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# Student Conference on Conservation Science - New York

## Talk and Speed Talk Abstracts

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Aaron Aunins<sup>1</sup>, Bonnie Brown<sup>1</sup>, John Epifanio<sup>2</sup>

<sup>1</sup>Virginia Commonwealth University, Richmond, VA, USA; <sup>2</sup>U.S. Geological Survey, Champaign, IL, USA

## Genetic Evaluation of American Shad Restoration Success

The American shad *Alosa sapidissima* has experienced severe declines throughout its native range due to habitat degradation, fragmentation, and over-fishing. Hatchery supplementation is often used for stock restoration, but the effects of supplementation on population structure and genetic diversity are rarely assessed. We employed microsatellite DNA markers to evaluate how supplementation of the James River American shad population with Pamunkey River larvae since 1994 has impacted genetic diversity and population structure. Population genetic parameters of other major Chesapeake Bay tributaries (Susquehanna, Rappahannock, Potomac, and Nanticoke) stocked at varying intensities over the same period were also characterized. Effective population size estimates were low, ranging from 35 in Susquehanna to 820 for Pamunkey, reflecting the imperiled status of Chesapeake Bay stocks. Prior to supplementation, the James and Pamunkey populations exhibited subtle genetic differentiation, which was absent among post-supplementation samples, presumably due to supplementation. A similar lack of post-supplementation differentiation was observed among other shad populations of Chesapeake Bay. Genetic diversity of the James and other Chesapeake Bay shad populations was high prior to stocking, and remained high throughout years of intensive supplementation suggesting supplementation did not reduce neutral genetic diversity. Nevertheless, Chesapeake Bay American shad population abundances are currently at all time lows, indicating supplementation alone has not been an effective management strategy. We suggest that in light of the homogenizing effect of supplementation, the most fruitful effort for rebuilding shad stocks is to intensify improvement of spawning habitat quality and accessibility, especially in regions where distinct populations still exist.

Aske Skovmand Bosselmann

University of Copenhagen, Copenhagen, Denmark

## Disappearing Shade Trees Reduces 'Eco' in Ecoagriculture

Small scale shade coffee systems are an important source of trees in 'ecoagriculture' landscapes that have the dual objective of agricultural production and provision of environmental services. Understanding the impacts of and drivers for land use change is necessary to manage trees in these landscapes. This study assesses the loss of shade coffee during the period 2000 to 2009 in a Costa Rican biological corridor, and investigates possible predictors for land use change by applying an ordered probit model to household and land use data from 217 households. Additional telephone interviews with 224 farmers broadened the land use change data. The results showed a 50% reduction in the coffee area and an estimated loss of 40,000 shade trees from the studied farms. Treeless pasture and sugar cane were among the dominant new land uses. Significant predictors of land use change included income activities, family labor, coffee prices, and harvest of shade tree products. Supported by qualitative information, the data points towards a process of deagrarianization, where labor intensive farming is reduced in favor of other land uses and non-farm activities. Households with stronger ties to coffee farming are found to be less influenced by this process. It remains to be seen if the national program of payments for environmental services will be able to counter the ongoing changes. If not, the loss of trees in the ecoagriculture landscape will have serious implications on the area's role as biological corridor, in terms of habitat connectivity as well as other environmental services.

Jessica Daniel

Duke University, Durham, NC, USA

## Island Conservation: A Community Based Approach in Utila, Honduras

Utila is a small island off the coast of Honduras that has a diverse population including a large fishing community. The island is also a popular tourist and SCUBA diving destination due to its location on the Mesoamerican Barrier Reef. A number of factors have led to several issues for the island's diverse ecosystems including degraded water quality, increased development, destruction of mangroves, decreased coral cover and declines in fish populations. As a community that depends largely on fishing and the health of its surrounding reefs, these issues can translate into a negative impact on the local economy. To help target conservation and outreach efforts on the island, I conducted a survey to determine the knowledge, attitudes, and behaviors of Utilian locals regarding the environment and local conservation efforts. The findings from this survey indicated a baseline understanding of environmental issues facing the island and local concern with enforcement of environmental regulations. In order to increase monitoring and protection of local resources, aid in regulation enforcement and incorporate the community in local environmental management, a collaborative environmental management approach is proposed. This presentation will touch on experiences in Utila, present study findings, and outline potential steps to implement community based environmental management on the island.



Robert Denton<sup>1</sup>, Stephen Richter<sup>1</sup>

<sup>1</sup>Eastern Kentucky University, Richmond, KY, USA

## Evaluation of Amphibian Communities in Constructed Ponds

Among the many causes for amphibian declines, habitat loss and alteration remains one of the most significant. A lack of federal protection for isolated wetlands that provide habitat for unique species has resulted in the loss of breeding habitat. Ponds built for mitigation purposes often do not replicate removed ponds in structure or ecological processes. In the Daniel Boone National Forest (DBNF), Kentucky USA, ridge-top ponds have been constructed for habitat enhancement consistently for the last 23 years. We compared amphibian communities of multiple types and ages of these constructed ponds and natural, reference ponds using constrained ordination and analysis of similarity (ANOSIM) procedures. In addition, individual amphibian species' abundance was predicted via linear stepwise regressions using a suite of habitat variables. Amphibian communities differed significantly between ponds types (Natural, New Construction Method, Old Construction Method). Wood frogs (*Rana sylvatica*) and marbled salamanders (*Ambystoma opacum*) were almost exclusively found in natural, ephemeral ponds, whereas large Ranid frogs (*Rana clamitans*, *Rana catesbeiana*, *Rana palustris*) were found to only be breeding in permanent, constructed ponds. Habitat predictors for some species showed differing preferences within habitat gradients. New construction methods were intermediate between old construction method and natural ponds in terms of habitat variables and amphibian community composition. Discussion will include how the results of this research directly address the monitoring needs of amphibian communities in ridge-top ponds of the DBNF and how this research has helped to refine management practices and construction protocols.

Chris Free<sup>1</sup>, R. Matthew Landis<sup>1</sup>, James Grogan<sup>2</sup>

<sup>1</sup>International Institute of Tropical Forestry, Middlebury, VT, USA; <sup>2</sup>International Institute of Tropical Forestry, Leverett, MA, USA

## Mahogany Population Dynamics: Implications for International Trade

The Convention on International Trade in Endangered Species (CITES) Appendix II listing for big-leaf mahogany *Swietenia macrophylla* King (Meliaceae) requires verification that exported volumes of mahogany are obtained without detriment to natural populations. To investigate whether current legal logging practices for mahogany in the Brazilian Amazon are sustainable, we developed an individual-based model that realistically simulates population dynamics observed from 1995–2008 in southeastern Amazonia based on annually censused demographic data describing all phases of mahogany's life cycle, from seed production and dispersal to adult senescence. Simulating harvest regulations designed specifically for mahogany after its listing on CITES Appendix II in 2002, the model demonstrates that current management practices in Brazil will lead to population decline and commercial extirpation within 3-4 cutting cycles (60-90 years) where observed population structures lack sub-commercial trees at densities sufficient for short-term replacement. Simulations indicate that reducing logging intensity by increasing the minimum diameter cutting limit (MDCL) and or increasing the commercial tree retention rate only nominally improves short-term sustainability due to persistent adult tree mortality during 30-year periods between harvests. Restoring population densities and creating sustainable management systems will therefore depend on successful recruitment by seedling regeneration in place or established through enrichment planting in logging gaps at the time of first harvest. Because background densities of mahogany regeneration are generally very low or absent in natural forests, post-logging enrichment planting with active long-term manual tending to ensure seedling survival and robust growth must accompany mahogany harvests to meet the CITES Appendix II non-detriment provision.

Alexander Georgiev<sup>1</sup>, V. Lokasola<sup>2</sup>, M. Emery Thompson<sup>3</sup>, A. Lokasola<sup>2</sup>, R. Wrangham<sup>1</sup>

<sup>1</sup>Harvard University, Cambridge, MA, USA; <sup>2</sup>Vie Sauvage, Kokolopori, Democratic Republic of Congo;

<sup>3</sup>University of New Mexico, Albuquerque, NM, USA

## Bonobos Crop-Raid During Times Of Nutritional Stress

We present data on crop-raiding by a new study population of bonobos (*Pan paniscus*) in Kokolopori community reserve in the Democratic Republic of Congo and assess the level of 'human-wildlife conflict' as perceived by the local Bongando people. Behavioral observations and endocrine sampling were used to establish the nutritional context of bonobo crop-raiding and interviews were used to gather socio-economic data. Crop-raiding occurred at low rates only during the first study period (on ca. 4 days during 3 months, Oct-Dec 2006), a time when the bonobos ate little wild fruit. During this period bonobos had low C-peptide and high cortisol levels, indicating low nutritional status and elevated physiological stress. Relative to the first study period, wild fruit consumption and C-peptide levels were higher in the second study period (Jun-Jul 2007), while cortisol was significantly lower. Most people did not regard bonobos as major agricultural pests. Forest hogs and rodents

were reported to cause most damage to crops, particularly because they target the staple of the Bongando people, cassava tubers. In contrast, bonobos only ate sugar-cane, pine-apples and bananas. Thus, while crop-raiding by bonobos at Kokolopori is relatively infrequent, it may be nutritionally important to them when wild fruit are scarce. There seems to be little conflict between people and bonobos over crops in this area. We suggest that disseminating information emphasizing the fact bonobos resort to feeding on cultivars only in 'times of hunger' may help build understanding and good will among the local Bongando for protecting bonobos in Kokolopori.

