, *Wildlife Conservation Society*

Conservation during global conflict: opportunities to curtail wildlife trade through work with the U.S. military

Political conflict can have devastating effects on the environment. One indirect outcome of military conflict is the significant buying power that military personnel and affiliates possess to influence local markets, including the ability to drive the demand for wildlife products. The Wildlife Conservation Society is working with the Department of Defense's Legacy Natural Resources Program to develop a comprehensive outreach and education program to curtail military demand for wildlife products. We surveyed military bazaars (n=4) in Kabul, Afghanistan from April to December 2008 to observe which species were available to soldiers in markets. We also surveyed army personnel (n=371) at Fort Drum, New York, USA in June 2008 who had been deployed or stationed overseas including in Afghanistan. In Afghanistan, skins of wild felids and the Eurasian wolf *Canis lupus* were the most commonly observed wildlife products for sale. At Fort Drum, 40% of the soldiers surveyed had either purchased or seen other members of the military purchase or use wildlife products, yet only 12% had heard of CITES. Current efforts to raise awareness and the consequences of purchasing wildlife trade products target military personnel serving abroad, as well as soldiers preparing for deployment. We use outreach and training materials to convey messages about wildlife trade, reduce demand for wildlife products, and explore the potential for military to proactively combat wildlife trade in the field.

Kristiansen, Trond, *Institute of Marine Research*

Mechanistic insights into the effects of climate change on larval cod

Understanding the bio-physical mechanisms that shape variability in fisheries recruitment is critical for estimating the effects of climate change on fisheries. In this study, we coupled an Earth System Model (ESM) simulation with a mechanistic individual-based model (IBM) for larval fish to analyze how climate change may impact the growth and survival of larval cod in the North Atlantic. We focused our analysis over 5 regions that span the current geographical range of cod and are known to be important spawning populations. Under the SRES A2 scenario, surface ocean temperatures are projected to increase by > 1°C for three of the five regions and stratification is expected to increase at all sites between 1950-1999 and 2050-2099. Enhanced stratification was projected to lead to decreases in large phytoplankton productivity and mesozooplankton biomass,

particularly during the spring and fall. Decreased abundance of mesozooplankton and increased larval metabolic costs associated with warming temperatures were projected to reduce larval size during spring and fall, increasing their exposure to invertebrate predation. Larval survival and weight during the summer showed relatively modest changes at four of the five sites. Projected annual mean survival rates, however, decreased at all five sites. In contrast to past observed responses to climate variability in which warm anomalies led to better recruitment in cold-water stocks, our simulations suggest that reduced prey availability under climate change caused higher temperatures to have a negative impact on larval survival throughout the cod range. In the lower prey environment projected under climate change, the higher metabolic costs due to higher temperatures outweighed the advantages of higher growth potential.

Krosby, Meade, *University of Washington*; **Robert Norheim**, *University of Washington*; **Brad McRae**, *The Nature Conservancy*; **David Theobald**, *National Park Service*

Riparian Climate Corridors: Prioritizing valley bottoms as natural conduits for climate-driven range shifts

Climate change is causing large shifts in many species' ranges, as parts of existing ranges become climatically inhospitable and species move into areas that remain suitable (i.e., refugia) or become newly suitable. Maintaining and restoring ecological connectivity has thus been recognized as a critical tool for minimizing the threat of climate change to biodiversity. Riparian areas provide particularly valuable movement pathways for climate-driven range shifts; they naturally span the climatic gradients species ranges are likely to follow as they track shifting areas of climatic suitability, and because they are naturally buffered against warming, they may offer some of the best climate adaptation opportunities in flat landscapes with high levels of human modification. Yet previous approaches to identifying riparian corridors for climate adaptation have been largely subjective and ad hoc. We used a fine-scale map of valley bottoms (i.e., potential riparian areas) across the Pacific Northwest, USA, to identify and prioritize those likely to offer effective movement corridors for climate-driven range shifts. We created a simple index that measures the extent to which valley bottoms span temperature gradients, are buffered against warming, and are unmodified by human activities. Results revealed significant variance in riparian climate-corridor quality across the region, and stressed the importance of incorporating multiple scales of analysis and interpretation.

LaCivita, Lisa, *George Mason University*

Working Landscapes in Virginia

The mission of the Virginia Working Landscapes is to study and encourage the sustainable use of Virginia's landscapes for native biodiversity through community engagement and scientific research. The effort currently focuses on stemming the decline of native plants, birds, and insects in eastern U.S. grasslands due, in part, to intensive land management and invasive plant species. Participating properties are monitored for bird, plant and pollinator species to provide baseline data and trends on restored landscapes. Landowners are networked with each other for the dissemination of information and with state and federal agencies that can provide specific technical and financial assistance. Demonstration sites have been established that showcase best practices and opportunities are provided for landowners to visit and tour working farms that serve a dual purpose in agricultural production and biodiversity. Lead by the Smithsonian Conservation Biology Institute an extensive network of groups are partnering, to advance the science of land management and develop best practices relevant both to working farmers and conservationists.

Lacy, Robert, *Chicago Zoological Society*; **Philip Miller**, *IUCN SSC Conservation Breeding Specialist Group*; **Philip Nyhus**, *Colby College*; **John Pollak**, *Cornell University*; **Becky Raboy**, *University of Toronto*; **Sara Zeigler**, *Virginia Tech*

Metamodels: Connecting models and people for inclusive, integrated, transdisciplinary analysis of populations facing multiple threats

Population viability models have facilitated important advancements in species conservation planning, but existing species risk assessment approaches have been criticized for their narrow disciplinary perspective and limited success in assessing coupled biological-human complexity. We describe a novel metamodel approach to species risk assessment for systems in which diverse threats are addressed through different disciplines, act at different spatiotemporal scales, or interact in non-linear ways. A metamodel links multiple, discrete models that depict components of a complex system, by governing the flow of information among models and the sequence of events in a simulation analysis. Each discrete model simulates processes specific to its disciplinary realm while being informed of changes in other parts of the metamodel by accessing common descriptors of the system, populations, and individuals. Interactions among models are revealed as emergent properties of the system. We introduce a metamodeling platform to implement this approach and illustrate how it can reveal complex processes that link population dynamics to external forces such as other species, infectious disease, landscape change, and climate. The metamodel approach can be used to integrate the expertise of diverse disciplines to address conservation problems that require understanding and action at the levels of populations, habitats, ecological communities, ecosystem processes, and human activities.

Lance, Richard, *U.S. Army Corps of Engineers*

Detecting terrestrial animal eDNA in aquatic samples from desert watering sites

On arid lands, limited water resources attract a large diversity of wildlife from large geographic areas. Wildlife that live in these restricted habitats, or that merely visit these resources or surrounding catchments for drinking or hunting, will deposit DNA that may eventually enter the aquatic milieu. We are exploring the potential for aquatic eDNA samples to be used as a tool for identifying the suite of terrestrial mammals (including bats) that live near or visit these resources, and for detecting rare or elusive species. In September 2012, eDNA samples were collected from 13 locations in the low desert and mountain canyons of southern Arizona. More than 60 multiplex primer sets aimed at amplifying mitochondrial targets within Microchiroptera, Carnivora, and Soricidae were designed using existing whole mitochondrial genomes in NCBI GenBank. After trials to identify those primer sets that provide the most reliable amplification of target species, the select subset of primer sets will be used to create, for each sample location, an enriched, pooled template for amplicon resequencing on a high-throughput next-generation sequencer. The single-molecule sensitivity of such sequencers and massive sequence output may allow us to detect species that have deposited very little eDNA in a system. Ultimately, the described approach, or variations thereof, may provide unprecedented power for detecting rare or elusive species in areas with limited freshwater resources.

Lange, Glenn-Marie, *World Bank (WAVES)*

How are the expanded national accounts being used by Botswana, Guatemala and other nations to foster sound decision-making and investment?

"How we measure development will drive how we do development." This is the idea behind the World Bank initiated partnership to promote Natural Capital Accounting, called Wealth Accounting and Valuation of Ecosystem Accounting, or WAVES. The critical role of natural capital in human well-being, especially in poor communities in developing countries, is widely recognized, but ecosystems continue to deteriorate, often in the pursuit of short-term economic growth. Unless the economic value of ecosystem services is recognized, their contribution to sustainable economic welfare will be seriously underestimated, resulting in under-investment in sustainable management and ultimately lower incomes. Extending the National Accounts for natural capital provides information to demonstrate the influence of natural capital on the major indicators of macroeconomic performance, such as GDP, employment and the balance of payments, and what can potentially be lost

under mismanagement. Hence, Natural Capital Accounting can be particularly effective for engaging agencies responsible for economy-wide management. Recent international agreement on the UN's System of Environmental and Economic Accounting provides credible methodology, although much work remains to be done.

The presentation will highlight progress in WAVES partner countries to extend natural capital accounting for ecosystems, and policy advances possible with natural capital accounting.

Lapointe, Nicolas, *Carleton University*; **Steven Cooke**, *Carleton University*; **Jack Imhof**, *Trout Unlimited Canada*; **Daniel Boisclair**, *University of Montreal*; **John Casselman**, *Queen's University*; **Allen Curry**, *University of New Brunswick*; **Otto Langer**, *British Columbia Marine Conservation Caucus*; **Robert McLaughlin**, *University of Guelph*; **Charles Minns**, *University of Toronto*; **John Post**, *University of Calgary*; **Michael Power**, *University of Waterloo*; **Joseph Rasmussen**, *University of Lethbridge*; **John Reynolds**, *Simon Fraser University*; **John Richardson**, *University of British Columbia*; **William Tonn**, *University of Alberta*

Principles for ensuring healthy and productive freshwater ecosystems that support sustainable fisheries

Freshwater ecosystems and the fisheries they support are increasingly threatened by human activities. To aid those seeking to manage and protect fisheries of inland ecosystems, we outline nine key principles of healthy and functioning ecosystems based on the best available science using Canada as a case study. The principles are: laws of physics and chemistry apply to ecology; population dynamics are regulated by reproduction, mortality, and growth; the importance of habitat quality and quantity; habitats must remain connected; species and their habitats are subject to ecosystem-scale effects; biodiversity enhances ecosystem resiliency and productivity; global processes affect local populations; anthropogenic stressors can have cumulative effects; evolutionary processes must be protected.

Additionally, we provide general recommendations for managing and protecting freshwater ecosystems and the fisheries they support providing examples of successful implementation for each management principle. Examples of management recommendations include: engage stakeholders, adopt a precautionary approach, embrace adaptive management, and implement ecosystem-based management. Ecosystems are complex with many components that are spatiotemporally intertwined. Ignoring linkages and processes significantly reduces the probability of successful management efforts. The principles of ecosystem structures and functions must be considered when developing policy and identifying management options.

Larsen, Trond, *Conservation International*

Conserving biodiversity and ecosystem services through CI's Rapid Assessment Program (RAP+) in Suriname

Almost entirely forested, Suriname is the greenest country in the world. However, looming plans for new mining concessions, roads, and hydropower projects could threaten its exceptional biodiversity and disrupt indigenous livelihoods. Consequently, Suriname represents a rare opportunity for carefully planned sustainable development before major changes have occurred. However, conservation planning in the rugged interior of the country is hampered by a lack of biological and socioeconomic data. Conservation International's Rapid Assessment Program (RAP+) has conducted a series of expeditions to integrate our understanding of vital linkages between biodiversity, healthy ecosystems, and human societies. By quantifying and mapping ecosystem services, such as wild food sources, we are helping to empower local indigenous communities to protect their natural resources. We are also training students and conservationists from local communities. We have documented thousands of species, including dozens of species new to science. Surprisingly, we found that even supposedly pristine rivers contain harmful levels of mercury, despite their remoteness and complete lack of upstream gold-mining. Working closely with a wide variety of stakeholders, we are now using our data to identify conservation priorities and to guide the creation of new conservation areas. This approach could provide a flexible, cost-effective tool to protect natural capital in other countries around the world.

Lauber, Bruce, *Cornell University*; **Nancy Connelly**, *Cornell University*; **Richard Stedman**, *Cornell University*; **Richard Ready**, *Pennsylvania State University*; **Gregory Poe**, *Cornell University*; **Selmin Creamer**, *Ithaca College*

Aquatic Invasive Species in the Great Lakes and Mississippi River Systems: Economics, Human Behavior, and Ecology

Policy decisions about how to control aquatic invasive species are driven in part by economics. We conducted a study of how aquatic invasive species movement between the Mississippi River system and the Great Lakes could affect the economic value of recreational fishing; this study has implications for the management of aquatic pathways between the two systems. Our work was informed by an understanding of economics, human behavior, and ecology. We conducted a mail and internet survey of 7,201 recreational anglers in a 12-state region encompassing the U.S. portion of the Great Lakes and Upper Mississippi and Ohio River basins. This survey collected detailed information about fishing trips taken in 2011 and about how anglers would respond to hypothetical decreases in recreational fish species. An economic model was developed to estimate the current and future value of the fishery. Our results show that

anglers would respond to decreases in fish stocks brought about by invasive species in a variety of ways, depending on their preferences and other characteristics. These angler responses are closely related to changes in the net value of the fishery, and, therefore, have policy implications. Our work demonstrates how integrating an understanding of economics, human behavior, and ecology can contribute to conservation, and how that integration can be improved in the future.

Lawrence, Niel, *Natural Resources Defense Council*

Environmental Impact Assessment and Public Lands Stewardship -- Biodiversity in Federal Lands and Federal Actions -- NEPA/NFMA/FLPM

Input by scientists and citizens alike into habitat conservation and climate response on US federal lands is more affected by three statut76e76s76 76t76h76a76n76 76a76n76y76 76o76t76h76e76r76s76:76 76 76T76h76e76 76N76a76t76i76o76n76a76l76 76F76o76r76e76s76t76 76M76a76n76a76g76e76m76e76n76t76 76A76c76t76;76 76t76h76e76 76F76e76d76e76r76a76l76 76L76a76n76d76 76P76o76l76i76c76y76 76a76n76d76 76M76a76n76a76g76e76m76e76n76t76 76A76c76t76;76 76a76n76d76 76t76h76e76 76N76a76t76i76o76n76a76l76 76E76n76v76i76r76o76n76m76e76n76t76a76l76 76P76o76l76i76c76y76 76A76c76t76.76 76 76E76a76c76h76 76s76e76t76s76 76s76t76a76n76d76a76r76d76s76 76f76o76r76 76a76g76e76n76c76i76e76s76 76t76o76 76d76i76s76c76l76o76s76e76 76a76n76d76 76s76o76l76i76c76i76t76 76c76o76m76m76e76n76t76s76 76o76n76 76p76r76o76p76o76s76a76l76s76 76a76f76f76e76c76t76i76n76g76,76 76a76m76o76n76g76 76o76t76h76e76r76 76t76h76i76n76g76s76,76 76b76i76o76d76i76v76e76r76s76i76t76y76.76 76 76T76h76e76 76N76F76M76A76 76a76n76d76 76i76t76s76 76r76e76g76u76l76a76t76i76o76n76s76 76u76n76i76q76u76e76l76y76 76i76n76 76f76e76d76e76r76a76l76 76l76a76w76 76i76n76c76l76u76d76e76 76a76 76b76i76o76d76i76v76e76r76s76i76t76y76 76m76a76n76d76a76t76e76.76 76 76F76L76P76M76A76 76c76o76n76t76a76i76n76s76 76m76u76l76t76i76p76l76e76 76p76r76o76t76e76c76t76i76o76n76s76 76f76o76r76 76t76h76e76 76h76a76b76i76t76a76t76 76o76f76 76e76v76e76n76 76n76o76n76- 76i76m76p76e76r76i76l76e76d76 76t76a76x76a76.76 76 76A76n76d76 76N76E76P76A76,76 76a76s76 76i76m76p76l76e76m76e76n76t76e76d76,76 76c76r76e76a76t76e76s76 76a76c76c76o76u76n76t76a76b76i76l76i76t76y76 76f76o76r76 76t76h76e76 76s76c76i76e76n76t76i76f76i76c76

76i76n76t76e76g76r76i76t76y76 76o76f76 76d76e76c76i76s76i76o76n76s76 76a76f76f76e76c76t76i76n76g76 76t76h76e76 76e76n76v76i76r76o76n76m76e76n76t76,76 76a76n76d76 76r76e76q76u76i76r76e76s76 76r76e76a76s76o76n76e76d76 76r76e76s76p76o76n76s76e76s76 76t76o76 76o76u76t76s76i76d76e76 76s76c76i76e76n76t76i76f76i76c76 76o76p76i76n76i76o76n76.76 76T76h76e76 76e76f76f76e76c76t76i76v76e76n76e76s76s76 76o76f76 76t76h76e76s76e76 76l76a76w76s76 76i76n76 76s76a76f76e76g76u76a76r76d76i76n76g76 76U76.76S76.76 76b76i76o76d76i76v

Layzer, Judith, *MIT*

Enabling Change: The Politics of Ecosystem-Based Management

According to its proponents, ecosystem-based management (EBM) should yield plans that a76r76e76 76r76o76o76t76e76d76 76i76n76 76i76n76t76e76g76r76a76t76i76v76e76 76s76c76i76e76n76t76i76f76i76c76 76a76s76s76e76s76m76e76n76t76s76,76 76p76r76o76t76e76c76t76i76v76e76 76o76f76 76e76c76o76l76o76g76i76c76a76l76 76e76l76e76m76e76n76t76s76 76a76n76d76 76p76r76o76c76e76s76e76s76,76 76a76n76d76 76c76a76p76a76b76l76e76 76o76f76 76a76d76j76u76s76t76i76n76g76 76t76o76 76n76e76w76 76i76n76f76o76t76m76a76t76i76o76n76 76o76v76e76r76 76t76i76m76e76.76 76B76u76t76 76s76k76e76p76t76i76c76s76 76w76o76r76r76y76 76t76h76a76t76 76E76B76M76 76w76i76l76l76 76n76o76t76 76d76e76l76i76v76e76r76 76o76n76 76i76t76s76 76p76r76o76m76i76s76e76 76a76n76d76 76i76n76s76t76e76a76d76 76w76i76l76l76 76d76r76a76w76 76s76c76a76r76c76e76 76r76e76s76o76u76r76c76e76s76 76a76w76a76y76 76f76r76o76m76 76t76h76e76 76t76o76o76l76s76s76u76c76h76 76a76s76 76l76a76w76s76u76i76t76s76,76 76a76d76m76i76n76i76s76t76r76a76t76i76v76e76 76a76p76p76e76a76l76s76,76 76a76n76d76 76p76u76b76l76i76c76 76r76e76l76a76t76i76o76n76s76 76c76a76m76p76a76i76g76n76s76o76n76 76w76h76i76c76h76 76e76n76v76i76r76o76n76m76e76n76t76a76l76i76s76t76 76 76h76i76s76t76o76r76i76c76a76l76l76y76 76h76a76v76e76 76r76e76l76i76e76d76.76 76T76h76i76s76 76p76r76o76j76e76c76t76 76s76y76s76t76e76m76a76t76i76c76a76l76l76y76 76c76o76m76p76a76r76e76s76 76E76B76M76 76w76i76t76h76 76m76o76r76e76

77c77o77n77v77e77n77t77i77o77n77a77l77
77a77p77p77r77o77a77c77h77e77s77 77t77o77
77p77t77o77t77e77c77t77i77n77g77 77l77a77t77g77e77-
77s77c77a77l77e77
77e77c77o77s77y77s77t77e77m77s77,77
77s77e77e77k77i77n77g77 77t77o77
77i77s77o77l77a77t77e77 77t77h77e77
77p77o77l77i77t77c77a77l77
77i77n77f77l77u77e77n77c77e77s77 77t77h77a77t77
77c77o77n77t77r77i77b77u77t77e77 77t77o77
77m77o77r77e77 77o77t77 77l77e77s77s77
77e77n77v77i77r77o77n77m77e77n77t77a77l77y77
77p77t77o77t77e77c77t77i77v77e77
77o77u77t77c77o77m77e77s77.77 77l77
77c77o77n77c77l77u77d77e77 77t77h77a77t77,77
77a77l77t77h77o77u77g77h77 77E77B77M77
77g77e77n77e77r77a77t77e77s77
77i77m77p77o77r77t77a77n77t77 77e77n77v77i77r77o

Lee, Elizabeth, *The University of Alabama*; **Ryan Earley**, *The University of Alabama*

Hormonal changes in a hermaphroditic fish exposed to ethinyl estradiol

A diversity of aquatic organisms inhabit mangrove habitats, which are becoming imperiled due to anthropogenic influences. Many mangroves are exposed to wastewater treatment plant effluents, potentially subjecting organisms to endocrine disrupting compounds (EDCs) such as ethinyl estradiol (EE2). The mangrove rivulus (*Kryptolebias marmoratus*) thrives in mangroves and is an excellent model organism in which to assess anthropogenic effects at the organismal level. Populations consist of self-fertilizing hermaphrodites with males being quite rare. Studies have shown male fish exposed to EDCs in freshwater habitats show a steep drop in sex hormones. We hypothesized that individuals exposed to EE2 would exhibit changes in estradiol (E2) and 11-ketotestosterone (KT; a fish androgen). We used 20 individuals (10 hermaphrodite, 10 male) from an isogenic lineage, SSH (Melbourne Beach, FL). They were kept in 500 ml glass jars with 25 ppt salt water for 30 d. Each day the water was changed and half received a dose of 4 ng/L EE2 and the other half received vehicle. At 30 d we collected waterborne hormone samples and excised gonads for histological analyses. Exposed males showed a decrease in KT while exposed hermaphrodites exhibited no change. Both sexes showed a drop in E2 when exposed. Our findings provide insights into how EDCs might disrupt reproduction in fishes and raise questions concerning the extent of exposure and the mechanisms driving EDC accumulation in mangrove ecosystems.

Lee, Tien, *Earth Institute, Columbia University*; **Ezra Markowitz**, *Princeton University*; **Peter Howe**, *Yale University*; **Chia-Ying Ko**, *Yale University*; **Anthony Leiserowitz**, *Yale University*

Global disparity in the predictors of public climate change awareness and risk perceptions

Climate change is one of the greatest threats facing humanity. Opinion polls suggest that levels of public awareness and risk perception vary worldwide, yet little is known on the underlying correlative structure of climate change perceptions. Here, using a global dataset, we explore the influence of socio-demographic, beliefs, and opinions in predicting public climate change perceptions. Globally, we find strong geographic trends and that education level and cause of global warming are key in classifying an individual's level of awareness and concern, respectively. However, modeling nations separately, we uncover complex interactions and global disparities in their correlative structures. Specifically, education is the strongest predictor of awareness outside of Europe, North America and Australia. Perceived cause of global warming is most critical when predicting threat perception in only Europe and Latin America whereas local temperature change perception is most vital in African and Asian countries. Analyzing the multi-dimensional structure of predictors of threat perception, we show that nations hardly cluster according to their geographic region and their dissimilarities are only weakly explained by national economic and ecological indicators. Overall, our results suggests that national, and international discourses must consider the correlates of public climate change perceptions if we want to build global consensus and collectively respond to this global issue.

Leidner, Allison, *NASA Earth Science Division/Universities Space Research Association*; **Woody Turner**, *NASA Earth Science Division*

Contributions of the NASA Biodiversity and Ecological Forecasting Programs to Conservation Biology

For over four decades, NASA has used the vantage point of space to observe Earth. The NASA Earth Science Division includes a Biodiversity program, a basic research program using satellite and airborne remote sensing technology to detect and understand patterns of biodiversity and characterize how they are changing through time. This program is complemented by the division's Ecological Forecasting program, an applications program that promotes the use of NASA observations, models, and scientific results for societal benefit by transitioning tools and applications to use by conservation partners. Conservation biology is a key focus for both the Biodiversity and Ecological Forecasting programs. Here, we describe these two programs, outline their aims, and review the solicitation and selection processes that support research and applications projects relevant to

conservation biology. Additionally, we highlight recently-launched and soon-to-be launched NASA satellite missions that will contribute to the next generation of observations that advance conservation science and practice. We will also provide examples of how funded research contributes to the conservation community. Finally, we identify resources for obtaining NASA datasets, which are all freely available, as well as NASA visualizations, which are showcased via the NASA hyperwall in the ICCB exhibit area.

Lenda, Magdalena, *Institute of Nature Conservation, Polish Academy of Sciences*; **Piotr Skorka**, *Institute of Zoology, Poznan University of Life Sciences*; **Dawid Moroń**, *Institute of Systematics and Evolution of Animals, Polish Academy of Sciences*; **Michał Woyciechowski**, *Institute of Environmental Sciences, Jagiellonian University*

Fragmentation or invasion - which is a bigger threat to biodiversity?

Habitat fragmentation and invasion of alien species are among the largest threats to biodiversity worldwide. Habitat fragmentation and invasions may be spatially autocorrelated but the relative effects of both phenomena on native biodiversity and ecosystem services are unknown. The aim of this study was to assess the relative effects of habitat fragmentation (habitat patch size and its isolation) and invasion (presence of invasive plant *Solidago* spp.) on species richness of native plants and pollinators (wild bees, hoverflies, butterflies) inhabiting fallow lands in the agricultural landscape of Poland. Using GIS we chose habitat patches that ranged in size between 0.5 ha and 4 ha and isolation between 25 m and 300 m. The habitat patches were divided into two categories: invaded and non-invaded by alien plant. We found that in smaller, more isolated habitat patches invasion of alien species was rare in comparison with larger and less distanced habitat patches. Likewise, plant and pollinator species richness was larger in more distanced non-invaded habitat patches than in invaded patches which were not isolated from each other. Our results clearly show that when the habitat fragmentation and invasion of alien species co-occur in one area the latter has much stronger negative effect on biodiversity and ecosystem services. Thus, in some circumstances the habitat patch isolation may prevent spread of invasive alien species.

Lepczyk, Christopher A., *University of Hawaii at Manoa*

Green spaces offer critical habitat to many species of plants and animals, provide locations for people to experience nature, and provide a number of important ecosystem services. This closing presentation synthesizes the talks of the symposium and discusses the overall value of these important habitats, both socially and ecologically for conservation.

Leslie, Heather, *Brown University*

The Many Paths to Ecosystem-Based Management

Leslie will provide closing remarks for the symposium, highlighting the connections among the themes addressed by the earlier speakers. To help guide the discussion to follow, Leslie, an ecologist and conservation scientist with substantial experience in interdisciplinary investigations of conservation and management, will introduce a framework for human-environment scholarship that researchers and practitioners alike may use to develop more effective collaborations and navigate the diverse approaches used to investigate the processes and impacts of ecosystem-based approaches.

Levenson, Jacob, *Conserve.IO*; **Pernell Francis**, *Caribbean Association of Whale Watch Operators*

Leveraging Mobile Technology-Informing Resource Management: Connecting Stakeholders to fill data gaps, A Tourism Associations Unique Partnerships

Scientists, resource managers, and conservationists face an ever-present challenge of collecting data of sufficient rigor that it can be used to inform management with confidence. Enabling electronic data collection using a new tool known as WhaleSpotter, data collection using opportunistic platforms becomes much easier. Caribbean Regional Association of Whale and Dolphin Watching Operators has implemented a unique cloud-based data collection program affording the opportunity to collaborate on cetacean sightings across the region. With an extensive network of members through more than ten islands in the Caribbean region, Caribwhale works to promote conservation education, implements operator training and certification programs to ensure a high caliber among its members. Collaborations have led to scientific publications, reports, and innovative projects advancing regional conservation. Caribwhale's sighting database tool allows operators to document sightings during whale watch excursions, and collaborate on photo-identification. This unique collaboration has resulted in filling in knowledge gaps in species distribution and inter-island movements. The successful collaboration could not have been achieved without the efforts of stakeholders from diverse disciplines. Partners from academia, private-sector businesses, and non-government organizations are working together to fill in critical knowledge gaps of cetacean distribution.

Lewis, Jesse, *Colorado State University*; **Kevin Crooks**, *Colorado State University*; **Sue VandeWoude**, *Colorado State University*; **Larissa Bailey**, *Colorado State University*

The effects of urbanization on interactions between wild felids: implications for disease transmission

Landscape pattern that is altered by habitat fragmentation can affect interactions among species and ecological processes. Bobcats and mountain lions broadly occur over a similar range in the western US, although it is unclear how these 2 species interact on a finer scale. Further, additional research is necessary to understand how urbanization influences the interactions between these species and disease dynamics in wild felid populations. We evaluated how urbanization affected the inter-specific interactions between bobcats and mountain lions across 2 study sites in Colorado, USA characterized by varying degrees of human development. Within each study site we maintained a grid of 40 motion-activated cameras and used occupancy modeling to evaluate inter-specific interactions. As expected, our data demonstrate high spatial overlap between bobcats and mountain lions across a broad extent where bobcats did not avoid areas occupied by mountain lions. On a finer scale, we predicted that interactions between these 2 species would be higher in areas associated with urbanization, compared to wildland areas away from human development, due to home-range pile-up along urban boundaries. Bobcats tended to avoid areas that mountain lions recently visited, but only in wildland habitat and not in habitat adjacent to urban development. Our results provide important information about how urbanization influences species interactions and the potential for disease transmission.

Lewis, James, *IUCN Amphibian Specialist Group*

Red List Assessments, Citizen Science and the Future of Conservation Assessments

The IUCN Red List of Threatened Species is an essential tool for conservationists, researchers, policy makers and donors alike. In 2004 the Global Amphibian Assessment (GAA) published assessments for all 5,743 amphibians known at the time. This was the result of a three year initiative involving more than 500 scientists from over 60 countries. Since then, new information on amphibians has increased dramatically, and there is roughly one amphibian species described every two days. For the Red List to remain a relevant tool each new species requires an assessment while all other previously assessed species need to be reassessed within a ten year time frame. The IUCN SSC Amphibian Red List Authority is tasked with keeping the Amphibian Red List current. With only one full-time and a half-time staff members and a small team of volunteer experts this process is proving extremely challenging. Historically, the majority of GAA assessments have been performed through workshops, bringing together experts to assess species. Although this approach has many advantages, it is no longer economically viable for reassessments, given current financial limitations. Through a collaboration between the IUCN SSC Amphibian Specialist Group, iNaturalist.org and the IUCN SSC Global Reptile

Assessment, a new online tool has been developed to bring Red List assessments to an online global community. During the first half of 2013 these tools will be used to assess a number of amphibian and reptile species with the long-term aim of creating a tool widely accessible to all IUCN SSC Specialist Groups interested in assessing species online. We will begin by presenting the online tools and explaining how they were developed. We will end by summarizing an ongoing pilot applying the tools to neotropical amphibian reassessments and describe future plans for scaling the effort.

Li, Juan, *Center for Nature and Society, Peking University*; **Dajun Wang**, *Center for Nature and Society, Peking University*; **Hang Yin**, *Shanshui Conservation Center*; **Duojie Zhaxi**, *Qinghai Snowland Great Rivers Environmental Protection Association*; **Zhala Jiagong**, *Shanshui Conservation Center*; **George Schaller**, *Panthera*; **Charu Mishra**, *International Snow Leopard Trust*; **Tom McCarthy**, *Panthera*; **Hao Wang**, *Center for Nature and Society, Peking University*; **Lan Wu**, *Center for Nature and Society, Peking University*; **Lingyun Xiao**, *Center for Nature and Society, Peking University*; **Lamao Basang**, *Qinghai Forestry Department, Sanjiangyuan National Nature Reserve*; **Yuguang Zhang**, *Chinese Academy of Forestry*; **Yunyun Zhou**, *Chinese Academy of Forestry*; **Zhi Lu**, **Center for Nature and Society, Peking University**

The Role of Tibetan Buddhist Monasteries in Snow Leopard Conservation

The endangered snow leopard lives in rugged mountains in 12 countries of Central Asia and on the Tibetan Plateau. Current conservation strategies, including nature reserves and incentive programs, have limited capacities to protect snow leopards. In this study, we investigated the role of Tibetan Buddhist monasteries in snow leopard conservation in the Sanjiangyuan region on the Tibetan Plateau. From 2009 to 2011, we systematically surveyed snow leopards in the Sanjiangyuan region, and analyzed their relationship with corresponding environmental variables using MaxEnt modeling to obtain a snow leopard distribution map. This model indicated 7,674 km² of snow leopard habitat lay within Sanjiangyuan Nature Reserve's core zones. At the same time, we found high spatial overlap between monasteries and snow leopard habitat, with 46% monasteries located within snow leopard habitat, and 90% within 5 km. The 336 monasteries in the Sanjiangyuan region could protect more snow leopard habitat (8,342 km²) through social norms and active patrols than covered by the Nature Reserve's core zones. Furthermore, most local herders claimed that they did not kill wildlife, with 42% adding that they did not kill because it was a sin in Buddhism. Our study indicates that monasteries play an important role in snow leopard conservation. As a strategy, monastery-based snow leopard conservation could be extended to other Tibetan Buddhist

regions, covering about 80 percent of global snow leopard range.

Li, Yiming, *Institute of Zoology, Chinese Academy of Sciences*

Ecological Knowledge to Reduce the Religious Practice of Releasing Invasive Species

Originating from the traditions of Buddhism and other Asian religions, the ceremonial release of wildlife poses a paradox. Buddhism is generally considered to have great respect for the environment and a desire to cause no harm to any living being, but Buddhist wildlife releases have resulted in biological invasions. By evaluating the release of two highly invasive species--American bullfrogs *Lithobates catesbeianus* and red-eared slider turtles *Trachemys scripta elegans*--across four provinces in China, we found that this invasion stems largely from a lack of invasive species knowledge. Targeted public education about invasive species could be an effective strategy for preventing religious release of invasive species on a global scale.

Linder, Joshua, *James Madison University*; **Erin Knight**, *James Madison University*; **Christos Astaras**, *WildCRU*; **Matthias Waltert**, *Georg-August University*; **David Okon**, *WWF-Cameroon Coastal Forests Programme*; **Richard Lawler**, *James Madison University*

Spatiotemporal patterns of primate abundance and mixed-species association in a heavily hunted

Cameroonian forest: implications for conservation action

Bushmeat hunting has become pervasive and intense in many parts of the African tropical forest zone, leading to declines in primate populations and alterations in primate community structure. While the impact of hunting on seed dispersal and forest regeneration has been investigated, few studies have considered the implications of overhunting for other ecological processes. We investigate how bushmeat hunting has influenced spatial and temporal patterns of primate abundance and how changes in primate community structure may alter the frequency and composition of mixed-species primate associations. Relying on long-term data sets from transect and recce surveys conducted in different areas of Korup National Park, Cameroon, we show that hunting intensity is increasing, primate community structure is changing, and even the species most resilient to hunting may be declining. While mixed-species associations were historically and continue to be common, their composition may be changing over time. To effectively conserve the rich primate community, as well as other large-bodied mammals and the natural ecosystem functioning in Korup NP, we advocate for the creation of conservation-priority "no-take" zones in the park. This can be accomplished through the integration of anti-poaching patrols with novel methodologies

(such as acoustic monitoring), conservation education in local communities, and hunter engagement as skilled field assistants in monitoring and research projects.

Lipsky, Andrew, *SeaPlan*

Connecting Science with Policy and Practice

An experienced interdisciplinary scientist, regulatory expert, and policy advisor, Lipsky will offer a unique perspective how use-inspired investigations of management in practice can and have informed policy development and implementation in the US state and federal domains. Based on his recent role as a senior advisor to the White House National Ocean Council, where he was integrally involved in the development and implementation of the policy, he will share observations of opportunities and challenges to science-to-policy translation and offer recommendations on how knowledge of ecosystem-based management in practice may be most effectively translated to guide future implementation and assessment. Applications of the National Ocean Policy in practice will focus on three SeaPlan projects now underway: 1. Filling key knowledge gaps associated with the interaction of marine fisheries, e.g., Groundfish and lobster, and offshore renewable energy development at the Block Island Wind Farm, Rhode Island 2. Facilitating agreement between the offshore wind industry and fishing interests through industry to industry engagement; and 3. Developing critical marine recreational use data products and information systems to inform regional ocean planning efforts in the Northeastern US.

Liu, Owen, *Environmental Defense Fund*; **Jacob Kritzer**, *Environmental Defense Fund*; **Jenn Aiosa**, *Environmental Defense Fund*

Integrating ecosystems and communities into fisheries management: the Virginia blue crab sanctuary revisited

The Virginia blue crab sanctuary was created in 1942 to protect spawning females, and was expanded over time in response to stock depletion to provide additional protection of blue crabs' seasonal migration. The biological performance of the sanctuary has been evaluated before, using fishery-independent dredge survey data and mark-recapture data. However, there have been no analyses to date of its socio-economic effects. Based on interviews with scientists, managers, and watermen, we show that the crab sanctuary affects fishing communities differently based on factors such as the presence or absence of nearby large tributaries and distance from shore to the border of the sanctuary. These results are pertinent to a current industry-led effort to reevaluate blue crab management in Virginia. At the same time, there has been a recent scientific effort to map a course towards ecosystem-based fishery management for Chesapeake Bay. In this research, blue crabs have been shown to associate

with healthy oyster reefs, which provide nursery and foraging habitat. Blue crabs and oysters are currently managed separately, but their ecological linkage calls for an integrated ecosystem approach to spatial management. We propose a series of design alternatives for the blue crab sanctuary that could better achieve management objectives for both the blue crab fishery and oyster restoration, while increasing flexibility for watermen communities.

Lohr, Bernard, *University of Maryland Baltimore County*;
Brian Rolek, *University of Maine*; **Aymen Hussein**,
University of Maryland Baltimore County

Song variation in Grasshopper Sparrows (*Ammodramus savannarum*) with an emphasis on the critically endangered Florida subspecies (*A. s. floridanus*)

There is considerable conservation value in the ability to discriminate between birds of the morphologically similar eastern and Florida subspecies of the Grasshopper Sparrow (*Ammodramus savannarum*), which co-occur in central Florida until early May. The sedentary Florida subspecies (*A. s. floridanus*) is the most critically endangered of all recognized subspecies of this bird. We investigated whether Grasshopper Sparrows might be distinguishable at a distance based on song. We recorded 34 individuals of the Florida subspecies and measured the frequency and duration of several components of the principal advertisement song, the "buzz" song, using the SIGNAL/RTSD sound analysis software. This song normally consists of four short, introductory notes followed by a longer, rapidly amplitude modulated ("RAM") sequence, which is in turn followed by a final note. Our measurements were then compared with identical measurements from songs of the eastern subspecies. We found that the duration of the introductory portion of the RAM sequence was longer, the peak frequency of the song's RAM sequence and last note was lower, and the bandwidth of the RAM sequence smaller in the Florida subspecies than in eastern birds. We also found population-level variation within the Florida subspecies' songs. These results suggest that acoustic characters may be useful as population-specific markers as well as subspecies-specific markers in the Grasshopper Sparrow in central Florida.

Lubansky, Tanya, *New Jersey Institute of Technology*; **Gareth Russell**, *New Jersey Institute of Technology*

Novel use of identification of individuals to model small-scale movements and habitat selection of endangered baleen whales in the Gulf of Maine

Quantifying the movement patterns of animals is critical to the understanding of life history and thus important to their conservation. Identification of factors that determine where an animal is located spatially and what drives movement

around that area greatly aids the creation of effective management plans. There has been a recent increase in the development of spatial habitat models of large endangered whales, whose offshore distributions make comprehensive data financially and logistically difficult to collect. With this study, I demonstrate use of photo-identification data to model habitat selection, minimizing the need for invasive research and greatly increasing the sample size used in such endeavors. A conditional logistic model was written for a 20-year sightings dataset collected on Bar Harbor Whale Watch Company vessels, examining choice of individuals over a given landscape and incorporating the cost of movement. Habitat choices were represented by static and remotely sensed variables including bathymetry, slope, tidal interaction, and SST. Results show significant active decisions of whales to move towards specific conditions; these optimal sites also shift between species and depend on group size. These models are validated by systematic boat surveys conducted during the past two field seasons. This research provides new insight into whale decision-making that can be of great use in marine spatial planning and applicable to many already existing datasets.

Luna Salguero, Betsabé, *Sociedad de Historia Natural Niparáj, A. C.*; **Héctor Reyes Bonilla**, *Universidad Autónoma de Baja California Sur*; **Nuria Torrejón Arellano**, *Sociedad de Historia Natural Niparáj, A. C.*; **Amy Weaver**, *Sociedad de Historia Natural Niparáj, A. C.*; **Israel Sánchez Alcántara**, *Universidad Autónoma de Baja California Sur*; **Adriana González Azcárraga**, *Universidad Autónoma de Baja California Sur*

MPA with Small No-Take Zones Produce Bigger and More Fish in Five Years: Case Study from Espiritu Santo Marine Protected Area, Gulf of California

Espiritu Santo National Marine Park was established in 2007 because of its high biodiversity and biological productivity, which sustain an important artisanal fishing even when the core zones (no fishing allowed) is only 1.4 percent of the area. The aim of this work was to analyze the changes observed from November 2005 to November 2011 in abundance, length, and biomass of 11 commercially important species (Serranidae: *Mycteroperca rosacea*, *M. prionura*, *Epinephelus labriformis*, *Cephalopholis panamensis*; Lutjanidae: *Lutjanus argentiventris*, *L. novemfasciatus*, *Hoplopogrus guentherii*; and Scaridae: *Scarus ghobban*, *S. perrico*, *S. compressus* and *S. rubroviolaceus*). Abundance data were obtained in observation cylinders of 7.5m radius, and size was assessed in transects of 2x30m, at depths of 3 to 20 meters. All the species tended to increase the average size, biomass and abundance with significant differences through time. The rate of change was higher for biomass, followed by size and finally abundance. As the increase was general in the MPA, the core area is apparently a clear net exporter of biomass. In addition, we observed that the family Serranidae was relatively stable in

size, thus indicating that these species fluctuate less than the others families, probably due to its longevity and long generation time. This study demonstrates short-term benefits of relatively small, no-take zones for the improvement of the status of target species and, thus artisanal fishery in general.

