

**IMPACT OF SAND MINING ON THE DOLPHIN POPULATION OF KULSI RIVER OF NORTHEAST INDIA**

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Kusi River in central Assam holds 6% of the total Gangetic dolphin (*Platanista gangetica*) population of the Brahmaputra river system of Assam and 86.6% of the total dolphins of the river is concentrated in its 3 km stretch near Kukurmara. Sand mining is the biggest disturbing factors to the dolphins in this river stretch. We conducted our study to understand the impact of sand mining to the concerned dolphin population through conducting comparative study between sand mining operated and non-operated sites, mainly by observing dolphin behavioral response, difference in water quality as well as biotic community composition and abundance. Our study confirmed that although the sand mining has been changing the normal habitat ecology of the operated sites, still it has been maintaining the required water depth of that 3 km stretch. Besides, the local communities are getting more economic benefits from sand mining than fishing on the same river stretch, which on the other hand has been helping in the sustainable development of dolphin food. These results confirmed our findings about 25% population increase in Kushi River within the last 10 years, a completely different scenario in comparison to the other parts of Brahmaputra river system, where the total population has been declining at a rate of 25.9% over the last 12 years.

**FERAL LIVESTOCK AS A POTENTIAL THREAT TO TREELIKE CACTI-DOMINATED ARID LANDSCAPES: A CASE FROM THE ARGENTINIAN MONTE ARIDO**

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Species introduction and naturalization represent a serious threat for many natural protected areas and one such case of worldwide concern is feral livestock in arid ecosystems. Damage suffered by the treelike cacti (*Trichocereus terscheckii*) dominating the landscape of rocky slopes was surveyed in 7 locations within the Ischigualasto Talampaya World Heritage Site (Argentina) by measuring the number, position, and size of damages. In parallel we estimated the abundance of large herbivores (*Lama guanicoe*, *Bos taurus*, *Equus assinus*) through dung transects. Results show relatively high damage levels (4077 damaged individuals) and their concentration within the 0.501.75 m high range (chi squared test, p Wallis test,  $p < 0.05$ ) and for the two feral livestock species ( $p < 0.001$ ). Finally, damage levels are correlated with frequencies of cattle and donkey dung in transects (Spearman  $r$ ,  $p < 0.05$ ), but not with that of guanaco. We conclude that the continued presence of feral livestock gives rise to damages to treelike cacti potentially affecting their populations and threatening the physiognomy of the protected landscape.

**EFFECTS OF AN ENSO-RELATED FIRE ON THE BIRDS OF A LOWLAND TROPICAL FOREST IN SUMATRA**

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The effect of fire on tropical forests is of great conservation concern. In Indonesia, where fires have devastated large areas of forest in recent decades, little is known about the specific impacts on faunal communities. We surveyed birds in a lowland tropical rainforest in Sumatra for five years after the 1997 fires. Comparisons of bird community composition in burned and unburned areas indicate that during the first five years after burning, (1) original burn severity strongly affects bird community composition at both the genus and family levels, (2) bird community composition continues to change progressively in medium and severely burned forest as well as adjacent unburned forest, and (3) the degree of impact is taxon- and guild-specific, with understory insectivores most detrimentally affected. Although species richness may temporarily increase in burned areas, this study suggests that multiple wildfires will lead to a decline in diversity over a large scale as birds of open fields replace interior forest specialists.

**HAKE HABITAT IN THE CALIFORNIA CURRENT: DISTRIBUTION, DYNAMICS AND MANAGEMENT IMPLICATIONS**

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Migratory species present a unique challenge for marine conservation. Their habitat is spatially dynamic therefore highly variable over time. Also, many migratory stocks are transboundary thus associated with complex policy scenarios. Understanding the spatial processes driving the distribution of these species is essential for effective management and conservation. Pacific hake is an ecologically and commercially important California Current (CC) species. The hake stock is shared between the United States and Canada. A great deal of controversy revolves around this fishery as stock distribution along the West Coast of North America is highly variable, with the larger and most valuable fish intermittently occupying Canadian waters. This study uses acoustic data to examine the three dimensional distribution of hake in the CC system. We analyze data on abundance and distribution of hake, intensity and distribution of alongshore flow and temperature. Our three dimensional view of hake habitat reveals fundamental processes driving hake distribution that could not have been described by the traditional two dimensional view of marine habitats. We find hake habitat to be highly dynamic and related to current flow. Habitat boundaries appear to change in response to interannual climate forcing. The management and conservation of Pacific hake, must take these dynamics into account.

**FARMSTEADS AND FARMERS CAN SUPPORT FARMLAND BIODIVERSITY!**

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The agricultural landscape has been simplified during the last decades. Non-cropped habitats (field islands, ditches, natural pastures, etc.) are scarcer than before and species have less feeding and nesting sites. Islands among the crops are the farmsteads. Biologists examining biodiversity in the farmland have often neglected the farmsteads. Nature at the farmstead will depend on the management but also on the surrounding landscape. The bird fauna on 16 farmsteads in central Sweden was surveyed during spring and summer 2004, the landscape was analysed by a GIS-analysis, and the farmers' perception of nature and nature conservation was revealed by an open-ended interview. The farms differed in size 35–600 ha and the farmers differed in age 34–77 years. In total 29 bird species were found. The species richness was highest on farmsteads with husbandry and farmsteads close to grazed land. The farmers differed in many ways but unifying was their deep knowledge of the land and local nature and the anger of being forced to manage their farm according to general, non-local, inflexible programs, schemes, or laws. The importance of farmsteads for biodiversity can be increased by informing and discussing with the farmers, acknowledging their knowledge and supporting their creativity.

**ONE FOREST THREE COUNTRIES: PREDICTING THE ECOLOGICAL AND ECONOMIC IMPACT OF ROADS IN THE MAYAN FORESTS**

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The Mayan forest is the largest remnant tropical forest in the Mesoamerican biodiversity hotspot. In spite of national and international conservation strategies to reduce rates of deforestation, such as the Mesoamerican Biological Corridor, the rate of forest loss has been steadily increasing since 1970. Moreover, a major development project proposed to connect a series of roads is planned for the region. The objective of our project is to predict the impact of the roads on the Mayan forest in Belize, Guatemala, and Mexico and to understand their role on deforestation dynamics. To quantify the historic deforestation trends in the region we analyzed Landsat images for three time periods (late 1970s, 1970s–1990, and 1990s–2000). We then developed models to implement a cost-benefit analysis of the proposed roads for each of the countries. Our land-cover change analysis showed differences in the trend of deforestation dynamics between the three countries with Belize showing a large reduction in deforestation and Mexico showing a steady increase, and Guatemala showing a rapid increase between 1990 and 2000. Our cost-benefit analysis suggests that the economic benefits associated with proposed road building will not be sufficient to counterbalance the cost of building and maintaining the roads. This research suggests that the proposed road network will likely contribute to further deforestation, and fragment key conservation areas in the Mayan forest while providing little economic benefit.

**CONSERVATION SIGNIFICANCE OF TEMPERATE FLOODPLAIN SPRINGBROOKS**

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Floodplain springbrooks, common features of temperate river systems, have largely been ignored in favor of conservation efforts directed at mineral and hot springs in desert, cave, or volcanic influenced ecosystems. Springbrooks add to floodplain diversity and function through dynamic ground and surface water interactions, high productivity, and food web linkages across aquatic and riparian ecotones. We describe physical features and biological community structure of springbrook habitats from temperate floodplains around the Pacific Rim and the Rocky Mountains. Specific examples of stable thermal regimes (5–15 C), high rates of aquatic primary production (130 mg / m<sup>2</sup>), fish production (3.81 g / m<sup>2</sup> trout), and biogeochemical cycling from the Middle Fork Flathead River Nyack floodplain are explored. We examine case studies from western North America of floodplain springbrooks supporting endemic and threatened species such as the Banbury Springs Lanx snail (*Lanx* sp.), coho salmon (*Oncorhynchus kisutch*), and water mites (*Hydracharina*). Finally we delineate the wide variety of threats faced by springbrook ecosystems ranging from invasion by non-native species such as brook trout (*Salvelinus fontinalis*), water pollution, floodplain development, dams, and groundwater extraction.

**GALAPAGOS SHARKS AND HAWAIIAN MONK SEALS: A CONSERVATION CONUNDRUM**

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Predation by Galapagos sharks (*Carcharhinus galapagensis*) is the single greatest mortality source for pre-weaned monk seal (*Monachus schauinslandi*) pups at French Frigate Shoals. We hypothesized that the predation involved a small number of sharks, as tested by direct monitoring and removal of limited numbers of active predators. Mortalities peaked from 1997–1999 (31–22, respectively) and declined by > 50% after monitoring and removal efforts began in 2000. The number of pup mortalities was relatively stable from 2000–2005, with 10–12 losses each year (15–21% of the annual cohort). Twelve sharks were removed and the numbers of patrolling sharks declined during diurnal hours. Most predation occurred at Trig Island, but it increased at other sites over time. We attribute these results to shark displacement away from Trig Island. The decision framework for implementing the shark removal experiment was evaluated in terms of expected costs and benefits (to both monk seals and sharks), uncertainties in the predation data, and concerns about the acceptability of a removal project within a refuge. Given the declining status of endangered monk seals and the probable minimal effect of the shark removals, we concluded that available data were sufficient to support the removal experiment.

**DEVELOPMENT OF PARTICIPATORY CONFLICT RECONCILIATION PROCESSES: THE CASE OF BIODIVERSITY CONSERVATION AND AQUACULTURE IN THE SADO ESTUARY (PORTUGAL)**

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Effective conservation policies may lead to a recovery of populations which compete with human activities, namely when food production (e.g. aquaculture) offers attractive resources for carnivore vertebrates (such as otters and seals). This presentation describes a participatory process for the development of environmental policy instruments to reconcile the conflict between biodiversity conservation (in this case otters) and fish farming in the Sado Estuary Nature Reserve (Portugal). An initial assessment was undertaken through a set of interviews with stakeholders followed by a discourse analysis, complemented by an evaluation of existing policies and instruments. We found that there was a strong conflict between the fish-farmers and the Nature Reserve administration, motivated by opposing interests and by a communication gap, and there were no instruments in place to address it. A participatory conflict reconciliation process was then initiated, combining the use of formal participation techniques—consultation workshops—with an informal approach of information gathering and building of trust, based on individual meetings. This has resulted in the celebration of a sustainability contract, involving fish-farmers, the Nature Reserve Administration and the Municipality. A first result of this agreement is the proposal for the creation of a fish certification scheme, promoting an ecologically sustainable production and the economic competitiveness of the sector.

### **CAN PERENNIAL VEGETATION LINK SPECIES, FARMS AND COMMUNITIES?: PARTICIPATORY ACTION RESEARCH TO DEVELOP LANDSCAPE SCENARIOS IN IOWA, USA**

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The once biodiverse prairies of Iowa, USA, have experienced nearly complete loss of natural perennial vegetation and concomitant decline in species due to agricultural intensification. While current scientific research posits that restoration of perennial cover in agricultural landscapes may benefit both social and ecological resilience, rural residents and policy makers show little awareness of and appreciation for these linkages. In order to bridge gaps between science, people, and policy, our research integrates tools from landscape ecology and participatory action social science. We conducted 40 ethnographic interviews with farm owners and operators to identify values, clarify assumptions, and envision future landscape scenarios. In response to the broad question, "what do you value about the rural countryside?" interviewees more readily valued social, rather than biophysical, aspects of the landscape. Almost all farmers responded favorably to restoration of habitat and biodiversity on marginal agricultural land. However, many doubted these practices could be implemented in their own watershed due to more pressing farm priorities, lack of civic connections, and distrust of government programs. Interviewees envisioned that successful conservation policy initiatives must link restoration of biodiversity with "restoration" of neighborly social connections across the landscape, especially communication between farm owners, operators, and conservation agency personnel.

### **POTENTIAL EFFECTS OF SEA-LEVEL RISE ON TERRESTRIAL HABITAT AND BIOTA OF THE NORTHWESTERN HAWAIIAN ISLANDS**

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Climate models predict that global average sea level may rise considerably this century, potentially affecting species that rely on coastal habitat. The northwestern Hawaiian Islands (NWHI) have high conservation value due to their concentration of endemic, endangered, and threatened species and large numbers of nesting seabirds. We explored the potential for NWHI habitat loss by creating topographic models of several NWHI and evaluating the potential effects of sea-level rise by 2100 under a range of basic passive flooding scenarios. Projected terrestrial habitat loss varied greatly among islands: 3% to 65% under a median scenario (48 cm rise), and 5% to 75% under the maximum scenario (88 cm rise). Spring tides may repeatedly inundate all land below 89 cm (median scenario) and 129 cm (maximum scenario) in elevation. Continued sea level rise after 2100 would likely have greater impact on low-lying atolls, where virtually all land is less than 2 m above sea level. Higher islands may provide longer-term refuges for species. The effects of habitat loss on NWHI biota may be greatest for endangered Hawaiian monk seals, threatened Hawaiian green sea turtles, and the endangered Laysan finch at Pearl and Hermes Reef.

### **LINKING POPULATION VIABILITY ANALYSIS TO ENVIRONMENTAL DRIVERS OF VITAL RATES FOR THE ISLAND FOX (*UROCYON LITTORALIS*)**

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Increasingly sophisticated methods are available to analyze demographic data to identify environmental drivers of vital rates, yet results are rarely incorporated into population viability analyses (PVA). We present such an analysis for the island fox (*Urocyon littoralis*) a rare endemic occurring on six of the Channel Islands off the southern California coast. We analyzed mark-recapture data from 11 grids on four islands over 17 years to identify important drivers of variability in vital rates and used our results to parameterize a PVA for the three northern islands, where foxes declined catastrophically in the 1990s, apparently due to eagle predation. We hypothesized that fox vital rates were driven by three factors: eagle numbers, fox densities, and rainfall patterns. We built linear logistic models linking hypothesized factors to vital rates and selected the most parsimonious models based on likelihood and information theory methods. The best covariate model for survival included a negative effect of eagles, both positive linear and negative quadratic effects of density, and rainfall effects that varied spatially. We incorporated these drivers into stochastic demographic models that included both unassigned process variance and model selection uncertainty to describe future fox population dynamics under varying conditions.

**POPULATION AND ROAD COMPONENTS OF ALTERNATIVE FUTURE HUMAN FOOTPRINTS: FORECASTING THREAT AT THE ECOREGIONAL SCALE**

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Conservation planning in transboundary ecoregions is facilitated by threat forecasting tools appropriate for landscapes with heterogeneous land uses. The Northern Appalachians ecoregion, which crosses the United States / Canada border, faces threats from development, overharvesting, and airborne pollutants, while representing one of North America's richest forest biodiversity conservation opportunities. The future human footprint (FHF) analysis incorporates dynamic components of the current human footprint to map temporal and spatial aspects of human influence over a 40-year horizon. To date, the FHF incorporates (a) trend models for human population and (b) probability surfaces for paved, public roads through a linked logit model, under two growth scenarios. Accumulation of new subdivision roads alone will affect nearly 10,000 km<sup>2</sup> over coming decades. If regional growth rates during the 1990s (-22 to +23%) continue, urbanization will intensify while rural populations will decline, creating opportunities for conserving landscape-scale linkages. If regional growth rates accelerate to plausible levels, however, exurban growth will overtake most of the unprotected coastal and riparian areas, isolate protected areas, and increase development pressure on privately-owned forestland. Plans for large scale highway and energy projects further threaten the integrity of the region.