**Angela Guerrero Gonzalez<sup>1</sup>, Ryan McAllister<sup>2</sup>, Jonathan Corcoran<sup>1</sup>, Kerrie Wilson<sup>1</sup>**

*<sup>1</sup>University of Queensland, Brisbane, Queensland, Australia; <sup>2</sup>CSIRO Sustainable Ecosystems, Brisbane, Queensland, Australia*

### **Scale Mismatches and the Role of Social Networks**

It is increasingly recognized that an understanding of the social and institutional landscape in which conservation work is conceived, planned for and implemented is as important as the ecological if we want our conservation initiatives to be successful. However, little is understood about the complex interactions between social and ecological systems and their impact on the success of biodiversity conservation initiatives. The different institutions that interact in the process of planning and implementing for conservation influence how conservation problems are defined, the actions that are formulated, and how they are implemented on the ground. These decisions might not match the ecological patterns or processes relevant to the conservation problem, creating a scale mismatch. Our paper explores the role of social networks in minimizing such mismatches. Social network analysis is employed in a case study in Western Australia to determine how the pattern of relations that is formed around conservation efforts affects scale mismatches, and how these might be overcome. This study contributes towards understanding the relationship between social networks and successful biodiversity conservation, and has implications for how conservation partnerships are developed on the ground to increase the success of conservation investments. The potential mismatch between ecological and institutional scales poses a significant challenge to those committed to attaining on-the-ground conservation outcomes; but despite wide recognition, application in the field of biodiversity conservation has been limited. With billions of dollars spent every year on conserving biodiversity it is critical that we uncover ways in which this challenge can be overcome.

**Clare Gupta**

*University of California, Berkeley, CA, USA*

### **People-Park Relations Around Chobe National Park, Botswana**

This talk will highlight findings from my doctoral research regarding people-and-park dynamics in two village communities living next to Botswana's Chobe National Park. While numerous political ecologists have shown the deleterious effects that the creation of protected areas can have on local communities, my research shows that conservation activities can also rupture social networks and economic relationships that include people and places beyond those immediately adjacent to the protected area. Botswana's Chobe National Park exerts not only direct effects on surrounding Chobe Enclave communities in terms of decreased access to natural resources and land, but also indirectly alters the circulation of people and resources between this rural locale and more urbanized parts of Botswana. Rural-urban economic linkages in Botswana have historically been quite strong, yet my research indicates that, today, urban migrants in Chobe are less likely to invest their earnings in agricultural production than in the past. This is in part because district-level conservation and development policies that prioritize wildlife and park-based tourism have aggravated problems faced by smallscale rural farmers. As farming becomes less viable, resource flows between the urban and rural areas are in turn disrupted. At the same time, there are still lasting kinship ties that bind urban migrants to their rural counterparts, which cannot be ignored. The nature of this tension between change and continuity in the way that resources and people circulate between Botswana's rural and urban areas, and its implications for conservation, will also be addressed.

**Sara Hansen<sup>1</sup>, H. Brian Underwood<sup>1</sup>, James Gibbs<sup>1</sup>, Jacqueline Frair<sup>1</sup>**

*<sup>1</sup>State University of New York, Syracuse, NY, USA*

### **Abundance Estimation of Coyote Populations in New York State**

Coyotes (*Canis latrans*), a relatively new addition to the Northeast, have generated great interest in New York State regarding their population status. Due to scarcity of public lands in the region, population surveys must take place on private lands, limiting the scope and utility of many survey designs. We tested the efficacy of distance sampling methodology applied to road-based, call-response surveys that eliminate the need to access private lands while providing a robust population

estimate. To be an effective tool for monitoring populations, the approach requires an appropriate sampling design, predictable response rate, and accurate methodology for assigning distance classes to vocalizing coyotes. We tested alternative distance estimation approaches using a recorded coyote call broadcast at known distances (250 meters to 1000 meters) and the refined approach involved three observers spaced 500 meters apart triangulating on the calling coyote. Surveys at 541 statewide points conducted June - August 2010 yielded 117 responses (22% response rate), sufficient for a reliable abundance estimate indicating significant differences in regional density. Our triangulation approach provided distances accurate to  $\pm 200$  meters and provided sufficient sample sizes for probability of detection estimation ( $\hat{p} = 0.198 \pm 0.027$  SE). Our findings indicate that road-based call-response surveys conducted using distance sampling methods are effective for providing robust population estimates for elusive but vocalizing species like coyotes.

**Elizabeth Hunter<sup>1</sup>**, Washington Tapia<sup>2</sup>, Linda Cayot<sup>3</sup>, James Gibbs<sup>1</sup>

<sup>1</sup>*State University of New York, Syracuse, NY, USA*; <sup>2</sup>*Galapagos National Park Service, Puerto Ayora, Galapagos Islands, Ecuador*; <sup>3</sup>*Galapagos Conservancy, Fairfax, VA, USA*

### **Galápagos Giant Tortoises as Ecological Analogs**

The use of ecological analog species, or taxon substitutions, has recently been promoted as an option for refilling the niches of extinct species. Whether ecological analogs can replace extinct relatives in terms of ecological services rendered remains undocumented. Pinta Island in the Galápagos Archipelago provides a pertinent opportunity to explore the issue. The native Galápagos giant tortoise species on Pinta (*Chelonoidis abingdoni*) was a saddlebacked form that is extinct in the wild due to decades of overexploitation. In May 2010, 39 non-native Galápagos giant tortoises (sterilized hybrids) of two phenotypes (saddlebacked and domed) were introduced to Pinta by the Galápagos National Park Service. This first release of giant tortoises to Pinta, designed to implement changes in the ecosystem, precedes planned future releases to create a reproductive population. We assessed whether these ecological analogs differ in their abilities to fill the likely niche of the original Pinta tortoise by monitoring tortoise movements. We determined the environmental features driving habitat selection in a 50-hectare area surrounding the introduction point by creating resource selection functions. In the initial months after the introduction, the two phenotypes showed different habitat preferences – domed tortoises preferred higher elevation areas, whereas saddlebacked tortoises were more attracted to the giant arboreal cactus that populates lower elevations. Observed differences in behavior indicate that the saddlebacked tortoises are behaving more like the original Pinta tortoise. Ongoing studies will help clarify the role of variable morphology of analog species in filling vacant niches and whether behavioral differences will manifest themselves ecologically.

**Gwen Iacona<sup>1</sup>**, Franklin Price<sup>2</sup>, Paul Armsworth<sup>1</sup>

<sup>1</sup>*University of Tennessee-Knoxville, Knoxville, TN, USA*; <sup>2</sup>*Florida Natural Areas Inventory, Tallahassee, FL, USA*

### **Can We Predict the Cost of Invasion in a Protected Area?**

A common strategy for biodiversity conservation is to designate a tract of land as a preserve. However, invasive plant infestation is one threat to biodiversity that can occur regardless of land use designation. Understanding the site level drivers that influence invasibility can help guide decision making in conservation planning by allowing for the consideration of future management costs for a site. We examined the site level factors that relate to invasion intensity at a site by analyzing how the distribution of 30 different invasive plant species on more than 350 conservation lands in Florida was affected by site attributes such as parcel size, site elevation, minimum yearly temperature, and nearby human habitation density. We then examined how state funding for invasive plant control was related to site invasion intensity. Preliminary data suggest that the invadedness of a site decreased as site acreage increased, or as site elevation increased. In addition, site invadedness increased with an increase in surrounding human habitation density and yearly minimum temperature. These results suggest that costs of conservation can be minimized by avoiding sites that are more likely to harbor invasion, which has implications for biodiversity conservation because reserve selection processes rarely consider the invasibility of a site.

**Meha Jain<sup>1</sup>**, Shahid Naeem<sup>1</sup>, Ruth DeFries<sup>1</sup>

<sup>1</sup>*Columbia University, New York, NY, USA*

### **Agricultural Adaptation to Climate Variability**

Climate change is predicted to negatively impact millions of people across the globe, especially agricultural communities that depend on monsoon rains for high crop yields. To reduce these negative impacts, scholars and policymakers argue that these communities should adapt their cropping strategies to match new climate patterns. Unfortunately, there is little

understanding of why some farmers adapt their cropping strategies while others do not. Therefore, this study identifies the relative importance of various socio-economic (e.g. access to capital), biophysical (e.g. soil fertility), and perceptual (e.g. amount of rain needed to sow seeds) factors in enhancing or constraining the ability of farmers to adapt to monsoon variability in India. Preliminary household-level surveys suggest that while irrigation most strongly predicts which crops farmers plant and the date that they sow seeds, farmers also significantly respond to climate factors such as the amount of rain that falls before they sow seeds. This suggests that farmers do adjust their cropping patterns based on rainfall patterns, even if they have secure access to irrigation. Remote sensing analyses also show that farmers are changing their cropping strategies from year to year and suggest that some areas may be changing their cropping strategies to match with rainfall parameters like the date of monsoon onset. Overall, this study indicates that farmers do alter their cropping strategies based on current rainfall variability, and suggests that farmers may adapt to future changes in rainfall due to climate change.

**Patrick Jantz<sup>1</sup>, Nadine Laporte<sup>1</sup>, Andrew Plumtree<sup>2</sup>, Matthew McLennan<sup>3</sup>, Glenn Bush<sup>1</sup>, Jared Stabach<sup>4</sup>, Scott Goetz<sup>1</sup>**

<sup>1</sup>*Woods Hole Research Center, Falmouth, MA, USA;* <sup>2</sup>*Wildlife Conservation Society, Kampala, Uganda;*

<sup>3</sup>*Oxford Brookes University, Oxford, England, UK;* <sup>4</sup>*Colorado State University, Fort Collins, CO, USA*

### **Climate Mitigation and Corridors for Chimpanzees in Uganda**

Anthropogenic activities are on the rise around many protected areas in the tropics resulting in progressive isolation of large forest blocks. This is the case in the Albertine Rift area of northwest Uganda between the forest reserves of Budongo and Bugoma. Of particular concern is the maintenance of connectivity for eastern chimpanzee (*Pan troglodytes schweinfurthii*) populations that live in large forest blocks in Budongo and Bugoma. While chimpanzees are frequently observed in the human dominated matrix between reserves, forest clearing and conflicts with humans are placing chimpanzee groups outside reserves under increasing pressure. Because of the interest in generating multiple benefits with climate change mitigation activities, there is potential to use spatial network analysis to identify land parcels where reforestation will increase connectivity for species of conservation concern without compromising climate mitigation potential. In support of this goal, we applied least cost path algorithms to satellite maps of forest cover, socio-demographic databases, and stream center lines to map potential corridors between reserves which could serve as reforestation areas and improve connectivity for chimpanzee populations. Our mapped corridors compared well with independently collected nest site data, overlapping with more nest sites than expected by chance, suggesting that payments made to farmers to reforest their land can be geographically targeted to improve connectivity for chimpanzees. Ongoing work includes updating forest maps with high resolution satellite imagery to identify areas of recent forest clearing in corridors which could be prioritized for reforestation.