Lundquist, Carolyn, *National Institute of Water & Atmospheric Research Ltd., New Zealand/ University of Auckland*; **David Wiley**, *Stellwagen Bank National Marine Sanctuary*; **Rochelle Constantine**, *University of Auckland*; **Will McClintock**, *University of California, Santa Barbara*

Resolving conflicts between marine mammals and shipping traffic

Benefits of 'roadless' areas also apply to oceans, as shipping traffic can result in ship strike mortality of marine mammals. In Stellwagen Bank National Marine Sanctuary, USA, a collaborative effort of scientists and the shipping industry resulted in the movement of shipping lanes to protect right and other endangered large whales. Synchronous motion, acoustic recording tags were used to identify water column use and a long-term sighting database and passive acoustic network were used to develop maps of whale distributions relative to bathymetry and sediment type. These data were used to suggest alternative shipping lanes to reduce ship strike mortality, and implement a near real-time passive alert system to notify ships of the presence of right whales in the shipping lane. In the Hauraki Gulf, New Zealand, collisions with commercial shipping vessels are estimated to result in the death of at least two Bryde's whales each year, of a resident population of ~200 individuals. Information is being gathered to improve maps of whale distributions, and maps of 'actual' shipping tracks hotspots have been determined, as there are no fixed shipping lanes in the Hauraki Gulf. A working group of scientists, managers, and the shipping industry is working toward mitigation of this conflict. SeaSketch, a collaborative geodesign tool, can be used to investigate potential shipping options (speeds and lanes), and calculate benefits for conservation and costs to industry.

Lyons, Amanda, *Bowling Green State University*; **Nora Lisnizer**, *CENPAT*; **Pablo Yorio**, *CENPAT*; **Pablo Garcia-Borboroglu**, *CENPAT*; **Juan Bouzat**, *Bowling Green State University*; **Joseph Schalk**, *Bowling Green State University*

Demography and genetics suggest metapopulation dynamics of breeding colonies in the Patagonian Kelp Gull, *Larus dominicanus*

Demographic data from Kelp Gulls in Patagonia, Argentina, revealed an increase in the overall abundance of the species. However, individual colonies differed significantly in size and have variable growth rates. Demographic modeling showed that the growth of rapidly increasing colonies cannot be

explained solely by within-colony recruitment, suggesting that migration from other colonies is significant. We compared the genetic structure of four Kelp Gull colonies located along a coastline of ~1,000 km, each representing regions with different demographic trends. DNA analysis of intron sequences from the myelin proteolipid protein gene revealed similar intra-colony levels of sequence diversity. Analysis of molecular variance indicated some genetic structuring, with ~4% of the observed variation being explained by differences among colonies. Genetic structuring was mainly driven by the Punta Tombo colony being differentiated from La Pastosa and Vernaci, two colonies located within regions with the highest growth rates. Genotype diversity showed increased levels of heterozygosity in Punta Tombo and decreased heterozygosity in La Pastosa and Vernaci. Decreased heterozygosities and the presence of unique haplotypes could be indicative of more recent colonizations and subsequent drift of rare haplotypes within these colonies. Our results suggest that proper conservation strategies for the Kelp Gull should take into account the metapopulation dynamics of this species.

Macdonald, Catherine, *Abess Center for Ecosystem Science and Policy, University of Miami*

Legal barriers to ecotourism as a mechanism for shark conservation in the United States

In recent years, a number of researchers have suggested that ecotourism can play an important role in advancing legal protections for sharks and other vulnerable species. It has been argued persuasively that shark-based tourism can create economic incentives that encourage governments and individuals to protect sharks from threats including overfishing, finning, and indiscriminate use of longlines. In spite of concerns about the potential effects of feeding sharks on public safety, animal health and ecological function, there is no scientific consensus about the effects of shark-based tourism on shark behavior or well-being. This research traces the history of shark feeding in two areas in which shark tourism was previously practiced and has now been banned by law. The first, in Florida, traces the failure of a small but relatively organized and well-funded local shark tourism industry to avoid being regulated out of legal existence as a result of liability concerns. The second, in Hawaii, demonstrates some of the cultural challenges of regulating shark tourism, as well as the difficulties associated with effectively enforcing a ban once it becomes law. This research further attempts to explain some of the reasons that introduction of legal limitations on shark feeding are predictable and, perhaps, inevitable. For this reason and others, legislation protecting sharks that does not rely on their tourism-based economic value for justification is urgently needed.

Macey, Suzanne, *Fordham University*; **Caroline Chiu**, *American Museum of Natural History*; **Purva Vaidya**, *American Museum of Natural History*; **Kevin Shoemaker**, *Stony Brook University*; **J. Alan Clark**, *Fordham University*

There's No Place Like Home: Using Microsatellites to Determine Natal Homing in Bog Turtles and Understanding the Conservation Implications

The bog turtle is one of the smallest and most imperiled freshwater turtle species in North America. Conservation management for this species focuses primarily on protecting and restoring the wetland habitat upon which bog turtles rely. However, little is known about this species' nesting habitat requirements or its nesting ecology. Some turtle species exhibit natal homing, i.e., females nest in the same nesting area from which they hatched. If bog turtles also exhibit natal homing, protecting and restoring existing nesting areas should prove a more effective conservation tool than attempting to create new nesting areas. Because of the unreliability of permanently marking hatchlings and the delayed sexual maturity of females, assessing natal homing from long-term tracking studies is not feasible. This study uses microsatellite analysis to infer relatedness among nesting females. Using 18 previously described microsatellite loci, we are genotyping females who have nested in seven sites in New York State. We will use pairwise comparisons to determine relatedness coefficients between nesting females within a population and distance between their nests. If we find more closely-related females nest in closer proximity, such results will suggest natal homing is present in bog turtles. By better understanding the nesting behavior of bog turtles, we can help improve management decisions on habitat restoration, conservation methods such as translocation, and headstarting programs.

Madden, Francine, *Human-Wildlife Conflict Collaborati*

A Complex Systems Approach to Conservation Conflict Transformation: Reevaluating Our Current Practices to Effectively Address Human-Wildlife Conflict

Human-wildlife conflict (HWC) is more often a conflict between people about wildlife, than it is a conflict between people and wildlife. In fact, HWC often serves as a microcosm of the larger social system-level conflicts in society. Unfortunately, current practices – failing to address the drivers of HWC within the social system; discounting “irrational” actions even as they are important indicators of conflict; pushing for urgent solutions; and addictively relying on approaches which are comfortable and familiar – have resulted in narrowly drawn lines around what it means “to do” wildlife conservation that has limited our capacity for success. Even while efforts may succeed initially, they often fail to continually provide broader cycles of engagement and system-level feedback inhibiting the durability of well-

intentioned efforts. Thus, many of today's HWC failures are often a result of yesterday's solutions – especially those with too little emphasis on understanding the role of underlying and identity conflict and subsequently failing to create equitable, iterative decision-making processes that would ultimately reconcile the relationships needed to sustain and evolve them. Through use of theoretical models and illustrated case studies from HWCC's work, the author will make a case for our field's need adopt new capacities and approaches to effectively transform these seemingly intractable conflicts into opportunities for positive, durable, system-level change.

Madliger, Christine, *University of Windsor*; **Oliver Love**, *University of Windsor*

Applying Stress Hormones to Conservation Biology: The Value of a Context-Dependent Approach

Levels of stress hormones (eg., corticosterone, cortisol - CORT) are increasingly being implemented as integrative conservation biomarkers for monitoring disturbance levels and overall condition in wild populations. For such measures to indicate how populations will change in the face of environmental change, CORT levels must show a predictable relationship with fitness. There has been a general assumption that the relationship between CORT and fitness is negative (i.e., that increases in CORT levels are always indicative of increasing disturbance). However, there is growing evidence that the relationship is context-dependent, differing based on factors such as age, sex, and life history stage. We experimentally investigated the relationship between baseline CORT levels and fitness in a free-living population of tree swallows (*Tachycineta bicolor*) within and across breeding seasons. We show that the relationship changes based on the contexts of age, environmental quality (food availability), and reproductive stage. In addition, our results provide evidence that CORT levels can provide valuable predictive information, improving on traditional demographic monitoring methods. However, a predictive, context-dependent approach that considers factors such as life history stage, age, and habitat metrics may be necessary to effectively apply stress hormones as physiological indices of population disturbance or health.

Madsen, Stephanie, *At-Sea Processors Association*

Education Tax Credits: Found Money for Marine Mammal Conservation in Alaska

The member companies of the Pollock Conservation Cooperative own and operate catcher-processor vessels that catch pollock in the Bering Sea off Alaska. The PCC member companies pay a Fishery Resource Landings Tax based on the value of the pollock catch. The Alaska Education Tax Credit

Program provides a tax credit to businesses that make contributions to the Alaska accredited public and private nonprofit colleges for research and educational purposes. Since 2000 PCC member company combined contributions of over \$3 million have funded over 30 marine mammal research projects. Collaborators include multiple state and federal agencies, academic institutions, and no-profits throughout the Pacific Northwest and Canada, studying Steller sea lions, northern fur seals, harbor seals, and killer whales over an area from California through the Pribilof, Aleutian, and Commander Islands. Research has focused on marine mammal predators, foraging ecology, prey diets and nutrition, pollutants, and the potential for competition with groundfish fisheries for prey. Significant marine mammals declines that began as early as the 1960s and extending throughout much of the North Pacific Ocean and southern Bering Sea motivated many of the projects. Important accomplishments include development of implantable life-history tags used to investigate mortality, and the deployment of data loggers on pollock fishing vessels to evaluate the potential for fishing-induced declines in pollock abundance.

Maheshwari, Aishwarya, *WWF-India*

Conservation of snow leopard (*Panthera uncia*) in the Kargil Himalayas, Ladakh, North India

First base-line surveys were conducted in Kargil, Ladakh to document the occurrence and distribution of large carnivores and presence of snow leopard through camera photo trapping has been confirmed confirmed from the battlefield of India. Along 13 trails, habitat use by these carnivores was assessed through direct and indirect evidence. Eight vantage points were selected for estimating abundance of prey species; overall density estimated 0.09/km² for Asiatic ibex and for Ladakh 0.06/km² in areas surveyed of Kargil. Snow leopard-human conflicts was identified as one of the key threat to its survival. More than 500 cases of depredation i.e. 10% loss of the total livestock population by large carnivores in Kargil during 2009 to 2012 were reported by villagers. Loss of livestock by snow leopard, Tibetan wolf and Himalayan brown bear instigate the retaliatory killing of these carnivores. Scat analysis also revealed that 45% diet of snow leopard contributed by snow leopard. The root causes of this conflict are decline in the natural prey base and lack of infrastructure to maintain the livestock has been identified in the questionnaire surveys. Keeping this in view, safe guard measures; livestock corrals were provided to the local communities to maintain their livestock and reduce the livestock depredation along with conservation awareness workshops to enhance the wildlife knowledge among various stakeholders in Kargil.

Majyambere, Methode, *National University of Rwanda*; **Katherine McFadden**, *Clemson University*

Effects of Habitat and Buffer Zones on Small Mammal Diversity and Abundance in Nyungwe National Park, Rwanda

In Rwanda, buffer zones of plantation-style cultivation are commonly found adjacent to protected area (PA) forests. These areas are partially restricted but may give added protection to PAs while providing benefits to neighboring communities. Understanding the response of species in buffer zones is essential to design effective conservation programs for PAs. This study explores the role buffer and edge habitat play in maintaining species diversity and abundance of small mammal species in high altitude rainforest of Nyungwe National Park. We live trapped at three sites within the park and compared small mammal species diversity and abundance in tea and pine plantation buffer habitat adjacent to the park, forest edge, and forest interior habitat for a total of 6936 trap nights in 2011-2012. Only 11 of 29 total small mammal species captured in the study sites were able to use the plantation buffer habitat and 22 species were found to be intermediate in habitats, being able to use forest edges. We found 20 species occurring in the interior of the forest, at least 100 m from the edge. The greatest relative abundance of small mammal individuals occurred in interior habitat, followed by edge. Overall, buffer habitat supported more generalist species. Pine buffer habitat supported significantly higher species diversity than tea plantation. Results indicate that the type of buffer habitat may be important in maintaining species diversity within and surrounding protected areas.

Makkay, Amanda, *Fordham University*; **Evon Hekkala**, *Fordham University*; **Patrick Thomas**, *Wildlife Conservation Society*

Patterns of Relatedness and Genetic Diversity in Ex Situ Species: An Analysis of the Captive Snow Leopard (*Uncia uncia*) Population

As humans continue to encroach on once pristine ecosystems, these anthropogenically modified landscapes limit the effectiveness of traditional in situ conservation. When small populations continue to decline, despite in situ conservation, one way to ensure species survival is maintaining a population ex situ, or in captivity. The Association of Zoos and Aquariums (AZA) consist of more than 200 institutions that maintain ex situ populations and manage them according to the parameters outlined in species specific Species Survival

Plans (SSP). SSP's are designed to maintain 90% of genetic diversity for 100 years or 10 generations. The snow leopard (*Uncia uncia*) is one of the AZA's longest exhibited species, since 1903. Each year, their SSP presents management and breeding recommendations to maintain the genetic diversity of the founders and ensure a demographically stable population. These recommendations are based on the predicted mean kinship (MK) values, of each snow leopard, as derived by studbook data. Literature suggests that model based, studbook derived, values of MK differ from empirically derived measures, from molecular genetic data. We are comparing studbook derived and molecularly derived values of MK for the AZA's snow leopard population to advise future breeding recommendations. Preliminary data indicate that genetic values of MK, derived from DNA extracted from sloughed epithelial cells present on snow leopard scat, differ from studbook derived values.

Malcolm Jay, *Faculty of Forestry*; **Erica Barkley**, *Faculty of Forestry*; **Mike Burrell**, *Faculty of Forestry*; **Brian Campbell**, *Faculty of Forestry*; **Terrance Carleton**, *Faculty of Forestry*; **James Dennis**, *Faculty of Forestry*; **Alison Fischer**, *Faculty of Forestry*; **Tomasz Gradowski**, *Faculty of Forestry*; **Ben Kuttner**, *Faculty of Forestry*; **Mark Newman**, *Faculty of Forestry*; **Geoff Sherman**, *Faculty of Forestry*; **Charlotte Sharkey**, *Faculty of Forestry*; **Alissa Sugar**, *Ontario Ministry of the Environment*; **Agnieszka Sztaba**, *Faculty of Forestry*; **Mark Vanderwel**, *Faculty of Forestry*

Testing the Sustainability of Boreal Clearcut Logging: Forest Age and Habitat Structure

Clearcutting logging in the boreal forest is argued to be sustainable from a wildlife perspective because as harvested stands re-grow, their structural features emulate those developing after natural stand-replacing disturbances. However, two features of clearcutting may be problematic: 1) gradual elimination from the landscape of forests older than the rotation age and 2) failure of young forests to develop the structural complexity of old-growth forests. We tested whether such elimination was occurring by comparing 3 managed and 4 natural landscapes in boreal northeastern Ontario, Canada, and whether structural habitat development in pre-rotation age forests achieved that of older forests in a sample of 107 stands. In the managed landscapes, forests older than 100 years comprised only 17-35% of the landscape, whereas in the natural landscapes they comprised 54-78%. Among a diverse set of structural habitat variables, including 3 dimensional measurements of foliage stratification and measurements of standing and downed woody debris, 10 variables showed maximum values at or near the rotation age (80-100 years), whereas 6 showed maximum values at greater ages. These six variables were also key correlates of community variation for several faunal groups. Our results draw into the question the sustainability of clearcut-based landscape management in boreal forests and

call for land management practices that better maintain the structural features of old forests.

Mandle, Lisa, *Natural Capital Project, Stanford University*; **Leonardo Sotomayor**, *The Nature Conservancy*; **Stacie Wolny**, *Natural Capital Project, Stanford University*; **Sofia Vargas**, *The Nature Conservancy*; **Adrian Vogl**, *Natural Capital Project, Stanford University*; **Jerome Touval**, *The Nature Conservancy*; **Heather Tallis**, *Natural Capital Project*

Accounting for ecosystem services in mitigation: Can the Pucallpa-Cruzeiro do Sul road be developed with no net loss of ecosystem services in Peru?

Existing policies aimed at mitigating the environmental impacts of development focus primarily on preventing losses of biodiversity and ecosystem function. However, these approaches do not explicitly account for ecosystem services and impacts to people. When the link between people and nature is ignored, mitigation activities can redistribute ecosystem services, benefiting some people while neglecting others and creating social injustice. We use new serviceshed-based methods to track what parts of the landscape provide ecosystem services to different groups of people. With this approach, we estimate the amount of services that will be lost - and who will lose them - after the completion of a new road through the Peruvian Amazon. We assess the impacts of road development on nearly 250,000 people in 107 cities and towns in the Ucayali Region of Peru. We ask whether no net loss of ecosystem services can be achieved through mitigation. We find that, of the four ecosystem services we evaluated (erosion control; drinking water quality regulation for the pollutants nitrogen and phosphorus; and carbon sequestration), no net loss is possible only for carbon sequestration. Mitigation cannot return erosion control, nitrogen or phosphorous regulation services to all people impacted by road development. Given the billions of dollars spent on development projects globally, integrating ecosystem services into mitigation requirements is critical to protecting nature's benefits to people.

Mannle, Kate, *Rare Conservation*; **Amielle DeWan**,

Incorporating the 'likelihood of behavior change' into site prioritization for coastal fisheries management

Although the potential for fisheries recovery is critical for predicting the potential biophysical outcomes of conservation and management interventions, success will ultimately be determined by the ability to shift human behaviors. Many conservation prioritization frameworks seek to strike a balance between threats caused by local people and a conservation target but few take into account the factors that indicate communities are well suited to adopting new behaviors. Review of prioritization approaches from social marketing

and behavior change theory and the results from over 200 behavior change campaign sites were assessed. Certain factors including population and target audience size, local leadership, prior community engagement, and lack of external threats play a key role in creating an enabling environment for social change.

Marais, Christo, *South African Dept Environ Affairs*

Ecological Research Priorities for Carbon Offset Projects:
Not Provided

Marchini, Silvio, *Instituto Pró-Carnívoros*

Human dimensions of wildlife on the Amazon deforestation frontier, Brazil

For most Brazilians in the cities where policy is determined, Amazônia is nothing but a distant place and they have little connection to it. Attempts to save the forest have concentrated on creating protected areas but have mostly ignored the beliefs and attitudes of people on the deforestation frontier, most of whom are poor migrant farmers who need income, but lack fundamental knowledge of how to use the forest. Vivalda et al. established Escola da Amazônia in 2002 to research the human dimensions of the conservation crisis in Amazonia and to engage communities on the deforestation frontier – with a focus on students, teachers and schools – in conservation. Communication interventions and evaluation of results have been based on the charisma of the species that has a stronger presence in Brazilian youngsters' minds and hearts than does any other native mammal: the jaguar. We found that school-based communication interventions can have a powerful effect on perceptions of jaguars among students, and that students can effectively transfer that effect to their parents. In a different, more recent initiative - the Young Conservationist Award - we identify creative and influential teenagers in Amazonia and provide them with learning opportunities and incentives for them to create and disseminate conservation messages, which they do by using traditional and new communication technologies and by speaking as 'forest ambassadors' at schools in the major urban centers of Brazil.

Mark, Melissa, *Columbia University E3B*; **Arshiya Bose**, *University of Cambridge*

Evaluating Biodiversity Outcomes from Certification of Shade-Grown Crops

Agroforestry plantations provide habitat for biodiversity in tropical agricultural areas by maintaining structural and floristic complexity similar to forests. Third-party certification of shade-grown crops is promoted as a mechanism to ensure environmentally responsible management practices that promote biodiversity conservation. However, there has been no comprehensive evaluation of the impact of third-party certification on biodiversity conservation across geographic regions. Here we review the empirical evidence for the maintenance or increase in biodiversity as a result of third-party certifications such as Organic Crop Improvement Organization (OCIA), International Federation of Organic Agriculture Movements (IFOAM), Rainforest Alliance, Smithsonian Bird-Friendly and UTZ. We also present results from interviews with coffee farmer and their perception of the impact of certification guidelines on management practices. While the presence of shade trees is positively related to measures of biodiversity, the benefit of certification is less clear. In many cases, existing management practices are more heavily influenced by historical and economic factors than certification. Clear and tangible changes in management practice and resulting ecological outcomes have been difficult to observe. We suggest approaches to future research in areas where there are little data in order to better evaluate the efficacy of third-party certification on biodiversity conservation.

Martin, David, *Davidson College*

Noah Revisits Biodiversity Protection Prioritization

Since pledges to finance biodiversity preservation are a fraction of the identified needs, scientists must develop tools to help prioritize the many goals. Analysts and policy makers often describe this problem with the "Noah's Ark" metaphor to imply that society must choose how much biodiversity to save in aggregate and which specific components of it to save. Unfortunately, economic models proposed to answer these questions don't capture the complexity and interrelatedness that enriches ecological perspectives while ecological models often ignore the anthropogenic aspects that drive economic analysis. I develop a model for prioritizing species conservation policies that advances the integration of the economic and ecological perspectives. I start with Weitzman's (Econometrica 1998) basic Noah's Ark model that prioritizes species and build upon Perry's (EcolEcon 2010) and Arponen's (BiodiversConserv 2012) work to develop a model that includes economic and ecological concerns. I then show

how this microeconomic ranking fits within Norgaard's (EcolEcon 2010) macro-oriented ecological economics framework. I demonstrate this methodology with two examples from current issues concerning protecting Keoladeo National Park (India). In the first example I compare protecting the Siberian crane, the Sarus crane, and the greater spotted eagle. In the second example, I compare providing water to the park via monsoon runoff in a pipeline to restoring the flow of the Gambhir River.

Martin, Michael, *Rupununi Learners Inc.*; **Fernando Li**, *Rupununi Learners Inc.*; **Rudolph Sr. Roberts**, *Yupukari Village*; **Rudolph Roberts Jr.**, *Yupukari Village, Rupununi Learners Inc.*; **Ashley Holland**, *Rupununi River Drifters*

Community based links between education, ecotourism and investigations of *Melanosuchus niger* and *Podocnemis unifilis* in Yupukari Region #9 Guyana.

Yupukari village in Region #9 Guyana is the hub for an 8 year mark recapture study of *Melanosuchus niger* (Black Caiman) and newly formed monitoring and headstarting program for *Podocnemis unifilis* (Yellow Side-necked turtle). While linkages with local efforts in education, ecotourism and conservation management grow these two community driven investigations in the pristine Rupununi environment have their roots within international cooperation and support. After 8 years and over 680 individuals caught and recorded the villager based "caiman crew" seeks collaborations to continue efforts within an open range of study areas (telemetry, dietary studies, management dialogs, genetics). In its second season the Yupukari turtle project introduced 57 "headstarted" turtles into the Rupununi river system and is working to expand to other communities past 2013. Yupukari also has a regionally recognized wildlife club, public library and community based ecotourism product that integrate the two studies.

Martino, Robin, *Antioch University New England*; **Norbert J. Cordeiro**, *Roosevelt University*; **Beth Kaplin**, *Antioch University New England*

The Influence of Buffer Zone Matrix Type on the Disperser Assemblage at Two Large-Seeded Canopy Trees in Edge Forest, Rwanda

Few studies have examined how buffer zone matrix type influences ecological processes in adjacent forest edge. The buffer zone surrounding Nyungwe National Park, Rwanda, has the opportunity to play an important role ecologically in the management of the protected area.

Our research looks at how different land uses in the buffer zone influence seed dispersal of large-

seeded trees in forest edges. The distribution and abundance of seedlings of large-seeded trees are frequently controlled by the actions of frugivores. Changes in the composition or abundance of frugivores due to matrix effects could alter the pattern of seed removal, thus impacting regeneration processes. We used focal watches to test for differences in seed disperser visitations and dispersal of *Chrysophyllum gorungosanum* and *Syzygium guineense*, two large seeded species in forest edges adjacent to tea and pine buffer zones. Including interior control sites, we have a total of 663 observation hours in 2011-2012. Preliminary results indicate greater diversity and abundance of frugivores in forest edges adjacent to pine buffer vs. tea. Results from this research will contribute to the development of a holistic protected area buffer zone management approach that considers the ecological integrity of the protected area in addition to economic benefits of land use in the surrounding matrix.

Mashintonio, Andrew, *Rutgers University*; **Gareth Russell**, *New Jersey Institute of Technology*

Incorporating scale in habitat preference models improves prediction maps for elephants

Identifying the habitat preferences of large mammals is important for their conservation and management. The choice of habitat an animal makes will depend upon what resources it is selecting for and at which scale. We created multiple landscape scales by applying a smoothing kernel to each landscape variable, which averages all pixels within an increasing radius. We tested the difference in model fit between applying the smoothing kernel to all landscape variables together and individually. We used conditional logistic regression to estimate the likelihood of movement patterns of savannah elephants under different combinations of environmental variables at different scales. We compared the habitat preference predictions of maps created using only original, non-smoothed variables and maps created with additional smoothed variables. Smoothing different variables at different scales produced much better predictions of movement than a single scale for all variables. For elephants, maps of landscape quality based on multiple-scale smoothing match observed large-scale distributions of animals much more closely than maps based only on pixel-level selection. This analysis suggests that elephants select different habitat variables from the landscape at different scales, and the inclusion of multiple scales in habitat selection models will aid managers in identifying important habitat.

Mastrangelo, Matias, *National University of Mar del Plata and National Research Council of Argentina*; **Michael Gavin**, *Forestry 231, Department of Human Dimensions of Natural Resources, WCNR, CSU, USA*; **Pedro Laterra**, *Faculty of Agrarian Sciences, National University of Mar del Plata, ARG*; **Wayne Linklater**, *School of Biological Sciences, Victoria University of Wellington, NZ*; **Taciano Milfont**, *School of Psychology, Victoria University of Wellington, NZ*

Understanding and influencing landholders' options for conserving dry Chaco forests at the agricultural frontier

Agricultural expansion and intensification drive the fragmentation of dry Chaco forests. Designing interventions capable of reconciling agricultural production and biological conservation requires the integration of ecological and social disciplines. This study evaluated conservation costs (changes in bird species richness) and production benefits (changes in beef cattle yields) along an intensification gradient in cattle production systems of the Argentine Chaco (n=33). Silvopastoral systems integrating native trees and exotic pastures achieved high yields (60-70% of potential yields) and high bird species richness (70-90% compared to nearest forest), however, remnant forest fragments were critical for the conservation of forest-restricted bird species. Therefore, factors influencing intentions to conserve forest remnants were evaluated in surveys to landholders (n=89). The psycho-social

Integration of technologies to combat insect pests in agro ecosystems: An Indian perspective for the management of eggplant shoot and fruit borer.

Agricultural productivity and protection of the biodiversity that underpins it are greatly dependent on the integration of theories, disciplines and technologies. While ecological engineering tools involving integrated pest management (IPM) practices has a wider public acceptability, agricultural biotechnology using genetic engineering on the other hand has limited uptake and has given both, commercial production of 'biopesticides' and the making of GM crops, Bt brinjal (Eggplant) being the first vegetable for Indian agricultural sector for the management of eggplant shoot and fruit borer (ESFB). Since IPM limits over reliance on any specific technology and its consequences such as pest resistance, resurgence and environmental contamination, the present study reviews IPM modules for the management of ESFB like resistant cultivars, use of biopesticides, botanicals, microbial formulations and sex pheromones. Results revealed that integration of different IPM modules helped in development of successful IPM strategies. In the recent past there has been much debate regarding the insect-resistant Bt Brinjal and the influence that a single mortality agent such as 'Bt gene' can have on the insect pest regulation and control. Although it can keep pest populations at extremely low ebb, it could potentially harm natural enemies disrupting ecosystem processes in long run. A scope for synergy thus reflects that GM crops can be most effective when they are used as part of IPM strategies.

Maxwell, Sean, *The Environmental Decisions Group*

How much is new information worth? Evaluating the benefits and costs of resolving uncertainty in natural resource management

A trade-off commonly faced by decision-makers in natural resource management is whether to spend scarce resources on acting in the face of uncertainty, or gaining additional information in hope that it will improve management performance in the future. Value of information analysis can help facilitate this trade-off by determining how much management performance could improve if additional information is acquired. This study applies the concept of value of information analysis to the management of a declining koala (*Phascolarctos cinereus*) population in Queensland, Australia. Decision-makers managing this population must choose management strategies despite uncertainty about the accuracy of koala survival and fecundity rates, and the influence of forest cover on these rates. An age-structured matrix model of the koala population was used to evaluate the expected management performance for a range of budgets with current levels of information, and if uncertainty were to be resolved. This study is the first to translate the improvement in management performance due to resolving uncertainty into a dollar value. The results of the value of

Mathur, Anjali, *Raj Rishi Govt. College, Alwar, Rajasthan*

information analysis suggest that resolving uncertainty will do little to improve koala management performance, and that no more than 1.7% of a budget should be spent on gaining additional information. In this case, allocating resources to direct management action will probably give a better return on investment than gaining information.

McAlpine, Clive, *The University of Queensland*; **Christine Adams-Hosking**, *The University of Queensland*

Using expert knowledge for a threatened species: a national elicitation to quantify koala population trends.

Elicitation of expert opinion is a widely-used tool when data is limited or patchy. It is potentially useful for making conservation decisions because there is often a lack of empirical data on population numbers and trends. We conducted a structured elicitation procedure to quantify demographic trends for the Koala, that is declining throughout much of its natural range. Fifteen koala experts were asked to make bioregional estimations about koala population numbers and trends using a sliding window of the past three and future three generations, in a four-step question format. They were required to provide: a lowest plausible population estimate; a highest plausible population estimate; a best estimate and confidence that the true values were contained within the upper and lower bounds (range 50-100%). We found that bioregional koala populations in the states of Queensland and New South Wales, where they are now listed federally as vulnerable, have declined by 20% - 73% and 4% - 50% respectively, with the exception of one bioregion where koalas increased by 6%. In Victoria and South Australia, where koalas are not listed, populations have declined by 2% - 29%, with a 16% increase in one bioregion where koalas have been reintroduced. This elicitation process provides, for the first time, quantitative information to inform decision makers and land managers. It will assist in the implementation of a Recovery Plan for a species of national and international significance.

McClellan, Erin, *Univ. of California Santa Cruz*; **Stuart Butchart**, *BirdLife International*; **Don Croll**, *Univ. of California Santa Cruz*; **Nick Holmes**, *Island Conservation*; **Kelly Newton**, *Univ. of California Santa Cruz*; **Bernie Tershy**, *Univ. of California Santa Cruz*; **Dena Spatz**, *Univ. of California Santa Cruz*; **Chris Wilcox**, *CSIRO*

Predicting extinction risk for threatened island vertebrates due to impacts from invasive alien mammals

Islands are global hotspots of biodiversity and threat: island species make up a disproportionately large number of historic extinctions and currently endangered taxa. The leading threat to island biodiversity is invasive alien species (IAS),

particularly mammals associated with human activity. The relative impacts of different IAS on native populations are unknown, making it difficult to prioritize the most damaging species for eradication programs. We used the first comprehensive global island dataset of native and introduced species to quantify all known co-occurrences of native vertebrates and common invasive mammals, and identified cases of confirmed and suspected extirpations of the native fauna. Island vertebrates were most often extirpated in the presence of rats, mice, cats, mongoose, and mustelids. Native birds were 2-10 times more likely than native reptiles, amphibians, or mammals to disappear on islands with IAS. We used a logistic regression analysis to investigate additional predictors of extinction risk, including the number and combination of IAS and island size, latitude, and climate. We demonstrate that extinction risk for island species can be quantified and predicted using historical species records and simple island characteristics. The ability to explicitly measure extinction risk, and thus to predict the extinction risk averted via IAS eradication, is a critical step forward in developing robust conservation plans for islands globally.

McField, Melanie, *Healthy Reefs Initiative/Smithsonian*; **Lorenzo Alvarez**, *Smithsonian Institution*

Informing Reef Management Decisions Through Ecosystem Health Report Cards And Eco-Audits In The Mesoamerican Reef.

The Healthy Reefs Initiative (HRI) is a collaboration of 48 international, regional, and local partner organizations working to conserve the Mesoamerican Reef (MAR). HRI produces biennial Report Cards on the ecological health of the reef and Eco-Audits measuring the management response. The 2012 Report Card includes almost 200 sampling sites measuring reef condition based on a Simplified Index of reef health, which ranks values for: coral cover, fleshy macroalgal cover, herbivore biomass and commercial fish biomass. The majority of reefs were found to be in poor (40%) or critical (24%) condition, with only 10% ranked as good or very good, and 25% in fair condition. However, this report did measure a slight improvement in overall reef health compared with the 2010 assessment. In light of global coral reef declines, even such a slight improvement is noteworthy and encouraging. While the Index is useful for summarizing the complexity of reef health taking a closer look at individual indicators helps to understand the sources of declines and develop management actions. The Report Card includes reef management recommendations developed and prioritized in a regional workshop with partner organizations. The extent to which these recommendations are implemented in the MAR countries is then evaluated through the Eco-Audits, which help to catalyze stronger management actions.

McGuire, Sean, *Maryland Office Sustainable Future*

How has Maryland's GPI been most valuable in decision-making and what are the next steps for Maryland and other states?

State governments across the U.S. are exploring innovative measures to evaluate policy effectiveness, budget efficiency, and overall societal progress. Such measures include lists of impact indicators, valuation studies that supply full cost accounting, and aggregated valuation figures like the Genuine Progress Indicator (GPI). While states may look to such benchmarks on a specific policy topic, however, full integration of non-traditional approaches lags far behind in supplanting or even complementing metrics like the Gross Domestic Product and similar estimates of growth when making day-to-day decisions. Maryland's Government first calculated its GPI in 2010 and now updates data annually. Even with strong high-level support and national recognition, the shift from using the GPI as an interesting lens to a dominant tool for policy and budgetary analyses and decision-making is proving difficult for many reasons: bureaucratic inertia, lack of public understanding and acceptance, the power of sound bites and media coverage, jurisdictional competition, and wariness towards change. The session will describe these barriers from a Government perspective and some of the methods Maryland is pursuing to overcome obstacles. We will encourage interaction with attendees to identify potential steps to spur future transition to adoption and use of alternative measures.

McKinley, Peter, *The Wilderness Society*

Implementing Conservation in the Context of Climate Change in a Western Maine Forested Landscape

Implementation of conservation plans conceived outside of the context of climate change is challenging enough. Updating and implementing these plans in the context of climate change adds considerable difficulties from scientific and social standpoints. While high uncertainties regarding patterns of ecological disassembly and reassembly are a significant challenge to the science, equal or greater challenges remain in the realm of implementation. We are making demonstrable progress in both the planning and implementation of conservation in the context of climate change in a landscape of several hundred thousand acres in western Maine. Our work with partners and stakeholders has led to the identification of a potential new high elevation National Wildlife Refuge alongside a portfolio of other conservation projects ongoing or completed. This landscape has long been noted for its large blocks of contiguous forest and viable animal and plant populations from northern hardwood, mixed-wood, boreal spruce-fir, and alpine communities. These diverse attributes exist along a rather pronounced latitudinal ecological gradient and transition zone exaggerated by a mountainous topographic gradient that

we contend will assist various short term and long term adaptation mechanisms. The range of ecological attributes has brought diverse factions of people together based on the range of short term and long term conservation values they recognize.

McLaughlin, Shawn, *NOAA*

Observations on Local, Regional, and Global Declines of Marine Mollusks

The global decline of non-marine mollusks is well documented with 1000s of species included on the World Conservation Union Red List of Threatened Species and Endangered Species List. Few marine mollusks are listed despite greater overall diversity and increased exposure to climate change, invasive species, fishing, and habitat degradation. The loss of marine mollusks on the Atlantic coast of the U.S. has been attributed to overharvesting, disease, and habitat degradation. More recently, declines in softshell clam fisheries in Maine have been reported to be linked to the inability of spat to set on acidic sediments making them more vulnerable to predation. In Chesapeake Bay, the softshell clam population is threatened by losses due to increased fishing pressure, disease, high temperature, habitat degradation, and predation. The potential impact of ocean acidification on softshell clams in Chesapeake Bay and other marine species worldwide remains to be determined. Moreover, few long term studies of climate change have been conducted in the oceans compared to terrestrial systems and the potential impacts of multiple anthropogenic stressors acting additively, synergistically or antagonistically remain largely unknown. In this study, observations on the decline of softshell clams in Chesapeake Bay are presented and compared with marine mollusk declines in other regions of the Atlantic coast. The question of a global decline of marine mollusks will also be addressed.

McPherson, Tsitsi, *NA*

Conservation and Human Rights, an opportunity for Indigenous Peoples empowerment: a case study from Guyana, South America.

Conservation measures seeking to protect biodiversity without considering human populations intimately associated with the lands have had limited success. Using Guyana, South America, as a case study two conservation strategies are evaluated, one focusing primarily on biodiversity, the other being an integrated framework that acknowledges the human-biodiversity dynamics of indigenous peoples and their association with the land. Areas of conservation interest were determined using Maxent to model and overlay species distributions across Guyana. Using a biodiversity-only approach to conservation and available State lands, the

Government of Guyana could convert approx. 16% of its land to protected areas. Engaging Guyana's indigenous peoples in the decision making, administration, and management of protected areas would dramatically increase the percent of Guyana's lands under conservation measures to approx. 32 %. Given the remoteness of the many proposed protected areas and the limited interest in and knowledge of Guyana's biodiversity by people living along the coast, a collaboration between Guyana's indigenous peoples as primary stakeholders in the conservation process at the planning, implementation, and management phases and the Government of Guyana could greatly enhance conservation measures in the country while address underlying human rights issues associated with conservation in Guyana. This assessment is timely as Guyana has recently passed its Protected Areas Act.

Medellín, Rodrigo, *Instituto de Ecología-UNAM*

Latin American Bat Conservation Network: Locally-led continental collaboration

Latin America contains more bat species than any other region in the world and they face diverse threats, from direct killing to roost vandalism to habitat destruction and misguided vampire bat control. Latin America also has a significant number of bat professionals committed to conservation. RELCOM has become an articulated, effective, continent-wide conservation effort. Through education, research, and conservation actions, RELCOM has integrated 19 countries to save bats from Argentina and Chile to Mexico and across the Caribbean. Working on migration ecology, infectious diseases, endangered species, and more, RELCOM members (all local, effective conservation professionals) share a strategy, priorities, objectives, and success indicators. Training exchanges, courses, effective communication, meetings, and a horizontal structure all contribute to the successful growth and impact of the Network. Most countries have identified the Areas of Importance for the Conservation of Bats, thus linking a continent-wide grid that highlights the importance of bats and promotes the conservation regionally and country by country.

Melero, Yolanda, *University of Aberdeen, Institute of Biology and Environmental Sciences.*; **Matthew Oliver**, *University of Aberdeen, Institute of Biology and Environmental Sciences.*; **Xavier Lambin**, *University of Aberdeen, Institute of Biology and Environmental Sciences.*

Turning back the tide of American mink invasion at unprecedented scales in partnership with scientists and citizens

Successful eradications of harmful introduced invasive species have been mostly confined to islands while programs in

mainland areas remain small and cost-ineffective. A fundamental applied question is thus how to optimize invasive management at large scales while minimizing costs. In 2006, we created a project to achieve large scale eradication of invasive American mink in Scotland based on a partnership of citizens and scientists. The project was initiated by us (ecological scientists), implemented by trained volunteers, and latterly supported by social and computer scientists working on motivation and digital tools for volunteers. At present, the project has attracted > 600 volunteers including conservationists, hunters, farmers and rangers and it has succeeded to remove breeding mink from 10000km². Concurrently the scale of the task involved and the amount of data gathered allowed us to research issues in population ecology at a scale not normally amenable to investigation. We demonstrated that population productivity rates differ among areas with "hotspots" of productivity and emigrants dispersing up to 50km. However, rates of reinvasion varied among areas potentially due to density-dependent recolonization. These findings have been used to define the appropriate spatial scale of control and allocation of resources and thus, optimise conservation efforts. The success of this project relied on functional volunteer participation guided by the scientific research.