**RECONCILING LIVELIHOODS AND CONSERVATION THROUGH PARTICIPATORY RESEARCH**

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Because indigenous and local knowledge systems shape the ways local peoples engage with their environment and impact local ecosystems, research in conservation biology can often benefit from incorporating local people's knowledge into the research process. Participatory research engages ordinary people in the research process in ways that combine their knowledge with conventional scientific knowledge to produce a more robust account of the situation under study and also reconcile local livelihood and conservation needs. This can be in the form of jointly locating small populations of an endangered species or collaboratively devising appropriate research questions based on more accurate resource use patterns. Examination of examples from several arenas of conservation (riparian restoration, large mammal studies, forestry) illustrates the rewards and challenges of using a participatory approach, including the ethical, technical, and conceptual issues that arise. We offer recommendations to researchers for determining when a participatory approach is appropriate, as well as how to address the challenges. These include investing time, ways of building trust, and maintaining sensitivity to local social, political, and cultural contexts. The benefits of a participatory approach to the quality of the conservation research, as well as the local people involved, will often outweigh the challenges.

**IMPACT OF MARINE ACTIVITIES IN BRITISH COLUMBIA, CANADA**

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We quantified, for the first time, the impact of marine activities in the exclusive economic zone of British Columbia, Canada. Humans use the ocean for a multitude of purposes, many of which have a direct impact on marine life and habitat. Yet such uses are seldom analyzed in an integrated fashion. Using a GIS approach, we analyzed spatial information for 39 marine activities, including commercial and recreational fishing areas, transportation and infrastructure uses, and terrestrial activities adjacent to coastal areas. A relative scale was used to rank both the impact of marine activities and the extent of impact beyond the site of occurrence. Limited information on the latter led us to apply three ranges of buffer distances to the data (0–1 km, 0–5 km, and 0–25 km). Our most conservative estimate (0–1 km buffers) indicates more than 83% of the continental shelf of British Columbia is currently being used by humans. The large buffer assumption shows 98% of the continental shelf being impacted by humans. Our analysis provides a baseline for assessing future changes in the state of British Columbia's marine environment, and could assist in identifying areas of conservation potential.

**EFFECTS OF ULTRAVIOLET-B RADIATION ON GROWTH AND SURVIVAL OF AQUATIC AND MARINE ORGANISMS: A META-ANALYSIS**

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Ultraviolet B radiation (UV-B) is a global stressor with far-reaching impacts. Due to stratospheric ozone depletion, UV-B is increasing relative to both UV-A and visible wavelengths. An immense body of literature exists on the effects of UV-B radiation in a diverse array of aquatic and marine organisms. However, these data have not been quantitatively synthesized. Does UV-B have similar negative effects regardless of species studied, or are particular taxonomic or functional groups more susceptible to damage from UV-B than others? Are results from laboratory studies different from field studies? We used meta-analysis techniques to explore the effects of UV-B on survival and growth of organisms in freshwater and marine systems. Specifically, we used Hedge's *d* to compare effect sizes between ecosystem types (marine vs. freshwater), taxonomic groups, functional groups, and experimental venue (laboratory vs. field). Our results suggest that UV-B susceptibility varies greatly among organisms regardless of ecosystem, taxonomic group, functional group, or experimental venue. While UV-B positively impacts a few species, the majority of species in this meta-analysis are negatively affected by UV-B.

**CONSERVATION AND MITIGATION BANKING: THEORY AND PRACTICE IN CALIFORNIA**

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This research identifies the origins, differences, and theoretical benefits of mitigation and conservation banking policy to protect and recreate threatened and endangered environmental habitat in compliance with federal law. We consider lessons from a

decade of environmental banking experience in terms of private incentives and aggregate social costs and benefits. Our critique considers criteria for social cost efficiency, enforceability, and long-run incentives, and two case studies: Wildlands, Inc. Mitigation Bank and San Vicente Conservation Bank offer the confirmations and cautions of real experience. We conclude that banking provides significant incentive for landowners to identify and realize through commodification of sensitive and rare habitat, the high value society places on those lands. However, the spatial displacement and aggregation inherent in mitigation banking creates ecological risks, such as catastrophic infestation or wildfire. In addition, by engineering the location and quantity of sensitive habitat, we are creating a second risk pertaining to government or social failures. All of these risks have been realized to some extent in our short experience with banking, but so too have many of the theoretical benefits.

### **A MULTISPECIES RISK ASSESSMENT FOR RARE AND IMPERILED SPECIES IN FLORIDA**

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Florida, one of the most rapidly growing states in the United States, faces an urgent need to prioritize land use and maximize the value of protected areas. In response, our risk assessment for 60 rare and imperiled wildlife species used GIS and population viability analyses, combining habitat suitability maps with spatially-explicit population models for each species. This technique identifies the demographic variables with the greatest impact on survival and highlights which patches of suitable habitat are important for persistence. A number of clear trends have emerged. Survival of breeding adults was usually the most important parameter influencing population growth. Fecundity and juvenile survival rates appeared to be less important than adult survival for estimating risks of extinction. Most species lacked information on dispersal, average density, and carrying capacity, critically important parameters for developing spatially-explicit strategies. More attention needs to be focused on understanding the spatial constraints for vulnerable species, especially with increasing need to prioritize acquisition and management. The final result is a map that combines habitat suitability and demographic data for the set of species to highlight areas critical for conservation in Florida. We hope that this project can serve as a guide to other large-scale, multi-species planning efforts.

### **LINKING POPULATION VIABILITY ANALYSIS AND HABITAT SUITABILITY FOR THE CONSERVATION OF AUDUBON'S CRESTED CARACARA (*CARACARA CHERIWAY*) IN FLORIDA**

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Florida's rapidly growing human population creates an urgent need to prioritize land use to reconcile the needs of humans and native species particularly when species of conservation overlap with anthropogenic land use. We used GIS analyses and population viability analyses to address questions regarding the conservation needs of the Audubon's Crested Caracara, (*Caracara cheriway*), an opportunistic raptor endemic to Florida. This species is of particular concern because over 80 of known nesting locations occur on private lands. Using information from both the literature and field surveys, we constructed a spatially-explicit, stochastic population viability model to determine the most important demographic parameters for the Caracara, assess viability, and identify criteria for potential habitat. The most important demographic variable impacting viability was adult survival, and our spatially-explicit model indicated that the Caracara population in Florida is stable under current conditions, assuming no future changes. However, if nesting locations on private lands are not maintained our model indicated quasi-extinction. We also found that 5 of the 43 land cover types (e.g. Hardwood Hammocks) identified in Florida are significantly associated with home ranges. This approach provides a means of addressing conservation concerns for species at risk, especially those occurring primarily on private lands.

### **ASSESSING THE EFFECTIVENESS OF PROTECTED AREA MANAGEMENT: A CASE STUDY FROM NEPAL**

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In an effort of protecting biodiversity, Nepal has created an impressive array of protected areas (PAs) which cover more than 19% of the total area of the country. But only effectively managed PAs can fetch productive results. The main objective of this paper is to examine the effectiveness of PA management in Nepal. Specifically, it will explore (a) issues related to design and planning of the PAs, (b) availability of management resources, (c) output of the PAs management, and (d) impacts on biodiversity conservation and gaps within the framework for assessing management effectiveness of PAs developed by IUCN. I gathered data through literature review, field studies, and participatory appraisal and developed biological, socioeconomical, and community participation indicators of effective management. Preliminary analysis showed that there was a significant difference in planning between mountain and tarai parks with inadequate buffer zones to support local people and wildlife. Inadequate resources (e.g., manpower) and lack of assessment, monitoring and evaluation, and research were common symptoms across the PAs, most of which have not delivered their full potential in conservation, community development, and recreation. These findings suggested that managing the existing PAs effectively must be the priority over creating new ones for productive outcome.

### **HOW TO DESIGN A WILDLIFE CORRIDOR**

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For 5 years, in collaboration with state and federal wildlife and transportation agencies, we have been designing wildlife corridors in Arizona and southern California. With almost no scientific literature on assumptions and technical issues, we have been forced to choose among reasonable scientific approaches and develop new procedures, including (1) choosing a focal species approach, (2) choosing Most Permeable Corridor Analysis and Patch Size and Configuration Analysis (a low-tech spatially explicit population model), (3) defining the habitat areas to be connected (harder than it sounds!), (4) selecting 10–20 focal species, (5) choosing the driving variables and model structure, (6) recruiting experts to parameterize the habitat models,

(7) translating the habitat model into pixel costs, (8) evaluating whether the Most Permeable Corridor is sufficiently permeable (sometimes the best is not very good!), (9) making the linkage design robust to climate change, and (10) setting a minimum width to minimize edge effects and support metapopulations of species needing multiple generations to transit the corridor. These may be the first comprehensive set of procedures intended for designing multi-species wildlife corridors in real landscapes. We hope our description of assumptions, choices, and alternatives will promote better conservation and stimulate scientific investigation of corridor design issues.

#### **RECONSTRUCTING THE HISTORICAL DEMOGRAPHY OF AN ENDANGERED SEABIRD TO DIAGNOSE CAUSES OF DECLINE**

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Museum collections constitute a unique, underutilized resource for reconstructing demography of threatened species using ratios of the number of individuals in different age classes. When combined with comparative analyses and contemporary field studies, demographic reconstruction can identify the demographic parameters responsible for population declines. We demonstrate this approach by examining changes over the past century in fecundity and survival for an endangered population of Marbled Murrelets in central California. Reproduction ( $R$  = ratio of juveniles to adults) estimated with museum specimens (0.297) was 8.5 times greater than  $R$  from contemporary at-sea captures (0.035) and 9.3 times greater than from at-sea surveys (0.032). Comparative analyses predicted a juvenile ratio of 0.292. Adult survival did not differ between historic (0.840) and contemporary murrelets, as estimated from mark-recapture methods (0.882) or from at-sea captures (0.905), and were similar to predictions from comparative analyses (0.835). Casting these values into a matrix model, the historic population was projected to be stable and the contemporary population to decline; an LTRE indicated reproduction was the overwhelming cause of differences. Evaluation of sources of bias suggests they had negligible effect. Reconstructing historical demography from museum collections is an unexplored approach to gain insight for recovering threatened species.

#### **GEOGRAPHIC VARIATION IN FORAGING STRATEGIES OF WESTERN PACIFIC LEATHERBACKS – IMPLICATIONS FOR LONGTERM CONSERVATION**

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The Western Pacific region, particularly West Irian Jaya, Indonesia, contains the largest remaining nesting sites for endangered leatherback turtles (*Dermochelys coriacea*) within the Pacific Ocean. Protection and monitoring have significantly reduced anthropogenic threats at many beaches; however, the development of effective longterm conservation strategies requires an understanding of threats to the population outside the breeding area. Leatherbacks are known to range widely, but foraging destinations of Western Pacific turtles have been poorly understood. Since 2000, we have deployed satellite transmitters on leatherbacks at nesting beaches in West Irian Jaya ( $n = 34$ ) and Papua New Guinea ( $n = 20$ ), and at foraging areas off California, USA ( $n = 31$ ), to document movement patterns and elucidate stock structure. Results show that the relatively large nesting population in West Irian Jaya uses multiple foraging grounds in the nearby Indo-Pacific region and in distant eastern north Pacific waters off California and Oregon, USA. All post-nesting leatherbacks from Papua New Guinea moved southward into the western South Pacific. Although the diverse migratory pathways of this genetic metapopulation expose leatherbacks to a multitude of threats at sea, they may also provide a buffer against adverse anthropogenic impacts and environmental perturbations in the marine environment.

#### **MORPHOLOGICAL AND BEHAVIORAL CORRELATES OF POPULATION STATUS IN THE SOUTHERN SEA OTTER: A COMPARATIVE STUDY**

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The threatened southern sea otter has failed to recover at an expected rate following near extirpation by the maritime fur trade. Slow population growth has been attributed to increased mortality, but the role of density-dependence in limiting growth remains unclear. Thus, the characterization of range center populations as food limited could have important implications for the recovery of this species. We examined the relationship between population density and patterns of behavior and morphology in the southern sea otter by contrasting the recently established low-density population at San Nicolas Island (SNI) with the long established high-density population in central California (CC). The mean densities of invertebrate prey were higher at SNI than at CC, as was the mean rate of energy gain by foraging otters. As a likely consequence, body condition was better and foraging activity was reduced in sea otters at SNI compared with CC. Patterns of individuality in diet and foraging behavior, which characterized sea otters at CC, were absent at SNI. These findings support the hypothesis that food limitation is a likely factor contributing to the stalled recovery of the threatened southern sea otter and have important implications for the development of recovery tactics.

#### **DEFINING COMMUNITY TRAINING OBJECTIVES FOR CO-MANAGEMENT OF PROTECTED AREAS**

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Community-based organizations participating in co-management of protected areas throughout the world are being called upon to develop new skills and methods for conservation management and community development. Analyzing six training and evaluation models used in various parts of the world used for developing and measuring conservation skills, I synthesized common goals and objectives and placed them in the context of community organizations participating in co-management agreements with a government agency. From this analysis, I distilled thirteen training objectives for building the capacity of

community-based organizations to be effective and efficient co-management partners. These thirteen objectives form a basis for developing comprehensive training programs for communities in many parts of the world, and offer a benchmark for evaluating the capacity of communities to be co-management partners.

### **A GLOBAL ANALYSIS OF INTERNATIONALLY ADJOINING PROTECTED AREAS: CURRENT EXTENT AND FUTURE POTENTIAL FOR TRANSBOUNDARY APPROACHES**

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Internationally adjoining protected areas (IAPAs) represent the set of protected areas where formalized transboundary approaches are possible. Developing a global database of these IAPA's, incorporating the subset which already exist as formal transboundary areas, would help in understanding the relative importance and future potential of transboundary approaches, particularly where they may complement existing conservation interventions. GIS analysis of the World Database on Protected Areas (WCMC / IUCN, 2005) served as a foundation for identifying IAPAs. This was supplemented by available information, including a past analysis (Zbicz 2001), and subjected to peer review by selected experts. Methods used here represent a standardized methodology for identifying and monitoring IAPAs to aid future work and monitoring. The study identified 188 internationally adjoining protected area complexes and other transboundary conservation areas, incorporating at least 818 protected areas in 112 countries and representing over 16 of the global conservation estate. Priority countries and regions, based on number of complexes and total area within IAPAs, are identified. The degree of overlap between IAPAs and selected conservation approaches is described. This database represents a useful tool upon which to build and coordinate international transboundary initiatives across the globe.

### **IDENTIFYING THREATS TO ELEPHANTS IN CENTRAL AFRICA USING SPATIAL MODELING OF SURVEY DATA**

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Systematic site-based wildlife surveys in Central Africa, conducted under the CITES MIKE (Monitoring Illegal Killing of Elephants) program, have revealed that most elephant populations across the region are highly threatened. We analyzed data of selected MIKE sites to identify the main threats and factors that have an impact on elephant distribution and abundance. We used line transect methodology to estimate dung densities of elephants and a combination of remote sensing, field work and GIS to collect data on landscape and human-related factors. We compared different statistical techniques to model spatial patterns of elephants in relation to these factors. Elephants generally preferred remote and protected areas. The results showed especially the importance of law enforcement (protection infrastructure and patrols) and conflict in determining elephant distribution. Habitat related variables also appeared to have some influence especially where elephants were protected. We also demonstrate how monitoring combined with spatial modeling can help protected area managers and policy makers to understand and manage threats to wildlife, identify critical populations, and evaluate the impact of management policies.

### **RESTORATION WITHOUT BORDERS: A LARGE-SCALE ESA-LISTED ELKHORN CORAL (*ACROPORA PALMATA*) TRANSPLANT EXAMPLE FROM THE DOMINICAN REPUBLIC, YEAR THREE**

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In November 2002, over 200 healthy Elkhorn coral colonies (*Acropora palmata*) were transplanted from an approved international port dredging site to a hurricane damaged Elkhorn reef. Depending on their size (0.53.5 m diameter) the colonies were stabilized using tie wraps, wire, or cement. During the first year survival rates were extremely high (95, n = 50) and 97 of the colonies were overshooting their adhesion substrates. Live tissue coverage estimates were 7080. The colonies did not spawn yet colony branch tips were growing steadily. In 2005, three years after transplantation and one year post-Hurricane Ivan, survival rates dropped to 36, with 70 live tissue cover (n = 77 colonies). Only cemented colonies remained. We found no incidence of disease. Similar to natural reefs nearby, snail (*Coralliphilia* sp.) depredation was prevalent, with 1 to 17 snails infesting 27.3 of the colonies. High densities of urchins (*Diadema antillarum*, 6.43 / m<sup>2</sup>), some fireworms (*Hemodice* sp.) and boring sponges (*Cliona* sp.) impacted the transplants. On the restoration reef there were 0.07 juveniles / m<sup>2</sup> (3 years old), ten times more than all other size classes combined. Most importantly, broadcast spawning was documented in year three posttransplantation, indicating this restoration project now likely reaches well beyond the borders of our restoration reef.