**Emma Johnson**

*University of California, San Diego, CA, USA*

### **Time, History, and Narrative at the Tijuana River Estuary**

My doctoral research is about communicative and material practices of environmental management at the Tijuana River Valley and Estuary, situated at the westernmost portion of the US-Mexico border, where the Tijuana River flows north across the international boundary and meanders across both publicly and privately held lands into the Pacific ocean. This talk, based on a chapter of my dissertation, explores different kinds of time that are important in management and policy decision-making, as well as in education and interpretation. I then draw on ethnographic data and archival research, informed by theoretical work in science studies, cultural studies and critical geography, to characterize the specific ways that narrative and history are important in day-to-day work of conservation and restoration in the river valley. I then consider the ways that timelines are mingled in confused, surprising and sometimes productive ways. There are many scales and types of time that are relevant here, including personal and oral histories, geologic time, evolutionary time, and human history ranging from pre-Columbian settlements through Spanish conquest, the expansion of the USA and then the narratives of world-war II, cold war, globalization, and most recently, the war on terror. The Tijuana Estuary is at the meeting between land and sea, freshwater and salt, drought and flood, urban and rural, private and public, and between military and civilian. There are many competing narratives about the past and the future of the landscape, as well as about the human lives that intersect on this terrain.

**Geoff Kelley**



*University of Georgia, Athens, GA, USA*

## **Conservation Across Boundaries in the Big Bend Borderlands**

This paper presents findings from ethnographic doctoral dissertation research on trans-boundary conservation across the Big Bend region on the United States - Mexico border. This area exhibits high levels of arid-lands biological diversity and species endemism complimented by a long history of bi-national conservation interest. What does trans-boundary conservation mean on the Big Bend in the 21st century, and to what degree are these meanings shared within and across the nations, institutions and communities working and living in the conservation area? This paper applies Barth's theoretical analysis on ethnic boundaries as a proxy for investigating institutional boundaries across multiple social and political scales across the study area. At each of these boundaries are found evidence of collaborative participation and of contestation and friction. As conservation anthropologists continue to stress the importance of historical, political, economic, and cultural context needed to better inform conservation design, implementation, and practice, these findings illustrate how multi-scalar focus on institutional boundaries can be one way towards enriching perspective.

**Chaitanya Krishna<sup>1</sup>**, Kavita Isvaran<sup>1</sup>

<sup>1</sup>*Centre for Ecological Sciences, Bangalore, Karnataka, India*

## **Blackbuck and Agriculturists: Conflict or Coexistence?**

When human livelihoods are affected by wildlife, the persistence of wildlife is threatened. In such a socioecological system, the behaviour of both the players, people and wildlife have to be understood. We investigated the crop use behaviour of blackbuck, an antelope endemic to the Indian subcontinent in a semi-arid human-dominated landscape. A 108 square kilometer area consisting of protected and unprotected grasslands, plantations and crop fields was chosen, where intensive monitoring of randomly selected crop fields was carried out for two years. As these animals inhabit human-dominated landscapes, conservation of these animals is dependent on goodwill of local communities. Therefore, we assessed attitudes of the community towards blackbuck crop damage using a questionnaire survey. We found that crop use was surprisingly localized in the landscape. Damage was largely restricted to fields adjoining "refuges," that is nonagricultural habitats with relatively low human activity, with cereal crops being affected the most. Damage to fields adjoining refuges was considerable, ranging from 0-95% with an average of 38%. Results from the questionnaire survey revealed that overall attitudes towards blackbuck were remarkably positive, but a third of the respondents were averse to blackbuck occurring in the area. These currently tolerant views could change if no attempts are made to reconcile losses to farmers. We synthesized both the social and ecological findings to develop effective and affordable methods to mitigate blackbuck crop damage.

**Maria Jose La Rota-Aguilera**

*University of Texas-Austin, Austin, TX, USA*

## **Birds in Coffee Agroecosystems and Habitat Fragmentation**

Habitat loss and fragmentation are the main drivers of biodiversity loss, especially in the tropics, where the transformation of forested areas to agriculture is predicted to increase dramatically in the next three decades. Although several studies have elucidated the negative impacts of agriculture on biodiversity, recent work suggests that these areas are potential key ecosystems for maintaining biodiversity and ecosystem services. This study analyzed the landscape-level effects of habitat fragmentation on bird assemblages from coffee plantations in the tropical Andes of Colombia. The potential responses of avifauna to fragmentation were studied from 3 different perspectives. First, from a patch-level point of view, evaluating the effect of microhabitat factors (ex. canopy cover, tree density, type of crop). Second, from a species point of view, evaluating the role of species ecological traits (ex. Feeding habitat, abundances, territory size) and third, a from a landscape structure perspective, evaluating the effect of the landscape configuration and composition (ex. patch arrangement and patch metrics). In order to assess scale dependent effects, avifauna responses were analyzed using Ordinary Least Squares Regression and Geographically Weighted Regression at 4 different scales (0.5, 1, 2 and 4 km radius). Finally, this study incorporated a Species Distribution Model for the two less abundant taxa in order to visualize species-specific responses, not only to environmental and ecological variables, but also to different aspects of landscape structure. The results indicate that the avifauna associated with coffee plantations have a varying response to fragmentation and that these responses are scale-dependent.

**Marcia Macedo<sup>1</sup>**, Ruth DeFries<sup>1</sup>

<sup>1</sup>*Columbia University, New York, NY, USA*

## **Hydrologic Connectivity and the Future of Tropical Parks**



Tropical forest and freshwater ecosystems support high levels of biodiversity while providing important ecosystem services. Protected areas are the primary tool available to conserve these assets, but their success often hinges on land use decisions made outside their borders. The flow of water in river networks is a powerful mechanism linking protected areas to their surrounding landscapes, a hydrological connection that is often overlooked in the design and management of these areas. This study uses a multi-scale approach to examine the vulnerability of the Amazon protected area network to human development activities occurring outside its boundaries. At the landscape scale, we conduct a spatially explicit analysis of the patterns of land use change and fragmentation in the upper Xingu watershed, located in the heart of Brazil's agricultural frontier. Results indicate that headwater streams have been disproportionately affected by recent conversion of forests to agricultural land uses, resulting in decreased hydrologic connectivity. These changes are of particular concern because they threaten protected areas immediately downstream, which are designated for the subsistence of indigenous populations. Scaling up, we examine the size and location of Amazon protected areas relative to their watersheds in order to assess their susceptibility to similar hydrological alterations in the landscape. This study underscores the need to consider freshwater connectivity in the design of tropical protected areas, which have historically been biased towards terrestrial conservation targets. Effective conservation of freshwater ecosystems in existing protected areas will require a landscape management approach that explicitly considers their hydrological context.

**Kendra Mack<sup>1</sup>**, Thomas James<sup>1</sup>

<sup>1</sup>*Yale University, New Haven, CT, USA*

### **Environmental Predictors of Forest Presence and Composition**

In central Mongolia, home to an ancient pastoral culture, the Siberian boreal forest meets the Central Asian Steppe. Forest distribution and composition along this ecotone is expected to shift in response to the coupled effects of anthropogenic pressure and climate change. Increased understanding of potential forest reorganization is essential to understanding future conditions within this ecosystem and maintaining this forest as a cultural and socioeconomic resource for the local people. This project aims to model relationships between abiotic parameters and the region's six major forest species, taking into account spatial heterogeneity and interspecific competition. During the summer of 2011, data on forest distribution and composition will be gathered from 40 sites across a 300000 sq-km study area representing approximately one-fifth of Mongolia. The parameters to be assessed are elevation, slope, aspect and photosynthetically active radiation; soil moisture, pH, temperature and compaction; and species, diameter, height and location of all trees at each site. Temperature and precipitation data will be supplemented from local meteorological stations. The dataset will be analyzed using likelihood and Bayesian techniques to model the presence and abundance of the major tree species in the region. The second phase of this research will be conducted in 2012 and will use newly collected data to iteratively test the initial ecological niche model. The final model will be compared with climate projections for the area in order to make predictions about the trajectory of the forest in this region, as well as the potential re-organization that climate change may facilitate.

**Tali Magory Cohen<sup>1</sup>**, Tamar Narkiss<sup>1</sup>, Amit Dolev<sup>2</sup>, Yossi Ben-Ari<sup>3</sup>, Noga Kronfeld-Schor<sup>3</sup>, Amichai Guter<sup>2</sup>, David Saltz<sup>4</sup>, Gila Kahila Bar-Gal<sup>1</sup>

<sup>1</sup>*The Hebrew University of Jerusalem, Rehovot, Israel*; <sup>2</sup>*Israel Mammal Research Centre, Society for the Protection of Nature in Israel, Tel-Aviv, Israel*; <sup>3</sup>*Tel Aviv University, Tel-Aviv, Israel*; <sup>4</sup>*Swiss Institute of Desert Environmental Research, Ben Gurion University, Beersheba, Israel*

### **An Ecological and Genetic Study of Eurasian Otters in Israel**

The Eurasian otter (*Lutra lutra*) is considered to be the top predator in the wetlands habitat in Israel, its southern edge of distribution range. The Israeli otter population has undergone a dramatic decline since the 1960 due to habitat loss, illegal hunting, water pollution and road kills, and its population size is estimated at 100 individuals. The goal of this study was to assess the distribution of the otter population based on the presence of spraints and to determine the genetic variation of the populations located in different geographic regions in Israel using autosomal microsatellites. During 2002- 2010, spraint surveys were conducted yearly to determine otter activity and tissue samples were collected from 64 otter carcasses for the genetic study. Field surveys revealed changes in otter activity along the different regions, including reappearance of otters in the previously abandoned Northern coastal plains. The seven STR markers were found to be moderately polymorphic, substantially lower than European populations. Unique alleles found in the Israeli population suggest its isolation and limited or absent gene flow between the European and Israeli populations. Bayesian clustering indicated three groups, one of them constituted of only specimens from the Hula Valley, suggesting a lack of gene flow with the other subpopulations, possibly due to sufficient natural sustenance conditions. The results of this study emphasize the importance of wetland corridors for the dispersal of otters and delineate the information needed for implementing conservation efforts based on

the reintroduction of wild or captive reproduced otters.