Mendezona, Arren, *Colorado State University*

Working with gaining community support in coastal management and policy communication: A case study of southern Cebu, Philippines

Michaelis, Adriane, *University of Maryland, College Park*; **Hillary Lane**, *University of Maryland, College Park*; **Steven Allen**, *Oyster Recovery Partnership*; **Kennedy Paynter**, *University of Maryland, College Park*

Measuring oyster (*Crassostrea virginica*) restoration success in the northern Chesapeake Bay.

Restoration of eastern oyster (*Crassostrea virginica*) in the northern portion of the Chesapeake Bay is a complex task, requiring collaboration from a wide range of entities. With this in mind, it is critical to confirm that such efforts are effective. Quantifying restoration success recently became more clearly defined through benchmarks targeting minimum oyster densities of 15 oysters/m² and biomass of 15 g/m² to identify an oyster bar as restored. These metrics were generated by a partnership of federal, state, and academic scientists and officials, all associated with the Chesapeake Bay restoration effort. This study presents an overview of restoration monitoring from 2008 through 2012. Patent tong surveys revealed that within one year of planting of hatchery-reared juvenile oysters (spat-on-shell), the majority of bars showed oyster densities and biomasses exceeding minimum

targets. At older bars, surveyed three or more years post-planting, a smaller proportion of sites monitored from 2008 through 2012 met or approached 15 oysters/m² and 15 g/m². Though the number of sites currently meeting restoration metrics are low, when paired with an adaptive planting approach and increased spat survival observed since 2010, positive trends are anticipated in oyster restoration in the Maryland portion of the Chesapeake Bay.

Mihok, Barbara, *SCB Europe Section, Centre for Ecological Research, Hungarian Academy of Science*; **Eszter Kovács**, *Environmental Social Science Research Group, St. István University*; **Katalin Margóczy**, *University of Szeged, Department of Ecology*; **György Málóvics**, *University of Szeged, Institute of Economics and Economic Development*; **Judit Gebert**, *University of Szeged, Institute of Economics and Economic Development*; **György Pataki**, *Environmental Social Science Research Group, St. István University; Department of*; **Eszter Kelemen**, *Environmental Social Science Research Group, St. István University*; **Ágnes Kalóczkai**, *Environmental Social Science Research Group, St. István University*

Ecosystem service concept can help us better understand land use conflicts

Trade-offs in ecosystem services (ESs) often emerge as a result of land-use changes initiated by nature conservation regulations. The aim of this research is to reveal how linking trade-offs between ESs with stakeholders at different spatial and temporal scales can become a powerful tool to analyse land-use changes and related conflicts? Three case studies from the Hungarian Great Plain were compared integrating the ESs concept, trade-offs, stakeholders and scale. In the case study areas land-use changes occurred in the 1990s' due to nature conservation restrictions and land acquisitions. Field work was carried out between 2007 and 2011 applying qualitative methods (interviews and focus groups) to identify important ESs by different stakeholder groups. History of land-use changes and related ecosystem services were assessed using archival data. Local farmers have been the main losers of the land-use change, while there are many winners both at different spatial and temporal scales. In all three areas conflicts between local farmers and the national park emerged, but no conflicts between farmers and other beneficiaries. In many cases ESs are enjoyed and perceived at different spatial and temporal scales, separating stakeholders with conflicting interests both in time and space. Building on the results of the assessment, policy and other instruments can be advised specifically to investigate and handle the scale mismatches and the conflicts.

Miller, William, *Towson University*; **Gail Gasparich**, *Towson University*; **Joel Snodgrass**, *Towson University*

The Effects of Urbanization on Gene Flow and the Genetic Structure of a Headwater Salamander, *Desmognathus fuscus*, Over Multiple Spatial Scales

Many organisms are arranged in spatially explicit populations that are linked by the transfer of individuals among optimal habitat patches. Dispersal represents both spatial and temporal connectivity, and can be indirectly inferred via gene flow. Anthropogenic disturbance associated with urbanization may limit connectivity and decrease gene flow between populations. Organisms inhabiting stream networks may be particularly vulnerable to habitat fragmentation, as population processes are additionally constrained by stream network geomorphology, water flow, and individual dispersal strategies. Understanding how terrestrial and aquatic habitat fragmentation affects headwater species is of particular importance, as they experience a higher degree of isolation and more varied disturbance regimes. Microsatellite markers were used to compare patterns of gene flow in a headwater salamander, *Desmognathus fuscus*, between urban and rural watersheds. Gene flow was assessed using a paired spatial design across four watersheds. Preliminary results indicate the importance of both aquatic and terrestrial dispersal pathways in maintaining gene flow. High degrees of genetic differentiation between some closely located sites in urbanized areas and little difference among other, more widely dispersed sites in rural areas resulted in little relationship between Euclidian or stream distance among sites and genetic differences.

Miller, Tom, *Chesapeake Biological Lab*

Management of blue crab in the Chesapeake: Science to ensure the sustainability of a bay icon

Recent changes to blue crab management that focus on conservation of spawning females has led to increases in adult and juvenile blue crab that set the stage for a sustainable fishery while protecting the services blue crab provide to the Chesapeake ecosystem. Despite warnings of calamity early in the 20th Century, management of this species relied little on science until the end of the century. Traditional fisheries included pot and trotline fisheries for hard and soft shell crabs and a dredge fishery that caught a disproportionate number of on egg bearing females. Beginning in 1995, efforts to integrate our knowledge through stock assessments identified important gaps in our scientific understanding and harvest data. Inter-jurisdictional effects such as the BiState Blue Crab Committee played an important role in setting goals and expectations. Key investments in research by regional science and management agencies decreased uncertainties in estimates of stock status and motivated changes in management. In 2008, conservation measures to protect egg bearing females were implemented. The most recent 2011 assessment shows signs of population recovery reflective of the impacts of the conservation measures. Challenges, including sustaining the

population recovery and managing increases in effort, remain but the recent history of blue crab fisheries management in the Chesapeake Bay is a success story.

Milt. Austin, *University of Tennessee in Knoxville*; **Paul Armsworth**, *University of Tennessee in Knoxville*

How additional rare species surveys change our conservation priorities

Species distribution surveys are usually a central component of spatial prioritization for conservation. Additional species surveys have the potential to change the places we decide to protect. But by how much? How different would our priorities be if we updated them with the information we will have next year? In this paper we quantify the amount that new surveys of rare species change the conservation ranking of watersheds in Tennessee. We find that the results depend on the way in which watersheds are ranked. For instance, when ranking watersheds by apparent species richness, additional surveys have little effect on priorities. Further, this effect decreases as we amass survey data. When ranking watersheds by their contribution to complementary richness, additional surveys have, in many cases, an order of magnitude larger effect on priorities. As in the previous case, the effect diminishes with a growing dataset. Unlike the previous case, additional surveys may continue to change conservation priorities well into the future when prioritizing by complementary richness. These results indicate that additional rare species surveys can serve a greater and ongoing use when we prioritize complementarity across candidate sites than when we view sites in isolation.

Miteva, Daniela, *Duke University*

Forests & Context: Factors Shaping the Effectiveness of Indonesia's Protected Areas

Even though protected areas (PAs) remain the most dominant conservation intervention in developing countries, little is known about the factors affecting their performance. Focusing on Indonesia's villages between 2000 and 2003, we examine how socio-economic context shapes PA effectiveness at preventing deforestation and alleviating poverty. We use matching methods that allow us to isolate the causal impact of protection. Post-matching, we apply nonparametric regressions to examine how the impact varies with factors that proxy for the local benefits and costs of conservation: the protected villages' proximity to markets, poverty, electoral participation and social capital. We find that the average impact on deforestation and poverty varies by PA type. For example, while national parks significantly decreased deforestation, strict reserves had the opposite effect. Only the multi-use PAs had a significant negative impact on poverty. However, our findings indicate that the effectiveness of the

different types of PAs varies significantly with the distance to markets and the socio-economic characteristics of the villages. Our results suggest PAs are effective when the benefits to local people from conservation exceed the costs imposed on them by limiting extractive activities. By highlighting which factors shape the effectiveness of protected areas in reducing deforestation and poverty, our work has important policy implications for conservation and development alike.

Mockrin, Miranda, *USDA Forest Service*; **Sarah Reed**, *Wildlife Conservation Society, Colorado State University*; **Liba Pejchar**, *Colorado State University*

Conservation development: how does this alternative to rural sprawl contribute to private land conservation and residential development in Colorado?

Over the past several decades, concerns about the environmental effects of low-density rural development have led to regulations that provide guidelines or incentives for conservation development. This alternative to rural sprawl is characterized by developments with smaller lots, clustered homes, and the preservation of a significant amount of open space (>50%). Examining the spatial relationship between conservation developments and protected areas (PAs) is an important first step towards understanding the degree to which these housing developments augment or diminish landscape-scale conservation efforts. We gathered parcel-level spatial data on 196 conservation developments, including private lots and open space, for 12 counties in Colorado (approximately 75% of the known conservation developments in the state). Although conservation development occurs on a fraction of the developable land (

Mohan, Vik, *Blue Ventures Conservation*; **Alasdair Harris**, *Blue Ventures Conservation*; **Laura Robson**, *Blue Ventures Conservation*

Population-Health-Environment: lessons learned by Blue Ventures from five years of integrating family planning with marine conservation in Madagascar

Blue Ventures is a marine conservation organisation that empowers coastal communities in Madagascar to sustainably manage their natural resources. In response to an expressed unmet need by the communities we partner with, we started providing family planning and other health services five years ago, then fully integrated these with our conservation work to form a Population-Health-Environment (PHE) programme. Longitudinal data from clinical records and household surveys show that this programme has resulted in a fourfold increase in contraceptive use and reduced birth rates by a third, slowing population growth to the extent that the population is now 5% less than it would have been without this intervention, thereby decreasing pressure on natural resources

and supporting local conservation efforts. The programme is reaping the benefits of integration by sharing resources and skills between projects, strengthening community participation across the breadth of our activities, reaching wider audiences with combined health and conservation messages, and enabling communities to understand the complexity of environmental challenges by appreciating the links between reproductive health, food security and conservation. As a result, we are more effective in achieving both conservation and health goals than if either were tackled separately. By sharing our methods and lessons learned, we aim to inspire and empower other organisations to adopt this integrated approach.

Molnar, Jennifer, *The Nature Conservancy*; **Sheila Walsh**, *The Nature Conservancy*; **Timm Kroeger**, *The Nature Conservancy*; **Robert McDonald**, *The Nature Conservancy*; **Peter Kareiva**, *The Nature Conservancy*

Incorporating Ecosystem Services into Corporate Decisions: Results from site-level analysis

The idea that nature delivers benefits to humans is an easy sell. Turning that idea into changes in business practices is not so simple. It is clear what conservationists think they are achieving by pushing for the valuation of ecosystem services. What businesses hope to gain from ecosystem valuation is not going to be easy to achieve. To address these challenges, we've evaluated 3 ecosystem services at The Dow Chemical Company's facility at Freeport, TX: freshwater supply, natural hazard protection, and air quality maintenance. Our approach demonstrates how ecological information can be tied to economics and used by a company. Our results make a business case for investing in nature to meet a business need: that reforestation can be a cost-comparative alternative for air quality compliance, before accounting for public and ecosystem benefits. We also showed that natural solutions aren't always enough: we modeled how coastal habitats reduce flood heights and economic damages from storms, but not enough to reduce a planned levee's height 10km inland. And we assessed public and ecosystem values, not just the private benefits: coastal habitats provide large benefits to local communities and habitat for wildlife, in addition to supplementing the levee's storm protection. Conservation isn't going to be a win-win solution for business and nature in every case on its own, but this methodology significantly advanced business's ability to account for nature and understand tradeoffs.

Moore, Donald, *Smithsonian National Zoo/Conservation Biology Institute*; **Mark Sturm**, *National Park Service*

Collaborative capacity-building in the Southern Cone on behalf of endangered Pampas deer and habitat: An evolving success story.

Our studies of endangered Pampas deer (Moore 2001, Sturm 2001) took place on Uruguayan private ranches where this "National Historic Monument" was protected by local landowners as part of their personal commitment to protecting national patrimony. Since that time, we have remained associated with stakeholders including ranchers' associations, Ministries and Institutes as well as many NGOs operating throughout the historic range of Pampas deer, and wildlife managers and academics who are consistently in-country and committed to understanding and sustaining Pampas grassland and species. Our collaborative capacity-building activities have included outreach to ranchers' association meetings, using WCS-NPS-SUNY support to host an IUCN-DSG co-sponsored, Uruguay-based Distance Sampling workshop (2002), leading a Smithsonian-led behavior workshop in Argentina (2010), and helping to anchor a Uruguayan ecotourism workshop via our NPS and Smithsonian bases of operation (2010). The positive, professional results of this interdisciplinary, collaborative capacity-building are evidenced in the all-Uruguayan-authored works by Gonzalez for adults (2010) and children (2011), as well as our assistance in PhD thesis defense by Cosse (2010). This persistent collaboration over more than two decades, with and by many of our committed colleagues from various disciplines in Argentina, Brazil and Uruguay, has the single intent of conserving one of Earth's most important grasslands and native wildlife

Moore, Rebecca, *Google Earth*

Roadless area mapping at global scale via Google Earth Engine

Google Earth Engine is a new technology platform that enables monitoring and measurement of the earth's environment at global scale. The platform includes a large catalog of earth observation data and offers intrinsically-parallel computational access to thousands of computers in Google's data centers. Earth Engine includes an application programming framework, or "API", that allows scientists access to these computational and data resources, to scale their current algorithms or develop new ones. Methods previously developed for road disturbance mapping at small (city) scale are being implemented in Google Earth Engine, on Google's large database of road information, to generate roadless area and road disturbance maps at country, continent and global scale. Combining science with massive data and technology resources in a cloud-computing framework can offer advantages of computational speed, ease-of-use and collaboration, as well as transparency in data and methods. This can aid in supporting a more informed and systematic global approach to conservation planning and policy.

Moreira, Danielle, *Universidade Federal do Espírito Santo*; **Clinton Jenkins**, *North Carolina State University*; **Sérgio Mendes**, *Universidade Federal do Espírito Santo*; **Stuart Pimm**, *Duke University*

What history tells us about fragmentation and regional extinction of mammals in the Atlantic Forest?

The Brazilian Atlantic Forest has an extraordinary terrestrial biodiversity. Large mammals might be the most well-known species, but they are still poorly known when it comes to the status of their conservation. Most medium and large sized mammals are threatened, a consequence of extensive habitat destruction. This brings up the question: How many of these species are likely to be prone to regional extinction in the Atlantic Forest? We address these issues for 24 species of mammals listed as threatened. We gathered historical and current observation points from naturalists' and scientific publications and through interviews with experts. We then calculated the density of forest fragments to identify remaining suitable habitat within the species' ranges. Observation points were divided into historical (before 1990) and current records (after 1990) and then superimposed on the density maps. Mammals are currently present mostly where the forest density is higher. For some species, such as the lowland tapir, giant otter, and giant anteater, no current records were present in some areas of higher forest density. Ten species do not have current reports for the last 20 years for some regions, meaning they are very likely to become regionally extinct, if they are not already. Historical analyses like this reveal possible regional extinction of species in a simple way, especially when they are not readily apparent.

Morley, Craig, *Waiariki Institute of Technology*; **Linton Winder**, *Unitec Institute of Technology*

The effect of mongoose (*Urva auropunctatus*), island quality and habitat on the distribution of native and endemic birds on small islands within Fiji

This study investigated the effect of the presence of an introduced predator, environmental quality and habitat on the distribution of native and endemic birds on 16 small islands within Fiji. Previous studies attribute bird declines and extirpation anecdotally to the mongoose. In total, 9055 birds representing 45 species were observed within four key habitats (forest, villages, crop land and coastal vegetation) on the 16 islands, half of which had mongoose present. The presence of mongoose, environmental quality and habitat type had a measurable influence on observed extant native and endemic bird communities. We conclude that three ground birds were negatively influenced by the presence of mongoose and that eight birds were particularly dependent on good quality forest habitat. Conservation priorities in relation to protecting Fiji's

endemic birds (and other endemic species) from the effect of mongoose and habitat modification are discussed and preventative measures suggested.

Morson, Jason, *Rutgers University*; **Hal Brundage**, *Environmental Research and Consulting, Inc.*; **Eleanor Bochenek**, *Rutgers University*

Movements and Habitat Use of Juvenile Atlantic Sturgeon in the Delaware Estuary

Atlantic sturgeon belong to a prehistoric group of fishes that existed for more than 70 million years. A principal fishery in the Delaware Estuary was supported in the late 1800s and early 1900s. Populations of Atlantic sturgeon are at historically low levels along the Atlantic coast of North America. Considerable research on the biology of sturgeon in the Delaware River and Bay has been performed. However, little is known regarding the occurrence, distribution, and movements of juveniles. Knowledge of the seasonal utilization of different parts of the estuary by, and habitat requirements of juvenile sturgeon is critical to the species' protection, management, and recovery. The lack of informed knowledge of their essential habitats precludes the implementation of appropriate protection and enhancement management strategies. In order to address this we collected and acoustically tagged juvenile Atlantic sturgeon (n = 56) in the Delaware estuary. Sturgeon tagging took place between October 2008 and November 2011. Sturgeon movements were monitored using a network of 127 receivers throughout the estuary from October 2008 through January 2012. Atlantic sturgeon utilized different parts of the estuary at different stages of juvenile development. The implications of these findings for management strategies of Atlantic sturgeon in the Delaware estuary are discussed.

Moseby, Katherine, *Arid Recovery*; **John Read**, *Ecological Horizons*; **David Paton**, *The University of Adelaide*; **Adam Bester**, *Arid Recovery*; **Steven Delean**, *The University of Adelaide*

Keep on Counting; the importance of long term monitoring in reintroduction programs

Arid Recovery is an Australian conservation organisation that benefits from long term support from mining, government, community and university partners. This strong partnership provided rare logistical support to enable long term post-release monitoring of four species of IUCN- listed reintroduced mammals. Population indices of the bilby, burrowing bettong, stick-nest rat and western barred bandicoot were measured up to 39 times over 12 years after release and compared with environmental variables using generalised additive models. Interestingly, even over a 12 year timeframe, there was strong evidence for an overall temporal

increase in density for three out of four species, suggesting that reintroduced populations may take decades to stabilise. Interspecific differences in population fluctuations were due to varied responses to rainfall, summer temperatures and time since release. These differences helped formulate species-specific future release strategies including release timing and size of release sites. We suggest that after the initial intensive monitoring of reintroduced individuals to determine short term success, a second phase of population monitoring should be conducted seasonally until strong temporal population increases after release are no longer apparent. Long term monitoring should also encompass several cycles of environmentally-induced fluctuations to enable reintroduction success to be effectively evaluated.

Muffett, Carroll, *Center for International Env'l Law*

The Role of Science in International Legal Action on Climate Change

The prospects for an ambitious and binding global agreement on climate change have grown increasingly uncertain, even as the evidence of serious climate impacts grows around the world. These impacts are being felt from Arctic communities to African villages to small island nations, many of which are struggling for their very survival. As political processes have stalled, State and non-State actors are exploring new legal strategies to transform the climate debate and drive meaningful policy change to address the climate threat. These strategies involve a huge array of forums, plaintiffs and defendants—from legal opinions at the International Court of Justice, to appeals to human rights bodies by individuals and communities, to consideration of transboundary climate impacts in environmental impact assessments under regional treaties. Along with the traditional legal hurdles faced in all litigation, potential plaintiffs in transboundary climate litigation must confront intense diplomatic and economic pressures, the limited jurisdiction of tribunals and the complexities of proving cause and effect in the climate context. International trade law and its fora must learn to accommodate climate policies as well. By building our understanding of the linkages between global trends and local impacts, scientists will play an important role in the development and utilization of these new legal approaches to addressing climate change, and in their outlooks for success.

Mulvaney, Kate, *Purdue University*; **Linda Prokopy**, *Purdue University*; **Seungyoon Lee**, *Purdue University*; **Tomas Hook**, *Purdue University*

Hauling in a Net(work) of Information: Utilizing Affiliation Networks to Better Understand Great Lakes Fisheries Governance

Although Great Lakes fisheries management has expanded to include multiple governmental jurisdictions and stakeholders, an understanding of how many organizations are involved in governance and the relationships among those organizations remains unknown. Based on an email survey of policy and decision makers from the Great Lakes Fishery Commission (GLFC), we investigated the affiliation network of formal and informal relationships with organizations throughout the Great Lakes region. The respondents identified relationships with 149 organizations. This large number of organizations could provide many opportunities for sharing information with and soliciting information from stakeholder and research organizations, but it could also add political pressures from these groups. The GLFC network has specific communication roles including the important coordinating role of the GLFC staff and connections to fishing organizations through stakeholder representatives. In addition to formal relationships, informal relationships are an important component of the affiliation network with more than 1/3 of all relationships identified as informal and 16 organizations identified only through informal relationships. Affiliation networks are just beginning to be utilized in natural resource governance, but could be a useful tool for understanding the connection between diverse stakeholder organizations and natural resource managers.

Muñoz, Lorena, *University of Tromsø*; **Vera Hausner**, *University of Tromsø*

Monitoring human disturbances in protected areas using distance sampling methods

Monitoring of human disturbances is important to assess the effectiveness of protected areas (PA). Indicators for trail evolution, informal trails and trampling have been widely studied, but they rarely have been connected to the dispersion of recreational use in the PAs. Distance sampling of recreational cues allow for spatial analyzes of the non-consumptive disturbances in protected areas. We recorded cues of recreational use around point of interests (parking lots, cabins, lakes) and trails (formal and informal), using a distance sampling design in 12 protected areas in Norway. In general there were few recreational cues in the Norwegian parks; only 4020 cues were recorded in the 426.7 km line transects sampled. Most of the cues were found in the frontcounty (

Murray, Kris, *EcoHealth Alliance*; **Luis Verde**, *University of Queensland*; **Martina Di Fonzo**, *University of Queensland*; **Ana Davidson**, *Stony Brook University*; **Moreno di Marco**, *Sapienza University of Rome*

Addressing the neglected role of threats in comparative extinction risk analysis

Comparative extinction risk analysis is a common approach for assessing the relative plight of biodiversity and making conservation recommendations. However, the usefulness of such analyses for conservation practice has been questioned. One reason why comparative extinction risk analysis may underperform is that threats (e.g., habitat loss, invasive species) are often overlooked, despite being widely regarded as proximal drivers of species' endangerment. We review the use of threats in this field from the literature, and investigate via two case studies the practical effects of threat exclusion on the interpretation and application of model results. Threat variables are routinely (59%) identified as significant predictors of extinction risk, yet while most studies (78%) include extrinsic factors of some kind (e.g., geographic or bioclimatic information), the majority (63%) ignore threats. In our case studies, omitting threats reduced model predictive performance and management relevance of results, and lead to considerable disagreement in a downstream conservation application (species ranking). We conclude that the use of threats in comparative extinction risk analysis is important and increasing but currently in the early stages of development. Better threat quantification and the development of more appropriate conceptual and statistical frameworks are priorities for improving the practical value of future studies.

Mwangi Kiragu, *BirdLife International*; **Iain Dickson**, *BirdLife International*

Supporting capacity building for biodiversity conservation - lessons from a 28 year NGO business partnership.

Given the precarious state of much of the world's biodiversity prioritising where and how to invest limited conservation resources is of the utmost importance. Here we present the key results from a review of the Conservation Leadership Programme, a 28 year old award scheme which currently operates as a partnership between BirdLife International, Conservation International, Fauna & Flora International, the Wildlife Conservation Society and BP plc. Since it began the programme has evolved from awarding one-off expedition grants for UK students to providing sustained support to developing world projects led by early-career, in-country nationals. Using a review of the programme's outputs and results from a 2010 survey of programme alumni we aimed to investigate what this evolution has meant both for biodiversity conservation and local capacity building. Results suggest that this shift has had a positive effect on in-country conservation capacity with 98% of county nationals currently working in conservation within their project's target country compared with 36% of non-country nationals, projects led by county nationals were also more likely to result in the creation of an NGO. A further result was that projects receiving the highest level of support were far more likely to deliver in terms of protected area designation, NGO creation and

species discovery. These findings demonstrate the importance of sustained, targeted support in maximising the contribution of such projects.

Nail Kelly, *University of Minnesota*; **Karen Oberhauser**, *University of Minnesota*

How cold is too cold? Cold tolerance of immature monarchs in North America

Eastern North American monarchs are well known for their long-distance annual migration to high elevation overwintering sites in Mexico, a journey that can cover over 4500 km. However, climate change models indicate these sites may not be suitable for monarchs within as little as 40 years. Citizen science reports from Gulf Coast states have shown some monarchs are now present and breeding throughout the winter, where immature monarchs may be exposed to freezing temperatures. To test immature monarch cold tolerance, I exposed monarchs to freezing temperatures and recorded both the supercooling point (SCP) and lower lethal temperature (LT50) for different developmental stages. Median SCPs for immature monarchs range from -26.1° to -9.6° C, with eggs having the coldest SCP and third instar larvae having the warmest SCP. Although the LT50s for larvae are below each stage's respective median SCP, no survival was observed below the lowest recorded SCP, suggesting that larvae are freeze-intolerant. However, eggs seem to be chill-intolerant, with an LT50 occurring at a temperature higher than their median SCP. While most monarchs tested were summer monarchs lab-reared in Southern US winter conditions, these results were further verified by testing wild winter monarchs raised on native milkweed in Texas. These findings can help inform future modeling and conservation efforts for monarchs throughout their life cycle, in particular guiding host plant restoration and habitat management.

Naujokaitis-Lewis, Ilona, *University of Toronto*; **Marie-Josée Fortin**, *University of Toronto*; **Hugh Possingham**, *University of Queensland*; **Tara Martin**, *CSIRO*

Conservation planning for migratory bird species under climate change

Seasonal migrants present a unique challenge for conservation planning under climate change. As migratory bird species rely on distinct breeding and nonbreeding habitats across their annual cycle, both threats to climate change and the cost of protecting lands may differ substantially depending on the seasonal range considered. Ultimately, these factors can influence the prioritization of lands for conservation. We use the potential range dynamics of Nearctic-Neotropical Parulidae migrants under future climate changes across both breeding and nonbreeding ranges to contrast static and

dynamic conservation scenarios on conservation priorities. Using Marxan, we evaluated two climate change adaptation strategies: protection of climate refugia and the promotion of connectivity across environmental gradients. Inclusion of potential range shifts under climate change strongly influenced sites prioritized and emphasized the need to adopt a dynamic conservation planning framework. Differences between the two climate change adaptation scenarios were magnified depending on the seasonal range under consideration, in part related to smaller nonbreeding range size relative to the breeding range and the magnitude of northern projected shifts for breeding ranges. Our results highlight the importance of integrating habitats required across the annual cycle into systematic conservation planning scenarios as they result in stark regional differences in climate change vulnerabilities.

Nelson, Joanna, *The Natural Capital Project, Stanford University*; **Leah Bremer**, *The Natural Capital Project, Stanford University*; **Rebecca Chaplin-Kramer**, *The Natural Capital Project, Stanford University*; **Heather Tallis**, *The Natural Capital Project, Stanford University*; **Jonathan Higgins**, *The Nature Conservancy*

Monitoring watershed ecosystem services in Latin America: connecting investors, conservation activity, and water outcomes in water funds

The risk of water scarcity is a rising threat in a rapidly changing world. Communities and investors are using the new institution of water funds to enact conservation practices in watersheds to bolster a clean, predictable water supply for multiple stakeholders. We operationalize monitoring standards for ecosystem-service reporting, from experimental design to supporting field implementation, in two case studies: Quito, Ecuador, and Cali, Colombia. In the big picture, we ask: a) Do water funds' restoration and protection actions work at the plot scale? b) Does the suite of investments work at the basin scale or point of use? We partnered with nine water funds to move from theory to practice, from new monitoring standards to field implementation, in a statistically robust and cost-effective way. Capitalizing on a tool to optimize water funds' investments in nature (RIOS), we report on the process of creating the monitoring scheme and subsequent metrics for water fund performance. For example, model estimates suggest that the Quito Water Fund's restoration of all degraded floodplain areas would increase the annual dry-season base flow by 21 million cubic meters, with a 75% reduction in sediment loads. Previous monitoring plans have not matched the scale of desired results, due to resource constraints and access to land under different ownership types. Our results highlight the need to draw on innovative data collection and analytic methods to improve monitoring action.

Ness, Ryan, *Toronto and Region Conservation Authority*; **Meaghan Eastwood**, *Toronto and Region Conservation Authority*

Reconceptualizing Urban Biodiversity: An Evolving Approach to Urban Landscape Ecology in the Toronto Region

The Toronto and Region Conservation Authority (TRCA) is a watershed-based public agency dedicated to conserving, protecting and managing renewable natural resources within the largest metropolitan area in Canada. Over the last 30 years the TRCA approach to urban biodiversity management has evolved significantly, from an emphasis on rare species and significant natural features toward a holistic approach that considers the function, character and value of the entire landscape. This has been catalyzed by a recent re-examination of the goals of urban conservation management and a greater understanding of the role played by urban ecosystems in human well-being. The presentation will illustrate this progression in management practice by utilizing an urban forest spatial analysis case study, describing the methodology used to develop a decision-making tool that guides tree planting efforts of local conservation managers in both urban and natural areas. This tool aims to identify and prioritize spatially explicit tree planting locations that best satisfy local demands for ecosystem services based on the social-ecological characteristics of each unique neighborhood within the study area. While there are challenges associated with balancing stakeholder perspectives, the outcomes are an important first step towards managing urbanized landscape for optimum function and ecosystem services.

New, Leslie, *US Geological Survey*; **Emily Bjerre**, *US Fish and Wildlife Service*; **Brian Millsap**, *US Fish and Wildlife Service*; **Mark Otto**, *US Fish and Wildlife Service*; **Michael Runge**, *US Geological Survey*

Adaptive Management of Golden Eagles on Wind Farms in the U.S.

In the United States, a substantial proportion of the country's renewable energy is expected to come from wind power. Despite rapid development, our understanding of wind facilities' environmental impact is poor. A particular source of apprehension is avian mortalities due to collisions with rotating turbine blades. A great deal of uncertainty surrounds the factors contributing to bird collision risk; environmental-decision making in this context is difficult. Yet, government agencies and project proponents will be faced with recurrent decisions on project operations, siting and design, compensatory mitigation and permits for lethal take. Adaptive management is beneficial in these circumstances, since it incorporates uncertainty into the decision making

process in a structured way, and provides a mechanism by which it is possible to simultaneously learn about and manage natural systems. Using golden eagles, we show how pre-construction monitoring can be used to predict a project's annual eagle fatalities, how learning occurs through management and post-construction monitoring designed to address the known uncertainties, and how this information can be used to reassess and adjust management actions for individual projects and wind farm development as a whole. Although we focus on only one aspect of wind farms' environmental impact, our case study exhibits the broad potential for adaptive management to aid the progress of renewable energy development in the face of uncertainty.

Nichols, Margaret, *Landcare Research*

Optimising camera traps for monitoring small mammal

Invasive animals require applied techniques for observation and management. However, low densities and secretive behaviours make monitoring some species difficult. Camera traps have mostly been used to spot large animals, but until recently field staff have shied away from their use with smaller species. We sought the most economical and effective camera traps to monitor small and medium-sized mammals. The experiments consisted of multiple pen trials using stoats (*Mustela erminea*), cats (*Felis catus*) and hedgehogs (*Erinaceus europaeus*). We tested: 1) still photographs vs. video, 2) trigger speed (0.2-2.1 seconds), 3) passive infrared (PIR) vs. microwave sensor, and 4) white vs. infrared flash. The white flash produced the most identifiable photographs of species, but also frightened some test animals. The microwave sensor had a low success rate in contrast to the PIR sensor. Video cameras had comparable success rates to still footage, however much more effort was required in processing and computer time. We see camera traps as a promising tool for monitoring invasive species. Detection rates may be improved by eliminating visible and audible cues emitted by cameras. Also, standardising the field of view for each camera will help to make results more comparable between different locations and times.

Nickerson, Brandon, *Oregon State University*; **Clinton Epps**, *Oregon State University*

Isolation Predicts Both Neutral and Adaptive-linked Genetic Diversity of Desert Bighorn Sheep Populations

Previous research investigating the influence of population isolation on genetic diversity has largely focused on neutral genetic diversity, assuming that adaptive genetic diversity follows similar patterns. However, natural selection on adaptive variation could mediate loss of genetic diversity through drift in some cases. We examined patterns of neutral and adaptive-linked genetic diversity using fecal DNA

systematically collected from 13 populations of desert bighorn sheep (*Ovis canadensis nelsoni*) in the Mojave Desert of California. Using samples previously genotyped at 14 neutral microsatellite loci, we genotyped 5 additional neutral microsatellites and 4 microsatellite loci linked to adaptive immune system genes. Genetic diversity (allelic richness and heterozygosity) of neutral and immune-linked loci were correlated. As previously established for neutral diversity in this study system, genetic diversity of immune-linked loci declined as isolation (distance between populations and anthropogenic barriers to movement) increased. Our results suggest neutral diversity can accurately reflect consequences of habitat fragmentation for adaptive diversity, at least when populations are small and fragmentation is extensive, which could in turn affect individual fitness and population persistence. These findings are particularly relevant to conservation of desert bighorn sheep in the Mojave, where proposed renewable energy developments may cause further habitat fragmentation.

Nolte, Christoph, *University of Michigan*

Ecological, social, and demographic impacts of protected areas in the Brazilian Amazon

Ongoing research has demonstrated the success of protected areas in reducing deforestation in the Brazilian Amazon. Less is known about their economic and social impacts. We use census and satellite data to examine how protected areas and indigenous lands affected deforestation rates, economic poverty and population growth in 6728 Brazilian census units between 2000 and 2010. We base our impact estimates on differences between census units with high coverage of protected areas or indigenous lands and matched control groups of otherwise similar census units with low coverage. We find that all protection types have significantly reduced deforestation rates, although with variable social and demographic impacts. Strictly protected areas were associated with reductions in demographic growth, while sustainable use areas were not. Neither category was estimated to have affected economic poverty. However, census units under indigenous lands exhibited significantly higher economic poverty and lower demographic growth than similar unprotected census units. Our findings underscore the importance of protection type in jointly affecting ecological, economic and demographic outcomes of spatial conservation policies.

Novack, Anthony, *WA State Dept of Fish and Wildlife*

Profiling Poachers: Using Randomized Response Technique to Assess Rates of Hunting Violations by Deer and Elk Hunters in Washington State

Nunez, Cassandra, *Virginia Polytechnic Institute and State University*; **James Adelman**, *Virginia Polytechnic Institute and State University*; **Daniel Rubenstein**, *Princeton University*

Linking social environment and stress physiology in feral mares (*Equus caballus*): group transfers elevate fecal cortisol levels

With a broad understanding of species' physiology and behavior, managers and conservationists can better predict species' response(s) to perturbation, achieving results that more fully address stakeholder interests. The management of feral horses (*Equus caballus*), for example, is a contested issue: despite years of debate, Congress, the Bureau of Land Management, and horse advocates have yet to come to a tenable solution. Feral horses have a complex social structure: decreases in social stability reduce female fitness. However, the physiological mechanisms linking social stressors and fitness remain unknown. We studied group changes in feral mares (an activity that induces social instability) on Shackleford Banks, NC. During group changes, mares exhibit elevated fecal cortisol, a physiological marker of stress. In addition, mares making more group transfers show higher cortisol levels. Our results suggest that social instability is integrated into an animal's physiological phenotype and have implications for feral horse management. Shackleford mares contracepted with porcine zona pellucida make 10 times more group changes than untreated mares. Such animals may be at higher risk of chronic stress, which can impair cardiovascular and immune function. Our results support the growing consensus that links between behavioral and physiological systems should be considered when establishing the effective, humane management and conservation of animal populations.

Nutter, Felicia, *Tufts University Cummings School of Veterinary Medicine*; **Richard Kock**, *The Royal Veterinary College*; **Scott Newman**, *Food and Animal Organisation of the United Nations (FAO)*; **Samuel Muriuki**, *African Union InterAfrican Bureau for Animal Resources*; **Thomas Nyariki**, *African Union InterAfrican Bureau for Animal Resources*; **Lindsey McCrickard**, *Food and Animal Organisation of the United Nations (FAO)*; **Serge Nzietchueng**, *University of Minnesota*; **Tracy McCracken**, *Virginia-Maryland College of Veterinary Medicine*

WILD: An Introductory One Health Course on Wildlife Health and the Human-Livestock-Wildlife-Environment Interface, and how it supports conservation

Infectious diseases in wildlife are important ecologically for population regulation. There is increasing recognition that disease transmission at the human-livestock-wildlife-environment interface is a significant problem mainly driven by human and domestic animal population growth and

behavior, impacting biodiversity conservation, food security, livelihoods, livestock and human well-being. Disease prevention, control and management across sectors is a complex problem requiring an integrated approach. A One Health training module, WILD (Wildlife Investigation in Livestock Disease & Public Health), encourages collaboration across sectors to improve response to challenges at this interface. Participants from ministries of health, agriculture, wildlife, and environment are exposed to processes that drive disease emergence from wildlife and challenged to collaboratively devise solutions. Learning is transdisciplinary and forges cooperation in the classroom and beyond. WILD has reached more than 125 participants in over 30 countries, who continue to communicate through a project network. The course approaches health uniquely from the perspective of the environment and biodiversity context in which humans and animals co-exist. Inclusion of wildlife disease ecology in the design of human and domestic animal health systems, surveillance, and outbreak response training is a significant advancement over current practice and a major milestone towards the holistic One Health approach.

Nye, Janet, *NOAA NMFS NEFSC, Sandy Hook, NJ*

Cusk and Climate Change: assessing the threat to a candidate marine fish species under the US Endangered Species Act

Cusk (*Brosme brosme*) is a deepwater fish species associated with high complexity seafloor habitat. Population abundance of cusk in both US and Canada has declined over the last 40 years as a result of fishing activities and there is growing concern about the status of this species, although it is not formally assessed or managed. In addition to pressures from fishing, climate change may affect cusk especially because the southern limit of its range in the Northwest Atlantic is in the Gulf of Maine. We modeled the habitat of this species using US and Canadian trawl survey data using a Generalized Additive Model (GAM). Although many factors were considered, temperature and bathymetric complexity (based on a topographic roughness index) were the most important variables in the prediction of cusk occurrence. We used statistical downscaling of 11 global climate models to predict temperature change in two future time periods (2020-2060 and 2060-2100) for 3 climate change scenarios (B1, A1B, and A2). We then used the ensemble climate model projections to project suitable cusk habitat in these two time periods under the three different scenarios. Results suggest fragmentation of habitat and reduced connectivity between Canadian and US populations that may diminish the resilience of cusk populations. This fragmentation occurs because of a spatial mismatch between areas with high complexity seafloor habitat and areas with suitable temperature.

O'Carroll, Aaron, *Canadian Boreal Forest Agreement Sc*

Innovative, practical, applied conservation models and agreements forged from a truce between forestry companies and conservation organizations in the Canadian Boreal Forest.

In 2010, the majority of Canada's forest industry, as represented by the Forest Products Association of Canada (FPAC), and a coalition of leading Canadian and International conservation organizations signed the Canadian Boreal Forest Agreement (CBFA). The CBFA commits the FPAC forest companies and conservation organizations to work together in the Canadian Boreal to, among other things, develop proposals for protected areas, plans for woodland caribou conservation, plans for reducing greenhouse gas emissions across the full life-cycle of forest products, an auditable, world-leading set of standards for forestry management practices and measures to ensure marketplace benefit for the implementation of these conservation plans. I report here on the circumstances that led to the Agreement, progress towards achieving the Agreement goals and discuss lessons learned from the process to date.

odewumi, oluyinka, *FUTA*

The impacts of medicinal uses of West African Manatee (*Trichechus senegalensis*) on its Conservation status in Nigeria

The impacts of medicinal values of West African manatee on its conservation were investigated in some selected towns in Nigeria. Oral interview and 300 self administered structured questionnaires were used to collect information from fishermen (270), and traditional herbalist (30) in these areas. 40% of the fishermen agreed that they kill manatee mainly for sale for medicinal purposes, 40% for consumption as food and 20% for both Manatee parts are known to be useful in 13 different ways as recorded in the study, some of which include; treatment of eye diseases, dislocation and fractures, all forms of skin diseases, mental disorders, impotency in men, used as an aphrodisiac and increase intelligent quotient of unborn child when eaten by pregnant woman. The estimated average yearly killing of manatee in the study areas in the past 1-10 years is put at 100-200, while it was greater in the past 11-20 years. This killing combined with the animals ecological limitations and reproductive habits have pushed the population to the brink of extinction in most of their natural ranges in Nigeria.