### **SEASONAL ABUNDANCE AND HABITAT-USE PATTERNS OF PARROTS IN GUATEMALA USING A CANOPY-BASED SURVEY METHOD TO ESTIMATE DENSITY**

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Parrot population surveys were conducted as part of a broader project to investigate parrot migration dynamics and regional conservation planning in lowland tropical forests. Estimating parrot abundance is problematic for those highly mobile species that dwell in vertically complex forest canopies, and estimation techniques are needed for monitoring populations of this endangered group. We describe our canopy-based survey method to quantify abundances of six parrot species in Guatemala, 1998–2000. We assess four factors affecting detectability, provide an approach to incorporate length of birds' time on the survey plot into estimates, and present estimates by season and landscape type for each species. Results demonstrate distinct differences in habitat associations among the species and significant seasonal declines in densities of four species. Radio telemetry with one species (*Amazona farinosa*) revealed that birds engaged in a predictable seasonal migration, a pattern which correlated with change in density recorded in population surveys. Similar seasonal population changes in the other three species suggest that migration is common in this parrot community. We discuss the importance of monitoring these migrants

that cross jurisdictional and biophysical boundaries, the insight they offer on regional habitat connectivity, and the challenge posed to conservation.

**ASSESSMENT OF INTERACTIONS BETWEEN AQUATIC LAND USE AND ENDANGERED SPECIES FOR AQUATIC LANDS THROUGHOUT WASHINGTON STATE**

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Habitat conservation planning fills a critical role in reconciling conflicts between development and conservation. As manager of more than 2.4 million acres of state-owned aquatic lands, Washington Department of Natural Resources (DNR) is charged with both fostering water-dependent commerce and protecting the environment. The agency is beginning to review its management practices on aquatic lands to ensure compliance with the federal Endangered Species Act (ESA). An initial component of this effort has been a comprehensive review of potential effects to ESA listed species and activities managed by DNR. This review led to the development of a spatial database tool that examines spatial overlaps between species and activities, and assesses the potential effects of interactions in terms of hectares of affected habitat. The results of this study describe the impacts to 20 listed and unlisted species from 34 land use types (e.g., outfalls, overwater structures). Results suggest that the greatest effects from activities are related to bridges, shipping terminals, and marinas. Species with the largest amounts of habitat potentially affected by land use activities include wide-ranging species like salmonids and bald eagles. Strengths and challenges of this project are related to the scope in terms of species, activities, and total area.

**SMALL-SCALE GENETIC ENDEMISM IN AN ENDANGERED FAIRY SHRIMP**

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Genetic markers can be used to estimate historical and contemporary connectivity among populations, and identify units for conservation and management. We used the mitochondrial gene cytochrome oxidase I to assess connectivity among populations of the fairy shrimp (*Branchinecta sandiegonensis*) in San Diego County, California. *B. sandiegonensis* is a federally endangered species, with habitat losses thought to exceed 90%. Fifty unique alleles were identified from over 300 individuals in 31 "complexes" of hydrologically linked pools. There is a high degree of small-scale endemism, and some complexes contain only unique endemic haplotypes. Regional genetic differentiation is high. These patterns are particularly obvious in peripheral populations and in areas with little anthropogenic disturbance. We found two highly divergent genetic lineages within the species, and with very few exceptions, pool complexes contain haplotypes from only one lineage. We recommend that anthropogenic homogenization of this species across its range be minimized as much as possible. Evolutionary significant units (ESUs) that should be prioritized for conservation include the two major clades and individual pool complexes. According to some interpretations of the ESU concept, every pool complex could be considered an ESU worthy of separate consideration.

**FROM PETS TO PEST: DIET, IMPACT AND MANAGEMENT OF A FERAL CAT POPULATION INTRODUCED ON A SMALL PROTECTED MEDITERRANEAN ISLAND**

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In many parts of the world, introduced feral cat populations have wreaked havoc on insular biodiversity, especially seabirds. Despite centuries of cats presence on Mediterranean islands, few investigations were yet conducted on this area. This study concerns the small island of Port-Cros (southeastern France), covered by a National Park statute, where we investigated the diet of the feral cat population and the spatial-temporal patterns of predation exerted on the Mediterranean endemic Yelkouan shearwater. The study of feral cat diet through the analysis of ca. 1500 scats revealed that this invasive species preyed mainly upon introduced mammals, especially ship rats (70 of the total ingested biomass). However this study also revealed that these endemic shearwaters constituted a secondary prey for the top predator. We evaluated that Port-Cros cat population was annually responsible for the death of ca. 200 to 600 shearwaters, i.e. 2 to 5 times the whole breeding population. Shearwaters were mainly preyed during the pre-breeding period, especially when nonbreeders visited the colonies. An eradication campaign was set up and diet of cats was monitored during the two year trapping period. A mathematical model describing the cat-rat-seabird system has also been developed and the simulations of the consequences of cat eradication will be compared with data from field surveys currently conducted on shearwaters colonies and rat populations.

**SELECTING TARGETS FOR LANDSCAPE-SCALE CONSERVATION PRIORITY SETTING: DO CONSERVATION NGOS DISAGREE AND DOES IT MATTER?**

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Recognizing that wide-ranging and rare species and many ecological processes can only be conserved within landscapes, areas typically larger than most protected areas, five international conservation organizations, partners of the US AID Global Conservation Program, are each developing and testing systematic planning approaches for conservation priority setting at the landscape scale. All five approaches set conservation targets—a subset of biodiversity on which conservation actions will be focused. There is concern, however, that these different approaches, often applied in overlapping regions, may select vastly different targets, and hence result in very different conservation strategies and outcomes. To assess the differences and similarities among the approaches, we applied each method in a workshop setting to a terrestrial landscape in Samburu, Kenya. We found major convergence among both holistic and umbrella species-based approaches that aimed to maintain a

functional landscape, choosing targets which represented biodiversity value and landscape functionality. These differed significantly from the one approach that aimed to avoid species extinction, prioritizing targets based on vulnerability and irreplaceability rather than contribution to landscape functionality. We predict different target selection methods with similar overall conservation goals would not result in vastly different outcomes, although further investigation based upon alternative landscapes would be necessary.

### **PURGING OF DELETERIOUS RECESSIVE ALLELES DURING HISTORICAL INBREEDING CAN LIMIT THE THREAT THAT INBREEDING DEPRESSION POSES TO POPULATION VIABILITY**

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An important issue in conservation biology is the extent to which inbreeding depression can be reduced by natural selection. If deleterious recessive alleles causing inbreeding depression can be purged by natural selection, outbred populations with a history of inbreeding are expected to be less susceptible to inbreeding depression. We designed two experiments using *Drosophila melanogaster* as a model system to test for an association between inbreeding history and inbreeding depression. In the first experiment, we created six purged populations from experimental lineages that had been maintained at a population size of 10 male-female pairs for 19 generations, and measured the inbreeding depression that resulted from one generation of full-sib mating in the purged and the original base populations. In the second experiment, we examined the inbreeding depression that occurred in lineages maintained under pedigrees that led to the same inbreeding coefficient but different levels of ancestral inbreeding. We found that the magnitude of inbreeding depression was reduced by 66% in populations that had a history of inbreeding, and by 40% in populations with high levels of ancestral inbreeding. These results suggest that purging can limit the threat that inbreeding depression poses to population viability and persistence.

### **IDENTIFYING CRITICAL ECOLOGICAL PROCESSES FOR BIODIVERSITY PERSISTENCE: A BOTTOM-UP APPROACH**

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Ecological processes structure and maintain ecosystems and their biodiversity. Conversely, the loss of processes can lead to loss of species and the sites that support them. While many processes will be effectively maintained through site scale conservation, the persistence of some will require a broader-scale approach. To ensure the long-term persistence of threatened species and the sites that support them, we need to incorporate broad-scale ecological processes into conservation planning. Using data on globally threatened birds and amphibians, this paper sets out a framework for identifying critical ecological processes that require conservation action beyond the site scale. We present the results of analysis showing that approximately 12% of globally threatened birds, and at least 20% of globally threatened amphibians, are threatened by changes in ecological processes that require conservation action beyond the site scale. The variety of these processes implies that a species-driven approach to identifying critical ecological processes is essential. Further, because some sea / landscapes hold multiple species threatened by similar ecological processes but with specific ecological process requirements that differ significantly, trade-offs may be needed in planning for their conservation.

### **SPACE UTILIZATION PATTERNS OF BOBCATS (*LYNX RUFUS*) IN THE SANTA ANA MOUNTAINS IN SOUTHERN CALIFORNIA**

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We studied the ranging behavior of bobcats in a 13,000 ha reserve in Orange County, California. A six-lane north-south highway bisected the reserve into a 10,000 ha portion contiguous with other protected lands and a 3000 ha portion adjacent to more urban development. We placed GPS radio collars on 4 male and 4 female bobcats in each section and compared their home ranges and movements. Individuals in the larger portion had larger home ranges (mean 95% utilization distributions SE: females 313 57 ha; males 1168 540 ha) than did bobcats in the smaller area (females 173 19 ha; males 344 92 ha). Ten bobcats had GPS locations within 500 m of the highway but only 2 individuals ever crossed it, despite several underpasses and culverts as potential crossing points. The two portions of the reserve differed somewhat in habitat composition, and human recreational use was significantly higher in the smaller section where camera traps detected 9 humans per 100 trap nights vs. 1 person per 100 trap nights in the larger area. While bobcat home range sizes may reflect these differences, restricted bobcat ranges in the smaller portion may simply reflect the reduced patch size created by urban edges and the highway.

### **LANDSCAPE ETHOLOGY: A CASE FOR SOCIALITY**

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There have been numerous calls urging conservation to integrate principles of animal behavior. Here, we assert that attention to sociality is critically needed. Sociality—the broader system of conspecific attachment, associations, knowledge, and behavior—defines the ecology of many threatened and endangered species, but is conspicuously absent from conservation design. Much of this oversight derives from difficulties ascertaining animal subjective experience, documenting social relationships in the wild over broad scales, and linking the quality of social bonds to fitness outcomes. Current neuroethology obviates some of these obstacles and underscores the importance of conserving social relationships and processes. Neuroethology suggests that understanding bonding patterns and processes is as key in determining the future of many populations of social animals as are demographic or habitat models. We articulate linkages among neuroethology, sociality, and conservation through the illustration of three case studies. We then discuss how varying levels of anthropogenic disturbance

through the disruption of social bonds and networks has potential population level effects. Such a "landscape ethology" seeks to understand the consequences of spatial heterogeneity in natural and human-dominated landscapes on the behavior and sociality of wild animals.

#### **AFRICAN BUSHMEAT MARKETS IN EUROPE AND NORTH AMERICA**

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Recent research has highlighted both subsistence and commercial dimensions of the multi-billion dollar trade in African bushmeat. Here we explore dynamics of one extreme aspect of this trade, the illegal sale of African wildlife for human consumption in European and North American cities. Specifically, we present results of seven months of discrete market surveys at four sites in North America and two in Europe. We compare results of our surveys with published and unpublished data from west and central African markets and show that (a) species composition of "foreign" bushmeat markets differs greatly from "local" markets with the former showing a higher proportion of primates and antelope, (b) price of exported bushmeat is significantly higher than locally-consumed equivalents, (c) approximately 70% of bushmeat sold in these foreign markets was smoked or cooked, and (d) the combined volume of bushmeat sold in these foreign markets typically was less than one thousand kilograms per month. We discuss our results in light of USDA and other reports on the sale of African bushmeat overseas. We also consider briefly the disease risk posed by the transportation of African bushmeat across international borders.

#### **DAYLIGHTING THE CULTURAL CURRENTS OF SCIENCE-BASED SALMON HABITAT RESTORATION**

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Salmon recovery plans focusing on habitat restoration have spawned intense controversy in the Pacific Northwest. In the rural Skagit River valley of northwest Washington state, people fear the loss of both salmon and farmland, but efforts to conserve one are often pitted against the other. Through ethnographic research with farmers, fishermen, fisheries biologists, tribal members, and others, I aimed to daylight cultural currents underlying the local debate over salmon habitat restoration, typically dominated by scientific information. A striking finding is that perceptions of restoration often revealed perceptions of American Indians, reflecting the growing power of the tribes in fisheries management in the face of persistent colonial sensibilities. Furthermore, perceptions of restoration science were influenced by the fact that the primary research center in the valley is sponsored by the local tribes. Meanwhile, people expressed spiritual-like attachment to distinct aspects of the landscape: farm, salmon, estuary. These places become meaningful through particular historical and experiential understandings of them, and help construct people's own identities. Yet while scientific knowledge guides restoration projects and celebrates biological diversity, it does little to celebrate the diverse cultural histories of the places to be restored, accounting for some of the passion inherent in this controversy.

#### **CROSS-COUNTRY COMPARISON OF NATIONAL RED LISTS WITH THE IUCN RED LIST AND IMPLICATIONS FOR CONSERVATION PLANNING**

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For four decades the World Conservation Union (IUCN) has been assessing the global threat status for species and publishing the results in the annually updated IUCN Red List of Threatened Species. Additionally, numerous countries have published national lists of threatened species, often based on IUCN guidelines for regional assessments. There is often much overlap in species considered threatened by IUCN and those included in national assessments, but discrepancies have important implications for conservation planning. We compared threatened species lists of five countries (Brazil, Colombia, China, Philippines, South Africa) with the 2004 IUCN Red List and found notable differences falling into four categories: (1) many species have been assessed nationally as threatened, but have yet to be assessed by IUCN, (2) a few species are considered globally threatened by IUCN, but are locally common and thus not threatened nationally, (3) some species are globally common and not considered threatened by IUCN, but are locally rare and therefore considered nationally threatened, (4) there are discrepancies due to errors made by either IUCN or a national assessment. We find that the first and last of these account for the greatest proportion of discrepancies, suggesting that reconciliation between lists at the two scales should generally be straightforward.

#### **ECOLOGICAL RAMIFICATIONS OF WILDLIFE POACHING IN PROTECTED AREAS**

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Humans currently overharvest many species, directly leading to widespread collapse of natural populations. This in turn indirectly impacts the organisms that interact with the "target" species, with the potential to drastically restructure communities. Yet we have only scant understanding of the strength and prevalence of such indirect effects of harvest, and of the mechanisms by which they occur. Here I show that wildlife harvest reduces the persistence of a canopy tree that is dependent on the hunted animals for seed dispersal. The primary dispersers of *Choerospondias axillaris* (Anacardiaceae) seeds are mammals that are highly prized by hunters. I use a natural experiment in northern Thailand, where National Parks vary in mammal abundance largely due to differences in illegal poaching intensity. Seed dispersal and seedling abundance of *C. axillaris* positively track this variation. Population modeling reveals that as mammal abundance drops, *C. axillaris* population growth rate transitions from positive to negative. In parks with heavy mammal hunting, *C. axillaris* is on the road to extinction. This suggests that conservation strategies not be based on single species, but on the preservation of ecologically crucial species interactions.