**Nicole Michel<sup>1</sup>, Thomas Sherry<sup>1</sup>, Walter Carson<sup>2</sup>**

<sup>1</sup>Tulane University, New Orleans, LA, USA; <sup>2</sup>University of Pittsburgh, Pittsburgh, PA, USA

## Indirect Effects of Fragmentation Limit Rainforest Birds

Tropical rainforest understory insectivorous birds are highly vulnerable to forest fragmentation, with declines often attributed to direct effects of decreased patch size. Yet this guild has nearly disappeared from larger fragments, eg., 1600ha La Selva Biological Station, while persisting at smaller nearby reserves, eg., 354ha Reserva Tirimbina. Fragmentation alters remnant mammal communities, which in turn can have dramatic cascading consequences. Collared peccaries (*Pecari tajacu*) have dramatically increased at La Selva post- 1970, concurrent with understory insectivorous bird declines. Our research supports a three-part indirect effects hypothesis: (1) *P. tajacu* are locally suppressing liana regeneration, (2) Understory insectivores forage selectively in dense liana tangles, and (3) Declines in this guild correspond with liana tangle loss. Research was conducted at seven sites in Nicaragua, Costa Rica, and Panama spanning a *P. tajacu* density gradient from 0->14/km<sup>2</sup>. The avian focal species, Ruddy-tailed Flycatcher (*Terenotriccus erythrurus*), and Dot-winged (*Microrhopias quixensis*) and Checker-throated Antwrens (*Epinecrophylla fulviventris*), all selected foraging sites with high liana density and cover. Sites where this guild has declined have higher *P. tajacu* densities and fewer liana tangles. This is the first study to our knowledge to show that this guild is vulnerable to loss of foraging microhabitats. Our research highlights the important role of indirect effects in rendering even large forest tracts unsuitable for remnant species, and suggests that reserve creation alone is insufficient to preserve some species. Our study also provides valuable information on how birds respond to changes in understory vegetation, vital information in an age of global climate-change-driven forest change.

**Rachel Nuwer<sup>1,2</sup>, Diana Bell<sup>1</sup>**

University of East Anglia, Norwich, Norfolk, England, UK; New York University, New York, NY, USA

## Threats to Biodiversity in the U Minh Peat Swamps, Vietnam

The landscape of U Minh in southern Vietnam contains the country's last remaining fragments of peat swamp forest and is home to several globally threatened and endangered species. But despite the presence of two National Parks, evidence indicates that illegal natural resource use by local communities has significantly impacted species' populations. This study aimed to investigate the nature and extent of natural resource use in U Minh. Through interviews, we found that location plays a significant role in whether or not individuals chose to harvest resources, suggesting that the National Parks are having some positive results in curtailing illegal harvesting. Most hunting and fishing was carried out for trade purposes by resource users of both sexes, and most interviewees preferred consuming livestock, suggesting that resource users do not rely upon natural resources for subsistence but rather for supplementing income. People who prefer consuming wildmeat were more likely to harvest natural resources than people who prefer livestock, demonstrating that these behavioural issues may be linked. Interviewees' preference for wildmeat type decreased with price, contrasting to urban consumers who value more expensive wildmeat varieties and suggesting that different factors are driving wildmeat consumptions amongst the rural Vietnamese. The majority of interviewees perceived a decrease in the size of species populations, accrediting the decline primarily to human harvesting pressures and thus indicating that more strict regulation of illegal harvesting activities is necessary for protecting remaining biodiversity. This study is the first to investigate local community impacts in U Minh.

**Emily Pipher<sup>1</sup>, Nicola Koper<sup>1</sup>**

<sup>1</sup>University of Manitoba, Winnipeg, Manitoba, Canada

## Effects of Grazing on Nest Success in Mixed-Grass Prairies

Grassland bird species are quickly declining, possibly due to losses of breeding habitat. Although most prairies are used as rangelands, no studies have yet examined how cattle stocking rate may influence the nesting success of mixed-grass prairie songbirds. Nesting success is highly influenced by predation. Because detectability of nests by predators is influenced by vegetation, nest success may be altered by grazing at varying intensities and durations. In 2009-2010, we monitored nests of five songbird species in southwestern Saskatchewan. Two 300x300m plots were located in each of 12 pastures with stocking rates ranging from 0.23-0.83 AUM/ha, which were grazed for 0, 2-3 or >15 years. GEEs confirmed that each species chose nest sites with significantly different vegetation characteristics than the surrounding landscape. While some species selected nest microhabitats with conditions consistently relative to the available habitat, others selected for specific vegetation characteristics that were independent of the surrounding landscape. Logistic exposure analyses indicated a nonlinear effect of stocking rate on nesting success of Sprague's Pipits in 2009. Chestnut collared Longspur and Vesper Sparrow nesting successes were negatively correlated with years grazed in 2009 and 2010, respectively. While these results indicate some



significant effects of stocking rate and duration on nesting success, the inconsistency of our results among years suggests these effects are probably not strong or pervasive. We suggest that cattle grazing is compatible with the conservation of these species. However, the specific vegetative characteristics required by some species may exclude them from nesting in areas with certain densities of cattle.

**Erica Pohnan**

*Yale University, New Haven, CT, USA*

### **Adapting Forest Restoration Approaches to Local Contexts**

Forest rehabilitation is a common strategy for ameliorating the impacts of deforestation worldwide, despite the fact that its impacts on local communities are poorly understood. Failure to adapt to local socio-economic conditions can undermine even the most ecologically sensitive initiatives. This is evidenced by cases in Southeast Asia where communities have destroyed newly reforested areas that impinged upon local property regimes, or have been unable to maintain seedlings due to lack of appropriate incentives. At the same time, both successful and failed forest rehabilitation efforts have been documented to cause negative socio-economic impacts including land-use conflicts, forced evictions, and exacerbation of poverty. This paper seeks to examine the nuances of this relationship by exploring the role forest rehabilitation has played in community livelihood strategies in two Southeast Asian countries. It draws from primary field research conducted in Thailand and the Philippines, which were selected based on their historical forest cover loss, prevalence of communities living within or around forest areas, and mutually unsuccessful experiences with forest rehabilitation. These two case-studies illustrate how forest rehabilitation approaches in these two countries have or have not been adapted to local socio-economic conditions, incorporated into local livelihood strategies, and reconciled with the prevailing national policy framework regarding natural resource management. The paper also argues that understanding these socio-economic and socio-political dynamics is crucial to the success of forest rehabilitation, especially given its increasing prominence in strategies for climate change mitigation, disaster risk reduction, payment for environmental services, and protected area conservation.

**Karine Princé<sup>1</sup>, Frédéric Jiguet<sup>1</sup>**

*<sup>1</sup>Muséum National d'Histoire Naturelle, Paris, France*

### **Predicting Impacts of Agriculture Evolution on Biodiversity**

Climate and land use drive biodiversity patterns at large scales. Besides, land conversion from complex natural systems to simplified agricultural ecosystems and increased exploitation of resources are major causes of the high current rates of biodiversity loss. Understanding and predicting responses of biodiversity to climate and agricultural practices changes are crucial to manage the ecological consequences adequately. To that end, we developed scenarios of farmland biodiversity through breeding birds, group chosen by EU to produce a structural indicator of sustainable development, taking into account climate niche predictions and changes in farmland use, as well as possible developments of agricultural policies in France. We created four scenarios of agricultural change: 1) continuing current trends (i. e. overall intensification), 2) biofuel development, 3) return to grasslands (extensification of livestock) and 4) overall agricultural extensification. Using the French Breeding Bird Survey's data, we assessed the impacts of these scenarios on different indicators: the Farmland Bird Indicator, reflecting the changing numbers of a group of species identified as specialist in farmland community, the Species Specialization Index, reflecting the proportion of specialist species in a community, and other indicators linked to phylogenetic or functional diversity. Using various indicators allows both accounting for the dynamics of biodiversity as a whole, and better understanding the various responses of the different elements of a community (e. g. the species richness, their trophic link) facing these potential scenarios. It is anticipated that declining species or/and species with small ranges will be especially vulnerable to agriculture evolution and climate change.

Konstantine Rountos<sup>1</sup>, Timothy Essington<sup>2</sup>, Christine Santora<sup>1</sup>, Ellen Pikitch<sup>1</sup>

<sup>1</sup>*Stony Brook University, Stony Brook, NY, USA;* <sup>2</sup>*University of Washington, Seattle, WA, USA*

### **Global Importance of Forage Fish to Fisheries and Ecosystems**

Forage fish (e. g. sardines, anchovies, herrings etc.) are pivotal to marine ecosystems and coastal economies around the world in a variety of ways. First, forage fish are valued as direct fisheries catch, representing some of the largest fisheries in the world. They also provide an important ecological support service as prey for higher trophic predators. This research is aimed at increasing our global understanding of how valuable forage fish are in marine ecosystems—both economically and ecologically. In order to quantify this, we conducted a meta-analysis of 72 Ecopath models from around the world, representing a wide variety of ecosystem types and latitudes. We examined three distinct roles of forage fish: 1) As an economic commodity (direct catch); 2) As prey for larger fish species that are commercially harvested; and 3) As prey for non-commercial predators. Here, we present the results in terms of both monetary value and catch volume, and identify patterns across latitudes and ecosystem types (e. g. upwelling ecosystems, tropical lagoons, Arctic ecosystems). These results show where forage fish are most important, and provide information that managers can use in addressing the tradeoffs between catching forage fish and leaving them to fulfill their ecological role. This information is integral in the development of more holistic ecosystem-based forage fisheries management worldwide.