Ojha, Nabaghan, *IPE Global Pvt Ltd*

Forest Conservation: Changing Dynamics in a Changing World

In India the enactment of proactive forest conservation policies and changes in management approaches from 'timber' to 'forest ecosystem' during the last few decades have promoted conservation and sustainable management of forest. The country is promoting afforestation on an unprecedented scale. Huge amounts of money are also being pumped in to increase the green cover in the country. Recognizing the carbon storage and sequestration potential of forests, India has given a new impetus to the forestry sector and has more than doubled the forestry budget. These laudable measures notwithstanding, there are certain developments that cause serious disquiet - none of them more worrying than the attempts at privatization of common property resources (CPR). What is most worrisome is the fact that many such attempts are ordinarily invisible, sugar coated as they are with terms like plantation to check global warming, compensatory afforestation to enhance forest cover etc. Large tracts of CPR are being taken away without the knowledge of the local community. Conserving forest resources sustainably is a bigger challenge for the country now than it has been ever before. Designing interventions for conservation and management of forest resources is becoming more complex by the day in the light of the fast changing global scenario. The paper tries to highlight the conservation and management issues in Indian Forestry sector with a set of recommendations for future.

Olakolu, Fisayo, *Nigerian Institute for Oceanography and Marine Research(NIOMR)*; Oyeronke Adegbile, *Nigerian Institute for Oceanography and Marine Research(NIOMR)*

Marine Conservation;Status and Challenges in Nigerian Coastal Environment

Nigeria is a maritime state with a coastline approximately 853km and an exclusive economic zone (EEZ) of 200 nm. The Nigerian Marine Environment is in close proximity with the gulf of guinea of the south eastern Atlantic Ocean. It is endowed with numerous living and non-living resources. Nigerian marine species are listed in IUCN red list as endangered and critically endangered. Nonetheless fishing effort in Nigeria is rising rapidly, fishing is the major livelihood in Nigeria coastal communities with the use of gill net, and fishery in this sector (artisanal) has contributed the highest percentage (75%) to the Nigerian domestic fish production. However, the major challenge is an accidental catch of some vulnerable marine resources (including sea-turtle, marine mammal) with gill net during fishing when the net is set and incidental capturing of female sea-turtle on beach during egg laying. Sea-turtle and other commercially important fish species are also caught as by-catch in industrial shrimp trawl fishery. Some conservation effort are on-going including awareness and sensitization of fishermen and community members on monitoring and release of these vulnerable species in some of these coastal communities, also by-catch and sea-turtle excluder devices for industrial shrimp

trawl fishery. However, stakeholders and volunteer involvement through integrated approach to conservation can bring about effective maintenance and restoration of biological diversity.

Olival, Kevin, *EcoHealth Alliance*; **Jon Epstein**,

Integrating wildlife conservation and zoonotic disease surveillance

At a time when wildlife are increasingly scrutinized in zoonotic disease investigations, it is important to consider conservation messaging and public outreach in these efforts. In particular, preventing the vilification of wildlife in the face of discovering potentially pandemic pathogens is critical. We will highlight examples of infectious disease research involving bats in several countries where conservation studies have been integrated with disease investigations. Bats have been historically reviled by the public, yet provide valuable ecosystem services such as pollination, seed dispersal, and insect control. Bats have also become a high profile taxonomic group as they are reservoirs of several emerging zoonotic diseases of high consequence. Of the more than 1,200 species of bats >25% are endangered, making integration of conservation efforts more critical. Typically wildlife departments in developing countries are mandated to manage wildlife and not to investigate disease issues. We highlight examples from three countries, Malaysia, Thailand, and Bangladesh, where Ministries of Environment/Departments of Wildlife have recently become active participants in health studies that successfully integrate bat conservation. Each of these countries has experienced the emergence of zoonotic diseases, which fostered the adoption of a One Health framework involving participation from the wildlife sector in disease surveillance. In each case, epidemiological studies have included detailed research on bat ecology, demography, and behavior of direct conservation value. Despite these successes there is room for better messaging between health and conservation sectors.

Olsen, Glenn, *Patuxen Wildlife Research Center*

The role of conservation medicine in whooping cranes in North America

The whooping crane (*Grus Americana*) is the most endangered crane species in the world, numbering only 22 birds in 1941. Today numbers are around 550 birds, with close to 400 in the wild. The species is sensitive to a number of disease agents, some of which, such as eastern equine encephalitis and West Nile virus, are zoonotic. Toxins or contaminants and even climate change, as it affects the water levels in the Guadalupe River in Texas or the Platte River in Nebraska, impact whooping crane survival. Recently black fly species breeding in Wisconsin have been implicated as

causing disturbances to nesting whooping cranes. The whooping crane recovery team, formed jointly by the U.S. Fish and Wildlife Service and the Canadian Wildlife Service has one veterinarian as a member and has an advisory team of veterinarians and wildlife biologists working to improve survival of the wild birds and to develop new and safer reintroduction techniques using captive reared birds.

Onial, Malvika, *Nature Science Initiative*; **B Phalan**, *University of Cambridge*

Food production and biodiversity conservation: Reconciling farming with nature?

A rapidly growing human population and increasing expectations for the amount and quality of food in many parts of the world will drive a rising demand for food and other agricultural goods. Increasing intensification of agriculture to meet this demand is expected to impact biodiversity. Two contrasting approaches that address this issue are 'land sharing' and 'land sparing'. The first approach advocates retaining natural habitat patches and maintaining less intensive farmed land within the agricultural landscape while the latter suggests increasing yields on existing farmland, thus preventing further loss of non-farmed habitat and creating the potential for making farmland available for restoration to a more natural condition. My study assesses these two contrasting approaches by analysing responses of biodiversity across low to high yielding land-use intensities through an empirical study of the relationship between agricultural yields and population densities of birds and trees in northern India. Results indicate that many bird species dependent on forest and wet grassland and a majority of native tree species are likely to have higher regional populations under 'land-sparing' rather than under 'land sharing'. This study makes an effort to provide an understanding of the effects on biodiversity of different production systems and land use intensities to evaluate possible options that can benefit biodiversity conservation while also achieving desired yield targets.

Ormsby, Alison, *Eckerd College*

Conservation and Conflict: Sacred Groves of Sierra Leone

Sacred groves in Sierra Leone, West Africa, are small community-managed forests that are linked to cultural traditions. These groves harbor natural resources, including diverse flora and fauna. Research was conducted in the Tonkolili District of central Sierra Leone in June and July 2012. A semi-structured questionnaire was used to interview 99 residents in 16 communities about natural resource use and rules regarding local sacred groves. The presence of small mammal populations and human uses of natural resources within the groves was documented. The historic role of

sacred groves and their use during the recent 11-year war was also investigated. Societal traditions and rituals are key to the continued protection of the groves. The groves' cultural significance and local management help ensure conservation of these small forested areas.

Osunsina, Israel, *Federal University of Agriculture, Abeokuta, Nigeria*

Indigenous People and Conservation Education and Awareness in Some National Park in Nigeria

The involvement of local people in Environmental education and awareness and its role in Biodiversity conservation around some National parks in Nigeria were investigated. Questionnaires were administered to elicit information from the villages around the parks viz: CRNP (985 respondents); GGNP (1079 respondents); KLNP (1134 respondents) and OONP (1013 respondents). Environmental education programmes and conservation attitudes were assessed and responses elicited. In CRNP, 53.9% respondents indicated that environmental education had been conducted in their area, while in GGNP, KLNP and OONP, the respondents who indicated that environmental education was done in their villages were moderately low (39.3%, 36.2% and 41.1% respectively). The result of the Chi-square shows that there is significant relationship between the age ($X^2 = 90.222$, p

Oyamaguchi, Hilton, *UCLA*; **Thomas Smith**, *UCLA*

Importance of the Amazon-Cerrado gradient in preserving adaptive variation in a changing world

Conserving adaptive variation is extremely important in the face of climate change. Environmental gradients have been shown to be critical regions for harboring adaptive variation and speciation. Our research investigates the evolutionary processes important in generating morphological, vocal and genetic differentiation in the frog *Dendropsophus minutus* along the gradient between the Amazon rainforest and the Cerrado in Brazil. Multivariate analyses of morphological data shows significant differences between habitats and that divergence between habitats is greater than within. In addition, we find vocal and genetic divergence between both habitats. These results suggest that natural selection is important in the divergence process between populations and suggests that the Amazon-Cerrado gradient may play an important role in the speciation process. Conserving this gradient will be important for maximizing adaptive variation under climate change. Results underline the importance of preserving not only the pattern of biodiversity, but also the processes that produce and maintain it.

Paquet, Paul, *Raincoast Conservation Foundation*

Ecological effects of marine waterways in Canada's roadless Great Bear Rainforest

Landscape fragmentation affects wildlife population viability, in part, through the effects it has on individual dispersal. In addition, some forms of human disturbance impinge on dispersal without physically fragmenting habitats. For example, connectivity for terrestrial and marine mammals that rely on water passageways for travel can be adversely affected by human disturbances such as boat traffic. In Canada's Great Bear Rainforest, traffic on inland marine waterways is increasing and potentially interfering with movement of large terrestrial mammals (e.g. wolves, grizzly and black bears, deer) among islands and the mainland. Boats pose lethal threats to mammals via collision and impede movements by direct interference. Humans in boats occasionally harass and kill deer, bear, and wolves as these animals travel between landmasses. In addition, ocean channels, coastlines, and river systems provide humans access to remote areas and opportunities for killing wildlife not otherwise available. In southeastern Alaska, for example, people who gained access by boat to areas otherwise secure were responsible for more than 50% of all wolves killed by hunters and trappers. These disturbances are analogous with the adverse influences in terrestrial systems associated with roads, railways, and other linear infrastructure. Focusing on ecological implications of increasing marine traffic, we provide a novel overview of connectivity in the marine and terrestrial interface along British Columbia's central and north Pacific coast.

Parrish, Julia, *University of Washington*

Is there science in citizen science? Perceptions, myths and realities

In an era of increasing biodiversity loss the ability of professional scientists to document, much less ameliorate, these trends is quickly diminishing. Can non-scientists provide a solution? Results from a web-based meta-analysis of citizen science (CS) programs and follow-on surveys of program managers, and separately of biodiversity scientists, suggests that these programs remain largely untapped by professional science. Although 97% of surveyed programs indicated increased scientific understanding as a goal, scientists felt that the main goal of CS is not research, but outreach and education. Scientists indicated they would trust programs housed within academic institutions and data collected by young adults (college students or adults with a college degree), whereas most programs were actually housed within the non-profit sector (NGOs) and contained a preponderance of adult learners, especially retirees. A mere 12% of programs were searchable in Web of Science, and publication propensity was tied to program age, spatial scale, QAQC, and headquarter type. However, biodiversity CS program growth is exponential, involving millions of citizens

collecting data on diverse taxa, systems, and issues. The majority of programs are 10+ years old, have a spatial extent of >100km, make their data available, and have QA/QC procedures in place. Ignoring this burgeoning public, as biodiversity and ecosystem services continue to erode, makes science inefficient and potentially irrelevant.

Partridge, Dustin, *Fordham University*; **J. Alan Clark**, *Fordham University*

Urban Green Roofs and Wildlife Conservation

Urban environments are generally comprised of impermeable surface and often lack suitable stopover and breeding bird habitat. For example, 34% of Manhattan's surface is rooftop, while only 13% is green space. This study examined if green roofs can be a viable bird conservation tool in an otherwise depauperate urban environment. A green roof is a roof covered with a waterproof membrane and growing medium, and planted with vegetation. Green roofs reduce the cooling and heating needs of buildings, minimize stormwater impacts, and reduce urban heat island effects. However, no study to date has evaluated avian use of multiple green roofs in a highly urbanized area. I compared bird and arthropod diversity on green roofs in New York City with nearby non-green roofs. To document the presence of birds, I used direct observations and deployed acoustic recorders to monitor bird vocalizations. I collected arthropods with bowl and sticky traps. I identified over 35 bird species using green roofs in New York City and have found that arthropods are more than 6 times more abundant on green roofs than non-green roofs. This is the first study to examine the role of green roofs as stopover habitat for migrating birds. The number of green roofs in New York City is increasing, yet the amount of unused available roof space remains high. This research demonstrates that green roofs can provide valuable wildlife habitat in heavily urbanized environments, and can be a successful conservation tool.

Patricio, Harmony, *SCB FWFG Board, FISHBIO*

Relationships between threats to rare wildlife from human consumption and availability of fish for villagers in Lao PDR

The Mekong River hosts well over 850 fishes, with the second highest species diversity and the most productive inland fishery of any river on Earth. The aquatic resources of the lower basin support over 60 million people with food and income. The region is undergoing rapid change, associated with concerns over impacts on fisheries and related food security. With increased development there is also growing pressure on rare terrestrial wildlife that has historically been part of the local diet. We have worked with villagers in the Lao People's Democratic Republic to establish community-

based participatory research on fisheries and sustainable livelihoods. Teams from four villages were trained to monitor the fishing catch, household food consumption, and fish sales at local markets. Despite targeted conservation efforts such as outreach and establishment of National Protected Areas, food consumption surveys have shown that rare or endangered terrestrial wildlife continues to be present in diets. Here we discuss the relationships between fisheries harvests and the consumption of rare terrestrial animals. We conclude that in remote areas of the Mekong Basin, conservation of fishes and rare terrestrial animals are inherently linked.

Patterson, Katheryn, *George Mason University*; **Esther Peters**, *George Mason University*; **E.C.M. Parsons**, *George Mason University*

Using multidisciplinary diagnostic tools to characterize tissue-loss diseases in staghorn coral, *Acropora cervicornis*

The combined effects of anthropogenic stressors, including global climate change and ocean acidification, increases in coral diseases, and frequency and duration of coral bleaching, put coral-reef ecosystems at high risk. White-band diseases (WBD I, II) and rapid tissue loss (RTL) have caused dramatic declines in endangered *Acropora cervicornis* populations across the Caribbean and tropical western Atlantic Ocean. No studies have been conducted to date to determine whether recent tissue loss represents a single disease condition caused by a single pathogen, or if similar tissue-loss disease signs represent different diseases caused by a variety of pathogens. We used histopathological and molecular techniques to analyze coral tissue and adjacent sediment samples to characterize WBD and RTL. Preliminary data suggest differences in composition of the microbial communities of healthy and diseased tissue and the presence of more than one disease. These techniques will provide a mechanism for differential diagnosis of coral diseases in *A. cervicornis* if multiple diseases that share similar signs have unique associated microbial communities and/or different causal agents. The histological and microbial samples collected during this study provide insight into the character of WBD and RTL diseases at the cellular level. These results have global conservation implications in aiding managers developing best practices for reef restoration.

Pelz Serrano, Karla, *CBS, Universidad Autónoma Metropolitana-Lerma*; **Charles van Riper III**, *Sonoran Desert Research Station*; **Melanie Culver**, *SRNE, University of Arizona*; **David Bergman**, *USDA APHIS Wildlife Services Arizona*

Adaptive Research management and conservation genetics of the American beaver across borders

The American beaver was considered an important fur-trading item in the late 1800's, which resulted in the near eradication of the species. Efforts to restore beaver populations began in early 1900's, but almost no attention to the genetics or biology of the beaver was considered. After populations recovered, their management changed, ranging from lethal control to conservation. The purpose of this study was to assess if there was an impact of overexploitation and different management actions on the genetic diversity of the beaver in seven areas across North America. We used nine microsatellite loci, control region and cytochrome b mitochondrial gene fragments, to assess genetic diversity measures of 153 individuals from seven areas in the U.S. At the microsatellite loci, results across populations show high genetic diversity ($HO = 0.613$, $HE = 0.740$), and high genetic differentiation ($FST = 0.128$, $RST = 0.199$, P

Persha, Lauren, *University of North Carolina*

Forest sector decentralization in Tanzania: Unpacking the role(s) of governance for improved livelihoods and conservation

Governance issues are central to much empirical conservation research and policy action, particularly in the context of decentralized strategies which ostensibly aim to use governance changes to deliver improved conservation and livelihoods. Governance failures anywhere on the institutional spectrum can serve as enduring barriers to effective conservation, and good governance - particularly at local levels - is seen as crucial for improved equity and sustainability around livelihoods and resource use. But the elements which underpin these broad generalizations are poorly understood. For instance: 1) Under what conditions and by what mechanisms does decentralization successfully promote more effective resource governance? 2) What are the income and equity impacts of improved governance across households in terms of resource-based livelihoods and altered conservation and use dynamics? I draw on preliminary data from an ongoing impact evaluation of Tanzania's forest sector decentralization to examine how variation in two governance components (strength of participation in local forest institutions by forest users; institutional nestedness) relate to key social and ecological objectives: contribution of forest products to livelihoods, harvest intensity and legality, and forest sustainability. Analyses draw on data from households, local governance institutions, and forest plots collected from some 50 villages and forests and 1500 households across 10 districts in Tanzania.

Petracca, Lisanne, *Panthera*; **O. Eric Ramirez-Bravo**, *Durrell Institute for Conservation Ecology*; **Lorna Hernandez-Santin**, *Departamento de Ciencias Químico-Biológicas*

Occupancy estimation of jaguar *Panthera onca* in east-central Mexico: A corridor uncertain

The use of wildlife corridors to maintain landscape connectivity has become increasingly relevant to the conservation of wide-ranging species, including the jaguar *Panthera onca*. Jaguars are particularly threatened in Mexico, where corridor linkages are tenuous due to habitat fragmentation. Our study assessed a section of potential corridor south of the Sierra Madre Oriental in eastern Mexico. We conducted 245 interviews with local inhabitants in 140 36 km² sampling units and compiled detection histories for jaguar and five prey species: the collared peccary *Tayassu tajacu*, red brocket deer *Mazama americana*, white-tailed deer *Odocoileus virginianus*, spotted paca *Agouti paca*, and armadillo *Dasyopus novemcinctus*. These detection histories were then analyzed via site occupancy modeling. Each sampling unit was assigned a probability of habitat use based on (1) both smaller prey species (paca, armadillo) and (2) at least two of the larger prey species (collared peccary and two deer species) using habitat in that unit. This probability estimate was considered a proxy of each sampling unit's prey base and therefore its suitability as a jaguar corridor. Though the prey base in some areas appears adequate to support a jaguar population, the paucity of jaguar sign over the past year and presence of large-scale development projects are major roadblocks to this region's potential. We suggest that the eastern coast of Mexico may not be a priority area for range-wide jaguar conservation.

Pfaff, Alex, *Duke University*

Decentralization & Development-Environment Tradeoffs: federal versus state conservation choice & impacts on Amazonian deforestation

We model federal versus state location of protected areas in Brazilian Amazonia then empirically examine impacts on 2000-2004 deforestation. States are hypothesized to weight local costs more, relative to external forest benefits, than the federal government. We examine the differences in decisions empirically for two types of protected areas, the Integral (strict) and the Sustainable Use (permitting some deforestation by people who were already resident), while comparing them both to more exogenously determined Indigenous protected lands. In doing our comparisons, we control explicitly for different land characteristics between protected and not. Including those controls halves the estimates of deforestation reduction, since protection tends to locations with low deforestation threat. Federal and Indigenous areas reduced deforestation but State areas did not, due to a lack of enforcement plus cost-avoiding location for Sustainable Use. Within Federal areas, Sustainable Use areas significantly block deforestation. They are oriented around people and thus deforestation pressure, which gives them something that can be blocked. The more isolated Integral locations are much more likely to be forested even

without protection. As global funds may compensate REDD, these results inform domestic policy design given local tradeoffs. Global actors may heed differences across local actors when agreeing to an institution.

Phillips, Tina, *Cornell Lab of Ornithology*

Setting professional metrics: articulating conservation outcomes for integrated social-ecological systems

Within natural resource management, conservation outcomes are conceived on a variety of levels, but typically measured directly through habitat and species assessments (Kapos et al. 2008). Citizen science, however, tends to affect conservation indirectly through application of research findings, education of stakeholders, and individual and community-level actions. Despite the increased pressure by funders and other stakeholders to influence conservation outcomes, few citizen science projects have been able to demonstrate conservation outcomes at the socio-ecological level (Jordan, Ballard, and Phillips, 2012). One reason for this is that project leaders and practitioners have not adequately articulated what those conservation outcomes are and how they align to project activities. Moreover, few project leaders have identified how they would measure success. During this session I will define the challenges and opportunities for evaluating conservation outcomes of citizen science across different models of engagement and describe how using approaches from evaluation and conservation biology can help professionals articulate their conservation outcomes for social ecological systems. I will also highlight a few case study examples demonstrating how evaluation can be used in the design and implementation of a project to provide context specific strategies for articulating and measuring conservation outcomes in citizen science.

Pilliod, David, *USGS - Boise, ID*

Successes and challenges of using eDNA to monitor amphibians in high-gradient streams

Environmental DNA (eDNA) methods have been successfully used to detect amphibians in high-gradient streams, but several challenges remain for implementing this approach to monitor native and invasive vertebrate species. To test the efficacy and limitations of this method, we designed molecular qPCR assays for two amphibians (Idaho Giant Salamanders, *Dicamptodon aterrimus*; Rocky Mountain Tailed Frogs, *Ascaphus montanus*). We then tested how water collection methods affected detection probabilities and eDNA concentrations in 1L water samples pumped through cellulose nitrate filters. Preliminary results suggest minimal differences between sample collection methods, allowing the user to choose the most convenient method for their particular application. When eDNA was at low levels in

the stream, or when few replicates were collected, eDNA concentration estimates had relatively low precision due to occasionally high or low amounts of eDNA in replicate samples. We found that eDNA concentrations were positively associated with field-based estimates of density, biomass, and proportion of transects occupied across 13 streams, especially when outlying replicates were removed. We expected eDNA concentrations to be higher when water samples were collected just downstream from animals, but our analyses suggest that eDNA concentrations were not influenced by distance from animal, location in the stream, or time of day. We detected an increasing amount of eDNA within 6-24 hours after animals arrived into a previously unoccupied stream and we found that eDNA degraded exponentially until it was undetectable within 8-18 days depending on exposure to sun and temperature. More work is required to test the limitations of eDNA applications; however, our preliminary findings suggest that this technique has the potential to be a highly sensitive and cost-efficient tool for monitoring aquatic species, even in high-gradient streams.

Pinsky, Malin, *Princeton University*; **Boris Worm**, *Dalhousie University*; **Thomas Frölicher**, *Princeton University*; **Michael Fogarty**, *NOAA Fisheries*; **Simon Levin**, *Princeton University*; **Jorge Sarmiento**, *Princeton University*

Using local climate velocity to guide North American marine conservation planning

Marine conservation strategies worldwide are designed around species distributions and biogeographic patterns, often under the assumption that these patterns are relatively stable. With climate change, however, distributions are shifting as species seek more suitable conditions. There is an urgent need for credible predictions of future species distributions to guide conservation planning. We therefore tested projection methods against four decades of scientific surveys for 360 marine taxa on the continental shelves of North America. We found that much of the variation in species shifts in both latitude and depth could be explained by the rate and direction of local climate velocity. We also found evidence that fishing affected range shifts and that bottom-dwelling taxa lagged behind their thermal niches more than other taxa. Our results suggest that species shift at different rates, and even in different directions, because they are tracking the complex mosaic of local climate velocities. These findings imply that projections of species distributions based on downscaled IPCC-class climate models will be useful tools for evaluating existing conservation plans and for guiding a new generation of climate-ready marine conservation and fisheries management.

Pitt, Amber, *Clemson University*; **Robert Baldwin**, *Clemson University*; **Benjamin Stegenga**, *Clemson University*

Amphibian Movements Suggest Isolated Wetlands Should Be Regulated under the Clean Water Act

Wetland conservation in the U.S. often focuses on distinct aquatic features that fit into particular delineation categories based on geophysical characteristics and plant communities. Federal wetland policy does not protect isolated wetlands, despite their importance for maintaining biodiversity, unless a "significant nexus" with a traditional navigable water body is established. Determination of a significant nexus is currently based largely on surficial hydrological connectivity. However, if biodiversity conservation is to be a major goal of federal wetland policy, biological connectivity requires attention. We used radio-telemetry to track three anuran species to assess biological connectivity of aquatic features in two index landscapes with a variety of water bodies. Anurans moved among isolated wetlands and traditional navigable water bodies, suggesting a significant nexus based on biological connectivity exists among isolated wetlands and traditional navigable water bodies. Our results suggest that a significant nexus can exist among isolated wetlands and traditional navigable water bodies and it may be appropriate to regulate at least some isolated wetlands under the Clean Water Act. The regulation of isolated wetlands under the Clean Water Act may provide a powerful tool for protecting imperiled isolated wetland-dependent species that are not currently protected under policies targeting endangered species (e.g., Endangered Species Act).

Polaina, Ester, *Doñana Biological Station (EBD-CSIC)*; **Eloy Revilla**, *Doñana Biological Station (EBD-CSIC)*; **Manuela Gonzalez-Suarez**, *Doñana Biological Station (EBD-CSIC)*

Which socioeconomic characteristics make a country more susceptible to harbor threatened mammals?

Threats suffered by vertebrate species, including mammals, are predominantly induced by human activity. Although the main immediate causes of decline are habitat modification and direct prosecution, behind every direct threat there are political, economic and social decisions made by humans. The present work aims to clarify how these socioeconomic decisions influence the presence and abundance of threatened mammals at a country scale. We obtained several socioeconomic indicators for every country, grouped into seven categories according to the World Bank: agriculture, population, economy, environment, health, labour and social protection, and private sector. Mammals vulnerability to extinction was assessed using the Red List and distribution maps of the International Union for Conservation of Nature (IUCN) to assigned species to countries. Results from generalized linear models show that the economic (mainly trade of goods and services indicators) and population features of a country (e.g. percentage of urban/rural population) are those that best explain the presence and abundance of threatened mammals within its borders. These

results show the relationship between socioeconomic human decisions and extinction risk at a global scale, and could aid in defining the changes to our lifestyle necessary to preserve the world mammals.

Pompa, Sandra, *Fondo Mexicano Conserv. Naturaleza*

Mesoamerican Reef Conservation: A New Generation of Leaders in the Caribbean

The current loss of biological diversity is one of the most severe global environmental problems. Despite their value, marine ecosystems are rapidly deteriorating; this is partly because roughly 60% of the world's human population lives within 100 km of the coast line, and 20% of ecosystems adjacent to oceans have been highly modified. Because of those anthropogenic environmental changes, many marine species and populations have undergone local, regional, or global extinctions. Given this scenario, the NGO Fondo Mexicano para la Conservación de la Naturaleza (FMCN), The Summit Charitable Foundation, and the Mesoamerican Reef Fund (MAR Fund) partnered to form The Mesoamerican Reef Leadership Program (MAR Leadership), to boost reef conservation by empowering emerging leaders from the four nations of the MAR (Mexico, Belize, Guatemala, and Honduras) with bolstered professional skills to develop innovative and replicable projects to conserve the region's coastal and marine ecosystems as well as improving the livelihoods of local communities that depend on this threatened marine resource. The Program operates via annual "cohorts" of 10-12 Fellows, whose professional endeavors bear a connection to the health and integrity of the coastal-marine environment. Each cohort cycle runs for 18 months and features group training, individually tailored training, seed funding for project design, peer-to-peer learning, mentoring, technical assistance, and other networking opportunities.

Possingham, Hugh, *The University of Queensland*; **Michael Bode**, *The University of Melbourne*; **Carissa Klein**, *The University of Queensland*

Optimal conservation outcomes require both restoration and protection

Conservation outcomes are principally achieved through the protection of intact habitat or the restoration of degraded habitat. Restoration is only recommended where protection is no longer practicable, 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 protection safeguards more biodiversity and generates greater ecosystem services per unit area, conservation lacks a theory that can coherently compare the relative outcomes of protection and restoration. Here, we use a dynamic habitat

model to integrate these two actions into a unified conservation theory. Using nonlinear benefit functions, we show that both protection and restoration are crucial components of a conservation strategy that seeks to optimize either biodiversity conservation, or ecosystem services provision. In contrast to conservation orthodoxy, it can be optimal to begin restoration before all intact habitat is protected, and in some circumstances restoration should take precedence over protection. The relative priority of protection and restoration depends on their costs, and also the relative time-lags inherent in both actions. We use two examples to demonstrate these conclusions: bird conservation in tropical rainforests, and coastal protection from mangrove forests.

Poudel, Abishek, *Department of National Parks and Wildlife Conservation, Nepal*

Human-Tiger Conflict in Chitwan National Park, Nepal

Human-tiger conflicts are serious issues of conflicts between local people and park authority and the conflicting situation potentially play negative role in park management. This study aimed (1) To determine the trend and nature of human-tiger conflicts (2) To understand peoples' perception and mitigation measures towards tiger conservation. Both primary and secondary data were used to determine human-tiger conflicts in Chitwan National Park. Systematic random sampling with 5% intensity was done to collect the perception of the villagers regarding human-tiger conflicts. The study sites were selected based on frequencies of incidences of human attacks and livestock depredation in Rajahar and Ayodhyapuri Village Development committees. The trend of human casualties by tiger has increased in last five year whereas the trend of livestock has decreased. Reportedly, between 2008 and 2012, tigers killed 22 people, injured 10 and killed at least 213 livestock. Conflict was less common in the park and more intense in the sub optimal habitats of Buffer Zone. Goat was the most vulnerable livestock followed by cattle. The livestock grazing and human intrusion into tiger habitat were the major causes of conflicts. Developing local stewardship and support for tiger conservation, livestock insurance, and compensation policy simplification may help reduce human-tiger conflicts.

Pressey, Bob, *James Cook University*; **Paul Ferraro**, *Georgia State University*; **Valerie Kapos**, *United Nations Environment Programme World Conservation Monitoring Centre*; **Georgina Mace**, *University College London*; **Madeleine Bottrill**, *Conservation International*; **Michael Obersteiner**, *International Institute for Applied Systems Analysis*; **Alex Pfaff**, *Duke University*

The mismeasure of conservation

Protected areas are the cornerstones of the global conservation strategy but have a serious failing. They are concentrated in areas that are remote and have least value for subsistence or commercial uses. Therefore, they tend to occur where threats to biodiversity are low while losses of biodiversity continue unabated elsewhere. Importantly, this failing is hidden by common measures of conservation progress that emphasize the number and extent of protected areas rather than how much loss of biodiversity their establishment has avoided. We begin with examples of "residual" systems of protected areas (those dominantly in areas with least need for protection) that fail to live up to their promise of protecting nature. We then identify key characteristics of conservation measures needed to focus attention on avoided loss which is, after all, the real purpose of conservation. We place existing measures and recommended new measures in the context of a results chain that includes inputs, outputs, outcomes, and effects. Current measures focus on outputs (protected areas) but there are tractable methods for measuring effects, or how much difference protected areas make (additionality). The new measures can be applied retrospectively to existing reserves and projected into the future to identify where new protected areas can make the most difference. We conclude by outlining the opportunities for and obstacles to bringing these methods into policy and practice.

Pressey, Bob, *James Cook University*

An attractive but unsupported idea? Moving from case studies to insights into environmental surrogates for conservation planning

Environmental or coarse-filter surrogates are widely used in conservation planning, sometimes as a sole guide to the distribution of biodiversity, but more often as parts of larger, composite data sets. However intuitive their utility might seem, the evidence base for their effectiveness in depicting the distributions of species is inconsistent. Underlying the lack of strong generalisations about the effectiveness of surrogates are important factors that have almost never been standardised in their testing: study region, spatial extent and resolution, types of surrogates, types of species against which surrogates are tested, and the analytical approach for testing. Case studies will continue to emerge demonstrating the effectiveness, or lack of it, of surrogates. But what do these case studies actually mean? Understanding surrogates requires more comprehensive methods in tandem: 1. Review of ecological theory to understand why surrogates should work and what limitations can be expected; 2. Meta-analysis to identify what factors relate to effectiveness; 3. Artificial data sets that can be manipulated to identify aspects of data structure related to effectiveness; 4. Comparison and better understanding of testing methods (covering both pattern-based and selection-based tests), linking each method to one or more explicit questions. These comprehensive approaches offer the only

way of making sense of the hundreds of case studies that tell different, unconnected stories.

Primack, Richard, *Boston University*

Getting Your Article Accepted into a Leading Conservation Journal

In this session, designed especially for graduate students and other young researchers, the Editors of Biological Conservation (BC) and other international journals will provide pointers on how to get papers accepted into conservation journals; and what to do when papers get rejected. Such information is valuable, as the acceptance rate of BC and other journals is below 25% and will likely decline to 20% in coming years. Over 50% of submitted articles are rejected without review, and authors can seek advice from the Editors on the suitability of articles before submitting. In this session, we will discuss ways to make your article more appealing to Editors and a broad scientific audience, including writing a strong cover letter, working with colleagues to improve your article, and writing different types of articles, including Review Articles that have a higher acceptance rate and Perspectives that can include a personal viewpoint. Other strategies include matching your paper to what the journal publishes and making sure the work is substantial enough for publication. Issues to be discussed include having a good experimental design, improving the writing and organization, demonstrating relevance to management, and the need to place the work in a broad context in the introduction and discussion. On rare occasions an author may be successful in changing an editorial decision, but typically a paper rejected from one journal is revised and submitted to another journal.

Prugh, Laura, *University of Alaska Fairbanks*; **Stephen Arthur**, *Alaska Department of Fish and Game*

Wolves as shepherds: Optimal predator management for mountain sheep conservation depends on the strength of mesopredator release

Despite a long history of persecution, top predators such as wolves and mountain lions are making a comeback in North America, fueling heated clashes among scientists, policy makers, and the public about how to best manage these species. Successful conservation in these changing landscapes therefore requires a robust understanding of the ecological, social, and economic consequences of predator presence. We used empirical data and a stage-structured stochastic population model to examine the effect of wolf removal on Dall's sheep populations, considering both negative effects of wolf predation on sheep and indirect positive effects of wolf suppression of coyotes. Coyotes, wolves, and Dall's sheep ewes and lambs were radiocollared in the Alaska Range from

1998-2004 to determine survival rates and causes of mortality. Wolves were the main predators of adult Dall's sheep, coyotes were the main predators of lambs, and wolves were the main source of mortality for coyotes. In the absence of coyotes, the model predicted that wolf removal would cause a stable sheep population to grow by 3% per year. In the presence of coyotes, however, the model predicted that wolf removal would cause the sheep population to decline by 4% per year. These results highlight the importance of considering the response of mesopredators to large predator management, because accounting for their response can alter the predicted impact of management actions on sensitive prey populations.

Quinn, Samuel, *The Farm at Sunnyside*

Growing Food and Biodiversity: Integrating Conservation and Agriculture in Northern Virginia

Given the multitude of studies on the agriculture/conservation relationship, the next step toward encouraging widespread application of this research is to create the framework for integrating conservation practices into a farm business strategy. The Farm at Sunnyside, an organic fruit and vegetable farm in Rappahannock County, VA, is exploring this new model of agriculture in which conservation is an explicit part of the food production system. In 2010 the farm created the position of "conservation manager," a full-time biologist who works alongside farm staff to guide conservation initiatives such as inventorying biodiversity, monitoring ecological health, enhancing habitat for native species and quantifying interactions between agricultural and natural areas of the farm. The conservation manager directly contributes to the farm business by providing the expertise with which to maximize benefits from ecosystem services while acting as a first responder to address challenges such as pests and invasive plants. The program generates revenue through the sale of "wild products" like forest fruits and wildflowers from restoration areas, simultaneously promoting the value of native species while helping to recuperate the costs of restoration work. By relating our methodology for developing, applying and funding a farm conservation program we will make the case that agriculture can strongly benefit both ecologically and economically from a conservation perspective.

Raghunathan, Nima, *University of Liege*; **Louis François**, *University of Liege*; **Alain Hambuckers**, *University of Liege*

Modelling climate change impacts on key tree species used by lion tamarins in the Brazilian Atlantic Forest

We used 3 IPCC climate change scenarios (A1B, A2, B1) in a dynamic vegetation model (CARAIB), to determine the potential future distribution of biomes and 75 species of trees

used as food sources or sleeping sites by endemic primates, the golden lion tamarin (*Leontopithecus rosalia*) and the golden-headed lion tamarin (*L. chrysomelas*), in the Brazilian Atlantic Forest (BAF). Habitat conservation is a vital part of strategies to protect endangered species, and this is an approach to understand how key plant species needed for faunal survival might be affected by climate change and what changes to their distribution are likely. CARAIB computes the main physiological reaction of plants, e.g. water absorption or photosynthesis, as a response to temperature, precipitation, or CO₂ partial pressure. The model accurately predicted the current distribution of BAF vegetation types and for 66% of the individual tree species with 70% agreement obtained for presence. In the simulation experiments for the future, 72 out of 75 tree species maintained more than 95% of the original distribution and all species showed a range expansion. The results suggested that the trees may benefit from an increase in temperature, if and only if soil water availability is not altered significantly, as was the case with climate simulations that were used. However, the results must be coupled with current and planned land-uses to maximise the usefulness to conservation, as the BAF is subject to many threats.

Rakotobe, Domoina, *American Museum of Natural History*; **Ony Rabearivololona**, *Durrell Wildlife Conservation Trust*; **Tiana Rahagalala**, *Wildlife Conservation Society*; **Solofo Ralaimihoatra**, *Conservation International*; **Kimberley Landrigan**, *American Museum of Natural History*

Towards an Integrated Approach to Conservation: Lessons learned from a National Capacity Building Project in Madagascar

Due to its hotspot status, Madagascar has become the operating field of numerous conservation projects and practitioners. Among these efforts, the Network of Conservation Educators and Practitioners-Madagascar (NCEP-MD) was among the first to endeavor to de-compartmentalize disciplines, institutions, visions and methods. NCEP-MD aims to improve professional conservation capacity within the country through increasing access to high-quality teaching resources and training opportunities, and fostering collaboration beyond traditional frameworks. Since its inception in 2003, NCEP-MD has striven to implement an integrated approach to biodiversity conservation through the development and dissemination of trans-disciplinary training modules, trainings events for multi-level and multi-disciplinary academic and professional audiences, and the organization of exchange platforms for NCEP-MD network members. This presentation focuses on lessons learned during the past ten years. Project evaluations show that NCEP-MD has contributed to significant increases in conservation knowledge and opportunities for collaboration among conservation educators and practitioners in Madagascar. However, improvements in individual or

institutional performances were difficult to measure. Therefore, in 2011, NCEP-MD began developing certification programs that assess individual performance and reinforce shared responsibilities between public institutions, conservation NGOs, training centers and communities.

Ramp, Daniel, *University of Technology, Sydney*

Bringing Compassion to the Ethical Dilemma in Killing Kangaroos for Conservation

Conservation biologists seek to conserve and protect biodiversity but face considerable challenges because prevailing land-use practices are at odds with biodiversity conservation. Solutions are needed to redress the imbalance and practitioners employ a wide range of strategies to mitigate the effects of the many challenges faced. Problematically, environmental decision-making is not devoid of human interests, and strategies are commonly employed that suit entrenched positions and commercial gain, rather than valuing the needs of the non-human animals intended to be protected. We explore this by discussing the killing of kangaroos for conservation in Australia using the principles of 'Compassionate Conservation'. Ethical debate on the killing of kangaroos has polarised conservation and welfare scientists, yet the unifying aim of reducing harm to non-human animals of both conservation and animal welfare provides an opportunity to redefine the debate. Here we use a compassionate framework to explore restoration activities employing the principles of conservation through sustainable use within the heavily degraded rangelands of Australia. We contrast the dominant paradigm of consumptive use versus the more compassionate approach of eco-tourism. In doing so, we highlight some of the frailties in the arguments and suggest a way forward for conservation in Australia's rangelands.

Randrianandrasana, Maminirina, *University of Illinois*; **May Berenbaum**, *University of Illinois*; **Mamy Ratsimbazafy**, *SEPALI*

Eating insects for forest conservation in Madagascar

Madagascar is known for its rich natural biodiversity although its status as a hotspot is threatened by human activities. Integrated conservation approaches have been implemented in the past, such as earning money through unconventional sericulture involving rearing *Antherina suraka* (Saturniidae), near riparian forests for commercial silk production. In our study, we investigated the feasibility of adding another alternative income stream from sericulture by utilization of the pupae for human consumption. As entomophagy has been a common practice since ancient times, we set out to confirm whether insects remain a constituent of contemporary diets and whether new species could be

incorporated in the diet. We designed a survey of local people in potential or current sites of sericulture located near endangered forests of Madagascar comprising interviews of households and collections of edible insects. Evaluating preferences for particular species and willingness to try new ones, especially *A. suraka* pupae, was our chief objectives. Varieties of insects are known to be consumed by local people. Consuming the pupae of *A. suraka* would not be too great a cultural challenge as a new food in view of the fact that the same life stage in other Lepidoptera has been consumed before. This study may potentially contribute to more widespread adoption of sericulture of native species, increasing the economic value of local biodiversity and reducing overexploitation of forests in Madagascar.

Rasser, Michael, *Bureau of Ocean Energy Management*

Applied Science for Management of Marine Offshore Energy Resources

The United States Outer Continental Shelf (OCS) consists of approximately 1.7 billion offshore ocean acres. Compared to coastal areas, relatively less scientific data is available on the distribution, abundance and diversity of marine organisms in the offshore marine environment. The Bureau of Ocean Energy Management's Environmental Studies Program (ESP) develops, conducts and oversees science designed to inform policy decisions for managing offshore energy and mineral resources on the OCS. Specific examples of applied research conducted by the ESP will be discussed, including projects focused on investigating arctic fish community ecology, mapping deep water corals, and determining the abundance and distribution of birds with high resolution aerial imagery. These examples will illustrate how the ESP is using the latest remote sensing technology and other advanced methods to collect and analyze scientific information over large areas of OCS in a cost effective manner. Results from studies such as these are continually enhancing the quality of resource management and stewardship decisions for the vast offshore environment.