### **THE ROLE OF ETHNOGRAPHIC RESEARCH IN PROTECTED AREA DESIGN: EXPERIENCES FROM MILNE BAY, PAPUA NEW GUINEA**

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In order to design viable and effective protected areas, conservation planning increasingly needs to draw on social science tools and methods such as rapid rural appraisal, non-market valuation, and social impact assessment. This paper discusses the experiences of using ethnographic research in the design of marine conservation areas in Milne Bay, Papua New Guinea. We review how the assessment of traditional tenure and resource management practices has helped to reveal and document cultural values and practices, which are being incorporated into zoning schemes and management regulations. The participatory research process has also improved the quality of interactions between conservation proponents and stakeholder groups. This in turn has helped with education and outreach efforts, and increased the acceptance and buy-in of conservation objectives. The paper concludes with a discussion of time, human resource, and financial requirements of the ethnographic assessment.

### **SUSTAINABILITY OF SNAKE EXPLOITATION IN CAMBODIA: A LIVELIHOODS AND ECOLOGICAL PERSPECTIVE**

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The Tonle Sap freshwater ecosystem is home to eight species of water snake that are being heavily hunted to provide an income source for some of the poorest people in Cambodia, in particular through sustaining the crocodile farm industry. We have set up a stakeholder participatory monitoring program showing that over four million snakes are landed annually, raising strong concerns over the future integrity of these snake populations. Using an integrated approach our research aims to assess sustainability while also addressing the issues that are driving the exploitation. Interviews with resource-users have highlighted massive declines in snake catch sizes over recent years and disproportionate declines in the abundance of two species. Stakeholder interviews and activity monitoring have shown that this is a demand-driven system that is enabled by a large population of economically marginalized fishers. The rate of exploitation varies seasonally according to both the availability of snakes and changes in the supply of alternative resources that drive fluctuations in incentives for snake hunting. Snake hunting is a low margin economic activity, only pursued when fish catches decline. Applying a livelihoods approach to sustainability analysis thus enables us to identify the socioeconomic decisions of resource-users and integrate these into conservation planning.

### **GLOBAL BIODIVERSITY CONSERVATION PRIORITIES**

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The distribution of biodiversity and threats to it is uneven, and so prioritization is essential to ensure that the investment of globally flexible conservation donors minimizes biodiversity loss. Nine templates of global biodiversity conservation priority have been developed by non-governmental organizations, and have received enormous attention in the recent conservation biology literature. Most global conservation prioritization focuses on areas of irreplaceable biodiversity, especially in the tropics, but while some prioritize threatened areas, others prioritize pristine regions. Measurement of irreplaceability is generally based on the endemism of terrestrial vertebrate or plant species. Measures of threat have primarily been based on habitat loss alone. Many approaches have been based on spatial units defined a priori, and have used specialist estimates of biodiversity value rather than primary data. Despite these limitations, prioritization systems have been effective in directing globally flexible conservation investment. Continued incorporation of better data and broader metrics of irreplaceability (including for megadiverse invertebrates, aquatic biodiversity, phylogenetic history, evolutionary process, and ecological services) and threat will improve the rigor of global conservation prioritization. Meanwhile the application of these techniques at fine scales is essential to ensure the effectiveness of conservation on the ground.

### **BEE COMMUNITIES AND FOREST FRAGMENTATION IN TROPICAL COUNTRYSIDE**

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Despite concern over the global pollination crisis, there are no published studies on the effects of habitat fragmentation on entire bee communities in the tropics, and the area requirements of native habitat needed to provide pollination services to nearby crops (such as coffee) are unknown. We sampled bees and floral resources in 23 sites in southern Costa Rica over two years along a gradient of forest fragment size, from <1 ha to 230 ha, both inside forests and in adjacent pastures. Preliminary results indicate (1) no relationship between bee diversity or abundance and forest fragment size or isolation, (2) inconsistent relationships between floral resources and bee communities, (3) significantly lower bee abundance and richness inside forests versus in pastures only a few meters away (which could be an artifact of our inability to sample the canopy), and (4) strongly different community composition inside vs. outside of forests, including an entire tribe of bees (Euglossini, the orchid bees) that were relatively common in forests but not encountered at all in countryside a few meters away. These results confirm the conservation value for bee communities of preserving even very small (<1 ha) tracts of forest in tropical agricultural countryside.

### **LONG-TERM TEMPORAL TRENDS IN WHITE SHARK PREDATION ON PINNIPEDS**

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To assess long-term temporal trends in predator / prey relationships between white sharks and pinnipeds, we examined a 17-year (1988–2004) data set of daily shark attack surveys from Southern Farallon Island (SFI), California. We modeled

relationships between observer effort, seasonality, environmental factors, and predator / prey population abundance within and among years on the number of observed shark attacks at SFI. Effort and date of attack both showed a quadratic relationship with number of observed attacks. The seasonal peak in shark predation (30 October) did not vary interannually. Daily probability of attack was positively correlated with weekly total pinniped abundance and negatively correlated with maximum high tide during observations. After controlling for daily variation due to effort, date, and weekly total pinniped abundance, the average abundance of northern elephant seals best explained annual variation in the number of shark attacks observed. Controlling for shark abundance, annual variability in observed shark attacks was best modeled as an inverse function of northern elephant seal abundance, suggesting a functional response between northern elephant seal abundance and white shark attack probability. Knowledge of predator / prey dynamics between white sharks and pinnipeds is essential to understanding the role of top predators in regulating marine ecosystems.

**ASSEMBLY OF THE YELLOWSTONE SPECIES POOL AND IMPLICATIONS FOR REGIONAL CONSERVATION PLANNING**  
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We used the assembly of the Yellowstone biota as a natural experiment to investigate the processes that generated the modern species pool. Our aim was to ascertain how the physical environment and individual species characteristics have interacted to determine patterns of standing diversity. Taxonomic order, body size class, and biogeographic affinity were used to test whether the assembly of the Yellowstone fauna proceeded randomly over the past ten millennia. Our results indicated that the Yellowstone fauna is composed of a non-random subset of mammals from specific body size classes and with particular biogeographic affinities. Analyses of taxonomic order found significantly more Carnivora from the Rocky Mountain region and significantly fewer Rodentia from the Deserts region than expected from random assembly. Analyses using body size classes revealed deviations from expectations, including several significant differences between the frequency distribution of regional body sizes and the distribution of those species found within Yellowstone. Results for the birds of Yellowstone indicate a more random assembly pattern. Our novel approach focuses on the mechanisms generating diversity, not just current diversity patterns. This methodology will assist in the design of conservation strategies given future environmental change scenarios, especially in predicting the most susceptible species to environmental change and for delineating corridors important for future movement.

**VERNAL POOL VEGETATION OF CALIFORNIA: VARIATION, CLASSIFICATION, AND TEMPORAL DYNAMICS**

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Vernal pool ecosystems are complex and variable along many different spatial scales. Existing biological classifications of California vernal pools are based on whole-pool samples that do not reflect the internal heterogeneity of vegetation within pools. A recent classification of vernal pool vegetation demonstrates that whole pools consist of a complex of autonomous plant communities, thus changing our perception of vernal pool vegetation. We recognize Californian vernal pool vegetation as a new class *Downingio bicornutae-Lasthenietea fremontii*. The fine-scale classification of vernal pool vegetation makes the question of temporal community stability fundamental in the recognition of floristically-based vernal pool community types. To partially answer this question a long-term dataset was used to examine the range of annual and seasonal variation in vernal pool plant species. Results show that vernal pool plant species are not static; the vegetation has cyclic dynamics that may be stable over time at a "loose equilibrium." Diagnostic species for the class *Downingio bicornutae-Lasthenietea fremontii* and three orders within it show high values of temporal persistence. As the classification of vernal pool plant associations is refined, temporal persistence should be incorporated in determining the most useful diagnostic species to each association.

**CONTROLLING SPATIAL SPREAD OF THE INTRODUCED CORDGRASS SPARTINA ALTERNIFLORA: A BAYESIAN DECISION ANALYSIS**

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Mathematical models can help to evaluate alternative strategies for invasive species control, particularly if they address relevant scales, allow a direct linkage between field data and parameter estimates, and explicitly account for uncertainty. We illustrate these features with an individual-based simulation model describing local spread of the aquatic nuisance species *Spartina alterniflora* in Willapa Bay, Washington, USA. The model incorporates vegetative expansion of clonal patches and seedling establishment by sexual reproduction. We estimated the parameters by fitting the model to a 20-year time series of clone size and recruitment taken from aerial photographs of a 47-ha site within the bay. We used Bayesian estimation methods, which allowed us to incorporate prior information on *S. alterniflora* growth and reproductive rates and to predict the probability of meeting control targets under different management scenarios. For a given level of effort, the most effective strategies were those that preferentially removed the smallest clones and that began relatively early in the invasion, before a critical threshold of infestation was reached. These qualitative results are consistent with previous models of plant invasion, but our approach offers a rigorous statistical framework for confronting such models with data and for applying the results to decision analysis.

**POPULATION STRUCTURE, GENETIC DIVERSITY, AND DISPERSAL BEHAVIOR OF AN ENDANGERED HAWAIIAN BIRD: IMPLICATIONS FOR CONSERVATION OF THE OAHU ELEPAIO**

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Oahu elepaio (*Chasiempis sandwichensis ibidis*) are lower-canopy, non-migratory Hawaiian forest birds in the midst of a precipitous decline. Found in six main population fragments, they occupy a mere 4% of their historic habitat. To better inform recovery plans that may include translocations and captive breeding, we investigated the population structure, dispersal patterns, and genetic diversity of this endemic flycatcher by analyzing the mitochondrial haplotypes (Control Region II-III) and nuclear microsatellite genotypes (12 loci) of 91 individuals. Analyses reveal that the population is indeed genetically structured with significant *F<sub>ST</sub>*-values ranging from 0.029 in microsatellites to 0.132 in the Control Region. However, these mitochondrial and nuclear markers differ in their respective patterns of genetic structure and diversity, exposing differences between male and female dispersal behavior. Also revealed are low inbreeding coefficients within population fragments and recent gene flow among them, including the unexpected existence of dispersal events that cross deforested agricultural and urbanized regions. While gene flow among these fragments is important for conserving genetic diversity in this population, uniformly low inbreeding coefficients and the existence of contemporary long distance dispersers indicate that recovery efforts should place a higher priority on the more pressing problems of female adult survival and nesting success.

### **REGIONAL CHARACTERIZATION OF RIPARIAN AND UPSLOPE VEGETATION TO GUIDE STREAM HABITAT PROTECTION AND RESTORATION**

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Riparian vegetation influences instream habitat for fish and other aquatic species. In this study we hypothesized that a new approach to vegetation mapping yields data of sufficient accuracy and detail to distinguish a riparian signal for broad-scale riparian assessments in forested landscapes. The Gradient Nearest Neighbor approach integrates Landsat imagery with grids of field plots and other GIS data to assign detailed vegetation attributes to each pixel. We compared forest vegetation characteristics from Gradient Nearest Neighbor maps for 100-m riparian buffers and upslope areas in the Coastal Province of Oregon. We assessed map accuracy in riparian and upslope areas by comparing with data from regional inventory plots. The maps differentiated riparian and upslope areas for many forest attributes that have been empirically related to stream habitat (e.g., area of large conifer forest, abundance of large wood). Broadleaf vegetation, which commonly occurs adjacent to streams, was mapped for a larger percentage of riparian buffers than upslope areas. Large downed wood was most abundant in riparian buffers, especially in areas affected by historical wildfires. Accuracy of mapped vegetation attributes was similar for riparian and upslope areas. Our findings support the use of Landsat-based maps for regional characterizations of riparian areas.

### **LANDSCAPE-LEVEL CORRELATES OF MAMMAL POPULATION PERSISTENCE IN GHANA'S SAVANNA RESERVES**

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Understanding patterns and processes that underlie variation in protected-area effectiveness represents a critical component of successful biodiversity conservation. Using 30 years of monitoring data covering 41 large mammal species, we investigated the relationship between mammal population persistence and key environmental variables in and around six savanna reserves in Ghana, West Africa. A GIS database was created for Ghana including reserve boundaries, vegetation type and productivity, land use, and anthropogenic impact ("human footprint"). Spatial analyses revealed considerable variation in patterns of persistence among the six reserves and among the 31 monitoring stations distributed within the largest reserve, Mole National Park (4840 km<sup>2</sup>). At the reserve level, mammal persistence was positively correlated with percent tree cover and reserve size, and negatively correlated with human footprint and perimeter-to-area ratio. Within Mole park, no strong correlations were detected between the temporal change in mammal relative abundance at individual stations and the environmental variables tested. Our results demonstrate the usefulness of combining simple biodiversity monitoring with existing environmental GIS data for coarse-scale park management and planning, but suggest that finer resolution data will be needed to better understand patterns of variation within parks.

### **DESERT WILDLIFE RESTORATION: MONITORING WILDLIFE POPULATIONS IN THE CHANAN REMINGTON MEMORIAL WETLAND**

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Seepage from the unlined All American Canal has led to the establishment of wetland complexes within California's Imperial Valley. Within the 50-acre Chanan Remington Memorial Wetland, EcoSystems Restoration Associates implemented a 10-year wetland enhancement project that involves the removal of exotic / invasive species as well as the enhancement, restoration, and creation of native wetland communities. The intent of the project is not only to establish wetland vegetation but also to improve the habitat for desert wildlife species, including the federally and state-listed Yuma clapper rail and the state-listed black rail, two species that currently occupy the area. Therefore, a 10-year wildlife monitoring study that focuses on bird and mammal activity within the wetland complex and an adjacent control area was designed to determine the effectiveness of the wetland enhancement efforts. Ten bird point counts and 10 mammal tracking stations were established within the wetland enhancement and control areas. Results from this study will be used to determine changes in wildlife use of the enhancement site, to evaluate the effects of the restoration on the wildlife population, to determine changes in relative abundance and species diversity, to measure changes in population parameters, and to assess faunal changes over time.

### **CONNECTIVITY AND RESERVE DESIGN IN GALAPAGOS MARINE RESERVE**

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Reserve networks that include zones of full protection and sustainable use integrated into regional management plans for fisheries and coastal development are recommended to ensure biodiversity conservation in the oceans. However, linkages

between marine populations vary in time and space, which makes it problematic to determine a spatial configuration of reserves that optimizes connectivity while hedging against catastrophic events that would decimate associated groups. We developed Ecological Integrity (EI), an index of connectivity that combines distance and area that could (1) help assess the connectivity of existing MPA networks and (2) be a design criterion for establishing well-connected new reserves. We tested both applications of EI in the Galapagos Islands as part of the comprehensive process to re-zone the Galapagos Marine Reserve. Using GIS and MARXAN, we calculated EI for the existing zoning configuration, which protects 18% of coastlines in areas of non-extractive use. By maximizing the overall connectivity of the Reserve, we developed alternative arrangements of non-extractive use zones that may enhance biodiversity conservation and representation of key habitats and species. We recommend that connectivity be considered, along with other biodiversity targets and socioeconomic factors, in systematic conservation planning that integrates expert knowledge with the use of reserve selection tools.

**A COMPARISON OF ITERATIVE AND TERMINAL STAGE PROCEDURES ADDRESSING MULTIPLE OPPORTUNITY COST CONSTRAINTS IN SYSTEMATIC CONSERVATION PLANNING**

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Scarce resources and competing goals necessitate efficient conservation. Incorporating opportunity cost trade-offs into systematic conservation planning is one way to achieve efficiency and two approaches are available: iterative procedures where trade-offs are made within a reserve selection algorithm and terminal stage procedures where efficiency is evaluated upon algorithm completion. We compare the two methods in a systematic conservation plan for Milne Bay Province, Papua New Guinea. Conservation goals include targets for threatened species, representation, hydro-ecological process and terrestrial / marine integration. We apply standard conservation planning software to each cost trade-off individually (25 total) and use a conservation utility score (the number of times a planning unit is selected, [0,100]) to aggregate results into three scenarios: food security, macro-economic development, and viability. This approach is compared with a terminal one, where no cost is used and efficiency is addressed post hoc using multi-criteria analysis. We compare efficiency in terms of biodiversity and cost. Both approaches capture similar amounts of biodiversity, but the iterative procedure has a lower budget for most opportunity costs, except for area, where the terminal stage procedure has a lower total cost. We propose a hybrid two-step approach incorporating the iterative conservation utility score before using a terminal procedure to select the most efficient solution.