Julie Rushmore<sup>1</sup>, Damien Caillaud<sup>2</sup>, Leopold Matamba<sup>1</sup>, Rebecca Stumpf<sup>3</sup>, Kimberly Love-Myers<sup>1</sup>, Jaxk Reeves<sup>1</sup>, Sonia Altizer<sup>1</sup>

<sup>1</sup>*University of Georgia, Athens, GA, USA;* <sup>2</sup>*University of Texas at Austin, Austin, TX, USA;* <sup>3</sup>*University of Illinois at Urbana-Champaign, Urbana, IL, USA*

### **Behavioral Determinants of Disease Transmission in Wild Apes**

In recent decades, infectious diseases have threatened the health and persistence of Africa's endangered apes. Social contacts are known to affect the spread of infectious diseases in humans; however, for wild primates, data on variation in contact rates among individuals are needed to predict how social interactions affect pathogen transmission. Our work uses field-collected behavioral data to quantify contact rates and to provide a social network structure necessary for modeling disease transmission. Over a 10-month study period, we recorded the frequency and type of social interactions for a community of wild chimpanzees (N=50) in Kibale Forest, Uganda. Using generalized linear models and social network analysis, we examined contact variability (for group, close-proximity, and touching behaviors) among community members and evaluated the importance of both individual and environmental explanatory variables. Results show a high degree of heterogeneity in contact rates among community members and significant effects of age and relatedness on contact between chimpanzees. Our next step is to simulate transmission dynamics by combining social network data with infectious disease models. Overall, this work represents a multi-disciplinary approach to understanding how primate behavior affects pathogen transmission and will provide information needed to develop intervention strategies for protecting Africa's great apes in the event of a future epidemic.

Matthias Rös<sup>1</sup>, Federico Escobar<sup>1</sup>, Julio Louzada<sup>2</sup>, Gonzalo Halffter<sup>1</sup>

<sup>1</sup>*Instituto de Ecologia, A.C., Xalapa, Veracruz, Mexico;* <sup>2</sup>*Universidade Federal de Lavras, Minas Gerais, Brazil*

### **Beta Diversity of Dung Beetles in Human-Modified Landscapes**

We analyzed beta diversity of 31 dung beetle communities in human-modified landscapes originally dominated by forests in Africa (6), Asia (4), Europe (2), South America (9) and Central America including Mexico (10). The aim was to determine the magnitude of underlying processes which produce beta diversity. Diversity was measured both by presence/absence and abundance data using effective number of species. Beta diversity in human-modified landscapes is driven by the processes species loss, species gain, and species turnover. Our results suggest that susceptibility to these processes differs among biogeographical regions: in landscapes in Mexico and Central America, species gain is often as high as or higher than species loss, whereas in South American landscapes species loss in the transformed habitats is the major process. Mountain and lowland landscapes in tropical areas can differ also in their susceptibility to species gain or species loss. Transformed habitats in mountainous landscapes are often invaded from species coming from adjacent ecosystems. In tropical lowlands many dung beetle species are sensitive to habitat change and go locally extinct, whereas only few species invade transformed habitats. We show how to disentangle species gain, species loss and species turnover when explaining beta diversity, how these processes are related to the degree of habitat transformation and we discuss the biogeographical and ecological causes for the observed differences. Our results have major influence on conservation priorities and strategies. We discuss how to minimize negative effects of habitat transformation implementing adequate land use types and landscape design.



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**Jessica Schnell**<sup>1</sup>, Gareth Russell<sup>2</sup>, Grant Harris<sup>3</sup>, Stuart Pimm<sup>4</sup>

<sup>1</sup>*Rutgers University, Newark, NJ, USA*; <sup>2</sup>*New Jersey Institute of Technology, Newark, NJ, USA*; <sup>3</sup>*US Fish & Wildlife Services, Albuquerque, NM, USA*; <sup>4</sup>*Duke University, Durham, NC, USA*

### **Metrics Linking Fragmentation to Extinction at Large Scales**

Habitat fragmentation is one of the primary threats to biodiversity. Satellite imagery is providing increasingly detailed information on habitat distributions, yet efficient techniques for linking these data to species survival are in short supply. Starting with metapopulation theory, we compare two methods of making this link: metapopulation capacity, and extrapolated persistence time. Both metrics produce a suitable measure of largescale habitat fragmentation when we modify them to include a self-colonization term. Using satellite-based estimates for original and remaining forest habitat of selected forest-endemic birds, we compare our calculated values with the different levels of threat assigned to those species in the current IUCN Red List. We find discrepancies in species that are both over- and under-threatened, but particularly troubling are those species with higher relative fragmentation that lack adequate protective status, especially in the Atlantic Forest of Brazil. We provide maps for restoration planning using both forest blocks and corridors. Finally, we create overall maps weighted by species richness and our fragmentation metrics, to maximize conservation efforts for the most number of species possible.

**Priya Alicia Srinivas**

*Columbia University, New York, NY, USA*

### **Effects of Oil Palm on Bird Communities in Peruvian Amazon**

Oil palm is one of the world's most rapidly expanding crops, replacing humid forests across tropical regions. To date, relatively few studies have examined the effect of this land conversion on biodiversity. Existing studies have tended to focus on Southeast Asia, where the majority of the world's oil palm is produced. Because the Amazon Basin possesses the greatest area of suitable land for oil palm expansion, oil palm is predicted to soon emerge as a threat to Amazonian wildlife. This is the first study to examine how oil palm agriculture affects biodiversity in the Amazon Basin. We used mist nets, an effective method for surveying cryptic and nonvocal understory birds, to compare bird communities in forest and oil palm habitat in the Pucallpa region of Peruvian Amazonia. Species richness, species evenness, and overall abundance were all significantly higher in the forest than the oil palm habitat. Strikingly, less than 5% of all captured species were common to both forest and oil palm habitat. The species absent from oil palm habitat were disproportionately habitat specialists, forest interior birds, birds with high sensitivity to disturbance, and insectivorous and frugivorous birds. The results suggest that oil palm is particularly poor habitat for Amazonian birds. The landscape both within and surrounding oil palm plantations is important and can be modified to promote biodiversity. Nevertheless, given the paucity of diversity on oil palm plantations, the most effective conservation strategy likely involves preventing further conversion of forests to oil palm.

**Nicole Wilson**

*Cornell University, Ithaca, NY, USA*

### **Rethinking Climate Change Adaptation**

Alterations in Northern freshwater systems due to anthropogenic climate change have profound socio-cultural and ecological consequences. Indigenous communities, whose livelihood strategies that rely directly on their local ecology, are vulnerable to climatic variations. At the same time, indigenous knowledge, or intimate knowledge of the land and water, enables adaptation to climate change. Biocultural diversity emerges from the interactions of people with their landscape and is therefore enabled by indigenous knowledge. Applied research in the Koyukon Athapaskan Village of Ruby in the

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Yukon River Basin examines the role of indigenous knowledge systems within a coupled social and ecological system as human communities adapt to climate change. Narrative interviews and human ecological mapping were conducted with community experts to compile observations of social and ecological changes and document previous responses to these perturbations, including accounts of historic adaptive strategies. Our findings raise questions about current theoretical approaches to vulnerability, resilience and climate change adaptation. In addition, this research results in practical recommendations for conservation scientists, policy makers and community practitioners who are responding to the impacts of climate change.



**Samantha Attwood<sup>1</sup>, David Skelly<sup>1</sup>**

<sup>1</sup>*Yale University, New Haven, CT, USA*

## **Frog Defense: Does Amphibian Skin Protect from a Pandemic?**

There are currently a great number of amphibian declines occurring worldwide. Among the most important agents of these enigmatic declines is a recently emerged fungal pathogen, *Batrachochytrium dendrobatidis* (Bd), first discovered in 1998. Bd causes the emerging infectious disease chytridiomycosis, a fungal infection of the skin that has proven lethal to amphibians from a wide variety of amphibian taxa. I am currently comparing the inhibitory/detrimental effects of amphibian skin secretions from a variety of local New England species to Bd. This project is examining whether skin secretions from some resistant species may be toxic to Bd whereas the secretions of other species might render them more susceptible to infection from this pathogen. This work entails collecting secretions from individuals of varying species, then challenging Bd with these secretions and measuring the effect (inhibitory, detrimental, nonexistent), using an optical plate reader, of said secretions on the fungus on a per-species basis. Previous studies have examined the Bd-inhibitory effects of both antimicrobial peptides and symbiotic bacteria in the skin of amphibians, however none so far have looked at the inhibitory effects of skin secretions as a whole, which is what this project aims to accomplish. Rather than focusing initially on skin microbes or peptides specifically, this research aims to evaluate a challenge as close to the whole skin environment as possible. Using the entirety of the skin secretions from these frog species more closely resembles what happens in nature, and will hopefully improve our understanding of amphibian defenses against this lethal pathogen.