Ratnayake, Chaminda, *Field Ornithology Group of Sri Lanka, Department of Zoology, University of Colombo*; **Sarath Kotagama**, *Field Ornithology Group of Sri Lanka, Department of Zoology, University of Colombo*

Does forest dieback in montane cloud forests impact the endangered Sri Lanka Whistling Thrush *Myophonus blighi*?

Cloud forests in Sri Lanka are being rapidly degraded due to forest dieback (FDB). A climate-driven factor such as accumulation of toxic heavy metals in soils on wind slopes has been identified as the major reason for the observed FDB. Yet, very limited knowledge exists on how FDB affects

endemic forest-dwelling birds in Sri Lanka. This study aimed to monitor habitat occupancy of the endangered Sri Lanka Whistling-Thrush (SLWT) in Horton Plains National Park (HPNP) where severe FDB has been observed. We used three different FDB levels - low, moderate and heavy dieback and estimated the probability of occupancy of SLWT. A total of 48 line transects (100m) stratified according to the FDB level were used in four 1km² plots. Call play back was used to detect the elusive SLWT to maximize detection probability. Single-season occupancy modelling in PRESENCE software was used to estimate the probability of occupancy in different FDB gradients and the habitat occupancy of SLWT in HPNP was predicted by using the maximum entropy method (MAXENT software) and a habitat suitability map constructed. We found no difference in probability of occupancy of SLWT between FDB gradients. The constructed habitat suitability map for HPNP will contribute to developing a conservation management plan for SLWT in protected areas of Sri Lanka.

Ray, Justina, *Wildlife Conservation Soc. Canada*

Defining Recovery Under Canada's Species At Risk Act: De-listing Or More?

The interplay of scientific information and value-based information and decision-making under Canada's Species at Risk Act (SARA) requires careful, transparent distinctions between scientific and non-scientific considerations. Intended to guide the recovery — not simply the survival — of listed Threatened or Endangered species, a recovery strategy must be a scientific document and include recovery targets for that species across its entire Canadian distribution. These are meant to provide a scientifically defensible baseline to enable informed and transparent political decisions that follow about when, whether, and how to attain it. The absence of a statutory definition of “recovery” under SARA, however, requires reliance on interpretations of the legislation for guidance as to intent, as well as on scientific understanding of what is necessary to secure the long-term conservation of species. In this context, it is important to consider: 1) the legal and policy context for the definition of recovery objectives under SARA; 2) the scientific foundation for defining the necessary attributes for recovery; and 3) examples of how these concepts apply to various species. Although it might appear logical to declare a species recovered once it qualifies for down-listing or de-listing (an already ambitious target), this would shift the aim from providing for long-term persistence across a species' geographic range towards minimizing extinction risk.

Read, John, *Ecological Horizons*; **Katherine Moseby**, *Tetepare Descendants' Association*; **Chris Filardi**, *American*

The last wild island: Vital partnerships for sustainable conservation outcomes in Melanesia.

An innovative, decade-long partnership between landowners, NGO's and scientists has successfully mitigated pressure to log Tetepare Island, the largest uninhabited island in the South Pacific and one of the last remaining unlogged islands in the Solomon Islands. Three key factors underpin this partnership's success: 1) a well organized local landowner association that supports protection; 2) a conservation agreement that buttresses this support by providing tangible benefits in exchange for continued conservation performance, and 3) the high conservation value of the area protected compelling long-term international funding. Project rangers, staffed by the local community association, manage the largest marine and terrestrial protected area in the Solomon Islands, and have measured significant recovery of key resources (e.g., fish, trochus and coconut crabs). Hunting at nest-sites of critically endangered leatherback turtles has ceased and secondary threats (e.g., sea level rise, monitor predation) are being adaptively managed. In exchange for their support, community members receive employment, scholarships and sustainable livelihoods in lieu of short-term benefits from logging. The Tetepare model has been successfully duplicated at other biologically significant Melanesian locations. With continued enthusiasm of their support network, the project has left Tetepare's owners well-equipped to navigate an uncertain future with ever-increasing social and economic pressures.

Reed, J. Michael, *Tufts University*; **Robert McCarthy**, *Cummings School of Veterinary Medicine, Tufts University*; **Stephen Levine**, *Tufts University*

Feral cat population control: more effective when reproductive hormones remain intact

Feral cats are a significant factor in the mortality of birds and other small animals, they can be a public nuisance, and can spread disease. The American Veterinary Medical Association strongly encourages and supports actions to eliminate the problem of feral cats. Management of feral cat populations by trap, neuter, and release (TNR) has gained popularity in recent years. TNR as presently employed, however, is insignificant to the overall problem and is largely viewed as ineffective. In fact, TNR increases survival of neutered animals, and kitten survival increases as adults are neutered. As a collaborative effort (ecologist, veterinarian, systems modeler) we created an individual-based simulation model to predict the effectiveness of TNR, lethal control (LC), and trap-vasectomy/hysterectomy-release (TVHR) in decreasing feral cat population size. TVHR outperformed TNR and LC at all annual capture probabilities from 10% and 90%. TNR was counterproductive, generating population size increases

compared to no intervention at all. Unless over 57% of cats are trapped and sterilized annually by TNR or removed by LC there is minimal effect on population size. In contrast, with an annual capture rate of $\leq 35\%$, TVHR causes population size to decline. An annual capture rate of 57% eliminated

Reid, Frederic, *Ducks Unlimited*

Wetland linkages-surprising connections across continents and the globe

The importance of wetlands for water filtration, flood control, carbon storage, and as drivers of ecosystem productivity are well known and at the forefront of reasons why conservation of wetlands is given a priority in much of the world. Less well known are some of the global and continental linkages that showcase the need for an expansive view of the shared responsibilities among nations for stewardship of wetland habitats. For example, the vast freshwater flow of boreal rivers into northern seas drives northern marine ecosystem productivity from which much of the human population of the world derives its protein. The same freshwater flow also powers global ocean currents that determine continental weather patterns and in turn agricultural outputs of nations. Another interesting global linkage has recently become better understood—that of the millions of birds that move annually from boreal wetlands where they breed to wetlands across the globe where they spend the winter. Bar-tailed Godwits breed in western Alaska and Siberia and winter in Australia and New Zealand. They have historically been hunted by the Yupiks in the north and the Moari in the south. Sea ducks that breed in the Northwest Territories make their way to coastal wetland complexes in the U.S. like San Francisco Bay and Chesapeake Bay for the winter. Billions of birds that nest in North America's boreal region in winter become integrated into wetland natural communities across the Americas, some as far south as southern South America.

Ressurreição, Adriana, *Centre of IMAR of the University of the Azores*; **Alexandra Simas**, *Azores Sea Observatory (OMA)*; **Ricardo Santos**, *Centre of IMAR of the University of the Azores*; **Filipe Porteiro**, *Centre of IMAR of the University of the Azores*

Resident and expert opinions on marine related issues: implications for the ecosystem approach

Marine management is never an exclusively science-based endeavour. Putting the concept of ecosystem-based management (EBM) into practice requires building up a collective vision for Europe's regional seas where the values and views of different groups of stakeholders are identified and integrated. To date, such integration is lacking and Europe's marine policy is mostly driven by scientific and technical advice with little input from citizens and stakeholders. Here we report an overview of people's perceptions and views regarding marine environmental issues, where the opinions of the general population and a group of marine experts were analysed and compared. Results based on 735 face-to-face interviews conducted in the Azores archipelago (north-eastern mid-Atlantic) showed significant differences among experts and public opinion regarding drivers of change, marine pressures and management priorities. The survey also showed that the public was poorly informed about marine protected areas and eco-labelling schemes. Taken together these results build upon the widely held perception that there is a gap between what is known among the scientific community and what the public know and understand about the marine environment, and emphasise the importance of involving the public, scientists and other stakeholders in all stages of the marine management process.

Richards, Agnes, *Environment Canada*; **Cheryl-Ann Johnson**, *Environment Canada*; **Kathy Lindsay**, *Environment Canada*; **Cathy Nielsen**, *Environment Canada*; **Marlene Doyle**, *Environment Canada*; **George Arhonditsis**, *University of Toronto*

Using Spatially-Explicit Modelling to Examine the Effects of Threats and Mitigation Measures for Peary Caribou Populations in the Canadian High Arctic

Peary caribou, a species at risk listed as both threatened and endangered, is distributed throughout the Canadian Arctic Archipelago. Overall, populations have declined by approximately 72% since the 1980s and by 85% since the 1960s. The exception is the Boothia Peninsula population, which has increased by about 10%. Peary caribou optimize habitat use by moving around and between islands and these inter- and intra-island movements play a critical role in their survival. Our goal is to examine the feasibility of using a spatially-explicit population model to examine the effects of potential threats and mitigation measures. We will also incorporate Aboriginal Traditional Knowledge into these models by applying Bayesian methods. Threats, such as availability of winter forage, effects of climate change (e.g., sea-ice dynamics), human disturbance, and wolf predation will be examined. Mitigation measures, such as captive rearing will also be examined. Preliminary results of

population growth rates under various scenarios that include both threats and mitigation measures will be discussed.

Richardson, Kate, *Massey University*; **John Ewen**, *Zoological Society of London*; **Isabel Castro**, *Massey University*; **Doug Armstrong**, *Massey University*

Addressing the challenges of monitoring at community reintroduction projects: the case of hihi at Maungatautari Ecological Island

Reintroductions of endangered species are increasingly being led by community groups as part of local conservation projects. Although these initiatives have many potential benefits, they present new challenges for obtaining the post-release monitoring data needed for ongoing conservation management. We review the post-release monitoring techniques developed for the reintroduction of an endangered New Zealand forest bird, the hihi (*Notiomystis cincta*), to New Zealand's largest community conservation project, Maungatautari Ecological Island. This large (3400 ha) predator-fenced reserve presented new monitoring challenges due to its size, terrain and dense forest. 135 hihi were released at the reserve in four translocations between 2009 and 2011, and subsequent information on the fate of the population has been gathered through a combination of field and genetic research, and trialling of survey techniques using contractors, researchers, field staff and volunteers. The combination of these methodologies has enabled comprehensive information to be gathered to provide estimates of population size and growth, information on the occurrence of disease, and data on dispersal patterns in an establishing reintroduced population. We aim to establish long-term monitoring programmes at the site that continue to integrate science and communities, and provide conservation benefits for this endangered species.

Ries, Leslie, *National Socio-environmental Synthesis Center*; **Karen Oberhauser**, *University of Minnesota*

A citizen army for conservation: quantifying participatory research on monarch butterflies and its impacts on science, conservation, and behavior

Public participation in scientific research has been going on for decades and even centuries in some places. Recently there has been an explosion of interest as increasingly engaged citizens are eager to document their interactions with nature at the same time that conservation scientists are demanding real-time biological data at massive scales. While most programs focus on adult sightings, monarch scientists have pioneered engaging "super-volunteers" to collect more process-based data, such as tracking migration, juvenile development, and disease. We surveyed all monarch volunteer programs that collected data in 2011, quantified the amount

of time volunteers invested in collecting data for each project, and integrated these values, stratified by spatial location (at a 1 degree resolution) and stage of the monarch's annual cycle. Volunteers spent an estimated 86,000 hours in the field collecting data on monarchs in 2011; this is the equivalent of 40 full-time, year-round field workers. The majority of this time (70%) was spent on monitoring the fall migration, especially in the north central and eastern regions of North America. We also present a monitoring "gap analysis" that can be used to target future volunteer recruitment. Finally, we show that monitoring is leading to a more engaged citizenry, through volunteers who are participating in conservation and education activities and even presenting scientific results of their own research at national meetings.

Rioja-Nieto, Rodolfo, *UA-Sisal, Facultad de Ciencias, Universidad Nacional Autonoma de Mexico*; **Erick Barrera-Falcon**, *UA-Sisal, Facultad de Ciencias, Universidad Nacional Autonoma de Mexico*; **Gustavo Hinojosa-Arango**, *Centro para la Biodiversidad Marina y la Conservacion, A.C.*; **Rafael Riosmena-Rodriguez**, *Universidad Autonoma de Baja California Sur*

Benthic Habitat β -diversity Modelling and Landscape Metrics for the Selection of Priority Conservation Areas Using a Systematic Approach

Social, political and economic needs, particularly in developing countries, make the establishment, design and management of Marine Protected Areas (MPAs) difficult. In this study, we aim to assist the management of three coastal regions in Mexico, by proposing priority conservation areas (PCAs), based on β -diversity modelling and landscape metrics. Quantitative estimates on the percentage of cover of benthic substrates from ground truthed sites were used to perform a cluster analysis with the Bray-Curtis similarity index to identify main habitat types. In general, habitats were characterized by an inter-mix of sand, seagrass, macroalgae, rhodolith, and rock substrates. Thematic maps of benthic habitats were produced utilizing a supervised classification with the maximum likelihood rule on natural color mosaics of high resolution satellite scenes (overall accuracy >80 %, Kappa > 0.69). Scripts written in Matlab were then used to calculate β -diversity values based on the nature and distribution of habitats. A weighted overlay analysis considering habitat type, patch compactness (area/perimeter²) and β -diversity was performed to identify PCAs. About 20 % of the shallow benthic landscape of each region is proposed to be considered within a MPA scheme. By selecting sites with these landscape characteristics we are using a systematic approach to protect the natural processes responsible for maintaining diversity and the livelihoods of the local communities.

Robalino, Juan A., *Universidad de Costa Rica*

Explaining variation in forest spillovers and welfare effects of protected areas

Land conservation policies can significantly affect deforestation rates and economic well-being in surrounding areas. We try to explain the sign and the magnitude of these effects in Costa Rica. First, we empirically examine how parks affect deforestation rates in nearby areas. We find, without distinguishing roads and tourism presence, insignificant net effects on deforestation. However, these results are averages of treatment effects across space. When we explore in greater spatial detail, we find large increases in deforestation rates (around 9%) near roads in areas less affected by tourism (far from park's entrances). Second, we explore parks' effects on wages as a measure of well-being. The effects on wages in nearby areas also vary according to the presence of tourism. Wages close to parks are higher only for people living near tourist entrances. Workers close to entrances are not only employed in better paid activities but also receive higher wages for these activities.

Roberts, Callum, *University of York, England*

Large Fully Protected Marine Reserves: The Best Tool for Sustaining Ocean Ecosystems?

Fully protected marine reserves are areas completely off limits to fishing and other extractive uses. In the last half century, hundreds of reserves have been established in coastal settings where they have proven to be powerful tools for rebuilding depleted populations, restoring biodiversity and recovering habitats. Previously exploited populations frequently increase by 2-5 times following 5-10 years of protection, while habitats typically take decades to rebuild. The great majority of fully protected marine reserves established to date have been small, usually less than a few square kilometres. While a few very large reserves have been created, such as that in the British Indian Ocean Territory (Chagos), their effects remain virtually untested at very large scales and in oceanic rather than coastal habitats. This talk will explore the implications of these differences for the likely future conservation performance of large marine reserves.

Rodriguez, Claudia, *Dartmouth College*

When the policy tool fails: Explaining Land Use Change in Protected Areas

Land use change is one of the major threats faced by protected areas. Based on in depth interviews with 55 protected area managers from 17 countries in the Americas this paper systematically analyzes the influence of demographic, economic, institutional, governance and policy factors on land use change. The findings indicate that land

use change in protected areas is critically driven by the lack of policy integration between environmental, development and social agencies. Protected areas often swim against the current as other governmental agencies invest resources and provide incentives to the neighboring communities that increase land use change. The findings also indicate that land use change can be reduced through the development of sustainable livelihood projects by protected areas. Surprisingly, economic welfare of neighboring communities does not play a significant role explaining land use change.

Rodriguez-Clark, Kathryn, *Instituto Venezolano de Investigaciones Cientificas*; **Ada Sanchez-Mercado**, *Instituto Venezolano de Investigaciones Cientificas*; **Jose Ferrer-Paris**, *Instituto Venezolano de Investigaciones Cientificas*; **Shaenandhoa Garcia-Rangel**, *Universidad Simón Bolívar*; **Edgard Yerena**, *Universidad Simon Bolivar*; **Bruce Robertson**, *Bard College*

A novel combination of habitat and threat models can reveal potential ecological traps

Ecological traps can threaten the persistence of affected populations, so techniques to predict and map potential traps are needed. However, existing methods provide no estimate of spatial uncertainty. Here we present a novel method for visualizing potential ecological traps and their uncertainty at large scales in a natural landscape, and demonstrate its application using presence data for Andean bears (*Tremarctos ornatus*, Ursidae) in the Cordillera de Mérida, Venezuela. We applied a partitioning procedure to generate partially independent datasets, and used them to fit maximum likelihood models of the probability of occupancy. These were combined with an existing model of hunting risk to predict potential trap location and uncertainty. The best habitat suitability model predicted high suitability in the center and in northern parts of Cordillera de Mérida, as expected from expert opinion. However, more than a third of suitable area had a high potential trap index, and was next to or within the largest national parks. Conservation actions for Andean bears may be planned more effectively following field confirmation of trap predictions. Managers should avoid increasing connectivity between trap and safe habitat, and focus targeted education and law enforcement in confirmed trap habitat. Our approach will be useful in other species for identifying possible ecological traps created by hunting and other human activities at the landscape level

Rohlf, Dan, *Lewis and Clark University*

The Evolution Of US Policy On Endangered Species Recovery Since Passage Of The ESA

When enacting the Endangered Species Act in 1973, Congress emphasized recovery of species facing extinction as

the statute's primary purpose. In the statute's early years, lawmakers emphasized this goal by amending the statute to require preparation of recovery plans, allow for public participation in plan development, and require that recovery plans set forth both site-specific recovery measures and "objective, measureable criteria" to define when a species has recovered. Implementing recovery plans has faced many obstacles, however, including delays in plan preparation, funding shortfalls for recovery actions, and determinations that the measures set forth in recovery plans are merely discretionary even for federal agencies. Other challenging questions about recovery arise as the ESA enters its fifth decade, such as whether species dependent on human intervention in some facet of their life cycle can be termed recovered, and how to deal with uncertainties caused by climate change. Finally, a 2012 court decision giving federal agencies broad discretion to delist species as recovered regardless of whether the species has attained the criteria set forth in its recovery plan raises anew the fundamental question of when it means to "recover" imperiled species.

Roman, Joe, *Gund Institute Ecological Economics*

Applying ecosystem service valuation tools to environmental policy and decision-making

There is a critical need to link our understanding of ecosystem-service flows to policies that ensure their sustainable delivery. Ecosystem accounting provides one method for organizing and integrating information about how humans and nature interact. Such a framework can detail the interactions of a specific ecosystem, characterizing ecosystem-service flows, evaluating tradeoffs, and comparing projected outcomes of alternative management strategies. Ecosystem accounting models, such as the Multiscale Integrated Model of Ecosystem Services (MIMES) and InVEST, can be made spatially explicit and dynamic to account for variations in time, space, and decision-making. Although these models tend to be limited in their ability to directly inform stakeholders--since running them requires a high level of technical know-how and software requirements--new user interfaces have been designed to overcome this hurdle and allow stakeholders to explore various scenarios. Several case studies will be discussed, including the evaluation of tradeoffs for the Massachusetts Ocean Plan and efforts to revise economic analyses of critical habitat under the U.S. Endangered Species Act and other assessments required for most agency regulations by the White House Office of Management and Budget. Although these tools are still in development, their analyses are vastly preferable to overlooking ecosystem-service information when making policy decisions, which risks assigning a zero value to all services.

Romero, Jorge Alvarez, *ARC COE for Coral Reef Studies*

Marine conservation planning in practice: lessons learned from the Gulf of California

Overfishing, pollution, coastal development and climate change threaten marine biodiversity globally and compromise the services that marine ecosystems provide. Systematic conservation planning (SCP) provides a framework to identify areas where actions can be effective in addressing these threats, while minimizing the costs of interventions. We investigated the application of SCP in the Gulf of California, a marine hotspot where seven spatial prioritization exercises have been undertaken. We found that the use of SCP methods has progressed slowly (gaps include planning for land-sea connections and ecosystem services) and highlighted benefits and difficulties of undertaking SCP. According to experts, the implementation of new marine protected areas (MPAs) in the region has been influenced by some of the planning exercises. However, uptake of planning outputs has progressed slowly due to multiple factors (e.g., conflicting mandates and interests between organizations, limited technical capacities and resources, insufficient political commitment). Apart from MPAs, other benefits included: developing institutional skills and knowledge; improving collaboration and coordination between organizations; converging on the need to assess priorities for marine conservation in regional context; and building trust among organizations. The existence of multiple marine conservation plans in the region highlighted some of the complexities and benefits of having multiple sets of priorities.

Rose, Eli, *North Carolina Cooperative Fish and Wildlife Research Unit, NCSU*; **Theodore Simons**, *US Geological Survey, North Carolina Cooperative Fish and Wildlife Research Unit*

Using remotely sensed fire severity indices to predict bird distributions in southern Appalachian forests; an occupancy modeling approach

Prescribed fire is increasingly used to reduce fuel loads and improve conditions for wildlife. Nevertheless, landscape scale fire effects are often highly variable and difficult to quantify. Recent advances in the application of remotely sensed information are providing new tools for assessing habitat changes associated with fire. We illustrate the application of several fire severity metrics to models of avian distribution and abundance. We develop occupancy models for six avian species using habitat and burn severity co-variables and avian point count data collected in Great Smoky Mountains National Park during May and June 2012. Three species are associated with early succession habitats and three associated with late succession habitats. Overstory cover, difference Normalized Burn Ratios, and field derived fire severity metrics were consistently found among top models. Our results suggest that remotely sensed fire severity metrics can

be a useful predictor of occupancy probability for five of the six species modeled.

Rose, Naomi, *Humane Society of the US*

Human Dimensions in Marine Mammal Science

It should be a truth universally acknowledged that many problems in conservation have little to do with science but rather with human perceptions, opinions and values. In the case of marine mammals, some communities may value them as food, whereas in others they are valued as cultural icons. Public sentiment can run very high, whether marine mammals are considered competitors for fish, or species that must be protected at all costs, regardless of what science might show. In many, but not all, developed countries, marine mammals (especially cetaceans) occupy a special place in the public psyche and numerous studies have shown an elevated concern for marine mammal conservation, regardless of their actual conservation status. For example, one U.K. study found that 40% of the public would view more favorably, and more likely vote for, a politician who proposed a law specifically for the protection of cetaceans. In the past, such public opinion led to the passage of laws such as the 1972 US Marine Mammal Protection Act. Conservation interventions involving marine mammals that approach situations from a purely scientific standpoint, without considering the human dimension, are almost certainly doomed to failure; for example, the current stalemate at the International Whaling Commission and the failure of conservation attempts related to endangered marine mammals such as the Yangtze River dolphin.

Rosson, James, *USDA Forest Service; Southern Research Station*; **Anita Rose**, *USDA Forest Service; Southern Research Station*

Mortality Impact of the Hemlock Woolly Adelgid in the Great Smoky Mountains National Park

The hemlock woolly adelgid (*Adelges tsugae* Annand) (HWA) is native to Japan and China and was first discovered in North America in British Columbia in the 1920's. The Park Service discovered HWA near Fontana Dam in 2002 and since then it has spread throughout the Great Smoky Mountains National Park (GSMNP), killing many hemlocks and leaving a devastating visual impact to park visitors. We used landscape-level data from the USDA Forest Service, Forest Inventory and Analysis (FIA) program to statistically assess the impact of the HWA and describe the current status of *Tsuga canadensis* (L.) Carr. in the GSMNP. Individual *T. canadensis* trees ≥ 12.7 cm in dbh were tracked on sample units systematically located across the GSMNP and measured between 1998 and 2011. For all species, there were 2,892 dead and live trees ≥ 12.7 cm dbh measured on 83, 0.674 ha

sample units; 304 of these were *T. canadensis* spread across 50 of the sample units. The mortality rate of *T. canadensis* for the period, between 1998 and 2011, was 26 percent, the highest of any tree in the park. Of all dead trees in the park, 16.9 percent were *T. canadensis* followed by *Picea rubens* Sarg. at 11.6 percent. For live trees, as of 2011, *T. canadensis* ranked second behind *Acer rubrum* L. in the total tree population but ranked eighth in trees ≥ 20.0 cm dbh. The continued loss of this keystone species in the GSMNP will provide an open niche for other species and dramatically alter forest structure and communities.

Roth, Robin, *York University*; **Brian Thom**, *University of Victoria*

Idle No More: Best Practices and Lessons Learned from Indigenous Conservation Partnerships in Canada

It is necessary to build successful conservation partnerships with indigenous communities and yet concrete examples of how to do so from the perspective of indigenous peoples are difficult to encounter. This paper recounts the findings from a research project that focused on the best practices and lessons learned from indigenous conservation partnerships in Canada. We present the key findings from our detailed conversations with community leaders and practitioners who have built and worked within successful partnerships. Our findings point to essential elements, from the legal context of partnership arrangements, to strategies for incorporating indigenous knowledge and cultural practice, to the values embodied within interpersonal relationships while navigating these complex matters. The results are hopeful and demonstrate that meaningful conservation partnerships with indigenous communities are possible. And they are timely, as indigenous movements around the world, such as Idle No More in Canada, have renewed a debate about the recognition of aboriginal and treaty rights, the role of indigenous peoples environmental decision-making and governance, and the importance of partnerships between indigenous and settler communities. These questions have been central to the on-going collaborations between indigenous peoples and their conservation partners. The paper contributes to a renewed practice that can respond to the demands of indigenous peoples that we be idle no more.

Russell, Gareth, *New Jersey Institute of Technology*; **Joseph Wilder**, *Rutgers University*

An underwater, camera-based, automatic identification system for coral reef fish: a prototype of a continuous monitoring network for reef populations

Coral reefs around the world are in decline, but monitoring reef communities is costly and time-consuming. We developed an underwater camera system that can identify

coral reef fish to species as they swim past. The system was deployed in a large aquarium with a simulated Caribbean reef environment, and captured image sequences that, over a two-month period, included 16 species. A tracking algorithm located individual swimming fish, which were segmented from the frame. Basic shape statistics were used to select the 'best' (most side-on) images from an individual sequence, and a number of shape, color and texture features were extracted. These were then classified via trained neural nets organized in a hierarchical manner to progressively eliminate errors. Using independent testing sets, each of the eight 'common' species (accounting for 93% of the observations) were correctly identified at least 95% of the time. (The rarer species were lumped as 'unknown,' with their images being stored for later identification by hand.) A system like this could provide a network of reef census stations operating many hours a day. The output would have high statistical power for detecting changes in reef fish populations, providing an early warning system for reef impacts. It would also improve in accuracy and scope as the database of images grew. While our prototype system proved the principle, it was not fully ocean-worthy. The remaining challenges are largely those of marine engineering.

Russell, Diane, *USAID*

Evidence and evaluation in conservation program design: USAID's experience

The US Agency for International Development is a major investor in international conservation with over two decades of programming experience. This paper describes how USAID has employed evaluation findings and other data to inform design of new programs. Examples include evaluations of the Global Conservation Program, the Central African Regional Program on the Environment and the Liberia Land Rights and Community Forestry Program as well as evidence from applied research and "stocktaking," international fora, and partner consultations. Evaluation and evidence-based programming has growing prominence within the Agency. As such, the Forestry and Biodiversity Office launched a new program "Measuring Impact" (MI) that links improvements in and insights from evaluation, monitoring, and adaptive management to program design. MI is working with USAID/Washington and several USAID Missions on specific evaluations, including an innovative two-stage impact evaluation of its flagship program Sustainable Conservation Approaches in Priority Landscapes (SCAPES). This work bolsters the evidence base for USAID's emerging Biodiversity Policy, which emphasizes the role of biodiversity conservation in development outcomes. Challenges include ma 楫柿攢窠 數据凶耗 活戩澳櫛獲瑩°數瑣牯湴糙楮柿哇 瀕漠桴舫 狹挽瀆獲愠擎瑣啟撓 活汰砒瑩°景槩彌梲畴湯汚氧糙 浚湏凶湏愠撓 活汰砒數散璞懶裼毆 湏潦淙瓏湏 癩舫潭

概揚愠敲据囡崎活湮振 9118枚茱卡污 □118救獾鉏獮梯畴
整穿 澈瑜囡流妨振篲 118浹概敬孺槩 澈瑜囡流妨振搦挠
榻愁整猓愁滢滢僅湮湮囡潦囡異吐振氧馮嶽 ○刁榮愀換氈
攀痧痧 愀赫攀愀痧 漫氈愀礪

Ryder, Ollie, *San Diego Zoo Institute*

Preserving the last individuals of a species: Advances in methods to culture amphibian tissues for cryobanking

The IUCN Amphibian Conservation Action Plan calls for bioresource banking efforts for viable gametes and somatic cells of amphibian taxa, ideally as a distributed network of centers. Such a resource would facilitate research in systematics, disease risk factors and their management, as well as development and application of advanced reproductive technologies. With support from the U.S. Institute of Museum and Library Services, we have undertaken efforts to initiate, culture and freeze somatic cells from amphibians, with an emphasis on endangered taxa. Although amphibian tissues have historically proven more challenging to culture than other vertebrates, cell lines from six species have been successfully established and frozen, and methodological improvements in establishing amphibian cell cultures identified. Initial cell growth was achieved for >300 samples; 29 cell lines were successfully frozen, including the critically endangered *Rana sevosia*. These efforts more than tripled the prior number of reported amphibian cell lines. It is especially critical to establish and cryopreserve cell lines from amphibian species that might not be available in the future. The cell cultures can be expanded to generate large quantities of DNA/RNA, and could potentially be used for future somatic cell nuclear transfer or generating induced pluripotent embryonic stem cells. For species at the brink of extinction, access to banked viable cells may afford options for genetic rescue of critically small populations.

Salafsky, Nick, *Foundations of Success*; **Matt Deniston**, *Sitka Technology Group*; **Brian Knowles**, *Sitka Technology Group*; **Dan Salzer**, *The Nature Conservancy*

Scaling-Up Adaptive Management from Individual Projects to Aggregate Programs

Conservation practitioners have a long history of using adaptive management principles and tools, such as those contained in the Open Standards for the Practice of Conservation, to design, manage, monitor, and learn from specific site-based and thematic projects. There is now growing interest in scaling these principles and tools to apply to "parent programs" composed of multiple "sibling projects" - for example, a network of sites managed by an organization, or a portfolio of grants funded by an agency or foundation. In this talk, we share recent experiences in program-level

adaptive management, drawing on examples of developing a donor's funding strategy for the Galapagos Archipelago, performance measures for US State and Federal Fish and Wildlife Agencies, and a new cloud-based information system to manage and share conservation actions and projects. As with most scaling efforts, taking adaptive management from projects to programs is not a simple linear transformation. Key lessons include the need to 1) adjust planning, monitoring, and analysis units to a larger scale, 2) invest in developing standard lexicons, templates and information technology tools that ensure that projects are designed and monitored in a comparable fashion, and 3) ensure that adaptive management takes place in the context of regular program business practices. If done appropriately, program level adaptive management can improve cross-project learning and ultimately, the practice of conservation.

Sandin, Stuart, *Scripps Institute of Oceanography*; **Les Kauffman**, *Boston University*

Can the Coral Health Index (CHI) support Pacific Ocean reef conservation and management?

Sawaya, Michael, *Sinopah Wildlife Research Associates*; **Steven Kalinowski**, *Montana State University*; **Anthony Clevenger**, *Western Transportation Institute*

Genetic Connectivity at Wildlife Crossing Structures in Banff National Park.

Roads fragment and isolate wildlife populations which will eventually decrease genetic diversity within populations. Wildlife crossing structures may counteract these impacts by maintaining or restoring gene flow, but most crossings are relatively new, and there is little evidence that they facilitate gene flow. We conducted a three-year research project in Banff National Park, Alberta, to evaluate genetic connectivity at wildlife crossings. Our main objective was to determine how the Trans-Canada Highway and the crossing structures along it affect gene flow and population structure in grizzly (*Ursus arctos*) and black bears (*Ursus americanus*). We compared genetic data generated from wildlife crossings with data collected from greater populations using noninvasive genetic sampling. We detected a genetic discontinuity across the highway in grizzly bears but not in black bears. Grizzly bears detected at crossings assigned to populations north and south of the highway, providing evidence of bidirectional gene flow and genetic admixture at wildlife crossings. Genetic parentage tests showed that 47% of black bears and 27% of grizzly bears that used crossings were successful breeders. Differentiating between dispersal and gene flow is difficult, but we documented gene flow at wildlife crossings by showing a migration event followed by successful reproduction and genetic admixture. We conclude wildlife

crossing structures allow sufficient gene flow to prevent genetic isolation.

Saxon, Earl, *Forest Inform Partners*

Participatory Land Use Planning for Conservation, Livelihoods, Infrastructure and Agro-industrial Development in Southeastern Myanmar

Land use conflicts in southeastern Myanmar threaten Asia's largest block of contiguous lowland Dipterocarp forest. Some are due to a disconnect between legal and customary land tenure, others to decades-long conflict and still others to ad hoc and informal allocation of land. However, Myanmar does not have decades to resolve these issues if it is to protect biodiversity, modernize agriculture, provide for resettlement and anticipate impacts of climate change. The 1997 conservation plan proposed a system of protected areas spanning a tropical forest belt that runs for 600 km along the Myanmar-Thailand border. In the north, the Tanintharyi Nature Reserve, declared in 2002, has funding, staff and a management plan. In the south, the Tanintharyi National Park, declared in 2005, is a "paper park" and the proposed site of a major hydro-electric dam. The unprotected central sector is the proposed location for road, rail, powerline and pipeline corridors connecting Southeast Asia with the Andaman Sea at Dawei. In 2013 Tanintharyi Division's government convened a stakeholder workshop. Participants reviewed lessons learned from previous infrastructure and agro-industrial development. They used maps and satellite change imagery to identify plausible land use scenarios for the areas at risk. Their scenarios range from high-risk strategies that could ignite social conflict to strategies that buffer natural areas and protect forests and rivers on which community livelihoods depend.

Schaefer, Jame, *Marquette University*

Advancing the Collaboration of Religious and Conservation Biology Communities

Alarm over the accelerated rate of species extinction, degradation of ecological systems, and threats to the biosphere has prompted scholars and leaders of the world religions to dig deeply into their traditions and practices for ways of responding. They have discovered both treasures to retrieve and apply from their own faith perspectives and expressions of their faiths that may have lost their original meaning and/or need updating informed by contemporary scientific findings. Among the treasures found are compassion for living beings and the merits of relieving their suffering. Among the expressions of faith that need updating is the release of animals for the merit accrued by the individual who engages in this practice. Conservation biologists and religious communities should collaborate on this and other mutual

issues to advance biological diversity, the sustainability of Earth, and more responsible and authentic expression of religious faith.

Schloss, Carrie, *University of Washington*

Are we already conserving the stage? A land facet gap analysis for 14 ecoregions in the western USA

As species shift their ranges in response to climate change, communities will be reshuffled to form new associations. Such changes provide a challenge to the process of conservation planning, which has typically focused on protecting current patterns of biodiversity. One strategy for protecting biodiversity in a changing climate is based on the idea of protecting the diversity of abiotic conditions that influence patterns of biodiversity. Abiotic features, such as soil, topography, and geology, largely determine the distribution of biodiversity, but will remain stable in a changing climate. By protecting unique combinations of abiotic diversity, or land facets, it may be possible to protect areas that will foster a diversity of biota currently and in the future —although these will likely be different sets of species. It is not clear to what extent land facets are already represented in current protected areas or in biodiversity-based conservation plans. Here, we designate land facets across 14 ecoregions in the western United States. We assess the extent to which land facets are already protected and identify the types of land facets that are underrepresented in current protected areas. We found that land facet representation varied across ecoregions and was proportional to the land area designated for protection. Individual land facet representation

汚瘠瘠牡敦匠涸愨散4械数凶敲愨睬紫凶概煥備整涇
耀轟敲鼓璪揚愨擎漠桴物凶敲氣牡敲涇愨猶湫4耗涸潑
涪整瓊揚愨敲 敲暉牯獫 19盼晦璫 119啟璪枋映牯鈺
璪枋慮梯湯汚穉癮氣睡睡 D 吁敵刪汰凶景匠楣湫敵槩
涸整潑瓊湫慮 敵慧 措梯湯漠 汎浩瓊凶桃馮敲馱 aTh

Schroeder, Lori, *University of Alberta*; **Fiona Schmiegelow**, *University of Alberta*; **Edward Bork**, *University of Alberta*; **Tom Jung**, *Environment Yukon*

Rare Species in Relict Grasslands: Plant diversity responses to a reintroduced Wood Bison herd in Yukon, Canada

Wood Bison were reintroduced into the southwest Yukon in the late 1980s as part of national recovery efforts. The Yukon population has subsequently increased from 34 to more than 1,100 animals, prompting concerns that bison may compete with other ungulates in the area, and alter pocket grasslands within the boreal forest (relicts of ice age steppe) that contain rare, endemic plant species. The Yukon Wood Bison

Technical Team, which is composed of government, First Nations and co-management body representatives, has identified grasslands as focal points for vegetation monitoring in the Wood Bison Management Plan (2012). In order to quantify the impact of bison on grassland composition and diversity, bison location (GPS) data, fecal samples, orthophotos, existing plant inventory data and consultation with Champagne and Aishihik First Nations were used. After surveying vegetation cover at 70 sites representing different levels of bison usage, preliminary results indicate that both richness and Shannon's Diversity Index increase with the level of bison use, and that forbs are the driver of that change. Two new populations of the endangered Yukon Draba (*Draba yukonensis*) were also discovered. These results will inform ongoing management decisions and land use planning processes within the herd range and provide important information on an understudied and rare plant community believed to be analogous to Beringian Steppe communities.

Schultz, Courtney, *Colorado State University*; **Thomas Sisk**, *Northern Arizona University*; **Barry Noon**, *Colorado State University*; **Martin Nie**, *University of Montana*

Wildlife Conservation Planning Under the United States Forest Service's 2012 Planning Rule

In 2012, the U.S. Forest Service promulgated new planning regulations under the National Forest Management Act. These regulations represent the most significant change in federal forest policy in decades and have sweeping implications for wildlife. This presentation provides a history of wildlife provisions in the planning rules and then discusses the 2012 rule. The new rule is of concern because of its discretionary nature and the inconsistency between its intent and operational requirements. We recommend that the USFS make commitments to directly monitor populations of species of conservation concern and focal species and to maintain the viability of both categories of species. If the USFS determines that the planning unit is not inherently capable of maintaining viable populations of a species, this finding should be made available for scientific review and public comment, and the USFS should commit to doing nothing that would further impair the viability of such species. Where extrinsic factors decrease species viability, the USFS has an increased responsibility to protect those species. Monitoring plans must include trigger points, and plans must include provisions to ensure monitoring takes place. Enforceable provisions will help to prevent additional listings under the Endangered Species Act. Although the 2012 rule gives cause for concern, forward-thinking USFS officials have the opportunity to create a robust and effective framework for wildlife conservation planning.

Schuttler, Stephanie, *University of Missouri*; **Jessica Philbrick**, *University of Missouri*; **Alden Whittaker**, *Wildlife Conservation Society*; **Kathryn Jeffery**, *Agence Nationale des Parcs Nationaux*; **Lori Eggert**, *University of Missouri*

Social networking in African forest elephants: Hidden associations, but disconnected population

African forest elephants (*Loxodonta cyclotis*) are of immediate conservation concern because poaching for ivory has decimated populations. This species is the least understood of the extant elephants as they are cryptic in forest habitats. Fission-fusion sociality has been detected in Asian and African savanna elephants, and for the latter species, has importance for fitness. We investigated if forest elephants have kin-based fission-fusion sociality. Individuals were observed in savanna clearings within forests of Lopé National Park, Gabon in 2006, 2008, and 2010. We recorded associations between identified individuals and where possible, collected dung for genetic analyses. Using adult female associations, we created network models for years, seasons, re-sighted females, and for all adult females. We identified 118 adult females and collected dung samples from 40 individuals. Networks were characterized by low densities, disconnected components, short average path lengths, and high clustering coefficients. The average relatedness of adult females within a component was 0.093 ± 0.071 and components typically consisted of the same mitochondrial haplotype. One very large component consisted of 22 adult females, although there were few preferred associations (12.3%). There was no indication of differences between seasons or years. Our results offer some support for fission-fusion sociality in forest elephants, however it appears to differ in structure from the other species.