**LANDSCAPE CONFIGURATION DETERMINES THE RISK OF HUMAN-ELEPHANT CONFLICT INCIDENTS IN SOUTHEASTERN SRI LANKA**

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Conservation of Asian elephants (*Elephas maximus*) in South Asia needs to focus on the mitigation of human-elephant conflicts (HEC). Frequently, little information is available to support management decisions. We studied HEC in southeastern Sri Lanka combining ground monitoring in six selected areas with regional-scale questionnaire surveys. We recorded 3.6 incidents per km<sup>2</sup> per year with high incidence of attacks on houses and people. HEC was highly seasonal, with two periods of high damage (dry season and cropping season) in which causes for damage differed. Most of incidents were attributed to male elephants. The risk of HEC was successfully predicted by habitat modeling. At 25 km<sup>2</sup> resolution, all variables resulted significant in univariate tests. The most influential variables were those measuring human influence on the landscape and forest fragmentation. Slope and distance to water also entered the final model. The raiding behavior of elephants proved to be strongly influenced by landscape configuration, doing so in a complex mode with several factors acting and interacting simultaneously. This study identified priority areas, seasons, and segments of the elephant population for the development of mitigation measures and contributed to the understanding of how human alteration of landscapes affects our interactions with wildlife.

**DE FACTO MPAS OF THE UNITED STATES**

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Understanding human uses of marine areas is fundamental to ocean governance. While much attention has focused recently on use restrictions in marine protected areas (MPAs), little is known about the extent or potential impacts—both ecological and socioeconomic—of areas closed for reasons other than conservation. Established by several federal agencies, such “de facto MPAs” include safety and security zones, and other areas restricted during part or all of the year. As part of a national assessment of place-based marine conservation priorities, NOAA’s National MPA Center has inventoried, classified, and analyzed all 1235 federal de facto MPAs in U.S. waters. Most de facto MPAs, such as vessel traffic zones, allow access but specify how certain uses must be conducted. Fewer than half limit access or restrict specific activities. Interestingly, access is prohibited and restrictions enforced in fewer than one third of sites, and often for only part of the year. Although often equated with marine reserves, the realized conservation value of these sites may vary widely depending on their location, the duration of their access restrictions, and their use by the managing agency. These results have important implications for comprehensive marine zoning and ecosystem-based management.

**DECLINE OF CHARISMATIC MAMMALS IN WESTERN TANZANIA: CAUSES AND SOLUTIONS**

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Quantitative data on changes in population size and their possible causes are extremely difficult to obtain in the tropics. In the Katavi ecosystem of western Tanzania, repeated aerial censuses between 1987 and 2002 indicate that populations of most

species of large ungulate declined. Five competing factors that could be responsible for these changes. (1) Rainfall has increased over 25 years and (2) no obvious outbreaks of disease have been witnessed, suggesting that populations are not suffering food shortages or disease. (3) Predation by lions and spotted hyenas might have important impacts on middle-sized ungulates but estimates of predation rate depend on many assumptions. (4) Illegal hunting appears to impact giraffe, hippopotamus, and warthog populations adversely. (5) Tourist hunting of lions and greater kudu in adjacent hunting blocks appears too high and may be driving declines in these species. This study points to anthropogenic factors being chiefly responsible for the decline of large mammals in this ecosystem and it shows that alterations in management could halt this decline, particularly if illegal hunting activities are controlled. Generally, it highlights the conservation importance of conducting monitoring in conjunction with collecting diverse data when trying to stop population declines before they become too serious.

### **SOFTWARE TOOLS FOR COASTAL-MARINE ECOSYSTEM-BASED MANAGEMENT**

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The current move towards ecosystem-based management (EBM) of marine and coastal environments is an important opportunity to integrate science, natural resource management, and land-use planning. Coastal ecosystems are comprised of a vast array of natural and human systems and making decisions that incorporate multiple systems is extremely complex. Policymakers and managers need specialized tools to visualize and analyze the current state of resources and the potential consequences of their decisions on these resources. NatureServe recently conducted an initial assessment of software tools for coastal-marine EBM for the David and Lucile Packard Foundation. These software tools range from dynamic ecosystem models to spatial decision support systems to marine protected area design tools and span marine, terrestrial, and freshwater systems. We will present the results of our assessment of currently-available EBM tools and our vision for the next generation of coastal-marine geospatial analysis tools, as well as the direction of the Packard Foundation-supported consortium for EBM tools.

### **LAND USE CHANGES AND OIL EXPLOITATION EFFECTS ON AQUATIC BIODIVERSITY ON NEARBY A PROTECTED AREA IN TROPICAL LOWLANDS**

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By characterizing the habitat of thirty sites and ten sampling sites of aquatic macroinvertebrates, we analyze physical-chemistry and aquatic macroinvertebrates diversity in the Tarapoa Block, Ecuadorian Amazonia. Most of the places were visited twice in 2004, once in March and once in December. Macroinvertebrates were collected by using D-nets, Surber sampler, and Eckman dredge on second to sixth order rivers. Total aquatic macroinvertebrate diversity has over a hundred morphospecies. The main effects found in the rivers are due to wrong oil management practices in San Jose (oil town) and effects of the land use changes to agriculture that reduce to water quality and abundance of aquatic macroinvertebrates. Dissolved oxygen and conductivity were the parameters that changed the most. The best sites were in the nearest zones to the protected area, where the conditions of habitat and human use effects were lower.

### **ASSESSING INDIRECT EFFECTS OF HUMAN ACTIVITIES ON GIANT RIVER OTTERS (*PTERONURA BRASILIENSIS*) IN THE LOWER YASUNI BASIN, ECUADOR**

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Two family groups of giant otters (*Pteronura brasiliensis*) occupy 120 km<sup>2</sup> of streams and permanently flooded forests adjacent to the Yasuni National Park's buffer zone. This area is subject to the impacts of subsistence hunting and fishing, logging, farming, and unregulated tourism activities. We assessed the potential for indirect competition for food and space between humans and otters. We analyzed fish availability and utilization through harvest records, in situ sampling, and identification of fish parts in the giant otters' scats. Niche overlap analysis indicated a 54–82% overlap of fish consumption by humans and otters, depending on seasonal fish availability and the degree of specialization of each consumer. Dynamic segmentation and spatial analysis with Geographic Information Systems were applied to data collected on presence or absence of giant otters and humans. Hunting and fishing areas used by humans overlap in 70% of the area used by giant otters during the dry season. Higher grounds (or levees) located upstream and used for dens were less exposed to human disturbance than streams and ponds located downstream, where the frequency of direct encounters increased. Our observations suggest a possible shift in habitat use by giant otters due to fish scarcity and habitat degradation.

### **SUSTAINABLE PATCH-NETWORK CRITERIA FOR A DISPERSAL-LIMITED ENDEMIC BIRD**

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We developed a set of criteria for identifying sustainable patch networks for populations of Chucao Tapaculos (*Scelorchilus rubecula*). The criteria were based on empirical patch occupancy and telemetry studies, estimates of viable population sizes, and a few well-established biological assumptions. The criteria were used to predict numbers of breeding pairs potentially supported within a specified area, providing an index for comparison among real or hypothetical landscapes. We applied the criteria in 100-km<sup>2</sup> study areas within three test landscapes. Our analysis showed that restoration was unnecessary in a well-connected landscape, in which most patches were functionally connected, forming a large network adequate to support 3480 breeding territories. At the opposite extreme, none of the patch configurations in a highly fragmented landscape were predicted sustainable, either with or without management to increase connectivity. However, restoration of connectivity in a landscape with an intermediate fragmentation level was predicted to increase the sustainable population size from 246 to 782 breeding pairs. Thus, using the proposed criteria, we were able to identify landscape conditions where persistence was highly likely without conservation intervention, conditions where restored connectivity was inadequate to prevent extinction, and conditions where restored connectivity could potentially triple the sustainable population size.

### **CONSERVATION PLANNING FOR ECOSYSTEM SERVICES**

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While conservation NGOs increasingly recognize the importance of human concerns to conservation, they have not yet planned for ecosystem services in a rigorous, systematic fashion. This is in part because site-specific information on ecosystem service flows, from ecosystems to particular people, has been lacking. We explore the trade-offs and opportunities for aligning conservation goals for biodiversity and six ecosystem services in a conservation planning context. Focusing on the Central Coast ecoregion of California, we find weak positive and some weak negative correlations between the spatial concentrations of biodiversity and flows of the six ecosystem services across the ecoregion (carbon storage, flood control, forage production, outdoor recreation, crop pollination, and water provision). Considering biodiversity and each service independently, the areas that emerge as priorities for conservation often overlap more than expected, but weakly so. Biodiversity-focused conservation offers scope for protecting significant collateral flows of services. With the same "budget," targeting ecosystem services directly could improve overall efficiency of conservation (including of biodiversity), but risks greatly compromising biodiversity protection (by up to 45%), although considerably less so when targeting only positively associated services (a decline of 8%). Conservation of biodiversity will protect ecosystem services and vice versa, but there are substantial trade-offs.

#### **IDENTIFYING CONSERVATION GAPS ON THE UNITED STATES–MEXICAN BORDER: AN OPPORTUNITY TO IMPLEMENT BINATIONAL CONSERVATION STRATEGIES**

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Economic growth along the Mexico–United States border is a threat to regional biodiversity. Binational efforts are required to plan and implement sound natural resources management strategies. Gap Analysis projects use digital databases pertaining to land use and land cover, terrestrial vertebrate distributions, and locations of protected areas to identify gaps on conservation efforts and to identify potential sites for conservation. Gap Analysis projects in Mexico face special challenges due to limited database quality and availability. In order to overcome these challenges we generated land use and land cover information from satellite imagery for a region adjacent to the Rio Grande in the Mexican states of Chihuahua and Coahuila through supervised classification creating vegetation classes consistent with those used by United States Gap Analysis programs. Using available habitat association information for 141 study species that represent the entire terrestrial vertebrate fauna from the region, and collaborating with experts, we managed to generate our vertebrate distribution models. Finally, we developed Gap analysis for each of these species. Our results suggested that one out of 13 vegetation types and only 16 terrestrial vertebrates receive adequate protection. We identified areas with high concentrations of terrestrial vertebrates that could potentially fill some of these conservation gaps.

#### **NONGOVERNMENTAL TRANSBOUNDARY CONSERVATION IN NORTH AMERICA: THE EFFECTIVENESS OF CIVIL SOCIETY CONSERVATIONISTS WORKING ACROSS INTERNATIONAL BORDERS**

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The field of international relations has recognized the prominent—if neither dominant nor simple—role of civil society in many different forms of transnational interactions. Most of this work has examined the degree of influence that civil society has exerted on intergovernmental relations. But what effect can civil society actors have on conservation by working across borders primarily with each other—viz., without direct involvement in governmental affairs? The experiences of two transborder conservation initiatives, the International Sonoran Desert Alliance (ISDA) and the Yellowstone to Yukon Initiative (Y2Y), show that such "third sector" cooperation has enhanced conservation efforts in complex ways. Based on an analysis of sixty extensive field interviews using qualitative data analysis software, a comparative analysis between ISDA and Y2Y revealed seven potential institutional factors that appear to have some relevant causative relationship to conservation effectiveness. Specifically, these factors are mission breadth, constituency inclusion, communication systems, scientific participation and support, leadership dynamics, political backlash, and landscape vision. Although not quantitatively derived, these proposed factors are relevant to further development of the burgeoning study of "conservation effectiveness."

#### **REACHING A DECISION IN AN UNCERTAIN WORLD: STRUCTURED DECISIONMAKING UNDER THE ENDANGERED SPECIES ACT**

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With ever increasing scrutiny of listing decisions under the Endangered Species Act, the US Fish and Wildlife Service has endeavored to improve the quality and defensibility of such decisions. In the recent northern spotted owl five-year review, we employed a structured decision process to determine the appropriate listing status of this subspecies. This process allowed us to (1) involve upper level managers directly in the analysis and decision process, (2) parse the determination into discrete, manageable segments for detailed exploration and decisions, (3) develop a shared understanding of relevant legal standards, based on the combined experience of the participants, (4) explore scientific uncertainty, and (5) clearly document the rationale describing how the scientific information was applied to the legal standards in reaching a final determination. Costs and difficulties of this approach include the extensive preparation required to structure the decision process and commitment of considerable time from busy high-level managers to absorb the intricacies of the scientific information. We recommend this general approach for difficult natural resource decisions because it increases the involvement and ownership of decision-makers in critical determinations and improves the development and documentation of rationale for decisions, including explicit consideration of uncertainty.

**BIOECONOMIC MODELING IN CONSERVATION PEST MANAGEMENT: THE EFFECT OF STOAT CONTROL ON THE PROBABILITY OF MOHUA EXTINCTION IN NEW ZEALAND BEECH FORESTS**

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Pest control is a key activity undertaken to conserve threatened and declining species. While bioeconomic analysis has been used to contrast the relative efficiency of control strategies where pests affect economic resources, the same approaches have rarely been adopted in conservation settings. The mohua (*Mohoua ochrocephala*) is an insectivorous passerine indigenous to beech forests in New Zealand's south island. Mohua have undergone a 75% range contraction since stoats (which prey on nests and nesting females) were introduced to the south island in the late 1800s. Mohua nests are particularly vulnerable when stoat abundance increases in response to eruptions in the density of introduced house mice, which in turn respond to semi-periodic (4-6 year) mass seeding (masting) of beech trees. To better synchronize stoat control with periods of high stoat density, control could be triggered according to (1) time since last control, (2) beech seedfall, (3) mouse abundance, or (4) stoat abundance. Monitoring these environmental triggers incurs costs that should be taken into account when considering their relative efficiency. I derive an empirically-based stochastic model that links sequential change in beech seedfall, mouse abundance, and stoat abundance to a simple demographic model for mohua. I use the model to contrast the relative cost-efficiency of achieving conservation outcomes for mohua (specified in a quasiextinction framework), using these triggers to initiate stoat control.

**INTEGRATING CONSERVATION WITH TRANSPORTATION AND LAND USE SCENARIO PLANNING THROUGH DECISION SUPPORT TOOL INTEROPERABILITY**

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Transportation, and its secondary effect as a catalyst for development, is a key driver of loss of biodiversity and impacts to ecosystem function in the United States. Over the last decade, transportation agencies have struggled to find ways to reduce costs and unnecessary delays to accelerate project delivery with increasing consideration of environmental and other values. We have developed a workshop for the U.S. Federal Highways Agency (FHWA) to demonstrate the integration of conservation principles in transportation planning. Utilizing a real case study in Orange County, Florida, we mapped several components of biodiversity and ecological systems for an area slated for a new major roadway and associated development. We input this information to a decision support system, NatureServe Vista, to generate indices of conservation value. These indices were input to a transportation route optimization software, Quantm, to drive road alignment away from high value areas. Output from Quantm was used to generate predicted urban growth in a land use planning tool, CommunityViz. Roadway and urbanization scenarios were then input back to Vista for quantitative evaluation of impacts to retention goals for biodiversity. Results of this analysis in the form of conflict indices were used to identify avoidance areas for roads and high density development. This project illustrates how tools from three disciplines (transportation, conservation, and land use planning) can be integrated to meet multiple objectives and streamline the planning process in an iterative approach.