**Georgina Cullman<sup>1,2</sup>, Eleanor Sterling<sup>1,2</sup>, Paige West<sup>1</sup>**

<sup>1</sup>*Columbia University, New York, NY, USA*; <sup>2</sup>*American Museum of Natural History, New York, NY, USA*

## **Conservation Value of Community Lands in NE Madagascar**

Northeastern Madagascar is home to some of the largest remaining rainforest blocks in the country. The region supports unique and threatened biodiversity, of value to conservationists around the world. The newly implemented Makira Protected Area, encompassing 350,000 hectares and over 70 communities, reflects the varied values that conservation works to represent – biodiversity, climate change mitigation, economic development, and participatory natural resource management. Community lands surrounding Makira are expected to serve as the buffer zone for the park. With the implementation of the policy of forest management transfer from Madagascar's Ministry of Water, Forests, and the Environment, to these local communities, de facto land use restrictions have increased, forcing further pressure on lands whose use is less regulated (secondary regrowth, and other cleared or transformed lands). Using ecological data collected from over 100 vegetation plots on community lands in the region, I will explore the compatibility of different land uses with these diverse values of biodiversity conservation. Using satellite images and aerial photos, a land cover characterization of the larger landscape will place these vegetation plots in a larger context. Trade-offs in terms of different values will be explored in the context of debates regarding land-use intensification versus extensification.

**Austin Gallagher<sup>1</sup>, Neil Hammerschlag<sup>1</sup>**

<sup>1</sup>*University of Miami, Miami, FL, USA*

## **Stressed Sharks: Modeling Better Catch and Release Fishing**

Catch and release fishing represents a major driver of local and regional economies in North America. Despite its widespread appeal, the ecological sustainability of catch-and-release fishing relies upon the major assumption that the majority fish that are caught will recover and survive when released. Accordingly, there have been a wide range of studies seeking to gauge and improve its sustainability, with many investigations focusing on economically important game fishes. Despite this trend, similar studies on catch and release fishing of elasmobranchs—particularly sharks—are lacking. This is alarming, namely due to the well-documented declines in shark populations worldwide, whereby some species have declined up to 90% in the North Atlantic alone. Moreover, new data suggest that shark species exhibit a wide range of responses to commercial angling pressure, thus making management difficult. We employed blood physiological and metabolic field assessments to provide insights into the stress responses of various shark species subjected to recreational fishing in the Florida Keys and Bahamas. Results from both blood acid-base analyses and reflex impairment tests provided a relative species-specific framework of sensitivities and tolerances to angling pressure. Great hammerhead (*Sphyrna mokarran*) and blacktip (*Carcharhinus limbatus*) sharks showed the most significant perturbations in blood pH and pCO<sub>2</sub> levels ( $p < 0.0005$ , respectively), even after shorter fight times. Fight time and physiological disturbance displayed a positive correlative relationship across all species. We provide gear and fishing method recommendations for anglers and discuss the need to focus specific conservation approaches on species that may be of higher risk of post-release mortality.



Jonas Geldmann<sup>1</sup>, Megan Barnes<sup>2</sup>, Lauren Coad<sup>3</sup>, Neil Burgess<sup>1,4</sup>

<sup>1</sup>University of Copenhagen, Copenhagen, Denmark; <sup>2</sup>University of Queensland, Brisbane, Australia; <sup>3</sup>Oxford University, Oxford, England, UK; <sup>4</sup>World Wildlife Fund, Washington DC, USA

## Effectiveness of Protected Areas in Maintaining Biodiversity

There is considerable debate on whether protected areas deliver conservation outcomes in terms of species and habitat protection. Through a systematic review of published literature we investigated the extent to which claims of PA effectiveness are supported by published case studies on population data for vertebrate species. On the basis of the published literature we have conducted a meta-analysis of protected areas effectiveness and the key management element found to correlate with conservation success. Most studies originate from tropical Africa and show effectiveness of protected areas compare to surrounding lands, though population declines are frequently experienced inside reserve boundaries as well as outside. We find that the large majority of studies are conducted on animals of economical or iconic interest such as large mammals and birds. Hunting restrictions and the presence of guards are the most important predictors of conservation success, followed by the implementation of management plans targeted specific challenges of the protected area. This literature review is the first attempt to systematically address whether actions taken after designation of protected areas have an effect on conservation success, by using time series and abundance data from studies of population trends.

Catherine González<sup>1</sup>, Miriam Fernández<sup>1</sup>, Juan Carlos Castilla<sup>1</sup>

<sup>1</sup>Pontificia Universidad Católica de Chile, Santiago, Chile

## Connectivity Under Alternative Models of Marine Conservation

No-take marine protected areas (MPAs) have been shown to be effective tools to preserve biodiversity and marine resources, but their implementation has important social and economic costs. Protected areas with less restrictive regulations can be a feasible political solution to reach sustainable uses of marine habitats. We analyzed the potential of an integrated network of MPAs and management areas for small-scale fisheries (MAs) to meet conservation goals evaluating the impact on connectivity of marine species. To assess the connectivity, we estimated the distance among different areas under three scenarios: (1) only no-take MPAs, (2) all MPAs (no-take and partially protected), and (3) MPAs and MAs. To analyze the proportion of species that can reach the nearest neighboring protected area, we estimated the potential for dispersal of marine species using alongshore current speed (cm/s) and temperature-dependent planktonic larval duration (PLD, days). Results show that 67% of the no-take areas are more than 1,000 km apart. When partially MPAs are added, 37% of the MPAs were separated by less than 200 km. The mean potential for dispersal of most species (89%) is shorter than 200 km. Nevertheless, when MPAs and MAs were pooled together, more than 78% of the areas were as close as 10 km, enabling connectivity species in 70% of the spatial units. We discuss the need of to create new MPAs in regions where species have low potential for dispersal and the opportunity that MAs offers to improve connectivity in MPA networks.

Darcey Iwashita<sup>1</sup>, Rafael Bergstrom<sup>1</sup>, Mark Chynoweth<sup>1</sup>, Lisa Ellsworth<sup>1</sup>, Sarah Henly-Shepard<sup>1</sup>, Christopher Lepczyk<sup>1</sup>, Kara Miller<sup>1</sup>, Randi Rhodes<sup>1</sup>

<sup>1</sup>University of Hawai'i at Manoa, Honolulu, HI, USA

## Review of Solutions to Population Growth and Climate Change

The world's population is nearing 7 billion and is predicted to reach 9.1 billion by 2050. Continued population growth will result in increased resource consumption and greenhouse gas emissions, enhancing the effects of climate change. Synergisms between population growth and climate change will therefore have substantial negative impacts on environmental resources. However, solutions to population growth are often absent within the context of climate change solutions. Our objective was to examine the topics and solutions that address both population growth and climate change. Using ISI Web of Knowledge, we conducted a systematic search of peer-reviewed literature published between 1980 and 2011. Of 1,438 papers addressing population growth and climate change, only 153 (11%) included solutions. Among these 153 papers, the most frequent topics and solutions addressed the societal aspects of population growth and climate change. Land use/land cover change and greenhouse gas emissions were also frequently discussed, while changes in policy, economics, and land use/land cover were the most frequently offered solutions to population growth and climate change. Education was the topic least discussed and, along with energy and health, least mentioned as a solution. Importantly, the number of papers offering solutions increased significantly over time, with 48% of them published since 2008. These results suggest that while solutions to human population growth have seldom been discussed as climate change solutions, they are beginning to be considered in the literature. However, unless these solutions are enacted soon, environmental degradation will continue to increase with population growth.



**Temitope Kehinde<sup>1</sup>**, Michael Samways<sup>1</sup>

<sup>1</sup>*Stellenbosch University, Stellenbosch, Western Cape Province, South Africa*

## **Organic Vineyard Management Supports Insect-Flower Networks**

Food web interaction networks have provided important clues to the dynamics shaping biodiversity patterns in agricultural landscapes. We employed insect-flower interaction networks as a tool to examine biodiversity patterns between organic and integrated vineyards compared to natural reference sites. Networks were compared by analyzing important web structure indices from five pairs of organic and integrated vineyards and five natural vegetation sites in linear mixed effect models. We also assessed through permutational distance-based test for homogeneity of multivariate dispersion, whether organic and integrated vineyards contributed to loss of regional diversity through homogenization of their interaction networks. We found that interaction frequency, which is a known surrogate of reproductive performance in mutualistic networks, was higher in organic vineyards than in integrated vineyards. Neither organic nor integrated vineyards homogenized interaction networks compared to natural sites. Our results provide support and heuristic value to current arguments for the protection of vineyard habitats and for expanded knowledge on the effect of different management practices for the conservation of biodiversity. This is especially important in endemic rich Cape Floristic Region, a global biodiversity hotspot, where our study took place and, where pollinators are key drivers of plant speciation. Vineyard ecosystems, when well managed in this region, may support conservation of flower-visiting insects by serving as refugia, reservoir or alternative sites with rich resource benefits. Keywords: Biodiversity, Food web, Homogenization, Management, Network, Mutualistic

**Brooke Kelly**

*Columbia University, New York, NY, USA*

## **Palmyra Atoll Green Turtle Foraging Ecology**

Green turtles (*Chelonia mydas*) are thought to be herbivorous after recruitment to foraging grounds; however, recent studies suggest that green turtles supplement their diet with animal products. Further study is needed to substantiate if this is a widespread phenomenon. The foraging ecology of green turtles at the Palmyra Atoll National Wildlife Refuge (PANWR) in the Central Pacific has previously been unstudied and serves as a mixed stage foraging ground. Stable carbon ( $\Delta^{13}\text{C}$ ) and nitrogen ( $\Delta^{15}\text{N}$ ) isotopes provide information on diet and trophic position to aid in describing the foraging ecology of PANWR green turtles. Live-captured green turtles ( $n = 75$ ) were sampled from 4 atoll regions between 2008 and 2010 (curved carapace length (cm): mean = 73.55, range = 44.5 to 113.6). Scute biopsies were removed and the  $\Delta^{13}\text{C}$  and  $\Delta^{15}\text{N}$  values of the most recently deposited tissue layer (i. e. inner) were used to determine the proportional contributions of prey to turtle diet using isotopic mixing models, examine stage specific habits, and describe spatial variation in foraging habits. Differing  $\Delta^{15}\text{N}$  among size classes (Kruskal-Wallis,  $p = 0.013$ ) suggests that individuals may forage at different trophic levels; enriched  $\Delta^{15}\text{N}$  signatures may signify ingestion of animal products. These stage-specific habits appear to be related to habitat selection preferences as size class distribution differs between the four sampling regions (Kruskal-Wallis,  $p = 0.023$ ). Results from a mixing model will help substantiate these findings. This population contains individuals that likely utilize a more variable and complex dietary repertoire including omnivorous prey items.