Segan, Daniel, *Wildlife Conservation Society*

Aligning local management with national conservation priorities in the assessment of high conservation value forest areas

The concept of a High Conservation Value (HCV) forest emerged over 15 years ago within forestry management and has been used as a tool for individual land owners/concessionaires to identify and protect attributes of outstanding conservation value. The delineation of HCV areas gained momentum within the industry and nineteen countries have produced guidance documents on the process for identifying HCV areas. This has typically been a bottom-up process, where companies have used their own data to define conservation priorities in the absence of agreed national conservation priorities or planning frameworks. With increasing progress at the national level in systematically identifying conservation objectives and priority areas to achieve those objectives, there is now a critical need to integrate this work with industry led initiatives like HCV. Concession level HCV analysis must compliment national

conservation priorities and the areas identified and values managed for at the concession level must collectively achieve the national conservation objectives. WCS is currently working with an operator at a forestry concession near Mayumba in Southern Gabon to trial a framework for integrating national level priorities into the identification of concession level HCV areas. This talk will explore WCS' experience working with industry to integrate information and priorities identified from national level conservation assessment into site scale HCV assessments and management recommendations.

Selier, Sarah-Anne, *School of Life Sciences, University of Kwa-Zulu Natal*; **Rob Slotow**, *School of Life Sciences, University of Kwa-Zulu Natal*; **Bruce Page**, *School of Life Sciences, University of Kwa-Zulu Natal*; **Enrico Di Minin**, *Finnish Centre of Excellence in Metapopulation Biology, University of Helsinki*

Understanding elephant distribution in a human-dominated transfrontier landscape

Understanding factors that affect the persistence of charismatic megafauna in human-dominated landscapes is strategic to inform conservation decision-making and reduce conflict. In this study, we assessed the effect of environmental and anthropogenic factors on the distribution of elephants (*Loxodonta africana*) in the Greater Mapungubwe Trans Frontier Conservation Area in Southern Africa. We combined aerial counts over a 12 year period with 10 variables on food availability and landscape and anthropogenic variables in a logistic regression. Models were run for the entire landscape, as well as smaller management units with different land-use practices, such as ecotourism, trophy hunting, and a combination of hunting and photographic tourism. The results of all models showed that human activities, such as human population density, the use of electric fences, and hunting, negatively affected the distribution of elephants. The provisioning of water was also found to be an important variable affecting elephant distribution. When planning transboundary conservation areas and corridors in human-dominated landscapes it is important to take anthropogenic factors and their effect on the movements and distribution of megafauna into consideration. Particularly where countries with diverging management strategies are involved.

Sentman, Wayne, *Harvard University Extension School*; **A. E. Vo**, *University of California - Berkeley*; **Myra Finkelstein**, *University of California - Santa Cruz*; **Scott Edwards**, *Harvard University*; **Heidi Auman**, *University of Tasmania, Hobart, Tasmania, Australia*; **Michael Bank**, *University of Massachusetts - Amherst*

Pollution Canary - Albatross as Sentinels of Marine Pollution

Mercury and plastic pollution levels in the Pacific Ocean are considered to be increasing with high levels of mercury, lead, and plastic documented in North Pacific albatross species. Our group has shown that changes in methylmercury levels, in Black-Footed Albatross (BFAL) have increased as predicted from anthropogenic mercury emissions using museum specimens spanning the past 130 years. At the local scale, lead paint exposure from buildings on their breeding ground affected the population viability of Laysan albatross (LAAL), suggesting albatross are threatened by heavy metal exposure at both local (lead) and global scales (mercury). Plastic pollution in the oceans accumulates in zones of high density or "gyres". Our pilot study indicates that plastic can leach potentially toxic concentrations of metals (e.g., lead, zinc). Since the BFAL and LAAL feed at the top of the marine food chain, range across the Pacific, and feed along the gyres of plastic pollution, they are ideal sentinel species for marine pollution. Therefore, we propose that North Pacific albatross are an effective marine flagship species and understanding their exposure risks will support broader biodiversity conservation across the North Pacific.

Sexton, Joseph, *Global Land Cover Facility*; **Xiao-Peng Song**, *Global Land Cover Facility*; **Praveen Noojipady**, *Global Land Cover Facility*; **Anupam Anand**, *Global Land Cover Facility*; **Chengquan Huang**, *Global Land Cover Facility*; **Min Feng**, *Global Land Cover Facility*; **Saurabh Channan**, *Global Land Cover Facility*; **Do-Hyung Kim**, *Global Land Cover Facility*; **Danxia Song**, *Global Land Cover Facility*

A global, 30-m resolution tree cover dataset: consistency with the MODIS Vegetation Continuous Fields and accuracy relative to lidar measurements

Geospatial datasets representing Earth's tree cover are crucial for detecting forest gains, losses, and degradation. We generated a global, 30-m percent tree cover dataset using circa-2000 and -2005 Landsat images and the MODerate-resolution Imaging Spectroradiometer (MODIS) Cropland Probability and Vegetation Continuous Fields (VCF) Tree Cover layers. Our estimates maintain fidelity to the MODIS VCF (RMSE = 9% in 2000 and 12% in 2005) but improve accuracy in agricultural areas and discrimination of small clearings. Compared against lidar measurements in multiple biomes, the Landsat-based estimates exhibit accuracy equivalent to that of the MODIS VCF (RMSE = 17% for both MODIS- and Landsat-based estimates), but RMSE of Landsat estimates relative to lidar measurements is 3% percentage points lower than that of the MODIS data in a mixed forest-agricultural region. Saturation of the MODIS VCF at $\geq 80\%$ tree cover is retained in the Landsat estimates, but the Landsat data show greater potential for removal of errors through calibration to lidar, with post-calibration

RMSE of 9% compared to 14% in MODIS estimates. With 30-m spatial resolution and improved accuracy in agricultural regions, the 2000 and 2005 Landsat-based tree cover dataset is the highest-resolution multi-temporal depiction of Earth's tree cover available to the conservation community. The data and associated quality layers are provided for free download at the Global Land Cover Facility website (www.landcover.org).

Sharma, Ghanashyam, *The Mountain Institute India*

Impact of Climate Change on Conservation of Globally Significant Biodiversity Elements of Sikkim Trans-Himalaya in the Eastern Himalayas, India

A study of impact of climate change on the critical wildlife habitats was carried out through extensive biodiversity surveys, participatory community consultation and socio-economic assessments covering 2000 sq km in the Alpine/Trans-Himalaya (2500–6000 m) of Sikkim in the Eastern Himalayas. Rotational pastoralism of nomadic Dokpas, stocking density, and indigenous resources management pattern were assessed. Of the total 85 locations assessed, 80% had high stocking density of domestic yak and sheep resulting into overgrazing competition with wild ungulates. With the impact of globalization, ecological resilience and socio-cultural systems of the region suffer from unbalanced economic exploitation such as hydropower projects, unregulated tourism, and illegal collection/trade of species. Pronounced impact of climate change resulted into species migration, emergence of new diseases in domestic/wild ungulates, resource degradation and reduction of grazing regime due to low productivity. Further, habitat fragmentation, lowering of habitat ranges, population decline and vulnerability were also recorded. Thus, habitats of the last surviving species of the region such as Snow Leopard, Blue Sheep, Himalayan Tahr, Tibetan Argali, Southern Kiang, Tibetan Gazelle, Eurasian Lynx, Red/Tibetan Fox, Tibetan Wolf etc. are rapidly degrading. This globally significant biodiversity hotspot in the Khangchendzonga complex needs sustainable transboundary cooperation and conservation strategies.

Shattuck, Elizabeth, *Armed Forces DNA Identification Lab*;
David Foran,

Determining the Geographic Origin of Illegally Harvested Hawksbill Sea Turtle Products

Shen, Xiaoli, *Smithsonian Conservation Biology Institute*;
Norman Bourg, *Smithsonian Conservation Biology Institute*;
William McShea, *Smithsonian Conservation Biology Institute*;
Benjamin Turner, *Smithsonian Tropical Research Institute*

Effects of white-tailed deer on the invasion of exotic plants in a mid-Atlantic temperate forest

The forest ecosystem in eastern North America has experienced dual impacts from exotic plant invasion and chronic high herbivore density, yet the interaction between these factors is not well understood. We examined the impact of white-tailed deer (*Odocoileus virginianus*) on the abundance of four exotic (*Rosa multiflora*, *Berberis thunbergii*, *Rubus phoenicolasius* and *Microstegium vimineum*) and a native (*Cynoglossum virginianum*, known to be deer-dispersed) plant species, within a 25.6-ha mature temperate forest plot in Virginia, USA. A 4-ha 30-year-old fenced subplot was paired with a 4-ha control subplot within the plot. In each 400-m² quadrat, we measured each species' abundance and determined 11 environmental and stand variables. For each species, we constructed a conditional inference tree using the quadrats outside the two subplots to identify significant predictors for their abundance, and then constructed a second tree using the relevant significant variables from the two subplots and presence/absence of deer to examine the role of deer on their abundance. We found lower abundance of *C. virginianum*, *B. thunbergii*, *R. phoenicolasius* and *M. vimineum* but higher abundance of *R. multiflora* in the fenced subplot. Our results indicate chronic high densities of deer increased plant abundance for several exotic species with notable exceptions to *R. multiflora* possibly because lower diversity and abundance of avian community indirectly induced by deer limited its seed dispersal.

Sheridan, Michael, *Middlebury College*

Sacred groves and conservation in African farming societies: A Tanzanian case study

Shiffman, David, *University of Miami*

Using Twitter as a Tool for Conservation Education and Outreach from Scientific Conferences

If more conservation-minded citizens were aware of certain environmental threats and how to resolve them, these issues could be resolved more effectively. Scientific conferences focusing on conservation (like the ICCB) bring together countless experts on environmental problems and solutions, but are not an effective means of reaching the interested public on a large scale. If used properly, social media technology such as twitter can be a powerful tool for science and conservation outreach from conferences. This presentation will discuss using twitter to share important information from scientific conferences with the interested public around the world in real time. It will explain general principles of twitter for science and conservation outreach,

and will include a case study from the 2011 ICCB in Auckland, New Zealand.

Shoemaker, Kevin, *Stony Brook University*; **Resit Akcakaya**, *Stony Brook University*; **Michelle Verant**, *USGS National Wildlife Health Center*; **Philip Miller**, *IUCN-SSC Conservation Breeding Specialist Group*; **Damien Fordham**, *University of Adelaide*; **Robert Lacy**, *Chicago Zoological Society*; **Travis Livieri**, *Prairie Wildlife Research*; **Barry Brook**, *University of Adelaide*

Modeling the recovery of the endangered black-footed ferret in a linked predator-prey-disease system

Since the black-footed ferret (*Mustela nigripes*) was declared extinct in the wild in 1987, several populations have been reestablished from captive stock. In recent decades, outbreaks of sylvatic plague have threatened to undermine ferret recovery efforts by depleting the ferret's obligate prey base (i.e., prairie dogs). In a novel "meta-modeling" approach to population viability analysis, we linked a plague epidemiological model, a prairie dog metapopulation model, and a ferret population model to investigate ferret extinction risk in plague-affected landscapes. Based on results from 500 simulated landscapes with variable metapopulation size, growth rates, and connectivity, we found that ferret populations were most likely to persist within large prairie dog metapopulations (>150 distinct colonies) with low connectivity or permeability to plague. In addition, we detected an emergent cyclic pattern of plague outbreaks that resulted in oscillatory dynamics in prairie dog populations and thereby affected the stability of ferret populations. Using the Conata basin in South Dakota as a real-world case study (the site of a successful and rigorously monitored ferret reintroduction program), we found that black-footed ferrets were unlikely to persist unless either (1) ferrets could access a network of prairie dog colonies beyond the spatial scope of the current population or (2) permeability to plague was reduced via management.

Shriver, Greg, *University of Delaware*; **Chris Elphick**, *University of Connecticut*; **Brian Olsen**, *University of Maine*; **Tom Hodgman**, *Maine Department of Inland Fish and Wildlife*

The Conservation of Tidal Marsh Birds: Guiding action at the intersection of our changing land and seascapes

The total area of tidal marsh is estimated to be

Shwartz, Assaf, *Natural History Museum*

Virtual Garden: a novel tool exploring which elements of biodiversity people want in cities

Urban ecology is emerging as an integrative science that explores cities, biodiversity and people. Stimulating interdisciplinary research requires the creation of new tools that allows the investigation of people-biodiversity relation. While it has been established that access to green spaces or nature could benefit city-dwellers, the role of species diversity per se remains poorly studied. I developed a user-friendly 3D freeware (Virtual Garden www2.mnhn.fr/cersp/spip.php?rubrique173) that allows people to design their own public/private greenspaces and enables researchers to explore which elements of biodiversity people want, while accounting for other functions that people value in urban greenspaces. In 2011, 732 participants designed their ideal small public garden using Virtual Garden. An average garden contained 5 animals, 8 flowers and 5 woody species. While the distribution of flower and woody species richness appears to be similar to what would be expected by random choice, 30% of people did not place any animal species in their garden and people preferred charismatic animals avoiding non-native species. My result further highlight that the diversity of species placed in the garden was related to the nature people experience in their daily lives. Virtual Garden offers a standardized tool that allows exploring people-biodiversity relation in different environments, cultures and countries, but also an applied tool to consider people's opinions in urban planning.

Siders, Zachary, *Grand Manan Whale and Seabird Research Station*; **Heather Koopman**, *University of North Carolina Wilmington*; **Andrew Westgate**, *University of North Carolina Wilmington*; **David Johnston**, *Duke University*; **Laurie Murison**, *Grand Manan Whale and Seabird Research Station*

Seasonal variation in the spatial distribution of basking sharks (*Cetorhinus maximus*) in the Bay of Fundy, Canada: implications for vessel collisions

Basking sharks in Atlantic Canada are listed as a species of Special Concern because little is known about their true conservation status. The Bay of Fundy (BOF) attracts basking sharks between May and December due to high densities of diapausing copepod prey, but concurrently exposes sharks to high levels of vessel traffic. We developed a maximum entropy distribution model using 10 years of boat-based basking shark sightings, collected in the BOF to describe seasonal spatial variation in habitat use and habitat-vessel traffic overlap. Distance to the 200 m contour, sea surface temperature, and chlorophyll a concentration were the most determinant variables in our model. From June to September, suitable habitat was confined to waters >100 m and from October to December a shift to waters >200 m occurred. Predicted habitat and the International Maritime Organization BOF vessel traffic pattern overlapped, ranging from 9.93 % in August to 20 % in October-December. With

>1000 vessels using these traffic lanes during shark residency, a significant potential for vessel collisions with basking sharks exists. Over 800 hours of time-depth recorder data revealed that basking sharks in the BoF spent on average 24 % of their time between 0-15 m. Given the spatial overlap with ship traffic, diving patterns and low reproductive capacity of the species, collisions likely pose a significant detriment to basking shark recovery.

Sifleet, Samantha, *Environmental Consultant and Contractor to the US EPA*; **Anne Neale**, *US EPA*; **Lisa Wainger**, *University of Maryland Center for Environmental Science*; **Megan Mehaffey**, *US EPA*

Measuring ecosystem rarity to target conservation efforts

Conservation of biodiversity remains a high priority for maintaining many ecosystem functions, and conservation efforts often focus on protecting vulnerable species. Species population measurements may not be suitable for evaluating the collective benefits and services that emerge from entire ecosystems, particularly those that do not contain rare or charismatic species. Here we combine currently available land cover data with ecosystem taxonomy and landscape ecology principles to evaluate the relative rarity of natural ecosystems in the continental US. Our goal was to develop a measure of ecosystem rarity that can distinguish ecosystems with intrinsically limited extents consistent with historic conditions (i.e. riparian or bog systems) from those that have limited area due to land conversion. We present a relative rarity metric that ranks ecosystems based on current extent, spatial pattern type, and relative uniqueness. This metric shows promise when compared to more complex and expensive methods. The majority (57%) of the area covered by 'rare' ecosystems we identify in the continental US fall within the boundaries of the Nature Conservancy's Conservation Priority Areas, whereas only 28% of our 'rare' ecosystems are currently held in protected status. The ecosystem rarity index we developed captures both fine scale species diversity as well as regional ecosystem services. This type of metric can support efforts such as creating an ecosystem Red List.

Silver, Sue, *Frontiers in Ecology and the Enviro*

Journal expectations and peer review: an editor's perspective

Citizen science (CS) has been around for a long time, but the validity and reliability of CS data has been questioned by some scientists. To be fully accepted as a valid method for the collection of large-scale datasets, research papers based on CS projects need to appear regularly in mainstream scientific journals. This means finding suitable journals to publish CS-based work and then running the gauntlet of Editors and peer

reviewers, some of whom may still cling to outdated visions of questionable data, collected by enthusiastic amateurs with no understanding of scientific processes. New techniques and technologies have long since taken CS out of that realm, but the question remains: where to publish CS papers and what extra challenges might they face?

Skandrani, Zina, *Museum National d'Histoire Naturelle*; **Anne-Caroline Prévot-Julliard**, *Museum National d'Histoire Naturelle*

INSIGHTS ON HUMAN-ANIMAL RELATIONSHIPS THROUGH THE LENS OF PROBLEM ANIMALS: THE PIGEON CASE

In this paper we consider rethinking human-animal relationships essential for conservation issues. We penetrated these relationships through an analysis and deconstruction of animal social representations and categorizations/statute attribution. We relied for this on the cultural history of cohabitation between humans and pigeons, from domestic to feral forms, tracing and contextualizing the evolution of values attributed to the birds. As a result of our procedure and leaning on social representations theory, which conceptualizes identity as a location within representations, we highlight issues of human identity construction at stake in human-animal relations. We invite to rethink the impact of such human self-definition on environmental stances, as it could constrain further developments or improvements of conservation perspectives.

Smith, Jordan, *NC State University*

The Effects of Affiliation-Based Influence and Shared Information Sources on Rare and Little Known Species Conservation Behaviors

Little is known about how social network structure influences individual-level outcomes such as attitudes and behaviors; even less is known about the functions of network ties across scales of social organization. This research addresses the question of how cross-scale interactions within social systems lead to human behaviors that have direct ramifications for natural systems. Specifically, we examine the effects of affiliation-based influence and shared information sources (cross-scale ties), as well as species-specific attitudes, on individuals' behavioral intentions toward a threatened salamander located in the Midwestern United States. The analysis suggests the influence of species-specific attitudes on behavioral intentions is not dependent upon information and ideas that are exchanged in formalized membership organizations. However, the analysis also reveals that for some behaviors the influence of species-specific attitudes is dependent upon the types of information sources that individuals utilize. The presence of multiple cross-scale

information source linkages appears to be related to more 'socially-acceptable' behaviors such as putting the animal back in the river if it were encountered. The investigation illustrates that social and information networks function and interact at multiple scales; it also highlights how the structural characteristics of social and information networks affect human behavior and conservation outcomes.

Smith, Sarah, *Environmental Defense Fund*; **Jake Kritzer**, *Environmental Defense Fund*

Integrating ecological and social objectives in fisheries management: Fishermen's perceptions of closed area costs and benefits in New England

Closed areas are a spatial management tool used to accomplish a variety of biological and ecological objectives for fisheries, including protecting benthic habitat, reducing fishing mortality, protecting spawning activity, and rebuilding fish stocks. The use of closed areas as a fisheries management tool can have a number of intended or unintended social outcomes as well, including either creating or mitigating gear conflicts and changing where and how fishermen fish. The New England Fishery Management Council is evaluating the region's existing closed areas and designating new closures. We use interviews with industry members along with press coverage and public testimony to analyze fishermen's perceptions of the costs and benefits of groundfish closed areas in New England, including both ecological and socio-economic outcomes. Results highlight a diversity of perspectives within the industry on the objectives and outcomes of closed areas, and we examine how these perceptions differ among different fishing ports, gear types, and vessel sizes. We also describe area-specific proposals originated by the fishing industry, and how these have been included in the process of redesigning the closed area network. We argue that developing an understanding of these costs and benefits and how they are differentially experienced by fishermen is essential for integrating social and ecological objectives of closed areas and for optimizing management outcomes.

Soanes, Kylie, *University of Melbourne*; **Melissa Carmody Lobo**, *University of Melbourne*; **Peter Vesik**, *University of Melbourne*; **Michael McCarthy**, *University of Melbourne*; **Rodney van der Ree**, *Australian Research Centre for Urban Ecology*

From use to effectiveness: how well do crossing structures mitigate the impacts of roads on wildlife?

Millions of dollars are spent on wildlife crossing structures to mitigate the negative impacts of roads on animal populations. However their success is largely unknown due to a lack of research on population impacts. We use before-after-control-

impact (BACI) population monitoring to evaluate the effectiveness of crossing structures for the squirrel glider (*Petaurus norfolcensis*), a threatened arboreal mammal, along a highway in south-east Australia. Remote-sensing cameras, personal integrated transponder (PIT) scanners and BACI radio-tracking were used to determine the impacts of mitigation on squirrel glider movement. Mark-recapture surveys were conducted BACI to determine how survival rates changed as a result of mitigation. Crossing structures re-established squirrel glider movement across the freeway. Multiple individuals crossed regularly, suggesting resident animals use the structures for home range access. However, movement was only partially mitigated relative to control (non-freeway) sites. Previous research found the survival rate of squirrel glider populations at freeway sites was 60% lower than at control sites. Analysis of post-mitigation data is currently underway, and will reveal if survival rates have improved as a result of mitigation. This research will be used to determine if these structures are successful, or if additional management actions are required to preserve squirrel glider populations.

Soltanoff, Carrie, *NOAA, NMFS Office of International Affairs*, former *WWF*; **Helen Fox**, *WWF*

Global marine conservation priorities: Patterns in marine protected area development across nations

Similar to terrestrial protected areas, marine protected area (MPA) number and spatial extent varies among countries, habitats, and over time. Despite the Convention on Biological Diversity's commitment to the target of "at least 10% of each of the world's marine and coastal ecological regions effectively conserved by 2020," MPA coverage lags behind that of terrestrial areas. The relative paucity and heterogeneous distribution of MPAs indicates the need for better understanding of factors that foster MPA establishment at local, sub-national, and national levels. Assessment of the relationship between national-level MPA establishment and geographic, ecological, social, and political factors revealed that a country's coastline length, the Human Development Index (HDI), and spatial overlap with designated conservation priority areas are positively correlated with MPA establishment. These national dynamics explain a relatively small proportion of variation, however, indicating that other biological or social factors, as well as sub-national processes, also influence MPA establishment. One local-level social factor may be the existence of shifting environmental baselines among populations of fishermen. Understanding the particulars that catalyzed MPA establishment for "leaders" can highlight policies and practices that may merit replication elsewhere. Ensuring a supportive enabling environment at the national or even multi-national level can enhance success at the local level.

Souto, Tamia, *Smithsonian Conservation Biology Institute*;
Cecilia Núñez, *Smithsonian Conservation Biology Institute*;
Jessica Deichmann, *Smithsonian Conservation Biology Institute*; **Alfonso Alonso**, *Smithsonian Conservation Biology Institute*

Indigenous territories, industry, and science: finding common grounds to establish conservation projects

There is high overlap of oil and gas concessions with indigenous territories of great biodiversity in the Peruvian rainforest. It is therefore a goal to find common interests among indigenous peoples, biologists and corporations to develop sound conservation projects that improve peoples' livelihoods. We attest that conservation projects will have a higher chance of success if communities are empowered through active participation and are involved in the decision making process from the start. Equally important is that projects have a solid design, where assumptions can be systematically tested to achieve the desired goals. We present our work with two indigenous communities in the Lower Urubamba River, Peru where we applied a series of steps that embraced different types of knowledge to select and develop conservation projects that answered people's needs and considered all stakeholders accordingly. We conducted participatory workshops and surveys, and used the results to develop seven project ideas that incorporated local solutions to environmental problems. These were then prioritized by all stakeholders using a viability ranking system based on 11 criteria. Two projects were selected for full development in an Adaptive Management workshop where indigenous peoples, corporate partners and local scientists participated to develop the full proposals. This process demonstrates that even in highly contested situations, common ground can be achieved under the right conditions.

Spear, Stephen, *Project Orianna*

Using environmental DNA methods to improve detectability and assess reproduction in Eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*) monitoring programs

Eastern hellbenders (*Cryptobranchus alleganiensis alleganiensis*) are among the most threatened of North American salamanders, and thus monitoring populations is a priority for managers. Hellbenders are completely aquatic, and surveys require both intensive effort and can disturb important microhabitats. Many populations do not appear to be reproducing successfully despite continued presence of long-lived older adults. We developed a quantitative PCR protocol to amplify hellbender environmental DNA (eDNA) from river samples to 1) test for presence of hellbenders, 2) evaluate if eDNA quantification can test relative abundance, and 3) determine if eDNA amounts increase during the

breeding season. We filtered water samples at over 100 sites across Tennessee and North Carolina from May to October 2011-12. We successfully detected hellbender eDNA at all sites with current survey observations and also identified hellbenders at sites where survey efforts were not successful. Total estimates of eDNA in a 1L sample ranged from 0.012 ng to 8.19 ng, with an average of 0.5 ng. Estimates were not uniform across season, as we saw a consistent increase in the amount of eDNA in the fall breeding season relative to spring and summer samples, with increases as great as a hundredfold. This suggests that not only is the fall an optimal time for hellbender eDNA monitoring, but also highlights the promise of this tool to identify reproductive populations.

Springer, Jenny, *World Wildlife Fund*

Scaling Up Community Conservation and Natural Resource Management

Globally, significant areas for conservation are the traditional lands of indigenous peoples and local communities who depend upon forests, fisheries, wildlife and farming for their livelihoods and cultures. These local women and men are key actors in conservation and natural resource management, for the stewardship roles they have often played historically, and as the people on whom future sustainability depends. Community-based conservation and resource management have been part of conservation strategies for many years but are gaining increased attention. Reasons include increasing formal recognition by governments of community rights to significant lands and resources, a growing body of scientific research documenting the efficacy of community-based management of natural resources, and growing awareness of significant threats to the environment of indigenous and community lands. While experience from some countries demonstrates that community-based management can contribute significantly to large-scale conservation and rural development goals, too often the geographical scale of community conservation and natural resource management remain limited. This paper will present results from recent field experience and analysis on integrated approaches to scaling up community conservation and natural resource management, including key elements of effective CBC/NRM, strategies for scaling up and holistic approaches to community conservation across mosaics of land uses.

St. John, Freya, *University of Kent*

Public motivations for compliance with wildlife legislation: carnivore killing in rural Taiwan

Many approaches to managing and conserving natural resources depend upon rules that restrict human use. Activities aimed at encouraging compliance with wildlife legislation frequently adopt conventional enforcement tactics

aimed at generating deterrence. Economic theories of compliance hold that rule breaking occurs when anticipated benefits outweigh the costs. Knowledge of rules, personal values, and social motivations are also thought to play a role in fostering this compliance. However, there has been little attempt to test the relative importance of these factors in shaping compliance with environmental legislation. We use the randomised response technique, designed specifically for investigating sensitive behaviours, to investigate the relative contributions of knowledge of rules, personal values, economic, and social factors in stimulating compliance with wildlife regulations. We estimate the proportion of the rural population of north-western Taiwan killing four mammal species, and explore motivations for compliance using a modified logistic regression model. Nearly 10% of respondents admitted to requesting a hunter to kill leopard cats, protected in Taiwan, in the three years preceding the study. Preliminary analysis reveals the importance of exploring the role of personal values, economic, and social motivations in fostering compliance with rules. This study contributes to the understanding of factors shaping compliance with wildlife legislation.

Stiles, Margot, *Oceana*; **Michael F. Hirshfield**, *Oceana*

Country-level comparisons using conservation, livelihoods, governance and market indicators to estimate fisheries recovery potential

If we can recover marine fisheries and prevent future declines, we estimate wild fish can contribute at least 20% more to the global food supply. Much of this goal can be accomplished by focusing conservation efforts on the 30 countries with the largest marine fish catches, as a proxy for potential marine food production. These top 30 countries are divided nearly equally among emerging and developed nations. In this study we compared the potential to recover fisheries to feed people in 16 emerging economies, using 22 indicators of conservation, livelihoods, governance and markets. Our goal was to identify easily measurable indicators of the necessary pre-conditions to advance policy change which ensures the long-term sustainability of marine ecosystems and food fish production.

Stortz, Sasha, *Northern Arizona University*; **Thomas Sisk**, *Northern Arizona University*; **Erik Nielsen**, *Northern Arizona University*; **Jill Rundall**, *Northern Arizona University*; **Todd Chaudhry**, *Grand Canyon National Park*

Prioritizing areas for conservation and management across the greater Grand Canyon region using a participatory spatial analytical framework

The challenge of integrating ecological information and stakeholder interests into large scale planning is increasingly

addressed through collaborative efforts complemented by use of decision support tools and geographic information systems. Here, we demonstrate a novel approach to addressing stakeholder values, scientific data and cultural resource information in a trans-boundary conservation effort at the landscape scale. The Greater Grand Canyon Landscape Assessment is a Grand Canyon National Park-led effort to assess the condition of select natural and cultural resources and prioritize areas for management across 2 million hectares spanning beyond the park's borders to adjacent lands. Our work involves a) developing spatial data layers, models and tools for decision support, b) convening a series of workshops with diverse stakeholders to explore options and scenarios for prioritization and c) developing an evaluative process to test hypotheses about the qualities necessary for stakeholders to effectively participate in deliberation and spatial analysis. This study illustrates the opportunity to move beyond general metrics of collaborative process evaluation to assess the quality of stakeholder interaction with the data that is often at the core of science-based planning processes. Greater understanding of the influences of science on the deliberative process will help to empower stakeholders and improve outcomes of collaborative planning and conservation.

Strombom, Evelyn, *Smithsonian Conservation Biology Institute*; **Jonathan Thompson**, *Smithsonian Conservation Biology Institute*

Modern conservation: private vs public efforts in Northeastern, US

Federal efforts no longer represent a significant source of new land set aside for conservation. Today, private conservation easements and small, state-level acquisitions are the only new lands added to the conservation land base. Using state conservation databases from MA, we compared rates of modern private and public conservation since the 1960s. We used Classification and Regression Trees (CARTs) to examine the spatial relationship between forest conservation; development, US census derived measures of population density and wealth; and biophysical factors such as proximity to water and topography. Public efforts continue to conserve larger total and average areas of land, even though private interests began to outpace the government in total number of conserved parcels in the 1980s. CARTs ($p < 0.001$), but "low" house value (

Stutzman, Hannah, *Amazon Conservation Association*; **Amy Rosenthal**, *WWF - US*; **Adrian Forsyth**, *blue moon fund*

Creating Mosaic-Based Conservation Corridors to Respond to Major Threats in the Amazon Headwaters

Peru's southeastern Andes-Amazon region is home to rich biological and cultural diversity and is an emerging frontier

for development threats. Developing habitat corridors is considered one of the few effective methods for responding to the risk of large-scale land conversion yet relatively few examples exist in implementation. The presentation will describe Amazon Conservation Association's strategy of creating landscape-level corridors as a means to maintain landscape connectivity while allowing for human use. ACA designed 3 interlinking corridors in southeastern Peru based on a land-use mosaic, which includes an array of rights-holders and land tenures in addition to conservation areas. Supported by both science and community engagement, each corridor design considers social and political dynamics as well as ecosystem processes. Anchored by large protected areas, these conservation corridors consist of a patchwork of land uses, which permit economic development while allowing for gene flow and species migration. Implementation of the corridors has included sustainable livelihoods activities such as agroforestry, agriculture, aquaculture and ecotourism, along with creation of several types of protected areas, reforestation, capacity building and strengthening governance, communications, and support for development of conservation finance mechanisms. The presentation will discuss the current state of these initiatives as well as obstacles to success and lessons learned.

Sudan, Robinson, *Pollinator Partnership*; **Victoria Wojcik**, *Pollinator Partnership*; **Jennifer Blanchard**, *Honey Island Conservation Program*

Honey bee/native bee competition and delivery of pollination services to non-timber forest products on production forests of the US Gulf South

Forestry dominates land use in the US Gulf South. While timber products are essential to the region's economy, these lands are often alternatively managed to enhance wildlife habitat. They also provide forage for managed honey bee colonies between pollination contracts. With traditional forage lands becoming scarce and pollinators declining worldwide, maintaining sufficient habitat for wild and managed bees alike is imperative for successful conservation and agriculture. Despite a clear need, virtually nothing is known about the activities of pollinators on southern timberlands, and research on competition between wild and managed bees has proven contradictory. To examine this potential competition, flower visitors to titi (*Cyrilla racemiflora*) on timberlands were recorded over two years at sites with managed honey bee hives, sites without hives, and control sites. To examine pollination services among treatments and degree of pollinator dependence, eight plant species important as wildlife food resources were studied using a pollinator exclusion protocol. Flower visitation data suggest minimal bee competition, while control sites differed significantly from both treatments. Plant species showed pollinator dependence across sites, but small sample sizes may be an issue with the observed insignificant differences in fruit

set. This ongoing project reveals important aspects of bee interactions and habitat use, and future analysis will benefit from forthcoming seasons of data.

Surasinghe, Thilina, *Clemson University*; **Robert Baldwin**, *Clemson University*; **Mark Scott**, *South Carolina Dept of Natural Resources*

Historical land-use drives community composition of stream-associated salamanders

Human activities leading to land-cover change can result in persistent influences on ecosystems. Biodiversity-rich Piedmont of the Southeastern US was subject to extensive historical (1840-1920) cotton farming resulting in changes in the biota and the landscape. Widespread urbanization in Piedmont has introduced novel land-uses. We surveyed 100m-transects at 70 low-order streams for Plethodontid salamanders and collected habitat data. Using USGS land-cover dataset (2006) and aerial photographs (1940-1950) as current and historical data sources, we assessed the percent land-cover in 1Km-radii-buffers around each sampling site. Using percent land-cover as predictors and species richness and Shannon Index as response variables, we developed a model via a stepwise multiple regression. Optimal model parameters that predict species richness and Shannon Index indicated the importance of historical land-uses (human settlements, row-crop agriculture, forest cover) on stream-dwelling salamanders, despite vegetation recovery. Specifically, protected areas with agriculture or timber-based legacy were species-deprived, compared to those that were not farmed or lumbered. Conversion of forests into farmlands lead to soil erosion, sedimentation, higher discharge, and destabilization of uplands rendering those streams unsuitable for many salamanders. Our findings provide insights to assist stream restoration and landscape-scale conservation of regions with long-term historical land-uses.

Sutcliffe, Trish, *University of Queensland*

Marine reserve systems constructed using environmental domains do not comprehensively represent seabed fauna

In many instances around the world, knowledge of marine systems is limited and the cost of acquiring new data is high. Therefore, we need to know whether more readily available data is sufficient to design comprehensive and representative reserve systems. Here, we designed sixteen reserve systems based on the intersection of four kinds of domains (environmental domains; weighted environmental domains; pre-defined bioregions of the Great Barrier Reef; random) and four combinations of two constraints (cost to commercial fisheries, and clumping of reserves). To measure the efficacy of each reserve system, we evaluate how well 842 species collected at 1155 sites from the Great Barrier Reef seabed

were represented. We found that 10-22% of species had less than 10% of their biomass conserved under any of the reserve combinations, and that the number of species reaching a 30% conservation target was similar to random. We conclude that the large number of species that fall well short of the conservation target is unacceptable for a representative reserve system. Random reserve design is equally as effective as any of the combinations tested here. In this shallow water tropical marine ecosystem, seabed biota is not adequately conserved using environmental domains, and biological data is needed to inform the design process. Our study highlights that caution should be taken when designing reserves without biological data.

Sutherland, Ron, *Wildlands Network*; **Rob Baldwin**, *Clemson University*; **Paul Leonard**, *Clemson University*; **Derek Fedak**, *Wildlands Network*; **Rachael Carnes**, *Wildlands Network*

Modeling fine-scale habitat connectivity for terrestrial mammals, snakes, and turtles in the Southeast USA

The rich biodiversity in the Southeast USA is under threat from both rapid urbanization and climate change. Re-connecting the existing natural areas in the region is perhaps the best hope of preventing extinction for many species. However, scientists have been thus far unable to provide fine-scale recommendations for conservation practitioners as to the best land parcels to protect or restore in order to efficiently enhance terrestrial habitat connectivity. In this project, we take advantage of recent advances in supercomputing and connectivity modeling software to identify high priority habitat connectivity zones for a range of vertebrate species across a 7-state study area. Target species include black bear, red wolf, Florida Panther, eastern diamondback rattlesnake, timber rattlesnake, pine snake, and box turtle. We used expert opinion to derive dispersal resistance surfaces for each species, and then Circuitscape and other connectivity analysis tools to model the potential flow of these animals across the landscape. Our general results highlight the importance of three parallel connectivity zones in the Atlantic Coast portion of the Southeast (Appalachians, Fall Line Sandhills, and Coastal Plain Wetlands), and also demonstrate considerable significance for the numerous large river corridors that stretch inland perpendicular to the main arteries of connectivity.

Suzan, Gerardo, *UNAM School of Veterinary Medicine*

Habitat fragmentation, metacommunity structure, and disease ecology.

Habitat fragmentation results in decreased area and increased patch isolation, along with microclimatic and biogeographical changes, altering the richness and the relative abundance of species involved in disease transmission cycles, leading to

changes in pathogen persistence, prevalence and distribution in the landscape.

Tabor, Gary, *Center for Large Landscape Conserv*

Planetary Thresholds and Conservation Medicine

Perhaps we didn't aim high enough. Conservation Medicine was designed to bring together the ecological health, human health and animal health communities to address the health implications of environmental change. Tom Lovejoy termed those who practice conservation medicine as "Planetary Doctors". Today we stand at the brink of a real and impending conservation bottleneck. Within the next 100 years we will surpass several planetary thresholds relating to climate change, irreversible loss of global biodiversity, and the aspirations of 11 billion people. The next 100 years will test our collective resolve in finding a sustainable path for human livelihoods and nature conservation. Conservation Medicine needs to enlist the knowledge disciplines and institutions that can address this challenge. True planetary health will require more than combined collaborations between entrenched branches of the ecological, medical and veterinary science communities. We need to train planetary doctors and inspire citizens of our planet to be global health practitioners. As planetary doctors, we cannot simply treat the symptoms of this problem, whether it be emerging infectious diseases due to ecological change, or asthma within polluted cities. We must pursue a systemic and preventive health approach. Our ambitions are fueled by the planetary crisis at hand and thus we have no choice but to aim higher.

Takem Mbi, Bienvenu Magloire, *University of Yaounde I/INC*

Protecting the Cross River gorilla (*Gorilla gorilla diehli*) in a multi-stake landscape of Cameroon: assessment of current and emerging challenges

A sub-population of the Cross River gorilla (CRG) has been discovered in the Lebialem-Mone Forest landscape (LMFL) of Cameroon. According to the forestry law, the LMFL is a non-permanent forest estate implying that it can be converted into any form of land use. While FFI and ERuDeF are working with the administration towards designating a wildlife sanctuary for this CRG, the local populations are striving towards achieving their livelihood. Also, multi-national corporations and "power class" individuals are starting off large scale plantation agriculture. For FFI and partners to proceed with the plan, field information is mandatory. They need to know the changes that have occurred over time and become acquainted with the current and emerging challenges to conserving the LMFL. Landsat and SPOT satellite images for 1986 and 2011 respectively were employed to assess the changes. Questionnaires,

interviews, observations and FGDs were used to identify current and emerging challenges. Results proved forest cover reduced from 80% in 1986 to 66% in 2011 and that 84% of the population were actually aware. The drivers of the current change were identified to be: farming 69%, house construction 12%, and timber exploitation 10%. These same activities plus large scale plantation were recognized as emerging threats to the CRG of the LMFL. To continue with the plan, FFI and partners should work with all actors involved in the zone if they wish that the LMFL should be used sustainably.

Tamura, Narumi, *Meiji University*; **Noboru KURAMOTO**, *Meiji University*

Perk User's Attitudes towards Turtles

Abstract: In Japan, six species of aquatic turtles live in fresh water or semiaquatic habitats. Native turtles living on Honshu Island, *Mauremys japonica*, *Chinemys reevesii*, and *Pelodiscus sinensis*, are decreasing in number because of competition with alien turtles. The main species competing with native turtles in Japan, the red-eared slider *Trachemys scripta elegans* (young sliders are called "midorigame" in Japan), are distributed throughout Japan because these turtles are kept as pets. Many studies have investigated the manner in which *T. scripta elegans* colonizes ponds in Japan, but few reports describe popular perceptions. This study was conducted to support educational activities aimed at reducing the abandonment of alien species. Inhabitation of city parks by turtles was examined. Then a questionnaire survey was administered to park users to clarify their views of turtles and perceptions of *T. scripta elegans*. Alien turtles dominated native turtles in the two studied ponds. Furthermore, city park users like all turtles. However, alien turtles, including *T. scripta elegans*, are not as well liked. Reasons for abandoning *T. scripta elegans* include the idea that perceptions of young midorigame do not match perceptions of adult red-eared sliders. As one might expect, city park users do not know that breeding *T. scripta elegans* is difficult. City park users must be educated about the problem of alien turtles when exterminating alien species.