**RETURN OF THE SCIENTISTS: RESEARCH AND CONSERVATION ON THE OSA PENINSULA AFTER CORCOVADO NATIONAL PARK'S CREATION, 1975-1990**

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To inform future policy, conservation setbacks merit as much historical attention as periods of rapid progress. The celebrated but inadequately documented conservation history of Costa Rica's Osa Peninsula provides such historical case examples. The Osa has been a conservation microcosm and proving ground of conservation biology practice and philosophy in Latin America. In the 1960s-1970s, with national population spiking, this lowland wet forest frontier region saw sustained land-use conflict between subsistence farmers and a U.S. timber company. Amazingly, by 1975, U.S. scientists, international conservation groups, and the new National Parks Service had secured Presidential declaration of the northwest Osa as Corcovado National Park, based only on ecological merit and scientific research potential. For a decade, with an underfunded park administration enmeshed in removing squatters and patrolling borders, research station plans went nowhere, and few scientists worked in the park. This environmental history analyzes the scientific constituency's initial rebuilding in concert with new policy/conservation trends, especially the park's shedding of a "bunker" mentality; deployment of biodiversity parataxonomists; development of Sirena biological station; deconcentration of administrative authority; and physical expansion of other Osa conservation lands. Sources include government documents, scientific publications, private correspondence, oral histories, and field site visits.

**PEAK OIL: IMPLICATIONS FOR CONSERVATION**

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The maximum rate of global oil production is projected to occur within a decade, with the potential to disrupt economic systems. We used a dynamic modeling program to estimate global oil production levels using industry data. At current rates of growth and consumption, production will likely plateau at a maximum rate within this decade. We then analyzed two likely scenarios of reaching peak oil: a phasing-in of liquid fuel alternatives, and extraction of remaining reserves of oil in ecologically sensitive areas. We estimated net energy availability and life-cycle GHG emissions for potential liquid fuel alternatives including coal liquefaction, oil shale, tar sands, biofuels, and hydrogen. We conclude that currently viable alternatives (1) will not readily meet the demand gap left by oil depletion and (2) are significantly more carbon-intensive, leading to increased pressure to extract remaining deposits. Using remote sensing and available data, we mapped remaining oil reserves coincident with areas of high conservation priority.

**THE SCIENCE OF CONSERVATION PROJECT MANAGEMENT**

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As conservation scientists, we employ a peer-reviewed scientific process to formulate research questions and test our hypotheses and underlying assumptions. While conservation projects may have research components, ironically we often do not practice these same scientific principles to manage projects. We do not consistently articulate our hypotheses, test our assumptions, monitor change, and advance collective knowledge. The result is an inability to defensibly know and debate in a peer-review fashion what actions lead to desired results, and inadequate or nonexistent measures of conservation impact. To respond to this, the Conservation Measures Partnership developed the Open Standards for the Practice of Conservation. WWF is testing the applicability of these Standards in the large complex systems within which we work (e.g. MesoAmerican Reef, Southwest Amazon, Gulf of California, Galapagos, East Africa Marine). Initial work focused on producing strategic plans that meet the rigor of the Standards. This includes articulating theories of change with measures that can be tested and peer reviewed. While it will take years to fully assess the effectiveness of applying more rigorous scientific principles to project management, early results highlight the benefits and challenges of understanding what strategies and related measures work under what conditions.

### **USING PSYCHOLOGY TO ENHANCE SNAKE CONSERVATION**

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Fear, negative attitudes, and human behaviors present challenges for conservation of snakes. We present a conceptual model of how individuals develop beliefs, attitudes, and behavioral intentions toward snakes and snake conservation. Societal and community tolerance and desire for snakes is impacted by, and impacts, individual tolerance and desire for snakes. We used in-depth interviews (n = 60) and a self-administered mail questionnaire (n = 2000) to investigate how this tolerance, termed wildlife stakeholder acceptance capacity (WSAC), is affected by people's beliefs and attitudes toward snakes. A pilot outreach program to increase knowledge and influence attitudes was tested in 2004 (n = 12). Mean attitude scores improved by 10 and knowledge scores improved 25 after attending the program; changes were retained six months later. We then designed a larger experiment to test the efficacy of outreach methods to increase participant knowledge and positive attitudes toward snakes. Participants (n = 158) were randomly assigned to attend a live snake program, attend a slide show program, receive written outreach materials, or a reference group that received no materials. Individuals were resurveyed immediately after treatment and four months later to measure knowledge and attitude changes and retention. We present results and discuss implications for influencing WSAC to enhance snake conservation.

### **DOES EXTINCTION RISK SCALE FROM A LOCAL TO GLOBAL LEVEL?**

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Global species extinction typically represents the end point in a long sequence of population declines and local extinctions. However, there is still little appreciation of how local processes scale up to global patterns. In recent years, phylogenetic comparative analyses have provided conservation biologists with a more rigorous tool with which to explore and understand the underlying processes and patterns of contemporary extinction. We use a meta-analytical approach and find the main predictors of risk scale between local and global levels. Large body size, low population density, small geographic range, and a specialist mode of living are consistently correlated with elevated risk of extinction across taxa. We find no evidence that these, or other traits tested, vary systematically in their association with risk between scales, though a change in significant predictive traits between scales is apparent. While the ultimate threats to species are anthropogenic, knowledge of intrinsic biological traits can provide insight to the level of risk that both populations and species may face. Conservation biology must not only describe which species are at risk, and why, but also prescribe ways to counteract this.

### **RESTORATION OF LIZARD HABITAT BY EXPERIMENTAL REMOVAL OF INVASIVE ICE-PLANT**

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Mediterranean ecosystems are surpassed only by lowland tropical rainforests in regional biodiversity. This habitat type is also one of the most altered and threatened due to high rates of land conversion and establishment of invasive species. Managers in the Channel Islands National Park face one of the most challenging invasive plant problems in the United States. Conservation action, the removal of invasive iceplant species (*Malepura crocea*, *Mesembryanthemum crystallium*, *M. nodiflorum*, and *Carpobrotus chilensis*), was used in an experimental framework to investigate the potential impacts of iceplant removal on abundance of side-blotched lizards (*Uta stansburiana*). Lizards were captured in 24 10 m x 10 m plots in which three removal techniques (hand pulling, spraying herbicide, leaving vs. pulling later) were tested. Spraying and leaving dead iceplant was found to be the most time efficient removal technique. A significant negative correlation between the percent iceplant cover and the abundance of lizards was found. There was also a significant increase in the number of lizards captured in plots after iceplants was removed relative to controls. Our investigation of the effect of iceplant on lizard abundance, a previously unexplored aspect of the ecology of Mediterranean ecosystems, indicates that restoration can have a positive effect on lizard abundance.

### **THE MARINE PROTECTED AREA NETWORKS LEARNING PARTNERSHIP: AN INTER-ORGANIZATIONAL COLLABORATION**

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The international community has recently placed high priority on expanding the area of coastal and marine habitat protected under ecologically- and socially-coherent networks of marine protected areas (MPAs). However, major challenges remain in effectively managing and sustaining MPAs. Moreover, the emphasis on MPA networks is new, and we have much to learn about

how to design, adaptively manage, monitor, and finance such networks. Rapidly figuring out how to create and sustain MPA networks requires increased collaboration and focused learning among institutions working across sites and countries around the world. Conservation International (CI), The Nature Conservancy (TNC), the Wildlife Conservation Society (WCS), and the World Wildlife Fund (WWF) have created a learning partnership to accelerate resolution of these challenges. This partnership builds on a growing convergence among these organizations toward a framework for tropical marine conservation that emphasizes resilient and representative MPA networks. Through this partnership, 27 field practitioners and managers from 17 tropical countries are working together to address specific challenges affecting large-scale marine conservation efforts. Learning activities focus on the most pressing marine conservation needs as identified by members of this learning network: sustainable finance, social resilience, and biophysical aspects of MPA network design. Increasing knowledge through exchanges and field site visits is allowing these practitioners to accelerate their actions toward reaching global conservation targets within the next decade.

### **AN INTRODUCED PREDATOR ALTERS ALEUTIAN ISLAND PLANT COMMUNITIES BY THWARTING NUTRIENT SUBSIDIES FROM SEA TO LAND**

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The effects of introduced species have traditionally been studied within the framework of trophic cascades, but introduced species may also influence communities via non-trophic routes. We quantified how the introduction of foxes onto the Aleutian Islands indirectly transformed plant communities by reducing abundant seabird populations, thereby disrupting nutrient subsidies vectored by seabirds from sea to land. Fox-infested islands had soils significantly lower in phosphorus and nitrogen and plants low in tissue nitrogen. Soils, plants, slugs, flies, spiders, and bird droppings on these islands had low  $\delta^{15}N$  values, indicating that these organisms obtained nitrogen from internally derived sources rather than marine sources transported by seabirds. Fox-free islands supported lush graminoid-dominated plant communities while fox-infested islands supported low-lying forbs and dwarf shrubs. Experimental augmentation of nutrients on a fox-infested island over four years caused a 24-fold increase in graminoid biomass and a shift toward a graminoid-dominated community typical of fox-free islands. These results indicate that introduced species can influence plant productivity and composition through complex interaction web pathways involving both top-down forcing and bottom-up nutrient exchanges across systems.

### **ANADROMOUS FISH RESTORATION WITH COMMUNITY PARTNERS—SUCCESSSES AND CHALLENGES IN THE MID-KLAMATH RIVER BASIN**

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Efforts to restore the anadromous fishes in the lower Klamath River Basin have been underway for over two decades. Although overarching habitat restoration plans have been developed to guide the restoration of anadromous fish in the Basin, it has been local planning and implementation that have generated the most success. These efforts occur in rural communities and have been subject to considerable controversy in those communities and in the region. Stakeholders have opportunities for input to the restoration program via a federal advisory committee, as well as through local sub-basin planning and coordination groups involving community members, private landowners, and conservation agencies. In the Scott and Shasta river watersheds, cooperation among these stakeholders has led to significant improvements in habitat conditions and fish passage. In particular, local Resource Conservation Districts and Watershed Councils have been instrumental in developing voluntary restoration programs and coordinating grants to address larger, more complex problems for which solutions are increasingly expensive. Projects that require funding from multiple sources, such as removing diversion dams, and capturing agricultural runoff, are currently underway. Future successes will depend on the continued cooperation of landowners, conservation agencies, and local community groups utilizing a broad array of funding programs.

### **HUMAN ACTIVITY LINKED TO SPREAD OF PATHOGEN THAT CAUSES SUDDEN OAK DEATH**

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A striking consequence of globalization is the tremendous influx of infectious diseases and invasive, non-natives species worldwide. One invader of great concern is the fungus-like pathogen *Phytophthora ramorum*, which causes a devastating forest disease known as Sudden Oak Death (SOD) in many coastal forests of California and Oregon, as well as managed landscapes in Europe. Here, we evaluate the influence of human activity on the distribution of this pathogen at three spatial scales in northern California. At the local scale, we found that *P. ramorum* was significantly more common in soil found on hiking trails than from adjacent areas off trail. At the landscape scale, forested areas with high levels of recreation activity had significantly greater proportions of host trees exhibiting symptoms of infection. And at the regional scale, forested areas surrounded by large human populations were significantly more likely to have infected host trees. Collectively, these findings suggest that humans are important dispersal agents of a destructive pathogen and promote its spread. We suggest that efforts to address this epidemic may require aggressive management of human activity, which may be logistically and politically difficult to achieve.

### **EFFECTS OF ROADS ON ENDANGERED KIT FOXES IN NATURAL AND URBAN ENVIRONMENTS**

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We examined the effects of roads on endangered San Joaquin kit foxes (*Vulpes macrotis mutica*) on natural and urban study

sites in Kern County, California. The natural site encompassed three busy 2-lane roads. On this site, only 1 of 63 (2%) transmittered foxes was struck by a vehicle. Fox survival probabilities, reproductive success, litter size, nocturnal movements, den placement, and foraging patterns all were not affected by fox proximity to roads. The urban site encompassed numerous roads ranging from 2-lane local roads with low traffic volumes to 6-lane arterial roads with very high traffic volumes. On this site, at least 21 of 229 (9%) transmittered foxes were struck by vehicles. Vehicle strikes were more common on roads with more lanes, higher speed limits, and higher traffic volumes. Most (73%) road crossings observed occurred on local roads, although foxes did successfully cross 4 and 6-lane roads. We did not detect any adverse effects on kit foxes from 2-lane roads in natural environments, although facilitated human access and associated habitat loss could affect long-term population viability. Vehicles were the primary source of kit fox mortality in urban environments, but this mortality does not appear to be limiting urban fox populations. This mortality might be reduced by installing crossing structures where movement corridors (e.g., canals, golf courses) intersect roads.

**CONTROL OF NONNATIVE GRASSES ENHANCES GROWTH AND SURVIVAL OF ENDANGERED BAKERSFIELD CACTUS**  
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Competition from nonnative grasses has been suggested as a factor limiting the survival and reproduction of the federally and California endangered plant Bakersfield cactus (*Opuntia basilaris* var. *treleasei*). I removed nonnative grasses with either a grass-specific herbicide or manual clipping and compared Bakersfield cactus survival, growth, and reproduction to control plots. Removal of nonnative grasses significantly improved the survival and growth of Bakersfield cactus over a 3-year period but did not affect flower production. I documented the highest Bakersfield cactus mortality rates during the summer months, and the primary benefit from grass removal occurred after the growing season ended. The grass-specific herbicide Fusilade II was more effective for grass control and more beneficial for Bakersfield cactus health than clipping. Grass removal improved the growth of native forbs but also facilitated the invasion of aggressive, nonnative forbs. Any large-scale use of herbicide to benefit Bakersfield cactus must be accompanied by control of undesirable broadleaved herbs. Grass-specific herbicide would be useful for reducing fuel loads around individual cactus clumps prior to prescribed burning for habitat management.

**A COMPARATIVE ASSESSMENT OF BIODIVERSITY CONSERVATION ON FOUR FEDERAL LAND SYSTEMS IN THE UNITED STATES**

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The purpose of this assessment is to compare the roles of the four federal lands systems in the United States where biodiversity conservation receives substantial emphasis. These systems include the National Wildlife Refuge System, the National Forest System, the National Park System, and Bureau of Land Management (BLM) lands. All four have organic acts that, as amended, call for biodiversity conservation. However, national forests and BLM lands are managed for multiple uses, including prominent extractive activities, and national parks are managed primarily for natural area protection and outdoor recreation. Biodiversity conservation is most prominent on the national wildlife refuges, which are managed pursuant to the "wildlife first" of the National Wildlife Refuge System Improvement Act of 1997. The Refuge Improvement Act also requires the maintenance of the "biological integrity, diversity, and environmental health" of the Refuge System. Gap analyses are beginning to show that, of the four systems, the Refuge System represents the broadest range of ecosystems in the United States and protects the greatest number of threatened and endangered species. Together, the four systems have considerable potential to conserve the ecosystems, species, and gene pools of the United States due to distinctive management emphases, ecological characteristics, and economic geography.

**AFLP TECHNOLOGY TO SAVE THE WORLD'S "LIVING FOSSILS": A CASE STUDY OF A CRITICALLY ENDANGERED CYCAD, ENCEPHALARTOS LATIFRONS, FROM SOUTH AFRICA**

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*Encephalartos latifrons* is Critically Endangered with a declining population of 60 plants occurring in scattered groups. This is symptomatic of many cycads—globally the most threatened group of plants due to illegal trade and habitat loss. Survival plans focus on law enforcement, reintroduction, and supplementation programs using plants from the wild as well as from botanical gardens. However, the genetic distinctness of wild populations was unknown, garden plants had no provenance data, and law enforcement could not identify plants in trade. Our research had three goals: (1) determine the genetic structure and diversity of *E. latifrons* in the wild, (2) identify original wild populations for plants in ex situ collections, and (3) identify genetic markers to aid law enforcement. We examined 86 plants using amplified fragment length polymorphism (AFLP) markers. 417 AFLP markers were generated for each plant, creating a unique DNA fingerprint that can be used for law enforcement. We found high levels of genetic diversity in the wild and at Kirstenbosch Botanical Garden, but no population differentiation, indicating that all individuals originate from a single population. Bayesian clustering identified six distinct genotypes in the wild, all represented at Kirstenbosch. These results are now being used to refine law enforcement and reintroduction programs.