**Sarah Kornbluth<sup>1</sup>**, Kimberly Russell<sup>2</sup>

<sup>1</sup>*Rutgers University, Newark, NJ, USA*; <sup>2</sup>*New Jersey Institute of Technology, Newark, NJ, USA*

## **Quantifying Native Bee Pollination Services in Fruit Crops**

Information about the distribution of bees is critical to understanding the health of bee communities, as well as the pollination services they provide. Colony Collapse Disorder demonstrates that dependence solely on domesticated honeybees for agricultural pollination in the future is unrealistic. Native bees may be able to provide pollination services, but research that quantifies in-field distribution and diversity is limited. How far native bees forage in-field from adjacent nesting habitat is important information especially for large commercial farms. 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 fruit crops (pepper, tomato, and eggplant) with abundant natural habitat along one edge, we used pan traps and observations to quantify the density and diversity of bee pollinators at intervals within the beds. Additionally, over flowering periods we performed hand pollination and pollinator exclusion in mid-field followed by fruit collection, seed harvest and germination. We found over 30 species of native bee pollinating and statistical analysis of distribution and pollinator exclusion corroborates the level of pollination services provided. We find that a large organic farm has sufficient pollination services from native bees living in adjacent natural habitat.

Binbin Li<sup>1</sup>, Dajun Wang<sup>2</sup>

<sup>1</sup>University of Michigan, Ann Arbor, MI, USA; <sup>2</sup>Peking University, Beijing, China

## The Study of Fauna Diversity in Japanese Larch Plantation

Most artificial forests in China are monoculture and regarded as “green deserts” which create a host of problems. Our research was conducted in the Changqing National Nature Reserve of Qinling in China. We used Camera-Trapping, sign transect and vegetation plot to explore the biodiversity in plantation of Japanese larch (*Larix kaempferi*) and natural secondary forest patches. In our study, the Japanese larch plantation had much higher canopy cover and simpler understory structure than that of natural secondary forests. Moreover, shrubs and grass in Japanese larch plantation grew poorly and the recorded fauna diversity was low. Some animals such as golden snub-nosed monkey (*Rhinopithecus roxellana*), Chinese flying squirrel (*Petaurista clarkei*), and hog badger (*Arctonyx collaris*) were only found in secondary forests. However, there was no significant difference in relative quantity found in avian species, artiodactyl species and medium-sized carnivores between the two kinds of forests. The distributions and activities of some medium-sized and large mammals such as wild boar (*Sus scrofa*), Himalayan Porcupine (*Hystrix brachyura*) and Giant Panda (*Ailuropoda melanoleuca*) were restricted by the pine plantations. We also found that the transition belt between the artificial forest and the natural secondary forest had a relatively lower canopy cover, higher understory biomass and higher fauna biodiversity. We conclude that single species of woody plants and high plantation density negatively impact the understory which serve as food sources for animals and reduce the availability of habitats for some endangered species such as Giant Panda and snub-nosed monkey.

Jennifer Mortensen<sup>1</sup>, Michael Reed<sup>1</sup>

<sup>1</sup>Tufts University, Medford, MA, USA

## Can Social Behaviors Protect Populations from Extinction?

Although extinction risk in small populations is typically characterized as a result of stochastic processes, behavioral factors have also been shown to influence extinction. Notably, a suite of behaviors have been identified that cause extinction to accelerate (e. g. Allee effects). Although poorly explored, some other social behaviors might actually help facilitate the persistence of small populations. Behaviors can be included explicitly in simulation models for predicting extinction risk, such as population viability analysis (PVA). The goal of this research is to develop a novel behaviordependent PVA for the White-breasted Thrasher (*Ramphocinclus brachyurus*; WBTH), an Endangered cooperatively breeding Lesser Antillean passerine. Previous work suggests that cooperative breeding may buffer populations against the negative demographic effects typically experienced after habitat loss. Our results from the WBTH system supports this prediction; immediately following the loss of 41% of available habitat over two years, WBTHs continued to occupy the remaining habitat in high densities, with a significant increase in cooperative breeding, but no reproductive decrease. We expect that this buffering of population persistence through increased family size and stable reproduction is maintained years after habitat loss. Data for PVA development are currently available prior to and immediately after habitat loss, which encompass two of the three time points needed to establish the WBTH's demographic response. We will gather the third time point this summer, 5-years post-habitat loss. We expect that this PVA will guide WBTH management, and serve as the basis for future computational work on the relationship between social behavior and extinction.

Tiwonge Mzumara

Museum of Malawi, University of Kwazulu Natal, Blantyre, Southern Region, Malawi

## Status and Viability of the Lilian's Lovebird in Malawi

Lilian's Lovebird (*Agapornis lilianae*) is a globally recognized near-threatened species occurring in central southern Africa (Mozambique, Zimbabwe, Zambia, Tanzania and Malawi (BirdLife 2008). The species occurs in large flocks strongly associated with Mopane (*Colophospermum mopane*) woodlands. In Malawi, Lilian's Lovebird is only found Liwonde National Park where they are threatened by illegal hunting. Community members around the park often use poison at small pools of water to trap birds and small mammals in the park. This activity has caused the death of hundreds of lovebirds as they drink at pools in large flocks. A study was carried out to investigate the current status and distribution of Lilian's Lovebird in LNP and also to investigate the hunting activities of the communities around the park. We carried out transect walks (152km), water hole counts and drive transects between May 2010 to January 2011. Household questionnaires and focus group discussions were used in villages surrounding the park. Results showed that there are approximately 2000 individuals in the park. Their distribution varies greatly depending on the time of year. Communities start hunting as early as April and it is mainly for subsistence. The study also found that the Lilian's lovebirds are hunted most outside the park in fields and are considered as a significant agriculture pest. Given that the hunting in the field takes place during the breeding season this could have bigger impact on the Lovebirds existence in the park. Conservation should focus on ways to control hunting in fields.



**Thomas Radzio**<sup>1</sup>, Jaclyn Smolinsky<sup>2</sup>, Willem Roosenburg

<sup>1</sup>Drexel University, Philadelphia, PA, USA; <sup>2</sup>University of Southern Mississippi, Hattiesburg, MS, USA; <sup>3</sup>Ohio University, Athens, OH, USA

## **Low Compliance with a Bycatch Regulation Threatens Terrapins**

Bycatch in blue crab (*Callinectes sapidus*) pots is a leading threat to diamondback terrapin (*Malaclemys terrapin*) populations. Terrapins inhabit brackish coastal waters from Massachusetts to Texas, USA and lagoons in Bermuda. Commercial and recreational blue crab pot fisheries overlap with terrapin habitat throughout most of the terrapin's continental range. A simple, inexpensive bycatch reduction device (BRD) dramatically reduces terrapin bycatch in crab pots with little or no effect on crab catch. Several states require BRDs in their commercial and/or recreational crab pot fisheries, and additional states are considering similar measures. In 1999, Maryland adopted a regulation requiring all recreational crab pots to have BRDs. In 2005 and 2010, we documented the presence or absence of BRDs in recreational crab pots at multiple locations within the Patuxent River estuary, Maryland. In both years, we documented BRDs on fewer than 35% of pots. We conclude that mortality in crab pots remains a major threat to terrapin populations in the Patuxent River, despite management attempts to reduce this source of mortality. Accordingly, we provide recommendations to increase compliance with BRD regulations in Maryland and in other states that have, or are considering, BRD initiatives.

**Jessica Rosen**<sup>1</sup>, Yanisbell Sánchez Rodríguez<sup>2</sup>, Nelson León<sup>2</sup>, Nadia Bergamini<sup>1</sup>, Frederik van Oudenhoven<sup>1</sup>

<sup>1</sup>Bioversity International, Rome, Italy; <sup>2</sup>Instituto de Investigaciones Fundamentales en Agricultura Tropical, Havana, Cuba

## **Bridging Natural & Managed Landscapes in Cuban Mab Reserves**

The role of biodiversity in ecosystem health and services necessary for human survival is well recognized. What is less understood are the synergies between the agricultural systems of managed landscapes and the biodiversity of natural landscapes. Recent evidence has shown that while biodiversity is critical for agriculture, agriculture itself can contribute to conservation goals and the sustainable use of biodiversity, as asserted by the Convention on Biological Diversity. As a Caribbean biodiversity hotspot, much of Cuba's diversity lies within and around its UNESCO Man and Biosphere Reserves. Two of these reserves, Sierra del Rosario and Cuchillas del Toa, demonstrate how sustainable, low-input, diverse agricultural systems can coexist inside nature reserves, benefiting both the conservation of reserves and the livelihoods of the resident communities. However, these systems are under threat due to limited market access, non-existent incentives for sustainable agricultural practices, global climate change, and conservation management strategies that largely fail to incorporate agriculture as a component of the reserve system. The project seeks to address these threats by developing indicators to measure the impact of human-influenced natural environments on biodiversity and livelihoods, capitalizing on a newly established agricultural product sale and exchange program, and incorporating agro-tourism into the existing eco-tourism industry. The objectives are increased human and natural resiliency due to agricultural biodiversity, improved market access and payments for agricultural biodiversity conservation, and tourism activities that generate income for the reserve communities and management system while educating a broader population on the key role of agricultural biodiversity within natural landscapes.