Taremwa, Nathan, *National University of Rwanda(NUR)*; **Lambert Kwizera**, *National University of Rwanda*; **Jean Lambert Sebarezze**, *World Vision- Rwanda*

ENGAGING LOCAL COMMUNITIES IN CONSERVATION: AN OPPORTUNITY TO ENHANCE SUSTAINABLE BIODIVERSITY CONSERVATION IN RWANDA

This study investigates the strategy to engage local communities living adjacent to Akagera National Park in conservation as an opportunity to enhance sustainable

biodiversity conservation in Rwanda. The main objective of the study was to determine the strategy that would be adopted to enhance sustainable biodiversity conservation in national parks of Rwanda. The focal point were the local communities living adjacent to the Akagera National Park, located in the Eastern Province of Rwanda. A sample size of 70 was used and 66 agricultural households living adjacent to ANP and 4 people from the park, local administration were surveyed. Multiple regression analysis was used to determine factors contributing to the productivity and the willingness to pay (WTP) or accept (WTA) for the plan of conservation measures. Results showed that land and crop production influence the crop yield and that revenue local communities obtain from the selling of the harvest at the market was the major determinant of WTP. Other socio-economic characteristics were not statistically significant. The study recommends the provision of agricultural extension services and application of environmental valuation tools in assessing local communities' attitudes toward biodiversity conservation to enhance decision making for effective and sustainable conservation. Key words: Local Communities, Biodiversity Conservation, Akagera National Park, Rwanda

Tavano, Joseph, *Clemson University*; **Amber Pitt**, *Clemson University*; **Robert Baldwin**, *Clemson University*; **Thomas Waldrop**, *USFS, Southern Research Station*

Effects of fuel reduction treatments on movement and habitat use of American toads in a southern Appalachian hardwood forest

Prescribed fire is a commonly used management technique for maintaining fire-adapted ecosystems, yet empirical data regarding its effects on amphibians are limited and contradictory. We used radio-telemetry to examine the effects of prescribed fire on movements, mortality, and habitat selection of American toads (*Anaxyrus americanus*) in a southern Appalachian upland hardwood forest. We tracked 26 adult *A. americanus* between 27 January - 30 May 2012. Toads exhibited non-breeding site fidelity and traveled 993.5 m (± 265.9 m) mean (\pm SD) route distance between the breeding ponds and last recorded locations. We found no evidence of direct mortality of *A. americanus* from prescribed fire. Forward stepwise discriminant analysis revealed that the availability of coarse woody debris (CWD) was a significant discriminator between microhabitats used and random plots. Toads also maintained shorter distances from CWD in the burned than in the unburned locations. Our results indicate that prescribed fire as implemented in this study did not cause direct mortality, nor did it appear to inhibit migratory movements of adult *A. americanus*. However, fire reduced the diversity and availability of refugia, especially deciduous leaves, though the availability of alternative cover objects (e.g., CWD) in burned treatments allowed toads to inhabit those areas, suggesting the importance of maintaining near-

ground structural complexity for *A. americanus* in fire-managed forests.

Taylor, Erin, *New England Aquarium*; **Regen Jamieson**, *New England Aquarium*; **Tim Smith**, *World Whaling History*

Connecting New England to the Pacific: Historic American Sperm Whaling in the Phoenix Islands Protected Area

The Phoenix Islands Protected Area (PIPA) represents the largest marine protected area in the Pacific Ocean and a substantial oceanic conservation effort by Kiribati, a least developed country. In the mid-19th century, the PIPA was part of a hotspot for American whalers known as the "on-the-line" grounds. These whalers from New England particularly targeted sperm whales (*Physeter macrocephalus*), prized for their valuable oil. The vigorous whaling by the American fleet contributed to major declines in global whale populations. Sperm whale populations in the PIPA do not seem to have recovered, as they are rarely reported there today despite their known historical presence and the pristine condition of the PIPA ecosystem. Our research connects information on historic and current whale populations in the PIPA region. We investigate historic whaling logbook data of global whale sightings and kills that were compiled and mapped in previous studies. By revisiting this data and narrowing our regional focus, we have been able to recreate maps that offer insight into the historic temporal, spatial, and seasonal distributions of sperm whale populations in the PIPA region. This research provides new insight into the baseline population of sperm whales in the PIPA, which can be used to make inferences about current populations, reasons behind their slow recovery despite the pristine ecosystem, and the larger implications for PIPA managers and stakeholders.

Tenggardjaja, Kimberly, *University of California, Santa Cruz*; **Giacomo Bernardi**, *University of California, Santa Cruz*; **Brian Bowen**, *Hawaii Institute of Marine Biology*

Endemism, connectivity, and marine protected areas: A population genetics comparison of endemic and widespread reef fishes in the Hawaiian Archipelago

One of the key biological criteria for deciding which sites should be designated as marine protected areas (MPAs) is biodiversity, and endemism contributes to the biodiversity value of a potential MPA site. Limited dispersal potential and restricted geographic ranges characterize endemic species, placing them at a greater risk of extinction than widespread species. Because of these attributes, it is assumed that endemic species have lower levels of connectivity than widespread species. This study utilized genetic markers to investigate whether endemic and widespread reef fishes exhibit different patterns of genetic connectivity. The Hawaiian Archipelago is

a hotspot for endemic reef fishes, making it an ideal system for this study. Levels of genetic connectivity were assessed throughout the archipelago for two Hawaiian endemic (*Abudefduf abdominalis* and *Chromis ovalis*) and two Indo-Pacific (*A. vaigiensis* and *C. vanderbilti*) damselfish species. Both of the endemic species demonstrated multiple genetic breaks in the archipelago, as did *C. vanderbilti*. In particular, these three species shared a break between the Main Hawaiian Islands (MHI) and the Papahānaumokuākea Marine National Monument - a break also seen in two other endemic damselfishes. Management of the archipelago should be mindful of this emergent pattern among endemic damselfish species, which suggests limited connectivity between the MHI and the largest marine conservation area under U.S. jurisdiction.

Terrell, Kimberly, *Smithsonian Conservation Biology Institute*; **Richard Quintero**, *Smithsonian's National Zoological Park*; **Suzan Murray**, *Smithsonian's National Zoological Park*; **Bradley Nissen**, *Smithsonian Conservation Biology Institute*; **James Murphy**, *Smithsonian's National Zoological Park*; **John Kleopfer**, *Virginia Department of Game and Inland Fisheries*; **Brian Gratwicke**, *Smithsonian Conservation Biology Institute*

Cryptic Impacts of Variable Temperatures in a Declining Aquatic Salamander

The Appalachian region of the eastern United States is a hotspot of salamander diversity, but many species are experiencing declines, including the hellbender (*Cryptobranchus alleganiensis*). Although climate change is considered a serious threat to these species, little is known about how temperature affects salamander health. More frequent drought and intense rain are predicted in Appalachia, resulting in more variable water temperatures for stream-dwelling species. We investigated the health impacts of variable temperatures using a captive population of hellbenders. Tank temperatures were programmed to recreate a 7-day period of rapid warming and cooling (16-26-16°C) recorded in the population's natal stream. A control group was maintained at a constant, mean temperature (21°C). Body weight, leukocyte counts, corticosterone levels and plasma bacterial killing ability (BKA) were evaluated every 14 days during 6 consecutive temperature cycles. Analyses revealed increased BKA in hellbenders exposed to variable temperatures ($P < 0.05$), while all other metrics were similar to the control group. These data indicate that in situ patterns of temperature change elicit a functional immune response in hellbenders. Furthermore, this "cryptic" physiological response is not detectable using conventional stress indicators (i.e., corticosterone or leukocytes). Collectively, our findings highlight the need for a comprehensive approach to understanding climate change physiology.

Théo, FLAVENOT, *Museum National d'Histoire Naturelle*;
ADAM Yves, *Union Nationale des producteurs de Granulats*;
BAGUETTE Michel, *Museum National d'Histoire Naturelle*;
COULON Aurélie, *Museum National d'Histoire Naturelle*

Assessing the effects of quarrying activities on landscape connectivity in two amphibian species with contrasted ecological constraints

Industrial activity is a major driver of fragmentation, but each type of activity has a different impact. Quarrying causes the removal of initial habitat and may hence increase landscape fragmentation. Conversely, it may create particular habitats such as pioneer habitats or wetlands, probably increasing this way the connectivity for species associated with those environments. Moreover, the spatial configuration of quarries (i.e. isolated, clustered, or in stepping-stone networks) may modulate those effects. To assess the effects of quarries on landscape connectivity, we used a landscape genetic approach on two niche-separated anurans: the natterjack toad (*Bufo calamita*) and the common toad (*Bufo bufo*). Because the natterjack toad prefers poor-vegetated habitat while the common toad looks for heavily vegetated and forested habitats, this study tests the hypothesis that quarry density has positive effects on natterjack toad connectivity and negative effects on common toad connectivity. We compared genetic structure, gene flow levels and directions in seven areas with different densities of quarries. We also used an optimization process to assess resistance of quarries on gene flow in both species. In light of our results, we propose integrated landscape conservation measures for quarrying activities.

Thomasson, Kelly, *University of California, Santa Barbara*;
William Avery, *California State University, Sacramento*

Insufficient regulation of Maui's Marine Protected Areas may reduce Benthic Biodiversity

The waters of Maui County are essential to the livelihood of its residents. In addition to sustenance value, annual revenue from international tourism and marine activities keeps the island's economy afloat. Overuse of Marine Protected Areas (MPAs), due to their appeal as aesthetically vivid, conservation districts, has potential to degrade the very systems that MPAs are intended to protect. Marine ecotourism activities have been previously indicated as factors involved in coral reef degradation. We attempted to establish whether or not there was a notable decline in benthic substrate biodiversity in the MPA-managed areas of Maui County relative to that of non-conserved areas. Based on biodiversity indices, we hypothesized that there would be lower benthic biodiversity at MPA sites relative to those sites with no protected-status, within the boundaries of Maui County. Photographic quadrats of benthic organisms and substrate from 4 accessible conservation sites and 8 biogeographically similar controls were quantified and assessed through the use of biodiversity indices at two depth

ranges. Using MANOVAs, we found significantly lower biodiversity indices in MPAs relative to control areas. Given the lengthy establishment of MPAs in Maui County and the importance of marine preservation for the aesthetics, economy and biology of Maui county, these results suggest the need for change in the level of MPA usage and regulation of that usage.

Thornhill, Jennifer, *George Mason University*

Can New Metrics Help Us Bridge the Gap? A case study in the measurement of scientific literature's impact on decision making.

The emphasis that academic departments and publishing companies place on citation rates and impact factors may be a barrier to bridging the gap between science and decision making. Not only are activities and publications that bridge the gap often not encouraged or recognized for their value, there is no systematic way to measure the impact of these activities when they do occur. Development of a robust way to track "real world" impacts of publications could increase the value that is placed both on the underlying research and outreach efforts that are directed at decision makers. Examining 987 citations from five federal wolf delisting regulations, I found that literature that is used by decision makers ("high management impact literature") differs from literature that is deemed high impact in academic and publishing circles. This case study of the use of scientific literature in decision documents is a first step in creating an alternative method of measuring the impact of scientific publications-a "management impact index." A better understanding of the real world impacts could challenge academic institutions and publishers to reconsider the value placed on applied research and outreach, which in turn can provide much needed incentives for academic researchers to engage in research that can be directly applied to issues faced by decision makers.

Thurman, Lindsey, *Northwest Climate Science Center*;
Tiffany Garcia, *Oregon State University*

In hot water: developmental plasticity to a warming climate in a high elevation amphibian assemblage

The rapid loss of habitable climate space in montane ecosystems has resulted in a disproportionate number of extinctions in high elevation-restricted amphibian species. However, species capable of plastically altering life history traits, such as larval development rate, may exhibit optimal strategies for resisting a warming climate. We examined the larvae of three high elevation Anuran species from the US Pacific Northwest, the Cascades frog (*Rana cascadae*), Western toad (*Anaxyrus boreas*), and Pacific chorus frog (*Pseudacris regilla*), for their ability to increase larval

development rates in response to warming. Each species was exposed to two temperature regimes: the control treatment simulated historical, summer temperatures for the decade of 2001 to 2011; the warmed treatment mirrored the seasonal trend, but simulated a 4°C average increase in temperature. We quantified multiple larval growth characteristics to compare the variability in development as a function of these temperature regimes. We found significant acceleration in larval development rates under the warmed temperature regime (F=21.68, P

Tiwari, Brajesh, *North-Eastern Hill University*; **Manjumani Tiwari**, *St. Mary's College, Shillong*

Technological innovations in shifting agricultural practices by three tribal farming communities of Meghalaya, northeast India

Technological innovations in shifting agricultural practices by three tribal farming communities of Meghalaya, northeast India B. K. TIWARI Department of Environmental Studies, North-Eastern Hill University, Shillong 793022, Meghalaya, India Abstract: Shifting agricultural practices of three tribes of Meghalaya viz., Khasi, Garo and Karbi were studied to analyze and understand the technological innovations adopted by these communities in this age old practice. The methods used for this study involved participatory data collection on the socio-economics, agricultural practices and bio-physical resources through Participatory Rural Appraisal (PRA), household survey and participatory resource mapping of the villages. The study was carried out in six villages viz., Khrang, War-War, Kuswai, Khulia, Chekwatgre and Sasatgre two each inhabited by Khasi, Karbi and Garo tribes respectively. It was observed that a variety of indigenous technological innovations have been introduced by these communities for making the system more productive, less degradative and able to generate cash income for modern living. The innovations include: use of cover crops, retention of trees, prudent management of weeds, use of poles and logs for soil conservation, introduction of cash crops and fallow management. Evolved and adopted by these communities through experiential learning, these innovations have ample potential of replication elsewhere.

Toline, Catherine, *National Park Service*; **Alex Chow**, *Clemson University*; **Xubiao Yu**, *Clemson University*

Microplastics in the marine environment: Potential effects in US National Parks

The annual global demand for plastics has consistently increased and is now estimated at approximately 245 million tons. Nearly a third of the plastic resin production is converted into consumer packaging material that include disposable single-use items commonly encountered in beach

debris. A particular concern is the occurrence of smaller pieces of plastic debris including those not visible to the naked eye, referred to as microplastics, in the world's oceans. Ingestion of microplastics by microbiota, presents a very real problem. The concern is their potential for delivery of concentrated persistent organic pollutants (POPs), mainly those picked up from sea water, to the organisms. It is these dissolved POPs that are toxic. To begin to understand the threat of microplastics and associated contaminants on wildlife, we are developing the capacity to quantify, and sampling for, microplastics and selected contaminants across multiple marine parks, from remote to highly-urbanized. These data will provide the basis for identifying the need to increase focus on management of marine debris, monitoring and management of species particularly susceptible to effects of microplastics (e.g. shorebirds) and development of education and outreach materials to increase awareness of this threat to the environment.

Toomey, Jim, *Creator, Sherman's Lagoon*

dfvbnm,

For the past 20 years Jim Toomey has been writing and drawing the syndicated comic strip Sherman's Lagoon, which appears daily in over 150 newspapers. Through his cartoon, Toomey explores many ocean conservation issues and exposes his readers to odd forms of marine life and strange places. Using the ocean as a stage, he takes his characters far and wide. For example, Sherman and his friends have probed the depths of the Marianas Trench and hiked the Mid-Atlantic Ridge. They've visited hydrothermal vents and collected manganese nodules for fun and profit. Toomey has also taken his story line to many marine reserves, such as Papahānaumokuākea, the Great Barrier Reef, and Monterey Bay, where his characters frequently involve the native marine life in their harebrained schemes. In his presentation, Jim will address the challenge of informing the public about marine conservation issues through cartoons, with a particular emphasis on his many story lines that are set in marine reserves.

Tougas, Stephanie, *Fordham University*; **Rose Carlson**, *Fordham University*

Drivers of darter fish (Percidae) species composition in creeks and small rivers in Tennessee, USA

Darters (Percidae) are benthic dwelling fish that inhabit small streams and are often used as bioindicator species in assessments of stream quality. Darters have small home ranges and specialized habitat requirements such as clean substrate and high flow. Darters are also sensitive to many factors associated with degraded aquatic habitats, particularly urban environments, such as high turbidity and temperature.

Existing studies have analyzed urban-associated species composition changes at the fish community level, but few examine effects within one fish family. Identifying key anthropogenic stresses on composition changes within the darter family will shed light on how sensitive fish species are expected to respond to an increase in these stresses in an urbanizing landscape. My study analyzes drivers of darter composition of creeks and small rivers across ten sites, along an urban to rural gradient in Tennessee. I identified 22 darter species, with richness ranging from one to nine species. A multiple linear regression with richness as the response variable and dissolved oxygen, turbidity, water temperature and pH as explanatory variables revealed that the best predictor of richness was a model including both turbidity and water temperature. In addition, I am using GIS to analyze impacts of road and population density on darter composition and richness. These findings will help focus fish conservation efforts to avoid extirpation of sensitive species such as darters.

Trall, Barry, *Pew Environment Group-Australia*

Protection isn't enough - the problem of too few people in the Outback. Managing a huge landscape to prevent extinctions.

Outback Australia is one of the very few huge natural landscapes remaining on Earth. Its diverse tropical, arid and temperate ecosystems include enormous tracts of country which have not been directly impacted by industrial or agricultural activities. However, all its regions face ongoing high rates of extinctions of native plants and animals. In some regions threats to wildlife are posed by accelerating mining and associated water extraction, industrialization and fragmentation of habitat. However, Outback landscapes also face a suite of threats from a lack of active management, especially altered fire regimes and invasive feral animals and weeds. However, most of the Australian Outback now has fewer people residing and managing it than at any time in the last 50,000 or more years. Due to this lack of management many Australian plants and animals face ongoing declines and regional extinctions. Conservation in the Outback therefore requires both protective tenures and ongoing active management. Innovative new programs for Indigenous Rangers and improved management in national parks and privately owned reserves are providing a template for better management over Outback lands. These offer a way forward that works for wildlife, country and people.

Tredick, Catherine, *San Diego State University*; **Rebecca Lewison**, *San Diego State University*; **Douglas Deutschman**, *San Diego State University*

Using citizen-scientists to monitor species trends and inform management of habitat connectivity in San Diego County, California, USA

The San Diego Multiple Species Conservation Plan (MSCP) exemplifies the challenges of developing robust monitoring programs for multiple species across multiple jurisdictions. One of the primary goals of the MSCP is to maintain and monitor functional connectivity for wildlife. Although connectivity monitoring efforts have been in place since 1996, managers still struggle to answer whether preserved lands are functionally connected and whether certain species are declining in response to increased development. The San Diego Tracking Team (SDTT), a citizen-based volunteer organization, has collected extensive data on mammal tracks throughout San Diego County since 2000. We used these data to determine spatial and temporal trends in species occurrence and assess large-scale habitat associations and impacts of land use changes for tracked species (coyote, mule deer, bobcat, raccoon, gray fox, and mountain lion). Results showed significant declines in species occurrence for coyote, mule deer, raccoons, and mountain lions as well as significant differences in species occurrence across sites. Although trends were detectable using these data, our ability to infer drivers of those trends was limited due to the lack of fine-scale landscape and habitat covariates at sampling sites. We conclude by providing recommendations to improve the SDTT's protocol to better inform connectivity management and wildlife response to habitat fragmentation.

Tucker, Kimberly, *Stevenson University*; **Clayton Hurd**, *Haas Center for Public Service, Stanford University*; **Jan Mackinnon**, *Georgia Department of Natural Resources Coastal Resources Division*; **Keith Johnson**, *Stevenson University*; **Amber LaPeruta**, *Stevenson University*; **Steven Arbitman**, *Stevenson University*

Connecting Students and Communities to Conservation through Service-Learning

Conservation of natural areas frequently requires volunteer assistance. Volunteers gain from these experiences, but do not always learn much. By integrating Service-Learning into course curricula, students learn about the science going into conservation planning and restoration projects. Three examples of courses will be presented. Marine Biology, focused on the ubiquitous problem of marine debris by examining the path of trash to the Chesapeake Bay. Students in this course collected data about trash along the Jones Falls Watershed and shared that information with the community. A second course, Science of the Chesapeake Bay, is a course for non-science majors. Students in this course partnered with a local homeowners association, preparing seeds, growing plugs, and beginning a pilot study for a shoreline restoration project. The service component was completely integrated into the curriculum for the third course, Conservation Biology. This course focused on coastal conservation, but

specifically focused on monitoring the ecological relationship between the Spartina marsh ecosystem and the eastern oyster. Students worked directly with the Georgia Department of Natural Resources, gaining valuable experience, while providing manpower and data. These types of courses can provide hands-on learning about scientific principles, opportunities for learning about conservation organizations and their functions, and directly connect students to their community and natural environment.

Tulloch, Vivitskaia, *ARC Centre of Excellence in Environmental Decisions*; **Hugh Possingham**, *ARC Centre of Excellence in Environmental Decisions*; **Stacy Jupiter**, *Wildlife Conservation Society*; **Chris Roelfsema**, *Biophysical Remote Sensing Group*; **Ayesha Tulloch**, *NERP Environmental Decisions Hub*; **Carissa Klein**, *Australian Research Council Centre of Excellence for Environmental Decisions*

Designing robust marine reserves under uncertainty: trading off socio-economic costs against the risk of failing to meet conservation targets

Conservation planners should consider uncertainty associated with ecological data to minimize their effects and make informed decisions. Maps of conservation features are subject to high error, though this is rarely accounted for in conservation decision-making. We present a novel reserve design method that accounts for uncertainty in coral reef habitat data from the Kubulau fisheries management area, Fiji, balancing ecological and socio-economic objectives, and trading-off important attributes of conservation planning: risk, representation, and cost. We use the probability of occurrence of each habitat (mapping accuracy), derived from remote sensing data, to design marine reserve networks with a high chance of protecting every habitat. We compare this with a standard reserve design approach, and present 4 key results: 1) including mapping accuracy changes the location of priority conservation areas, with errors of omission and commission likely if mapping accuracy is ignored; 2) reserve networks with a high chance of protecting all habitats cost more, but are less risky as they are unlikely to miss representation targets; 3) less costly reserve networks are possible if we triage low accuracy habitats; and 4) increasing the probability of all habitats meeting targets from 50% to 99% would cost fishers less than an estimated 1% of their total income. Uncertainty should be explicitly accounted for in all decisions to maximize the chance of successful conservation outcomes.

Turner, Sara, *Mercyhurst University*; **J. Campbell**, *Mercyhurst University*

Genetic characterization of brown bullhead populations with skin tumors from Lake Erie

Fish health can be a key indicator of ecosystem health, with fish species such as the brown bullhead (*Ameiurus nebulosus*) serving as sentinels of environmental quality. Decades of fish sampling to monitor tumors in brown bullheads in Lake Erie have not yet successfully identified the cause of external tumors in this sentinel species, and the unresolved issue remains a stumbling-block in delisting Great Lakes Areas of Concern. A general explanatory model and review of potential causes of external tumors in brown bullhead indicate possible involvement of microbial and other agents, as well as genetically-based immunodeficiencies. We summarize progress to-date in the development of genetic markers and genetic characterization of brown bullhead (with and without tumors) from Lake Erie sites presenting varied histories of environmental degradation.

Tyre, Drew, *University of Nebraska-Lincoln*

Stepping out of the Ivory Tower while still calling it home: tales from the trenches

There is widespread belief that solving the pressing environmental issues of our time requires the participation of academics from all disciplines. However, carving out a life in the Ivory Tower means meeting the expectations of colleagues, chairs, directors, deans and all the rest. It is not obvious how helping to solve a real-world problem can translate into the kudos needed to achieve tenure and promotion. So how to do it? What are the tips and tricks of the trade that allow you to follow your heart and save the world, while still ensuring success in the Ivory Tower? I'll distill the experiences of some of the world's most successful conservation academics, along with my own experiences, to get the conversation started.

Underwood, Jared, *U.S. Fish and Wildlife Service*; **Mike Silbernagle**, *U.S. Fish and Wildlife Service*; **Mike Nishimoto**, *U.S. Fish and Wildlife Service*; **Kim Uyehara**, *U.S. Fish and Wildlife Service*

Managing Conservation Reliant Species: Hawaii's Endangered Endemic Waterbirds

Hawaii's coastal plain wetlands are inhabited by five endangered endemic waterbird species. These include the Hawaiian Coot, Hawaiian Duck, Hawaiian Stilt, Hawaiian Gallinule (Moorhen), and Hawaiian Goose. All five species are categorized as being "conservation reliant". The current strategy to recover these endangered birds includes land protection and active management. To assess the effectiveness of the current management paradigm, we compared species population trends across the state to those on six actively managed wetland National Wildlife Refuges (Refuges) thought to be critical for the survival of these endangered species. To perform the evaluation we relied on systematic

semiannual population counts that have been conducted across most wetlands in the state and monthly population counts have occurred on the six Refuges during the same time period. We found that statewide and Refuge populations of these five endangered bird species have rebounded from historic lows and over that last 20 years have slowly increased or remained stable. We also documented that Refuges are important to each species year-round and that a disproportionate percentage of the population for each species is found on them. Our understanding of why Refuges successfully house a disproportionate percentage of these "conservation reliant" species can inform current conservation efforts and increase long-term population viability for these species.

Vale, Cândida, *CIBIO/InBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos da UP*; **Stuart L Pimm**, *Duke University*; **José C Brito**, *CIBIO/InBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos da UP*

Micro-hotspots of biodiversity within hostile environments: the case of mountain rock pools in the Sahara desert.

The world is undergoing exceptional biodiversity loss, particularly in biodiversity hotspots. Most conservation efforts target these areas of exceptional endemic richness. Their identification is often carried at global/continental scales, thus likely missing regional patterns and small sized rich areas, i.e. local hotspots. The Sahara desert provides an excellent example. Generally, it is a species-poor area, but locally it exhibits high species richness in small and fragile humid habitats, like mountain lagoons. In Mauritania, recent studies have emphasized the conservation importance of these habitats, as they hold endemic fauna and range-margin populations of widely distributed species. We identified micro-hotspots of biodiversity, where high concentrations of species are threatened by human pressures and/or climate change, located in mountain rock pools (locally known as gueltas) of Mauritania (West Africa). The size of gueltas ranges between 0.001 ha and 1.0 ha and they concentrate about 36% of all Mauritanian vertebrates. The seasonal character of these habitats and relatively intense human use threatens biodiversity. Gueltas are crucial for long-term conservation of Mauritanian biodiversity. The patterns identified may be representative for all mountains of Sahara desert, where high concentrations of species are expected to be found in restricted and small sized gueltas. Such features constitute micro-hotspots of biodiversity deserving global attention.

Van Burm, Els, *University of Melbourne*; **Michael McCarthy**, *University of Melbourne*; **Geoff Heard**, *University of Melbourne*

Retrospective study of monitoring design to inform management of the endangered growling grass frog (*Litoria raniformis*) in Melbourne, Australia

Decision makers in conservation biology often have to make trade-offs about how to spend resources while dealing with considerable uncertainty. This uncertainty can be reduced by gathering more information about the system through monitoring. However, this extra knowledge does not always contribute to better decision making, meaning that resources spent on monitoring could have been spent elsewhere. This study investigated the case of creating new wetlands in Melbourne, Australia. These wetlands were created to offset urbanisation by reducing the extinction risk of an endangered frog (*Litoria raniformis*). The management question was to determine the number of new wetlands that need to be created to offset losses due to urbanisation. A stochastic patch occupancy model was used to describe the metapopulation dynamics of the frog. We investigated whether gathering more information about these dynamics contributed to the optimal decision. A simulation was run using different amounts of data and assuming particular costs for data collection and wetland creation. Results show that increasing the amount of data does not always change the estimate of the optimal number of extra wetlands. With this case study we conclude that the benefit of increasing the knowledge about a system will not always outweigh the cost of gathering the extra information.

Vance-Borland, Ken, *The Conservation Planning Institute*

How might insights gained from stakeholder network analysis be integrated into conservation decision-support tools?

Social networks play an important role in facilitating effective and sustained connections between regional systematic conservation plans and local conservation actions. Yet, social network analysis has not been incorporated into conservation planning initiatives, even though social network analysis has developed as a structured approach to identify characteristics of social networks that make them more or less effective at solving resource management problems. We discuss three contributions of social network analysis to conservation planning: (1) identifying stakeholders and their roles in social networks and characterizing relationships between them; (2) designing and facilitating strategic networking to strengthen linkages between local and regional resource management; and (3) prioritizing management and conservation actions using social connectivity measures alongside ecological data. Using data on coral reef areas in the Solomon Islands and a measure of the network centrality of NGOs operating in those areas, we found that Marxan identified high-biodiversity areas that were more likely to gain conservation implementation considering the network connections of NGOs working there. We propose that social network

analysis can be a valuable tool to inform decision making in conservation planning, and identify challenges and future research questions to be addressed before social network analysis can be fully operationalized into conservation planning processes.

Vargo, Tim, *Urban Ecology Center*

Using Citizen Science and community partnerships as tools for studying urban stopover habitats in Milwaukee, WI

Migratory birds utilize a variety of stopover habitats while on migration between their breeding and wintering grounds. One important set of habitats that are often neglected in these investigations, however, are those which fall within urban areas. These urban habitats include parks, disturbed habitats, residential areas, and natural areas. The Milwaukee BIOME (Biodiversity Monitoring and Education) project is a community partnership that formed to assess habitat use and quality of urban green spaces in Milwaukee County as stopover sites for migratory birds and bats. Over the course of seven years, the project has been successful in tapping into community networks and resources to provide quality research and monitoring experiences for close to 1,000 volunteers. The latest phase of this project has been to identify available resources such as e-bird and citsci.org and community partners such as the Urban Ecology Center, the University of Minnesota's Driven to Discover project and the Citizen-based Monitoring Network to provide opportunities for citizen scientists of all ages to analyze, visualize and present data. This presentation will look at the Milwaukee BIOME project as a case study in best practices for engaging the public in academic and applied research.

Veit, Peter, *World Resources Institute*

Legal Frameworks for Land Use in East Africa

In Africa, most land and many natural resources are the property of the state and/or vested in the government for the people. Governments have established separate, distinct rights regimes for land and many resources (e.g., oil, natural gas, minerals and wildlife), governed by different laws and administered by various institutions. Rural people may legally hold a relatively small bundle of land rights—usually limited to surface rights and some rights to certain natural resources (e.g., water rights for domestic use only). Often, rights to high-value natural resources are allocated to outside, foreign entities for large-scale operations. As a result, rights to various resources on/under a plot of land may be held by various individuals and entities. As governments promote economic development through private investments in their natural resources, instances of overlapping land and natural resource rights have become more common. Overlapping rights are a

growing source of rural conflict as rights holders pursue sometimes contradictory land use practices. We provide a legal review of mineral and petroleum laws in Liberia, Ghana, Uganda and Kenya to assess the authorities of resource holders operating on private land and the rights of landholders. We provide some comparative analyses across the two natural resources and across the research countries. The recommendations are designed to reduce conflicts over land use and better secure the wellbeing of landholders.

Veríssimo, Diogo, *Durrell Institute of Conservation and Ecology, University of Kent*; **Greg Vaughan**, *Geospatial Services*; **Douglas MacMillan**, *Durrell Institute of Conservation and Ecology*; . . .

Money talks: Understanding the drivers of online donations for conservation

Funding constrains have traditionally limited conservation interventions, with most organizations relying on individual donations as their key fundraising strategy. The WWF, for example, raised through this system in 2011, more than US\$ 415 million, about 53% of its total income. As such, an understanding of what drives individual donations is key to improve fundraising for conservation. One popular system of capturing individual donations is through symbolic animal adoptions. In this context, we set out to understand what were the factors driving animal adoptions on WWF-US website. To achieve this, we used a four year dataset on adoptions of 104 species. We used best-subsets regression and AICc values to identify the strongest model, which explained about a third of the variation in donations to different species. Species physical attributes such as appearance and body size played an important role in driving donations, with more attractive but smaller bodied species receiving more donations. Another key was the amount of online coverage that WWF-US dedicated to a species, with more coverage leading to an increased in donations. Lastly, the number of similar species within the dataset was also an important factor, with more distinctive species receiving more donations. This study is one of the first to investigate the drivers of real monetary donations to conservation, showing that both flagship species and marketing strategy can be crucial to fundraising.

Veysey Powell, Jessica, *University of New Hampshire*; **Kimberly Babbitt**, *University of New Hampshire*

What Size Buffer? Using a Landscape-Scale Experiment to Test How Buffer Width Affects Pool-Breeding Amphibian Demography

Forested buffers are a common management tool for pool-breeding amphibians in eastern North America, yet the demographic consequences of buffer size have not been

experimentally tested. We used clear cuts to manipulate buffer width at 11 vernal pools in central Maine. We assigned each pool to one of three treatments: uncut (i.e., reference), 100m buffer, or 30m buffer. From 2004 to 2009, we captured all adult spotted salamanders (*Ambystoma maculatum*) and wood frogs (*Lithobates sylvaticus*) using these pools. We assessed the relative importance of buffer treatment and other factors on abundance, recapture rates, sex ratios, and size. Buffer treatment affected salamander abundance, but pool hydroperiod mediated treatment effects. Wood frog abundance increased with mean hydroperiod across all treatments. For both species, the proportion of recaptured adults was lowest at 30m pools. Salamander sex ratio increased post-cut at both cut treatments, while frog sex ratio did not vary with treatment, year, or hydroperiod. Salamanders and frogs were smallest at 30m pools. Salamander, but not frog, recapture rates and size recovered with time. Our clear cuts were associated with short-term negative demographic consequences for these species, with 30m-treatment populations experiencing the most severe impacts. Conservation plans for these species should address both buffer width and pool hydroperiod.

Visconti, Piero, *Microsoft Research*

Perfect policy, imperfect implementation - balancing efficiency and likelihood of implementation in conservation planning

Systematic conservation planning focuses on optimizing trade-offs between conservation objectives and human activities. However, the most efficient plan can be very dissimilar to any other plan achieving the set of conservation objectives. This is problematic if all or part of the plan becomes unattainable, e.g. if sites are lost before they are acquired, and there are no replacement sites available. We demonstrate this by solving different conservation problems and showing in which conditions the optimal plan has limited chances to be implemented and where implementation attempts would miss the objectives. To balance optimality and likelihood of implementation we propose a new method for identifying conservation priorities and scheduling conservation actions. We generate a family of alternative plans and select that with the highest density of nearby plans in a non-metric multidimensional scaling space (i.e. plans with similar site composition). When perfect implementation is uncertain - a common reality - our method outperforms both all other heuristics tested and stochastic programming in terms of likelihood of achieving objectives and similarity of the conservation plan implemented with the plan intended. Our method can assist planning authorities to prioritize conservation efforts in the face of uncertainty about future sites' condition and availability.

Vogel, Sandra, *University of New South Wales*; **Jennifer Sinclair**, *University of New South Wales*; **William Sherwin**, *University of New South Wales*

A range-wide conservation genetic study of Little Penguins (*Eudyptula minor*): Augmenting population genetics at neutral loci with adaptive immune gene

Neutral genetic markers, i.e. genes not directly targeted by selection, are frequently used to quantify genetic diversity of populations and often provide the basis for management plans. However, patterns of variation and divergence in adaptive traits such as immune competence are not always correlated with variation in neutral markers. The validity of approaches using only neutral markers for development of conservation strategies is therefore questionable. The present study of conservation genetics and demography in *E. minor* aims to assess connectivity between penguin colonies along the Australian coast of New South Wales (NSW). A fine-scale analysis of genetic structure is being conducted to determine the extent of dispersal among these colonies and compare their genetic variability. In addition to using neutral genetic markers (microsatellites and mitochondrial DNA), we present the first study investigating non-neutral genetic diversity in penguins. Sequencing of an immune gene of the major histocompatibility complex (MHC) showed high allelic diversity at the functionally relevant peptide binding groove of the MHC molecule in penguins from Western Australia (WA). It is thus an ideal candidate gene to augment the population genetic study in NSW. This new genetic marker will be used to facilitate the choice of management strategies for *E. minor* and related species with a particular focus on resilience to pathogenic threats and immunogenetic population viability.

Von Holle, Betsy, *University of Central Florida*; **John Weishampel**, *University of Central Florida*; **Jennifer Irish**, *Virginia Polytechnic University*; **Scott Hagen**, *University of Central Florida*; **Annette Spivy**, *University of Central Florida*; **Monette Schwoerer**, *University of Central Florida*

Investigation of the effects of sea level rise on sea turtle, shorebird, seabird, and beach mouse nesting within the South Atlantic Bight

Sea level rise (SLR) and disturbances from increased storm activity are expected to diminish coastal habitats available for sea turtle, seabird, shorebird, and beach mouse nesting by removing habitat as well as inundating nests during critical incubation periods. The goal of our research is to evaluate past nesting patterns of fourteen coastal nesting species and predict future effects of sea level rise on nesting beaches along the South Atlantic Bight. Our study links long-term survey data for three species of sea turtle, three species of shorebird, five species of seabird, and two beach mouse species to maps of coastal vulnerability to sea level rise (SLR) in order to understand the effects of sea level rise on population viability.

First, we will present habitat suitability maps for coastal nesting species along the South Atlantic Bight. Second, we will integrate a model of future SLR along with long term field biological observations in order to predict vulnerability to nesting habitat loss for sea turtle, seabird and shorebird, and beach mouse species within our study region. Maps of coastal vulnerability to SLR combined with historical data sets of long-term and spatially extensive nesting habitat will lead to models that enhance our understanding of the complex environmental changes occurring from global climate change and their effects on globally imperiled species.

Waits, Lisette, *University of Idaho, Moscow, ID*

Approaches for ensuring accuracy in aquatic environmental DNA studies

Environmental DNA (eDNA) analyses provide great potential for detecting rare species, monitoring invasion fronts, re-discovering species thought to be extirpated, confirming successful removal of non-native species, and quantifying biodiversity. This novel method allows researchers to detect the DNA of species of interest from a water sample and has been shown to improve detection probability and cost efficiency compared to traditional field surveys. Since 2008 when the method was first demonstrated, the application of eDNA approaches has expanded rapidly. These eDNA samples are likely to be degraded, include inhibitors, and contain low quantities of target species DNA, requiring special precautions. As the use of this method escalates for monitoring purposes, it is critical to consider possible sources of error and develop field and laboratory protocols to ensure accurate results. This talk will review key approaches for avoiding error and contamination during the following stages: sample collection and handling, molecular assay design, DNA extraction, and molecular assay implementation. Careful consideration of sources of error and approaches for minimizing and avoiding these errors is key to the future development of eDNA methods for conservation biology.

Walsh, Jessica, *The University of Cambridge*; **William Sutherland**, *University of Cambridge*; **Lynn Dicks**, *University of Cambridge*

Does it matter that practitioners have poor access to the scientific literature?

Research on the effectiveness of conservation interventions is supposedly carried out for the benefit of practitioners. However, limited access to scientific literature is one of the barriers preventing practitioners from using science to inform their management decisions and its consequences for conservation practice are unknown. This study aims to test if improved access to scientific evidence in a concise,

summarised format could change practice. We studied the views of conservation practitioners on 28 management interventions to reduce predation on birds by invasive or other problematic species, which is an important global conservation issue. These were collected using two online questionnaires, before and after providing the practitioners with a summary of the scientific literature on the effectiveness of these interventions. Conservation practitioners were likely to change their views about an intervention on average 45.7% of the time after reading the literature. They were more likely to implement effective interventions and avoid ineffective actions. Practitioners who had more experience in the conservation field were less likely to change their management practices, despite having a lower awareness of the existing science. The practitioners' willingness to change their opinions when the evidence was easily accessible and clearly summarised, suggests that poor access to scientific literature can affect management decisions and limit overall conservation outcomes.

Walters, Linda, *University of Central Florida*; **Joshua Solomon**, *University of Central Florida*; **Jennifer Manis**, *University of Central Florida*; **Melinda Donnelly**, *University of Central Florida*; **Paul Sacks**, *University of Central Florida*

Simulating the impact of sea level rise on the intertidal oyster *Crassostrea virginica*

The eastern oyster *Crassostrea virginica* is an ecologically and commercially important species along the western Atlantic seaboard and Gulf of Mexico. With a goal of modeling the impact of sea level rise on intertidal *C. virginica* in the northern Gulf of Mexico, we deployed 10 oyster ladders in Apalachicola Bay, FL and 10 in Grand Bay, MS. Each ladder provides 36 oyster shells and 1 sediment trap at each of 5 intertidal heights (range: 30 cm increments from near mean low water to near mean high water). Hence, inundation time was our proxy for sea level rise. Oyster ladder data being collected for our model includes: oyster recruitment, oyster growth rates, oyster orientation, biodiversity (richness and abundance) of sessile and motile species, sediment loads, total suspended solids and abiotic variables. More sediment accumulated in traps closer to the benthos. Significant differences were also found with oyster recruitment - numbers peaked at intermediate submersion times while growth was greatest with longest submersion. Our data and subsequent model will be essential to resource managers and restoration specialists working to protect shellfish reefs over the long-term.