**SYNERGY IN CONSERVATION EDUCATION: THE IMPORTANCE OF CONTINUITY AND REPETITION IN ACHIEVING ATTITUDE AND BEHAVIORAL CHANGE**

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When anthropogenic factors are the primary threat to endangered species, modification of human behavior is often desirable. While achieving this can be straightforward with high-cost, direct techniques (e.g., law enforcement), there exist few data about program effectiveness with lower-cost, indirect techniques, such as environmental education, particularly at time scales longer than a few months. In the present study, Provita (a Venezuelan NGO) implemented three educational interventions over

two years to compare their effects on knowledge, attitudes, and behaviors relating to the critically endangered, endemic blue-crowned conure (*Aratinga acuticaudata neoxena*). Using a one-page questionnaire, we interviewed over 400 children before, immediately after, and 6 months after interventions in order to measure program effectiveness. As expected, all programs significantly increased the level of knowledge regarding the conure in both the short- and long-term. However, improvement in attitudes and behavior was smaller, suggesting either the need for a stronger focus on developing characteristics that support the expression of environmentally responsible behavior or a more effective evaluation tool. We saw the greatest improvement among students who participated in more than one intervention, suggesting that continuity and repetition of conservation messages is equally important as the type of educational strategy implemented.

### **INTERACTIVE IMPACTS OF KEYSTONE RODENT SPECIES: IMPLICATIONS FOR CONSERVATION AND BIODIVERSITY**

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Keystone species often play a central role in the structure and function of ecosystems. Understanding the interactive effects of multiple keystone species where they co-occur may have important implications for conservation and biodiversity. We implemented a large-scale field study in northern Mexico where the geographic distributions of black-tailed prairie dogs (*Cynomys ludovicianus*) and banner-tailed kangaroo rats (*Dipodomys spectabilis*) overlap. These species are considered keystones in grassland environments, but little is known about their roles where they co-occur. Our research evaluated (1) the potential keystone roles of black-tailed prairie dogs and banner-tailed kangaroo rats in a highly desertified annual grassland and (2) their interactive effects on grassland plant community structure and biodiversity. The mound and landscape-scale patches where the rodents were present versus absent differed significantly in vegetation structure, plant cover, species composition, and species richness, supporting the hypothesis that prairie dogs and banner-tailed kangaroo rats play keystone roles in desertified grasslands. The interactive effects of these keystone species resulted in enhanced landscape heterogeneity and plant species richness across multiple spatial and temporal scales. Our results demonstrate the importance of prairie dogs and kangaroo rats in these desertified grasslands, and have important implications for understanding the interactive effects of keystone species.

### **BEYOND TRAINING: ASSESSING THE IMPLEMENTATION OF AN ENVIRONMENTAL EDUCATION PROGRAM FOR WETLANDS IN THE SONORAN COAST**

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Over the last decade, significant efforts have been made to protect the wetlands of Mexico's northwest region, such as incorporation into the National System of Natural Protected Areas; identification of priority marine, hydrological, and terrestrial areas; and on site conservation and restoration projects; among others. As part of these strategies, formal environmental education has been an approach to increase citizens' knowledge and awareness about the importance of wetlands. Nevertheless, teachers' needs and perspectives have not yet been assessed and evaluated, and they are key actors in this process. This research addresses which factors facilitated teachers' support and involvement during the implementation of an environmental education program for wetlands, how this implementation occurred, and which were the teachers' main suggestions on this matter. Findings of this study support the need for environmental education programs that take into account teachers' professional needs, knowledge, beliefs, attitudes, and concerns. I conclude with a discussion of key issues that could increase teacher training effectiveness.

### **LARGE OLD FEMALES AND THE EFFICACY OF MARINE PROTECTED AREAS**

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Marine Protected Areas (MPAs) are been considered and implemented worldwide as a means of conserving marine biodiversity and sustaining fisheries, including the ongoing planning process along the California coast as mandated by the Marine Life Protection Act of 1999. While there is a great deal of empirical data on the conservation benefits of MPAs, their effectiveness as fisheries management tools is actively debated. Empirical evidence for fisheries benefits is scarce, and models have shown that the establishment of MPAs in fisheries that are already managed by setting quotas can lead to significant reductions of both fishery yields and population abundance of target species, thereby negating fisheries and possibly also conservation benefits. However, these models do not account for the documented increase in abundances of older, larger individuals within MPAs, which contribute disproportionately to reproductive output. Here we show that when realistic contributions of large, old females to reproduction are considered, MPA establishment increases both total population abundance and catches, especially for overfished stocks. Increased reproductive output from MPAs is a key mechanism for population recovery and increased fisheries yields, even in fisheries that are already managed through traditional approaches.

### **QUANTIFYING RELATIONSHIPS BETWEEN COMMUNITY SHIFTS AND ENVIRONMENTAL CHANGE**

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Quantifying how ecological communities respond during a time of decreasing precipitation is a first step in understanding how they will respond to longer-term climate change. Here we coupled analysis of interannual variability in remotely sensed data with analyses of bird and butterfly community changes in montane meadow communities of the Greater Yellowstone Ecosystem. The northern portion of the ecosystem, or Gallatin region, has smaller average patch sizes separated by ridges of mountains, whereas the southern portion of the ecosystem, or Teton region, has much larger patches within the Jackson Hole valley. The Gallatin region showed more overall among-year variation in the Normalized Difference Vegetation Index (NDVI), perhaps because the patch sizes are smaller on average. Comparing regions, the Teton region showed higher predictability of community assemblages as compared to the Gallatin region. The Gallatin region exhibited more significant temporal trends for

butterflies. Butterfly communities in wet meadows showed a distinctive shift along the hydrological gradient during a drought period. These results imply that the larger Teton meadows will show more predictable (i.e., static) species-habitat associations over the long-term, but that the smaller Gallatin meadows may be an area that will exhibit the effects of global climate change faster.

**MULTI-TAXA ASSESSMENT OF THE GENETIC IMPACTS OF FRAGMENTATION AND URBANIZATION IN SOUTHERN CALIFORNIA: LIZARDS (*SCELOPORUS OCCIDENTALIS*, *UTA STANSBURIANA*)**

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Habitat fragmentation caused by urbanization can have significant negative effects on wildlife communities. For species with low dispersal ability and / or sensitivity to the urban matrix, there will be reduced connectivity between habitat fragments. This reduction in connectivity causes a reduction in gene flow between subpopulations which can lead to decreased genetic variability and an increased likelihood of local extinction. We examined the genetic impacts of habitat fragmentation in two lizard species (*Sceloporus occidentalis* and *Uta stansburiana*) in the Santa Monica Mountains National Recreation Area (SAMO) north of Los Angeles, California. Lizards were captured using pitfall traps in 10 small habitat fragments and 10 larger core areas. We genotyped each species at 9 microsatellite loci to obtain measures of gene flow between fragments. We also used the computer program STRUCTURE to cluster individuals according to genetic similarity. Significant FST values between fragments indicated a decrease in gene flow and loss of connectivity between fragments. In addition, our STRUCTURE results show individuals with higher genetic similarity are clustered together in populations separated by major roads. Our results reveal that both species showed a strong genetic response to habitat fragmentation. Similar results were found in Jerusalem crickets studied from the same fragments.

**STATUS OF MATURE AND OLD-GROWTH FORESTS IN THE PACIFIC NORTHWEST, USA**

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Nearly 10 million ha of federal lands in the Pacific Northwest, USA, have been managed under the Northwest Forest Plan since 1994. The plan reduced logging levels by 80%; however, only recently are inventories on status and condition of older forests becoming available. Our objectives were to: (1) determine the areal extent of old (> 150 years) and mature (50-150 years) conifer forests using 2000 Landsat 7 ETM+ imagery, (2) examine levels of protection, and (3) determine degree of additional protection afforded to older forests if Late Successional Reserves (LSRs) and Inventoried Roadless Areas (IRAs) were fully protected. Since the time of European settlement, ~72% of the original old-growth conifer forest has been lost largely from logging and other developments. Old-growth conifer forest accounted for by protected areas (GAP 1 and 2), LSRs, and IRAs accounts for 66% of the old-growth conifer forests on public land, 51% in the region, and 14% of the amount that occurred historically. Outside of these land designations, an additional 1,240,271 ha of old growth occurs on other public land and 1,023,392 ha on private lands. Our results indicate the need to periodically monitor older forests and strengthen protections throughout the region.

**RESEARCH-BASED, NON-CHEMICAL RESTORATION OF COASTAL SAGE SCRUB IN A SOUTHERN CALIFORNIAN PRESERVE**

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Restoration of rare coastal sage scrub habitat at Audubon California's Starr Ranch Sanctuary in southern California commences year two of non-chemical control of the exotic herbaceous perennial *Cynara cardunculus*, which has invaded 251 ha of grassland stands at the 1575 ha preserve. Because analyses of aerial photoseries taken over 48 years revealed gradual coastal sage scrub colonization of grasslands, we decided to actively restore 102 ha of *C. cardunculus*-infested sites in which shrub species have begun colonization. Results from a factorial experiment established an optimum seeding rate and soil tamping technique. Restoration practices were further refined with a second experiment that showed that a combination of direct seeding and plug planting spaced over the growing season would be beneficial in our semiarid region. Exotic annual plant species require control during the restoration process. An experiment that investigated non-chemical techniques suggested that flaming and early brush cutting could control exotic annuals while natives established in early stages of restoration. Monitoring of active and passive restoration processes in a total of 18 ha over three years showed 50-60 native shrub cover in treatment areas with baseline 0-5 native cover.

**NOT THE QUAKING GIANT: EVIDENCE OF SMALL CLONE SIZE IN WEST COAST ASPEN**

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Molecular genetic evidence of clone structure in quaking aspen (*Populus tremuloides*) disputes the conventional understanding of clone size in western North America, and presents novel challenges for the conservation of this keystone species. Aspen is capable of vegetative reproduction via suckering that can produce large clones consisting of thousands of stems covering hundreds of acres. This peculiar life history has created a mystique around aspen among the public and in the popular media, which can affect management decisions on public lands through public comments and litigation. Analysis of 871 stems of aspen systematically sampled in northeastern California using six microsatellite markers identified 432 unique clones, with a mean of 2.02 ramets sampled per clone. Number of clones per stand was significantly correlated with stand area. Genetic diversity was high in all populations, and moderate but significant genetic differentiation was observed among populations (FRT = 0.028, 95% CI 0.021 to 0.035) and among stands (FSR = 0.07, 0.049 to 0.083). These results indicate that germplasm collection and stand restoration activities should include multiple genetic individuals per stand, and should minimize the movement of germplasm among regions.

**IDENTIFYING GLOBALLY IMPORTANT SITES FOR CONSERVATION WITHIN A WEST AFRICAN BIODIVERSITY HOTSPOT**

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The Guinean Forest of West Africa is one of the most highly fragmented of the 34 global biodiversity hotspots. Adequately conserving biodiversity unique to this hotspot requires identification of sites where conservation must be undertaken within the larger region. Two previous efforts to do this have either been data-driven but not multi-taxa (Important Bird Areas) or multi-taxa but not data-driven (1999 West Africa Priority Setting Workshop). We extended these by identifying Key Biodiversity Areas, sites of global significance for biodiversity conservation, as a data-driven, multi-taxon approach, and comparing the results with the two previous studies. We synthesized and analyzed fine-scale distributional data for 72 globally threatened species across 6 taxonomic groups and identified a total of 28 Key Biodiversity Areas covering 14,748 km<sup>2</sup>. This compares to 18 IBAs covering 7078 km<sup>2</sup> and to 13 priority-setting workshop sites covering 62,359 km<sup>2</sup>. As site conservation is one of the most effective tools in reducing biodiversity loss, the Key Biodiversity Areas identified here should form the basis for any future plans for new protected areas and improved management of existing ones within Guinea.

**CONTINENTAL CONSERVATION DEFICITS: AN ECOSYSTEM GAP ANALYSIS**

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Few attempts have been made to analyze the status of conservation efforts at a continental scale, mainly because of the lack of high-quality data sets at this scale. Given that land management agencies want to prioritize conservation efforts and spend limited resources wisely, we recognized the need to undertake a national gap analysis. We developed the most detailed national vegetation cover map feasible to analyze the degree of representation of ecosystem analysis units (an initial representation of ecosystem types) in the network of conservation lands for the continental United States. We combined The Nature Conservancy's ecoregions with the natural land-cover types of the National Land Cover Data Set and examined the conservation status of each combination. The majority of ecosystem analysis units have a small percentage of their total area residing in lands that are managed to support biodiversity. The median percentage of area conserved on status 1 and 2 lands (highest of four levels of protection) as designated by the Gap Analysis Program for the 554 ecosystem analysis units is 4.0% (SD 18.1%). This finding, which highlights our national conservation deficits, points to the need to address the size and diversity of the conservation estate.

**THE DISTRIBUTION AND CONSERVATION VALUE OF ENDEMIC GENERA AND FAMILIES**

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Global biodiversity priorities have been largely driven by species distributions of terrestrial vertebrates. Such choices rarely involve consideration of higher taxonomic uniqueness at the generic or family level, which represent a greater degree of evolutionary uniqueness than do species. Using a new global database of over 26,000 species distributions ([www.worldwildlife.org/wildfinder](http://www.worldwildlife.org/wildfinder)), we determined range restriction at the family and genus level for birds, mammals, reptiles, and amphibians. We considered a family or genus to be range restricted if the ranges of all species within it were limited to a single ecoregion (median size is 62,000 km<sup>2</sup>). We found that five vertebrate families (1% of total) and 345 genera (7%) are range restricted; eighty percent of these contained a single species. Birds have the most range restricted genera (115), followed by reptiles (99), amphibians (76), and mammals (55). Of the 825 terrestrial ecoregions, 162 have at least one endemic genus, including six that each hold more than 9 restricted range genera. The ecoregions tallying the highest counts of endemic families and genera are concentrated in relict Gondwanaland forests and are clear targets for conservation action. This new metric is an important addition to existing methods of global biodiversity prioritization.

**FLORISTIC DIVERSITY IN TROPICAL BIODIVERSITY ARCHIPELAGOS**

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Habitat destruction is recognized as the most critical driver of biological extinction. An important response of society has been the establishment of parks and reserves (NPAs). However important, NPAs will not be able to preserve sufficient biodiversity. Conservation outside NPAs will be an important conservation strategy in the tropics. Here we document how much biodiversity (vascular plants) is retained in an archipelago composed of the following land use types: NPA (representing continuous forest), forest fragments, secondary forest, riparian forest, roadsides, and live fences present around the Los Tuxtlas Reserve. Results based on a standardized sampling protocol (all plants with diameter at breast height 1.0 cm or more, in 0.1 ha / site type, replicated three times) show that the human-dominated matrix collectively retains about 70% of plant diversity and some significant biotic interactions of plants with animals. While fences had a negligible retention capacity, old forest (ca. 50 years) had a species richness (but not composition) similar to that of continuous forest. Riparian forests had 60–70% of continuous forest and were similar to fragments. However, intensification threatens the remaining biodiversity of the human-dominated landscape, which in turn threatens NPAs. We discuss a tentative agenda to study, monitor and conserve tropical biodiversity archipelagos and how such archipelagos can operate as biodiversity inocula for restoration programs.