**Amanda Rugenski**<sup>1</sup>, Matt Whiles<sup>1</sup>, M. J. Vanni<sup>2</sup>, K. R. Lips<sup>3</sup>, C. M. Pringle<sup>4</sup>, S. S. Kilham<sup>5</sup>

<sup>1</sup>Southern Illinois University, Carbondale, IL, USA; <sup>2</sup>Miami University, Oxford, OH, USA; <sup>3</sup>University of Maryland, College Park, MD, USA; <sup>4</sup>University of Georgia, Athens, GA, USA; <sup>5</sup>Drexel University, Philadelphia, PA, USA

## **Are Amphibian Declines Altering Stream Ecosystem Processes?**

The current rate of species extinctions and the understanding of the overall effects these losses may have on ecosystem processes remain relatively understudied. Despite great concern, there remains a lack of knowledge on the ecological consequences of declining biodiversity, which is imperative to guide conservation efforts and predict ecosystem level changes that may occur. Tadpoles can be diverse and abundant in tropical streams, where they may regulate flows and ratios of nitrogen (N), phosphorus (P), and carbon (C), thereby altering supplies of nutrients to other organisms. As amphibians continue to decline, understanding their effects on stream ecosystem structure and function is increasingly important. We used ecological stoichiometry as a framework for assessing nutrient cycling and consumer-resource interactions in pre- and post-amphibian decline headwater streams in Panama. We measured N and P excretion and C:N:P ratios of tadpoles, macroinvertebrates, and resources. Excretion rates varied among tadpole functional feeding groups (FFG) and supplied



between 83-134  $\mu\text{g}/\text{m}^2/\text{hr}$   $\text{NH}_4\text{-N}$  and 40-62  $\mu\text{g}/\text{m}^2/\text{hr}$   $\text{PO}_4\text{-P}$ . Excretion rates of macroinvertebrate shredders differed between pre- (0.824  $\mu\text{gN}/\text{mg}/\text{hr}$ ) and post-decline (0.071  $\mu\text{gN}/\text{mg}/\text{hr}$ ) sites. We found no difference in tissue C:N among sites for all FFG (3.1-3.6 among tadpoles; 4.5-9.2 among macroinvertebrates), but C:P and N:P varied among FFGs. C:N and C:P ratios of tadpoles and macroinvertebrates were lower than food sources at all sites. Results indicate that amphibian declines are altering ecosystem processes by changing taxon-specific patterns of nutrient cycling within stream food webs and potentially decreasing quality of food resources for other consumers.

### Taza Schaming

Cornell University, Ithaca, NY, USA

#### Use of Occupancy Surveys to Monitor Clark's Nutcrackers

Resource managers recognize the immediate need for determining an effective survey method for Clark's Nutcrackers (*Nucifraga columbiana*) because some populations are apparently declining, likely due to the high mortality of whitebark pines (*Pinus albicaulis*). The population status and habitat use of nutcrackers are poorly understood, in part due to the lack of a reliable method of surveying populations. My objectives were to carry out occupancy surveys that incorporate detectability to determine if (1) habitat is a significant cause of heterogeneity of detectability of nutcrackers, (2) occupancy probabilities corrected for detectability improve occupancy estimates, and (3) occupancy surveys are a reliable means to survey nutcrackers. My results demonstrate that it is necessary to correct for imperfect detectability when surveying nutcrackers, in order to increase reliability of occupancy and abundance estimates. The likelihood of detecting nutcrackers varies seasonally, and is conditional on time of day, local habitat, and point count radius. After accounting for the potential bias in detectability, model results suggested that nutcracker occupancy varied seasonally, and was variably impacted among seasons by survey time, tree density, local importance of whitebark pine, and number of whitebark pine cones per hectare. Results from surveys that do not control for detectability would likely be biased, and inaccurate conclusions about population status or trends could result. Occupancy surveys that incorporate detectability represent the best method thus far for monitoring nutcrackers accurately. It is vitally important to implement programs to investigate metapopulation dynamics of nutcrackers because this species is potentially on the cusp of a drastic decline.

Daniel Song<sup>1</sup>, Pierre Liancourt<sup>1</sup>, Peter Petraitis<sup>1</sup>, Brenda Casper<sup>1</sup>

<sup>1</sup>University of Pennsylvania, Philadelphia, PA, USA

#### Plants and Pollinators: Know Your (Functional) Role!

Pollination is a critical ecosystem function and is of great value to human societies (recently valued at \$223 billion); but we still lack basic understanding of plant-pollinator networks, such as how plants and pollinators assemble. One hypothesis proposes that plant-pollinator networks are structured by (compatibility) matching and nonmatching of biological attributes (i. e. forbidden links hypothesis). Few studies have incorporated the relationship between functional traits and interactions between plants and pollinators to test this hypothesis explicitly. Our objective is to relate plant and pollinator functional traits to their interactions by studying a plant-pollinator assemblage in Dalbay Valley, a mountain steppe of northern Mongolia. Permanent plots were set-up to monitor pollinator visitation frequency and flower abundance throughout the vegetative growing season. We also measured a suite of functional traits and biological attributes for 23 flowering plant species (corolla size, flower height, spontaneous selfing) and approximately 20 insect species (body size, body length, and wing length). Knowledge of the functional relationship between plants and pollinators may provide an alternative basis for conservation. Taxonomic information is useful but lacks detailed information about a species functional role. Functional traits, such as the flower's corolla depth or a bee's proboscis length, provide more information about a species' potential role in a plant-pollinator assemblage. Both layers of information, together, paint a more complete portrait of plant-pollinator networks and may further assist managers in the decision making process.

Rebecca McKay Steinberg<sup>1</sup>, Susan Clark<sup>1</sup>, Anita Morzillo<sup>2</sup>, Seth Riley<sup>3</sup>

<sup>1</sup>Yale University, New Haven, CT, USA; <sup>2</sup>Oregon State University, Corvallis, OR, USA; <sup>3</sup>US National Park Service, Thousand Oaks, CA, USA

#### Rodenticide Use and Non-Target Impacts in an Urban Ecosystem

Bobcat and mountain lion populations are declining in the Santa Monica Mountain region of California. Despite a US EPA policy regulating availability of anticoagulant-based rodenticides, unintentional poisoning may be contributing to their decline. Little is known about the ecological, social, and political factors affecting anticoagulant use in this urban area. Our study used an interdisciplinary approach to examine three questions: 1) Does felid habitat use include particular urban landscape features that may serve as attractants or refugia for prey species?; 2) What can we learn about residential



and commercial rodenticide use that may affect local felids?; and 3) What contextual recommendations can be made for improved pesticide regulations and carnivore conservation? A preliminary analysis of 40 urban bobcat locations shows that bobcat habitat includes landscape features likely to be used by prey species (e. g., fruit trees, fire breaks). Of 32 residential interviews about rodenticide use, homeowners' worldviews of nature and wildlife influence rodent control practices on their properties. Interviews with pest control operators suggest that most operators are not aware of secondary poisoning of carnivores. Collectively, both commercial and residential rodenticide use practices may contribute to secondary poisoning. Our results provide knowledge for understanding how urban residents and pest control companies affect carnivores by poisoning rodents. Results have management policy implications, including designing public outreach programs and informing adequate rodenticide regulations.

**Maria Wheeler<sup>1</sup>, Brady Porter<sup>1</sup>, Todd Katzner<sup>2</sup>**

<sup>1</sup>Duquesne University, Pittsburgh, PA, USA; <sup>2</sup>West Virginia University, Morgantown, WV, USA

### **Pre- And Post-Reintroduction Genetics of Golden Eagles**

This study examines the extent to which historical reintroductions of western golden eagles (*Aquila chrysaetos canadensis*) into eastern North America have influenced the genetic structure of contemporary eastern populations. Though geographically and potentially reproductively isolated from their western US counterparts, the eastern golden eagle population was augmented by multiple independent translocations of western birds between 1981 and 2006. We are evaluating the level of genetic distinction between eastern and western populations via comparing sequences of the mitochondrial cyt b gene and of ten microsatellite loci. Genetic material has been acquired primarily from naturally shed feathers from contemporary wild and captive birds as well as from historical museum specimens, to allow comparison of these two populations both before and after the reintroductions. Average cyt b sequence divergence between populations is 0.303%, with 0.314% sequence divergence across all specimens. The two most divergent individuals vary by 1.02%, from two contemporary eastern birds. Similarly, Bayesian analysis of microsatellite data has not revealed any definitive clustering of populations. These data indicate that the modern populations of eastern and western golden eagles are not currently distinct from one another. Work with historic specimens is beginning, to compare genetic differences pre-introductions with those in the present population. Results of this study have the potential to impact not only the management of golden eagles in the eastern US but also conservation planning for other species.

**Claudia Wultsch<sup>1</sup>, Marcella Kelly<sup>1</sup>, Lisette Waits<sup>2</sup>**

<sup>1</sup>Virginia Tech University, Blacksburg, VA, USA; <sup>2</sup>University of Idaho, ID, USA

### **Noninvasive Tracking of Jaguars (*Panthera onca*) In Belize**

Jaguars (*Panthera onca*) and other felids are extremely difficult to study due to their wide ranging behavior and crepuscular activity peaks. This study combines innovative noninvasive research techniques such as scat detector dogs, molecular scatology, remote camera trapping and Geographic Information Systems to gain valuable information on jaguars and other felids (mountain lions, ocelots, margays and jaguarondis) coexisting across fragmented forest habitats in Belize, Central America. We conducted scat dog surveys across five study sites from 2007-2010 and detected a total of 1192 scat samples. We optimized a set of 14 highly polymorphic microsatellite primers for all feline species and have identified so far 160 individuals (68 jaguars, 56 mountain lions, 29 ocelots and 7 margays) often captured multiple times. We monitored the felids simultaneously with remote cameras, which allows for a comparison of density estimates obtained from two different survey approaches. Furthermore, population connectivity, directional gene flow and dispersal patterns have been examined. All populations tested have so far shown moderate levels of heterozygosity ( $H_e = 0.58-0.65$ ) and low to moderate levels of differentiation ( $F_{ST} = 0.00-0.12$ ). Hypotheses concerning how natural or anthropogenic barriers influence the animals' movement and genetic connectivity existing across Belize will be tested. The study identifies populations under threat and proposes movement corridors between isolated habitat patches to ensure the animals' survival in a fragmented landscape. This is the first noninvasive study of a wild felid community and the techniques developed are widely applicable to the conservation and management of many other elusive carnivores worldwide.