Wang, Fang, *Smithsonian Conservation Biology Institute*; **McShea William**, *Smithsonian Conservation Biology Institute*; **Dajun Wang**, *Peking University*; **Sheng Li**, *University of Wisconsin*

Restoring Effective Migration Corridors in Giant Panda Habitat: A Species-specific Study

Giant panda are restricted to 30 isolated populations, 13 of which are small enough to be considered a high extinction risk. However, without adequate knowledge about how pandas move across landscapes, corridor establishment between existing populations is hypothetical. Assessing panda movement across the landscape outside of reserves, as well as movement for other large species, is the first step of an effective management plan. We surveyed 205 sites with camera traps, sign transects and vegetation plots along a presumptive panda corridor from 2010-2012 in Qinling Mountains, China. Occupancy models were constructed for 11 large mammal species to determine the relationship between species distribution, environmental variables and human infrastructure. The results were used to establish habitat suitability map and dispersal resistance surface. A network of hypothetical dispersal corridors was generated using least cost analysis. In addition, a scenario analysis was conducted to predict the effectiveness of different management options. The results suggest corridor connectivity varies among mammal species; small and medium-sized ungulates appeared neutral to human infrastructure, while small carnivores exhibited preference to human-caused fragmentations. Panda, black bear and takin avoided areas close to human infrastructure and lack migration corridors. Two potential movement corridors which cross highways are critical and should be considered conservation priorities.

Watson, James, *Wildlife Conservation Society*

Climate change corridors across the Albertine Rift: comparing species distribution models, vegetation models and models based on geophysical stages

One of the most species rich regions in Africa, the Albertine Rift region contains many threatened and endemic species that occur on mountain tops and as a result are likely to be sensitive to climate change. The high human population density in this region will exacerbate the impacts of climate change and there is a need to assess where dispersal corridors need to be conserved before they are lost to other land uses. Here we used three approaches to determine where corridors should be located: a) Modeling the current and predicted (in 2080) distributions of 93 endemic and threatened large mammals, birds and plants; b) modeling five key vegetation types both currently and in 2080; and c) identifying gradients in abiotic conditions which are likely to support a diverse set of habitat types today and under future climate change. This is the first time that such a three-pronged approach has been used to identify corridors. Results found key overlap areas for both species and vegetation types, many of which are found inside protected areas, and also identified critical corridors outside protected areas. Some key areas are the forested area

between Maiko/Tayna and Kahuzi Biega Parks in DR Congo and between Ugalla and Moyowosi /Kigozi Game Reserves in western Tanzania.

Watson, James, *Wildlife Conservation Society*; **Daniel B. Segan**, *Wildlife Conservation Society*; **Andrew J. Plumptre**, ; **Sam Ayebare**, ; **Grace Nangendo**,

Optimizing tradeoffs in woodland ecosystems: carbon, conservation and communities

Rapid population growth, human-forced climate change and the quest of economic development is changing how governments and local communities view the landscapes they live in. In the past decade we have seen significant changes to ecosystems as they have been reshaped to meet the demands of a variety of stakeholders from subsistence farmers, to forestry and extractive industries. In allocating scarce conservation resources from funding sources like REDD+, stakeholders that include governments, local communities and large scale industrial developers have been challenged to deliver co-benefits for biodiversity conservation and sustainable livelihoods through the protection of ecosystem services. However it is not clear whether there are always win-wins for the environment and the development community. Using the Marxan decision support tool, we outline a scenario planning based approach to landscape analysis designed to allow different stakeholders to identify clear land-use objectives, explore trade-offs in achieving those objectives and promote thoughtful and informed land-use decisions. We discuss the experiences in applying the methodology in three East African landscapes.

Webb, Christine, *Columbia University*; **Tory Higgins**, *Columbia University*

Regulatory focus theory as a framework with potential utility for conservation psychology

A central tenet of conservation psychology is that cultivating environmental concern requires an understanding of what motivates people to act. Surprisingly however, few formal theories of human motivation have been applied to this question. Regulatory focus theory (RFT) provides a promising new approach. RFT posits that people are primarily motivated via one of two self-regulatory orientations: promotion or prevention. While promotion emphasizes advancement toward desired ends, prevention emphasizes maintenance of current states. In this study, participants are given a wildlife conservation pamphlet in either a promotion- or prevention-frame. We then assess their level of motivation, defined as their concern for the initiatives in those brochures and their willingness to act (by donating a proportion of their compensation to support relevant causes). We are interested in the effectiveness of wildlife conservation

communications depending on: 1) whether they are framed as a promotion or a prevention message, 2) chronic (or induced) promotion/prevention differences in the audience to which one is presenting the message, and 3) the 'fit' between the way the message is framed and the orientation of the audience. The results of this ongoing study will shed light on the potential utility of applying RFT to wildlife conservation communications effectiveness, and can illuminate a fruitful intersection between formal human motivational theory and conservation psychology more broadly.

Weeks, Emily, *National Land Resource Centre*; **Susan Walker**, *Landcare Research*; **Jake Overton**, *Landcare Research*

The value of validated vulnerability data in conservation planning

Data needed for informed conservation prioritization are generally greater than the data available, and surrogates are often used. Although the need to anticipate dynamic threats is recognized, the effectiveness of surrogates for vulnerability to habitat conversion is seldom tested. Here we consider the importance of using validated vulnerability data in conservation planning tools that assist prioritization of conservation land in grasslands. We compared properties of two different vulnerability surrogates that have been applied in our study area to a validated prediction of habitat conversion-vulnerability based on recent assessment of land-use change. We found that neither surrogate was a particularly effective predictor of validated vulnerability. Importantly, both surrogates performed poorly in places where grasslands were most imminently threatened with habitat conversion. Our study suggests the integration of validated estimates of vulnerability into conservation planning tools may be an important requirement for effective conservation planning under dynamic threats and in rapidly changing landscapes. We apply our results to discuss the practical considerations and potential value of incorporating validated vulnerability into conservation planning tools both generally and in the context of New Zealand's indigenous grasslands.

Wegmann, Martin, *CEOS SBA Biodiversity at German Aerospace Center, U. Wuerzburg*; **Nathalie Pettoelli**, *Institute of Zoology, Zoological Society of London*

Unifying Conservation and Remote Sensing approaches

Climate change and landcover modification are one of the major challenges for conservation and biodiversity loss. Pereira et al. (2013) identified this challenge and argue for a coordinated global monitoring program. Necessary parameter to monitor biodiversity similar to the Essential Climate Variables are discussed within the Essential Biodiversity Variable discussion. This EBV system is currently defining

relevant globally applicable variables and some of these variables can be derived by means of remote sensing. Space borne measurements like habitat extent or its vertical structure and its changes over time is relevant for e.g. CBD targets and especially for on the ground conservation efforts. These new measurements need a strong interdisciplinary coordination effort in order to provide valuable variables for biodiversity monitoring as well as grasping the full capacity of remote sensing technology. The development and launch of new space borne sensors which are filling identified gaps needs a strong political joint effort. These sensors could be space borne LIDAR and hyperspectral data sets as well as multi-spectral data sets with a strong emphasis on providing long-term comparable information. We will present a range of case studies how remote sensing is used currently to derive valuable parameters for monitoring and as well future perspectives of integrated remote sensing biodiversity variable development including the political initiatives driving it.

Weller, John B., *Filmmaker & Author*

Protecting the Ross Sea: A Journey to and through the Last Ocean

The Ross Sea is special. The National Science Foundation stated back in 1998, "Little, if any of the ocean remains unaffected by fisheries, agricultural runoff, sewage, aquaculture and industry." The oceans are in serious trouble. The situation is getting worse. For one, we are catching fewer fish. Estimates are that we've eaten our way through 90% of the top predatory fish in the ocean since 1950. We have pushed many ocean ecosystems to the brink of collapse worldwide. The evidence, if we dare to look at it, is clear. But the Ross Sea, protected by its 500-mile-wide shield of ice, has remained largely insulated from this depletion. Many scientists have stated they believe that the Ross Sea may be the most healthy open ocean ecosystem left on earth. John started working on The Last Ocean, an outreach project directed specifically at the Ross Sea, with Antarctic Ecologist Dr. David Ainley in 2004. Since then he has worked full time on the project as fundraiser, organizer, designer, writer, photographer and filmmaker. His efforts have catalyzed an international movement to protect the Ross Sea. John is a SeaWeb Fellow and was awarded a prestigious Pew Fellowship in Marine Conservation in 2009. Weller's first short film on the Ross Sea was a finalist in the 2010 Blue Ocean Festival. The film has gained wide acclaim from peers in the photographic, filmmaking, and conservation worlds.

Wepprich, Tyson, *North Carolina State University*; **Erik Aschehoug**, *North Carolina State University*; **Heather Lessig**, *North Carolina State University*; **Frances Sivakoff**, *North Carolina State University*; **Nick Haddad**, *North Carolina State University*

Leave it to beavers: habitat restoration and source-sink dynamics in an endangered butterfly metapopulation

Although managers commonly use habitat restoration to conserve rare species, we rarely test whether we inadvertently create population sinks or ecological traps, which decrease population viability. The endangered Saint Francis' satyr butterfly (*Neonympha mitchellii francisci*) lives only on Ft. Bragg military base in North Carolina, USA and requires disturbance-dependent wetland habitat historically maintained by beavers and wildfires. We removed hardwoods and dammed creeks in a factorial design to experimentally test how restoration affects source-sink dynamics in a butterfly metapopulation. We demonstrate how top-down (predation) and bottom-up (host plant resources) processes change habitat quality for different life-stages. Predator exclusion experiments show that restoration increases egg predation and that partial inundation increases caterpillar survival. Hardwood removal made host plants less nutritious (higher %C) but more palatable (lower silica content) for caterpillars. We released butterflies and observed their movement behavior to measure how adults assess and respond to habitat quality. Movement behavior did not differ with restoration treatments. We discuss future experiments to determine which life-stages drive source-sink dynamics and share lessons for management of endangered species that are dependent on ephemeral habitat.

Wheat, Rachel, *University of California, Santa Cruz*; **Yiwei Wang**, *University of California, Santa Cruz*; **Jarrett Byrnes**, *University of Massachusetts, Boston*; **Jai Ranganathan**, *National Center for Ecological Analysis and Synthesis*

Crowdfunding for Conservation: Using Social Media to Build Support

Presently, the great majority of scientific research never reaches a broader audience, contributing to mistrust and misunderstanding of science among the general public and hindering conservation initiatives. Crowdfunding is a new funding model that has the potential to shift this paradigm by encouraging scientific transparency and public involvement in the earliest stages of the research process. Since cultivating early connections with a wide audience often determines the success of crowdfunding drives, this type of funding model can foster ties between scientists and nonscientists and develop early and lasting support for conservation projects. This presentation will highlight the utility of crowdfunding for individuals and conservation groups, the determinants of success, and how social media can aid in establishing positive relationships among researchers, project supporters, and stakeholders.

Whiteman, Liz, *California Ocean Science Trust*; **Tess Freidenburg**, *California Ocean Science Trust*

Developing a Report Card for California's MPAs California Ocean Science Trust

Ecosystem protection goals are increasingly the foundation of conservation policies worldwide, and assessments of ecosystem condition are being used to support evaluation of management effectiveness. However, assessing the condition, or 'health', of an ecosystem is not a straight-forward task. Often, managers rely on expert judgments, in which a diverse group of experts develops an assessment of condition based on a broad range of scientific data and results. These assessments are often communicated to policy-makers, managers and stakeholders using various report cards. Currently, despite some common theoretical underpinning, there is no clear framework for using expert judgment to develop such assessments. The lack of consistency of approach renders the tool of expert judgment, and the judgments themselves, vulnerable to attack and dismissal as "opinion", jeopardizing the use of this essential tool just as the needed transition to ecosystem-based management approaches is gaining momentum globally. Using data collected in support of MPA monitoring in California, we are implementing an expert judgment process designed to provide assessments of the condition or 'health' of these regional ecosystems. A key outcome of this project is the development of a report card to communicate the results of these health assessments in a way that is clear, intuitive and useful for informing management.

Whitton, Jeannette, *University of British Columbia*

An Analysis Of Recovery Strategies For Canada's Species At Risk

Science-based recovery strategies are powerful tools with the potential to guide species recovery. In Canada, listed species require a finalized recovery strategy within one-two years of listing for endangered, threatened and extirpated species. We analyzed over 200 finalized recovery strategies produced since Canada's Species at Risk legislation came into force in 2003. We scored the strategies for species traits, timeline to completion, threats, recovery objectives and description of critical habitat. We found that production of recovery strategies lags far behind set timelines, with the pace and likelihood of including critical habitat increasing since 2009. Analysis of threats reveals that recreation, and residential and commercial development are the most common threats in recovery strategies, and that certain threats decreased the probability of having received a finalized recovery strategy. Analysis of recovery objectives indicates that the most common targets involve maintaining numbers of individuals, populations and area, with no apparent relationship of the objectives to the criteria used in status assessment. For example, species assessed as endangered based on population declines were no more likely to target increases. On the

whole, our analysis finds that a low bar is being set in the documents intended to set benchmarks for species recovery, raising serious concerns about the prognosis for recovery of Canada's Species at Risk.

Wilberg, Mike, *University of Maryland Center for Environmental Science, Chesapeake Biological Lab*; **John R. Wiedenmann**, *University of Maryland Center for Environmental Science, Chesapeake Biological Lab and Institute of Marine and Coastal Sciences, Rutgers University*; **Jason M. Robinson**, *University of Maryland Center for Environmental Science, Chesapeake Biological Lab*

Fits and starts with oyster conservation in Chesapeake Bay

Oysters (*Crassostrea virginica*) are important ecosystem engineers in Chesapeake Bay because of their capacity to modify coastal and estuarine habitats and the highly degraded status. However, models to predict dynamics of ecosystem engineers have not previously included the effects of exploitation. We developed a linked population and habitat model for autogenic ecosystem engineers undergoing exploitation and parameterized the model to represent eastern oyster in upper Chesapeake Bay. We evaluated the effects of a range of management and restoration options including sustainability of historical fishing pressure, effectiveness of a newly enacted sanctuary program, and relative performance of two restoration approaches. Historical fishing mortality rates in upper Chesapeake Bay for oysters were above the levels that would lead to extirpation. Reductions in fishing, such as was done with the recent implementation of large-scale sanctuaries, were projected to lead to long-term increases in abundance and habitat. For fisheries to become sustainable outside of sanctuaries, a substantial larval subsidy would be required from oysters within sanctuaries. Restoration efforts using high-relief reefs were predicted to allow recovery within a shorter period of time than low relief reefs. Models, such as ours, that allow for feedbacks between population and habitat dynamics can be effective tools for guiding management and restoration of autogenic ecosystem engineers.

Wilkerson, Cynthia, *The Wilderness Society*

Moving Climate Science into Policy: Connecting Land and Water for Fish, Farms and Families in Washington State

Application of climate science goes beyond research. Washington's Yakima Basin is the 12th largest agricultural producing region in America. Once home to fish runs upwards of 800,000, Yakima Basin numbers have plummeted due to land and water use. This tenuous situation is made worse by climate projections - already reality with five economically devastating drought years since 1995. Instream

flow and water supply modeling demonstrate that adding 500,000 acre-feet of water storage could meet future supply needs for native fish recovery while accommodating agricultural and municipal needs. A multi-stakeholder group created the Yakima Basin Integrated Plan, an innovative plan that meets water supply needs in the face of climate projections. Results indicate that agricultural demand can be met and fish recovery will result in the largest sockeye run in the lower 48 states. The presentation will explore key conservation components of the plan and lessons learned through development and early implementation. Conservation tools include land acquisition, headwaters protection, public lands designation, recreation management and habitat restoration. Conclusion: to implement the direction of climate science, skilled conservation biologists, negotiators, and advocates must engage tribes, local governments, and recreationists. Lessons: 1) Diverse stakeholders must sit at the table; 2) Internal and external communication is crucial; and 3) leaders must rapidly adapt to new developments.

Willette, Michelle, *University of Minnesota The Raptor Center*; **Julia Ponder**, *University of Minnesota The Raptor Center*

Wildlife health monitoring systems in North America: from sentinel species to public policy

The case for monitoring wildlife health is compelling. The potential benefits include: detection of emerging infectious or zoonotic diseases; control of certain diseases in domestic animals, especially livestock; ascertaining effects of habitat change or invasive species; increased understanding of disease ecology and wildlife biology; and wildlife preservation. While there are systems in place for monitoring emerging disease in humans and some domestic animals, there is currently no comprehensive, integrated, national strategy for the monitoring or surveillance of wildlife disease in the United States. There are inherent challenges to creating an effective system for wildlife disease monitoring and surveillance. A surveillance system is dependent on the ability to collect an adequate number of biological samples from a representative wildlife population, analyze those samples for the presence of disease agents, interpret the results, identify trends and respond to emerging issues. Such a system requires a mandate, strategic planning and significant training and funding resources for implementation. Veterinarians involved in wildlife rehabilitation have a critical role in monitoring wildlife health, need to practice a more enlightened and comprehensive level of medicine, and should use the resultant information to educate and inform public policy.

Williams, David, *African Wildlife Foundation*; **Philip Muruthi**, *African Wildlife Foundation*; **Daudi Sumba**, *African Wildlife Foundation*

Community-based Conservation in Africa: utilizing high resolution satellite imagery towards a simpler approach to assess conservation impact

Community-based Conservation (CBC) has been advocated as a means to address the degradation of the wildlife habitat outside formal protected areas. Assessments of CBC conservation impact in Africa, however, have been hampered by a lack of quantitative data and analysis as monitoring and evaluation efforts were constrained from a lack of practical and cost-effective tools, especially for use by overstretched conservation and development staff. We used GIS to perform relatively simple but cogent spatial analyses to assess threat management for 2 tourism-based CBC projects in Kenya. Comparing high resolution imagery from project onset to the present, we applied straightforward image interpretation techniques to capture changes in land use and settlement patterns across CBC land management zones. In both cases, we found the CBC projects adhered well to their land use plans in not permitting settlement or cultivation in the conservation land use zones. CBC land management practices prevented further habitat degradation in valuable wildlife corridors and buffer zones contributing to significant threat reductions and increased wildlife use. Our approach is relatively easy to apply, uses increasingly affordable and available imagery, generates results that are easily communicated and replicated over time, and as such should complement the growing toolset for evidence-based conservation.

Wittmaack, Christiana, *Nova Southeastern University Oceanographic Center*; **Caryn Self-Sullivan**, *Nova Southeastern University Oceanographic Center*; **Curtis Burney**, *Nova Southeastern University Oceanographic Center*; **Garet Lahvis**, *Oregon Health and Science University*; **Denise Greig**, *the Marine Mammal Center*; **William Van Bonn**, *the Marine Mammal Center*; **Dr. Edward Keith**, *Nova Southeastern University Oceanographic Center*

Developing a New Diagnostic Technique for Domoic Acid Toxicosis in *Zalophus californianus*, a Sentinel Species of Oceanic Health

Domoic acid (DA) is a bio-accumulated neurotoxin produced by the diatom *Pseudonitzschia australis* that targets the hippocampus in the California sea lion (*Zalophus californianus*). Laboratory diagnostics are challenging due to a short excretion time. Similarity of clinical signs to other diagnoses further complicates diagnostics. Annual strandings of *Z. californianus* have occurred since 1998 (excluding 1999) and the abundance of DA producing blooms of *P. australis* appears to be increasing. The goal of our research is to formulate behavioral criteria for diagnostics. From May

2011 - December 2012 we observed 152 *Z. californianus* undergoing rehabilitation at the Marine Mammal Center in Sausalito California. Focal animal continuous scans were done for up to 15 minutes on each animal by a single observer. Abnormal behaviors were quantified from an ethogram. Animals with DA toxicosis performed head weaving (Wilcoxon's $Z=6.38050$ $p.001$) more often than animals with other diagnoses. Animals with DA toxicosis experienced muscle fasciculations both at the center and on the beach during rescue (Fisher's Exact Test, P

Wolfe, Barb, *The Wilds*

Sorta situ': The New Reality of Management Conditions for Wildlife Populations in the Absence of 'Wild' Spaces

Many anthropogenic drivers are compromising ecosystems and rapidly changing the landscape and the availability of 'wild' spaces. One outcome of these changes is the manifestation of a new global reality for wildlife. Where truly 'wild' populations are increasingly rare and more animals are managed in protected zones, refuges and conservation centers, the difference between in situ (wild populations in native habitat) and ex situ (captive populations in non-native habitat) becomes less distinct. In fact, most wildlife populations of today and tomorrow exist on a continuum between in situ and ex situ. We define this new reality as 'sorta situ' – neither one nor the other– to describe the changing nature of population management in the 21st century. The continuum of conditions for sorta situ populations can be viewed across two key variables: available habitat including space, habitat quality and the maintenance of ecosystem processes; and management intensity including health care and protection from outside threats. In the past, wildlife populations lived in their native habitat, without human intervention. Diseases and populations were, for the most part, self-limiting, and terrestrial animals were free to move in response to seasonal and dietary needs. On the other end of the spectrum, zoos managed animals outside their native habitat in small captive groups, treating disease and injury on an individual basis and controlling nutritional input and reproductive output. Today, fences, borders and human habitation limit the spaces wild populations can occupy, and small, fragmented populations require careful monitoring and management to avoid devastating population declines and extinction.

Wongbusarakum, Supin, *The Nature Conservancy*

Achieving forest conservation and human well-being: REDD+ efforts in Indonesia and Brazil

Originally established as an international funding mechanism by developed countries to reduce carbon emissions from deforestation and forest degradation (REDD), REDD+ has

become a means in many developing countries to finance and enhance local collaborations and policy development that support forest conservation, natural resource management, and the welfare of local communities. This presentation examines the efforts of The Nature Conservancy (TNC)'s Forest Carbon Programs to bridge forest conservation and human well-being. It focuses on a participatory process of identifying human well-being objectives, and indicators to measure the impacts of forest conservation on different aspects of human well-being. Two REDD+ projects will be used to illustrate the process. The first is in Berau, Indonesia. TNC works closely with local communities and governments to improve the societal welfare of forest dependent communities. Their well-being is defined as having 3 main constituents: 1) security through community forest management rights, 2) opportunities in livelihood and social services, and 3) empowerment. The second is in Central Xingu, in the Brazilian Amazon. There, the REDD+ effort is led by a coalition of multiple stakeholders to operate a program of incentives to reduce deforestation and degradation and to promote sustainable development. Both cases offer important lessons for how forest conservation and bettering human welfare are interdependent and mutually beneficial.

Woolery, Lee Ann, *University of Missouri*

Explore science: Enter through the arts; Art-Based Perceptual Ecology, a novel research strategy used in collaboration with scientific inquiry

The environmental challenges of the 21st century—notably loss of biodiversity—require creative and inspiring collaborations and demand that we work across disciplines. Science and art can complement one another and offer an integrative approach to conservation science. This presentation will highlight a natural resource inventory at Saguaro National Park, AZ, employing Art-Based Perceptual Ecology (ABPE), a novel research strategy used in collaboration with traditional scientific inquiry. Findings from the researcher's study: "Art-Based Perceptual Ecology as a way of knowing the language of place," demonstrate that practicing ABPE provides a shift in awareness, opening the researcher to detail in the landscape at scales previously unnoticed. The ABPE practice lends itself well to conservation, as accessibility to multiple scales in ecosystems is of great relevance to scientists studying global environmental change. Art-Based Perceptual Ecology does not reveal all of the answers, but it does offer a new language that may generate good questions and work synergistically with scientific inquiry to provide new solutions for scientists working in conservation and restoration efforts. Today we are in need of bringing more attention to the field of science—novel research strategies such as ABPE may be one way to inspire and attract creative minds to the field of science through the portal of the arts.

Wraithall, David, *United Nations University, Institute of Environment and Human Security*; **Kendra McSweeney**, *Ohio State University*; **Erik Nielsen**, *Northern Arizona University*

Mesomerica's Narco-Laundered Forests

Bridging as it does key global regions of cocaine supply and demand, Central America has become a primary conduit for trafficking from South America to the United States. As interdiction closed other northward pathways through the 1990s and 2000s, a Golden Spike for drug flows has emerged: the Meso American Biological Corridor (MABC). These remaining forests between Nicaragua, Honduras and Guatemala now serve as the primary relay point for trafficking activities, but other related activities -repackaging, smuggling and money laundering- have left a more enduring impact on forests. Satellite imagery shows a rapid spatial and temporal pattern of deforestation that coincides with trafficking relay points. For decades, a tension has existed in MABC conservation strategy around the questionable conservation dividend of indigenous-led forest management, and this tension has contributed to the weak land entitlement to indigenous communities. But now, drug trafficking is both driving deforestation and displacing indigenous communities, who are the last hope for an integrated solution.

Wu, Lan, *Center for Nature and Society, Peking University*; **Juan Li**, *Center for Nature and Society, Peking University*; **Ruiling Song**, *Center for Nature and Society, Peking University*; **Zhi Lu**, *Center for Nature and Society, Peking University*; **Dajun Wang**, *Center for Nature and Society, Peking University*; **George Schaller**, *Panthera*

Living in a Bear Country: Ecological Study of Human-Brown Bear Conflicts in Sangjiangyuan Area, Tibetan Plateau, China

Brown bear *Ursus arctos* is the largest carnivore on Tibetan plateau. Human-bear conflicts such as house damaging and livestock killing have become serious problems in the past decade and retaliatory huntings were increasing. Understanding ecological process of them will be the first step in making a conservation plan. We conducted sign surveys and community-based interviews since 2009. 3 bears were captured and tracked with GPS collars, which was the first time to collar brown bear in China. In addition, 12 electric fences were set for a pilot houses-protection experiment. GPS collar data suggests both male and female bears had ~2,000 km² annual home range area, which is large for females compare to other studies. 27% feces contained human-related food and the main natural food is marmot. The peaks of house damaging occurred in May and Aug, when local people moving to summer range and leaving their food storage unguarded while most marmots were

hibernating. In addition, 77% of livestock killing happened in Sep and Nov, right before bears went into hibernating. Binary logistic regression shows that conflicts are significantly correlated to the efforts people paid to looking after their house. The study indicates that brown bears are more likely to seek human-related food when the availability of natural food drops down. Therefore measurements should be taken to protect bears' prey, taking care of houses, as building electric fences partially reduced human-brown bear conflicts

Wyborn, Carina, *University of Montana*

Overcoming the 'coordination challenge': Connecting actors across scales to build effective relationships between science and practice

Over the past decade landscape scale conservation has risen to surprising prominence in Australia. These efforts are ambitious in their scale and scope, seeking to connect public, private and civil society actors to align conservation efforts across very large spatial and temporal scales. While these efforts have significant government and civil society support, they face significant challenges of collaboration and communication across vast, diverse landscapes, communities and agendas. Building on a long history of collaborative conservation practice, these efforts provide fertile lessons for a newly emerging National Network for Wildlife Conservation in the US. This presentation draws on the experiences of Habitat 141°, an emerging initiative which faced significant challenges at the outset of the collaboration. Despite strong support for the goals and aspirations of the initiative, Habitat 141° struggled due to an inability to reconcile fundamentally different perspectives on how to turn their vision into action. These challenges can be traced to a lack of funding and capacity as well as an inability to build the necessary relationships to link science with practice. The story is not entirely negative, as a number of local to regional scale initiatives emerged from Habitat 141°'s conservation planning efforts. This presentation will give an overview of the structure of Habitat 141°, critical factors shaping the negotiations and lessons to be learned from their experiences.

Yaffee, Steven, *University of Michigan*; **Julia Wondolleck**,

Ecosystem-Based Management on Land and in the Sea

Based on 20 years of research on ecosystem-based management in diverse social and ecological contexts, Steven Yaffee and Julia Wondolleck will report on the similarities and differences among land and ocean-focused ecosystem-based approaches. They will highlight a just released online database that includes 65 marine ecosystem-based management cases from around the world, and the lessons learned from this large set of comparative cases. Key themes addressed in these analyses include management strategies

pursued, accomplishments, facilitating factors, challenges, governance, monitoring, evaluation, and ways in which science was used to advance ecosystem-based management in different settings. They will conclude with a perspective on how the policy environment surrounding the adoption of terrestrial EBM evolved in ways that undermined a shift in management toward an ecosystem approach, and ask whether the conditions underlying management of marine systems are likely to follow the same pathway.

Yohannes, Liabeth, *University of Maryland, College Park*

The importance of babassu (*Attalea speciosa*) for the livelihoods of the extractivist communities of Extremo Norte Extractive Reserve, Brazil

Landless extractivists are often the poorest, most marginalized sector of Brazilian society whose livelihoods depend on natural resources. This research focuses on the importance of babassu (*Attalea speciosa*), a native palm of Brazil, for women quebradeiras ('nut breakers' in Portuguese) who harvest babassu for cash income, charcoal, cooking oil, construction material and other products. The objective of the research was three-fold: (1) reveal the current livelihood strategies of babassu extractivist communities of the Extremo Norte Extractive Reserve, a RESEX established in 1992 by the Brazilian government to provide quebradeiras with natural areas for harvest, but remains a paper-park; (2) highlight the challenges quebradeiras face; and (3) understand the role of diverse stakeholders in supporting or hindering babassu extractivist activity. I used surveys and semi-structured interviews to collect quantitative and qualitative data from people who derive income or subsistence products from babassu in Tocantins, Brazil. I conclude that implementation of the RESEX would provide greater economic opportunities for the region's landless babassu extractivists, but without strengthening the market for babassu products, babassu activity will decline and the RESEX will likely fail. Such an outcome would represent a lost opportunity for forest conservation at the deforestation frontier and loss of a local culture and economy featuring the sustainable harvest of forest products.

Young, Jennifer, *Fisheries and Oceans Canada*; **Marten Koops**, *Fisheries and Oceans Canada*; **Todd Morris**, *Fisheries and Oceans Canada*

Modelling Mussel Population Dynamics with Fish Host Density Dependence: Research Needs to Answer Management Questions

Roughly two thirds of freshwater mussels native to North America are considered imperilled, and there is a strong need for modelling of these species to inform management and recovery of at-risk populations. Growth of native mussel

populations may be hindered by their dependence on the presence of suitable fish hosts for the obligate parasitic life stage; management of host fish species for at risk mussels may also be necessary. Existing mussel population modelling has assumed that host populations are non-limiting and can be ignored. Using the framework of population matrix modelling we incorporate host density dependence to test the sensitivity of the model to the assumption of non-limiting hosts. Model results showed that a mussel population whose host is limiting is much more sensitive to the parasitic phase than a mussel population with a non-limiting host. Mussel abundance depended on: host abundance, host population trajectory, mussel life history, and host capacity for mussel transformation. When the host population was stable, a predictable, stable mussel abundance was reached. This equilibrium was sensitive to the life history of the mussel species, and to the availability of juvenile hosts but not that of adult hosts. Our work highlights areas of freshwater mussel research that are most important for answering management questions, such as the poorly understood relationship between host/mussel abundance and successful attachment to the host.

Yu. Fengqing, *Wildlife Ark, China*

Mercy Release Should not be Commercialized

Mercy release is a traditional Buddhist practice, which encourages followers to save captured animals and release them. However, more animals are captured and harmed due to the practice. For example, magpies became hunting targets since some Buddhists believed releasing them would bring good fortune and ordered them. Suggestions offered for being more merciful include: (1) Consult an expert to assure the animals to be released are able to survive in a new environment and will not compete with native species; (2) observe animal habitats, report poaching, and protect animals against poaching instead of releasing poached animals; and, (3) do not buy or sell animals to release.

Yuan. Wei, *University of Central Florida*; **Linda Walters**, *University of Central Florida*; **Eric Hoffman**, *University of Central Florida*

Larval settlement of *Crassostrea virginica* with non-native *Perna viridis*, *Mytella charruana*, and *Megabalanus coccopoma*

Since the introduction of *Perna viridis* (Asian green mussel), *Mytella charruana* (charru mussel) and *Megabalanus coccopoma* (acorn pink titan barnacle) into Florida waters, they have expanded both north and south along the Atlantic coast from their initial sites of introduction. Little is known about how these non-native species affect the already vulnerable *Crassostrea virginica* (Eastern oyster). A manipulative experiment was designed to test if *P. viridis*, *M.*

charruana and *M. coccopoma* prevent *C. virginica* larvae from settling and metamorphosing. Our results indicate that overall, the number of settled larvae was significantly reduced with the presence of *P. viridis*, *M. charruana* and *M. coccopoma* when compared to a control of *C. virginica* shells (Random block ANOVA, $p = 0.0364$). However, we found there was no difference in larval settlement on oyster shells with attached non-native species versus adjacent oyster shells without non-native species (Random block ANOVA, $p = 0.0864$). This data indicates that *P. viridis*, *M. charruana*, and *M. coccopoma* do limit oyster larval settlement and suggest that non-native species can be detrimental to the native oyster ecosystems.

Zavadskaya, Anna, *Kronotsky State Natural Biosphere Preserve*; **Vasily Yablokov**, *Lomonosov Moscow State University*

Tourism In Vulnerable Ecosystems Of Kamchatka: Impacts And Management (On Example Of Kronotsky Natural Reserve, Kamchatka, Russia)

Increased number of tourists in Kamchatka has created negative impacts on fragile ecosystems and unique natural objects that support tourism industry. However, data on limits of use and impacts of tourism are scanty. The paper draws on results of our research, conducted in 2008-2012 in tundra and thermal ecosystems of Kronotsky Biosphere Reserve and devoted to study of their transformation under recreational impacts and finding management tools for securing their long-term future. Classification of recreation impacts was given. The scale for defining condition classes and limits of acceptable changes for tundra ecosystems have been developed. As a result of multi-parameter analysis of thermal areas, using hexagon cell-based GIS-model, strong correlation between soil temperature and ecosystems recreation durability was found. The research showed that the most attractive and unique thermal areas with endemic and threatened Red-listed species (*Fimbristylis ochotensis*, *Agrostis geminate*, *Ophioglossum thermale*, *Lycopus uniflorus*, *Spiranthes sinensis*, etc.) have the lowest resistance to recreational impacts. Our findings became the base for development of methodology and spatial structure of long-term monitoring for vulnerable ecosystems and establishing the system of key sites in the study area. This research was supported by the Conservation Leadership Programme (project 0454611) and the Russian Foundation for Basic Research (projects 12-04-00272, 13-05-00870, 13-04-10037).

Zeh, Daniel, *James Cook University*; **Colin Limpus**, *Queensland Department of Environment and Heritage Protection*; **Michelle Heupel**, *Australian Institute of Marine Science*; **Russ Babcock**, *Commonwealth Scientific and Industrial Research Organisation (CSIRO)*; **Richard Pillans**,

Commonwealth Scientific and Industrial Research Organisation (CSIRO); Mark Hamann, James Cook University; Alana Grech, James Cook University; Helene Marsh, James Cook University

The potential of using data-logging acoustic receivers to study the movements and residency patterns of dugongs in port environments

An array of 28 acoustic receivers was installed over an area of 252 km² in Moreton Bay near Brisbane and used to compare the potential of automated acoustic tracking and ARGOS/GPS tracking to inform dugong spatial management, especially in the vicinity of ports. We captured 10 dugongs in the region and fitted them with acoustic and ARGOS/GPS transmitters. Individual dugongs were tracked from 6 to 90 days. Acoustic detections closely matched the extent of occurrence and core areas of habitat use indicated by the ARGOS/GPS tags when the dugongs were within the range of the acoustic array, providing proof of the concept. Acoustic technology potentially has the following significant advantages over ARGOS/GPS technologies for studying dugong habitat use in port environments: (1) the acoustic transmitters are much less expensive allowing at least a five-fold increase in sample size for the same outlay; (2) individual dugongs can potentially be tracked for much longer using the acoustic technology; (3) the absence of a tether should greatly reduce animal welfare issues and (4) the potential to track fast swimming animals should be improved. Composite home ranges calculated from merged 0.95 and 0.50 home range data from all individuals indicated that the 10 dugongs were active in an area nearly four times the designated Go Slow Zone indicating the need to extend this area to reduce the risk of vessel strikes to dugongs in Moreton Bay.

Zeller, Kathy, *UMASS, Amherst*; **Kevin McGarigal**, *UMASS, Amherst*; **Paul Beier**, *Northern Arizona University*; **Samuel Cushman**, *USDA Forest Service*; **Andrew Whiteley**, *UMASS, Amherst*; **Winston Vickers**, *Wildlife Health Center, University of California, Davis*; **Walter Boyce**, *Wildlife Health Center, University of California, Davis*

Effect of GPS collar sampling intensity on habitat selection inference: Mountain lions as a case study

In recent years, the use of Geospatial positioning (GPS) radio collars has skyrocketed due to their many advantages over VHF radio collars. However, battery life is usually the limiting factor of GPS collars and researchers are often forced to decide on a compromise between collar longevity and sampling intensity. There is little research to serve as guidance in making this decision. The studies that have examined this issue have focused on how sampling interval affects movement distance or home range size. Because GPS data is often used in resource selection functions, we looked at how sampling intensity affects inferences of habitat use. We used data collected on mountain lions (*Puma concolor*) in

southern California at a five-minute sampling interval. We subset this data to represent longer sampling intervals, from ten minutes up to six hours, and performed both point and step selection functions. We compared the resource selection function results from longer sampling intervals to the five-minute data and found that, for both point and step selection functions, the relative bias increases sharply between the five-minute and the 60-minute interval, at which point a threshold is reached. Our results suggest fix intervals as short as an hour may be insufficient for acquiring accurate estimates of resource use.

Zethoven, Imogen, *Global Ocean Legacy-Australia*

The Coral Sea Marine Reserve: Australia's Answer to Ocean Protection at a Large Spatial Scale

Australia is an island continent. Its marine environment is the most biologically diverse in the world. For over 15 years Australian governments have been working to establish a comprehensive, adequate and representative National Reserve System of Marine Protected Areas. Whilst the principle of representing each major habitat type is scientifically valid, a representative network fails to excite the public's imagination, unless in a world-recognised icon such as the Great Barrier Reef. Without public pressure, governments are not inclined to invest scarce funds in marine protection. The Global Ocean Legacy project therefore set out to ignite the public's imagination with a bold and simple vision: to secure the establishment of the world's largest fully protected marine reserve in the Coral Sea. A very large offshore reserve is also the most effective way to protect pelagic species and the cheapest with respect to recurrent management costs. We believed that by setting a very high bar of protection, the principle of representation would take care of itself. The 2012 proclamation proved this assumption correct: the Coral Sea Marine Reserve is now the largest reserve in the world, including the second largest fully protected area, and scores highly on representation of regional ecosystems.

Zimova, Marketa, *University of Montana*; **L. Scott Mills**, *University of Montana*; **Jared Oyler**, *University of Montana*; **Steven Running**, *University of Montana*; **John Abatzoglou**, *University of Idaho*; **Paul Lukacs**, *University of Montana*

Camouflage mismatch in seasonal coat color due to decreased snow duration: Will snowshoe hares keep up with climate change?

As a result of climate change, the duration of the ground snow cover in the temperate regions has shortened. We describe a novel and striking climate change effect on wildlife, whereby seasonal coat color becomes mismatched with background snow or lack of snow. Our objective was to quantify for snowshoe hares (*Lepus americanus*) the

phenology of seasonal coat color change and potential for coat color mismatch, as first step in exploring whether hares can adapt to a decreasing snowpack. We quantified snowshoe hare molt phenology, mismatch and survival for three years at two sites in western Montana, USA. We monitored over 450 hares weekly with radiotelemetry, quantifying the progression of the molts and snow cover across three years with vastly different snow conditions. We observed considerable mismatch between hare coat color and their background during spring and fall seasons. Some level of plasticity was observed in the rate of the spring molt which mitigated the color mismatch; during the spring of 2011 hares completed the molt about 2 weeks later than in 2010. By contrast, onset of coat color molts remained constant. We developed global circulation models downscaled at ecologically relevant scales (30m resolution) to predict changes in snowpack hares are likely to face in the future. Without evolution in coat color phenology, the reduced snow duration will increase the number of days that white hares will be mismatched on a snowless background by 3 - 8 fold.

Zivian, Anna, *Ocean Conservancy*

Who knows? The role of NGOs in brokering knowledge for ocean management

Environmental non-governmental organizations (ENGOs) play an important role in ocean and coastal governance, highlighting the need to protect, maintain, and restore healthy ocean and coastal habitats. They can have expertise in social and natural science, public participation strategies, communications, and governance. Because of their role on the periphery they are uniquely positioned to serve as knowledge brokers in ocean governance issues. At the same time, ENGOs advocate for particular policy solutions, which creates a tension between their work helping different types of knowledge travel among a range of policy, civil society, and research communities and their work advocating for specific programs. If an organization is at the same time transmitting knowledge and seeking to promote one particular perspective, can it, in fact, be a knowledge broker? While ENGOs clearly have relevant skills, do they have legitimacy? To look at these questions, I present a case study of Ocean Conservancy, an ENGO that works on the issue of ocean use planning. Its program involves educating, informing, and connecting the public, stakeholders, researchers, and decision-makers as well as advocating for US Congressional support of science-based, participatory, comprehensive planning as a tool to achieve healthy and sustainable ocean and coastal ecosystems. Ocean Conservancy is at once an advocate, a translator of knowledge, a recipient of information, and a public communicator.