**INSTABILITY VERSUS STABILITY OF AVIAN COMMUNITY COMPOSITION IN RIPARIAN HABITATS OF THE INTERMOUNTAIN WEST: WHAT'S GOING ON?**

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Riparian habitats in arid landscapes of the western United States are key centers of biological diversity for birds and other taxa, but they comprise less than 1% of the land area and are considered to be the most heavily degraded ecosystems in the west. Analysis of a filtered, maximally reliable sample of 349 BBS routes found that species composition of riparian bird communities varied substantially when compared by Jaccard's Index between the 1968–1983 and 1984–2001 periods. We hypothesized that the pattern of temporal instability in riparian species composition resulted from the degraded condition of most riparian habitats across the region. To test this hypothesis, we examined temporal and spatial patterns of riparian species composition across two landscapes in the northwestern Great Basin over a 12-year period of riparian habitat recovery in response to the removal of livestock grazing. We expected to find a pattern of increasingly stable species composition across time periods within the riparian avifauna of these relatively high quality habitats. Our results are consistent with the expectation that community stability of riparian birds during the breeding season is strongly associated with structural quality of their habitat. These results underscore the conservation importance of riparian habitats for breeding birds in the arid and semi-arid western United States, and lend urgency to the need for ecological restoration of riparian habitats across the region.

#### **LANDSCAPE CHANGE IN A PROTECTED AREA OF THE BRAZILIAN ATLANTIC FOREST**

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Landscape transformation is the principal factor affecting global environmental change and threatening biodiversity. The Atlantic Forest is one of the most important world hotspots for conservation and has been particularly affected by habitat loss. In order to understand ecological processes and to conserve the natural ecosystems it is important to quantify land cover change. In this work, we discuss land cover changes that occurred in a Brazilian Atlantic Forest site that has been converted in a protected area. We compared aerial photographs taken in 1974 to a high resolution satellite image from 2004 by visual interpretation in GIS. We used different landscape metrics to quantify the land use change. There was significant change in the landscape since 40% of the area was converted to different land cover classes. There was a great expansion of anthropogenic-related land cover classes and a retraction of natural formations such as forest and swamp. Our analysis of the landscape metrics revealed a loss in the ecosystem value of the remaining habitats since fragmentation and mean distance between patches were increased. These changes are related to human-perturbed landscapes and their understanding can direct conservation actions in the protected area.

#### **SEEDS OF CHANGE IN FISHERIES MANAGEMENT SPROUT ACROSS MALAWI: WILL CHANGES IN MANAGEMENT REGIMES SAVE THE FISHERIES?**

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In the early 1990s with the crash of chambo stocks in Lake Malombe and Lake Chiuta, it became painfully clear that key human life sustaining fisheries were threatened in many areas of Malawi. Permutations of a response rooted in involvement of fishers in resource governance took hold in several locations. Some were led by government and NGO partnerships, and others by concerned local fishers. Gathered through interviews, surveys, and focus groups, sufficient data permit preliminary identification of the bases for success in some cases and failure in others. They point the way to continuing to move fishing activity to long-term sustainability. Communicating with local fishers and leaders at the initiation of planning, involving them in planning, providing support for their management activities, and recognizing their authority together with enabling legislation, especially the Fisheries Regulations (1999), and establishing user group institutions with constitutions, a legal personality, and formal management agreements with government are some features of success that should be carried forward to conserve Malawi's fisheries. Restricting access is proposed as necessary but remains to be tested.

#### **IMPROVING LAND DEVELOPMENT AND STORMWATER MANAGEMENT POLICIES TO PROTECT IMPERILED AQUATIC SPECIES: A CASE STUDY IN THE ETOWAH RIVER BASIN (GEORGIA, USA)**

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Freshwater ecosystems are under increasing pressure from human land development practices. In the Etowah River watershed (Georgia, USA), a rapidly growing watershed northeast of Atlanta, there are currently 10 imperiled fish species, seven of which are state threatened and three of which are federally endangered. Working with local jurisdictions and developers on the development of a Habitat Conservation Plan pursuant to the federal Endangered Species Act, we developed site design guidelines for land development and a model stormwater management ordinance with the goal of protecting imperiled aquatic fauna. We identified zoning, subdivision, and stormwater regulations in the Etowah River basin that encourage development practices negatively impacting fishes through alterations in stream hydrology and developed alternative policies. We used a source control approach to stormwater management that differs from methods commonly used in the region. The goals of the recommended techniques are to reduce impervious surface area and preserve the natural hydrology of a site as much as possible, thereby reducing the negative impacts on aquatic ecosystems. Local governments were initially reluctant to change current practices, whereas the development community was supportive of the proposed guidelines and ordinance. Recently, the site design guidelines and model ordinance were adopted by the local jurisdictions involved.

#### **PATTERNS OF GENETIC CONNECTIVITY IN MARINE SPECIES AT MULTIPLE SCALES: IMPLICATIONS FOR THE MANAGEMENT OF CORAL REEFS**

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Understanding the scales over which populations are connected is critical for the proper allocation of conservation resources. Historically marine populations were thought to be open and genetically homogenized through the mechanism of long distance gene flow facilitated through pelagic larval dispersal. However, new evidence from both biogeochemical and genetic sources has

called into question the validity of that assumption. Furthermore, models for marine conservation predicated on basin or ocean-wide exchange of larvae may not be appropriate for all species, especially inshore tropical fisheries. Here, using genetic evidence, we demonstrate that several broadly dispersed and putatively monospecific taxa of coral reef fishes are actually highly divergent across island groups (Indonesia, Papua New Guinea, and Fiji), yet broadly homogeneous within island groups. These results indicate that models of conservation developed for terrestrial islands, which stress high levels of endemism between island groups and high biotic similarity within islands, may serve as useful frameworks for the development of marine conservation in archipelagos.

### **MODEL WITHOUT AGE STRUCTURE MAY OVERESTIMATE RISKS: USING SCALAR MODELS FOR PRECAUTIONARY ASSESSMENTS OF THREATENED SPECIES**

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Scalar (unstructured) population models, also referred to as count-based models, are based on time-series data of population sizes and may be useful for preliminary ecological risk assessments when data for more complex models are not available. Appropriate use of such models for management purposes, however, requires understanding inherent biases that may exist in these models. Through a series of simulations, which compared predictions of decline risk by scalar and matrix-based models, we examined whether discrepancies may arise from different dynamics displayed due to age structure and generation time. We also examined scalar and matrix-based population models of 18 real populations for potential patterns of bias in population viability estimates. The simulation study showed that scalar models had a precautionary bias (i.e., overestimating risks of decline), and this bias increased as a function of generation time. Models of real populations showed poor fit between scalar and matrix-based models, with scalar-models predicting significantly higher risks of decline on average. Results suggest that scalar models can be useful for screening-level assessments, which should in general be precautionary, but the potential shortfalls of these models should be considered before using them as a basis for management decisions.

### **THE RELATIVE EFFECT OF HABITAT LOSS AND TRAFFIC VOLUME ON ANURAN POPULATIONS**

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Habitat loss is considered to be the main cause of global amphibian decline. However, very low amphibian abundance near high-traffic roads suggest that the effects of high traffic roads may locally be at least as severe as the effects of habitat loss. We present the first test of the relative effects of traffic volume and habitat loss on amphibian populations. We selected 38 small breeding ponds in agricultural landscapes with four different habitat / traffic combinations: (1) high traffic, high habitat (forest / wetland), (2) high traffic, low habitat, (3) low traffic, high habitat, (4) low traffic, low habitat. Relative abundance of all anurans at the breeding ponds was measured in the spring / summer of 2005 using night call and visual day surveys. Preliminary results indicate that the mean abundances of seven species of anurans were at least somewhat affected by traffic volume, and in six of seven species the effect of traffic was at least great as the effect of habitat amount. Leopard frogs and American toads were particularly affected by traffic and were 3–4 times more common in low traffic than high traffic landscapes. These findings indicate that high-traffic roads can have a greater effect on amphibian communities than habitat loss.

### **CHANGES IN ABUNDANCE AND DISTRIBUTION FOR NORTHERN ANCHOVY IN THE PACIFIC NORTHWEST**

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The northern anchovy (*Engraulis mordax*) is a small, schooling coastal pelagic fish found widely distributed along the west coast of North America from Baja to British Columbia. As one of the dominant species in the California Current, it plays an important role in both the ecology and economy of the northeastern Pacific region. Northern anchovy is an important forage fish for marine predators, including fish, birds, and mammals, and supports a small bait fishery off the northwest. Over the last several millennia, anchovy abundance has fluctuated greatly due to regime shifts in ocean conditions. Our study examined the abundance and distribution of northern anchovy off Oregon and Washington using survey data collected by NOAA / National Marine Fisheries Service (NMFS) from 1999–2005. Seasonal fluctuations in anchovy density were calculated over predetermined transects and compared to observations recorded by a Sea-Bird SBE 19 SeaCat conductivity, temperature and depth (CTD) profiler. Anchovy numbers in the Pacific Northwest have been steadily increasing since 1999, coinciding with dramatic changes in the overall pelagic fish biomass off the Pacific Northwest.

### **HIGH-ELEVATION POPULATIONS ACT AS GENETIC REFUGIA AS CLIMATE WARMS**

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While the ecological effects of the current global warming are becoming increasingly apparent, there has been little evidence of its effects on the evolutionary potential of natural populations. Genetic diversity serves both as an indicator of demographic processes and as a critical component of adaptive change. We assessed genetic diversity of 28 desert bighorn sheep (*Ovis canadensis*) populations in southeastern California, where temperatures increased and precipitation decreased during the late 20th century. Genetic diversity was correlated negatively with predicted susceptibility to climate warming (based on a previously-established habitat model) and population isolation. Populations in lower-elevation, more-arid mountain ranges had lower levels of genetic diversity, presumably reflecting smaller effective population sizes due to increased rates of population extinction and founder effects. Our results suggest that populations in cooler, wetter habitats act as reservoirs of high genetic diversity in these metapopulations. However, our findings also suggest that high genetic diversity persisted only when population connectivity was also maintained. Gene flow between many of these populations has been disrupted by human

development, thus threatening the continued existence of these genetic refugia. Both population connectivity and habitat quality thereby mediate the effects of climatic variation on this desert-adapted ungulate.

**PROCESS-BASED MODELING OF CLIMATE CHANGE IMPACTS ON BIRDS IN THE ARID REGIONS OF SOUTH AFRICA**  
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Previous estimates of climate change impacts on South African avian fauna were based on correlative modeling. A process-based approach will increase model robustness under novel future conditions. Thermal regulation is one such process that may determine range limits in arid environments. When environmental temperature approaches body temperature, the thermal gradient becomes insufficient to ensure cooling through passive heat loss. Birds in such arid environments employ evaporative water loss as a cooling mechanism, but total body water sets an upper limit to the efficacy of this mechanism. Using an empirical relationship between environmental temperature and the rate of evaporative water loss, we model the response of the South African avian fauna in arid areas to increased temperature due to predicted climate change. Smaller-bodied species dominate avian assemblages in the western, arid parts of South Africa. These arid areas are predicted to experience an increase in temperature, and a decrease in precipitation. The resulting increase in water deficit will limit opportunity for birds to use evaporative cooling as a survival strategy, especially for small birds with limited body water. Smaller birds are therefore more likely to experience range reductions, with associated impacts on ecosystem function.

**THE NATURE CONSERVANCY'S CONSERVATION BY DESIGN TOOLKIT—CAPTURING AND SHARING CONSERVATION KNOWLEDGE**

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The Nature Conservancy (TNC) is a global conservation organization working in 27 countries through state, provincial, and country programs and through partnerships in additional geographies to implement conservation practices. This situation creates challenges for implementing a consistent and rigorous conservation approach and for knowledge exchange. As a result, we are developing a Web-based Conservation by Design Toolkit. Our pioneer project, The Ecoregional Assessment and Biodiversity Vision Toolbox, will be presented here. The Toolbox is organized around 14 standards developed jointly by TNC and WWF. These standards define the minimum requirements to develop thorough, credible, and useful ecoregional assessments / visions, but do not prescribe specific approaches to achieve them. A unit has been developed for each standard. Each unit provides guidance material and links to tools, resources, and case studies covering a variety of approaches. Case studies present best practices for a wide variety of information and capacity contexts. This product provides a two-way exchange of learning, soliciting case studies and dialogue from practitioners to offer wisdom and innovations to better assist others in their work. The toolbox is publicly available on the internet at <http://conserveonline.org/workspaces/ecotools>.

**QUANTIFYING THREE-DIMENSIONAL CANOPY STRUCTURE IN CONIFER FORESTS USING DISCRETE RETURN LIDAR**  
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Canopy densities strongly influence species-environment interactions, encompassing diverse processes such as habitat usage and fire dynamics. Landscape level canopy density has traditionally been quantified using spectral satellite data. While this method has proven moderately accurate, a certain level of generalization is accepted in structural detail. LiDAR is an exciting technology that can provide fine scale, three-dimensional vegetation structure information. Presented is a model for quantifying vertical distribution of canopy density using discrete return LiDAR based on the ratio of ground to non-ground returns. This ratio is indicative of how much laser energy is reaching the ground, providing a vertical measure of canopy density. Contagion and interspersed metrics were used to quantify structural pattern and patch interaction in four cross-section canopy strata based on height percentiles. Results demonstrate that patterns of canopy density across strata exhibit very different behaviors, often having nonlinear relationships between strata. These relationships demonstrate that the top of canopy view provided by spectral data lacks critical information relevant to ecological process. By addressing the juxtaposition of these differing vertical densities conservation decisions can be made across entire landscapes by utilizing complex measures of forest structure at scales that these interactions occur.

**GENETICS AND THE ENDANGERED SPECIES ACT: A REVIEW OF LISTING DECISIONS**

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One of the most persistent debates in species protection under the Endangered Species Act revolves around the taxonomic classification of various species, subspecies, or distinct population segments. Despite the increasingly pervasive use of genetics by the U.S. Fish and Wildlife Service and National Marine Fisheries Service, there currently are no national policies or guidelines about the proper use of genetics and what role such studies should play in determining whether a certain taxonomic group is afforded protection. Here I review a representative collection of USFWS and NMFS listing decisions that were informed by genetic research and examine how the data relate to the decision to list or delist a particular species, subspecies, or distinct population segment. Whether a taxonomic group is considered genetically distinct and therefore listable under the ESA is strongly affected by the amount and type of genetic data used as well as the extent of sampling. Results from this study raise a number of concerns regarding inconsistencies in the use of genetic information including examples of inappropriate or insufficient data.

**POSIEDON MEETS ARTEMIS: A METHOD FOR INTEGRATING TERRESTRIAL AND MARINE CONSERVATION PLANNING**  
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Cases like the dead zone in the Gulf of Mexico make it clear that marine ecosystems can be damaged by terrestrial inputs.

Examples like this show that marine and terrestrial conservation planning need to be linked in an explicit fashion. We designed a method that allows the inclusion of land-based threats to marine ecosystems in joint terrestrial-marine planning efforts. Using the Pacific Northwest Coast ecoregion (USA) as a case study, we developed an index of land-based marine threat level that synthesized watershed attributes (road density, % logged area, etc.) additively. River inputs to the coast drive temperature fluctuations, so we used ten year average sea surface temperature variance as a proxy for freshwater influence. This proxy determined the proportion of land-based threat applied to each marine planning unit. We evaluated the influence of land-based threats in marine planning by comparing MARXAN outputs for three scenarios: concurrent terrestrial and marine site selection with no threats, with only intra-system threats, and with integrated threats. Several MARXAN outputs were significantly different among scenarios. Our results confirm that integrated planning selects different terrestrial and marine conservation priority areas than traditional planning. These sites more accurately represent ecological integrity of land-sea processes.

### **THE BUCK STOPS AT THE COAST: UTILIZING A SPATIALLY-EXPLICIT THREAT ANALYSIS TO DETERMINE LAND AND SEA CONSERVATION PRIORITIES**

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There is a lack of quantitative spatial analyses addressing the problem of land and marine-based threats for integrated terrestrial and marine planning. These threats significantly alter land and seascape conditions and are therefore important to consider in conservation planning efforts. We have mapped and combined specific threats in the Pacific Northwest Coast ecoregion into a single index where those threats occur and utilized a decision support tool for evaluating different weighted indices. We compared three different approaches to weighting individual factors in the index and quantified their influence on site selection, including one without threats. Factors included shoreline armoring, road density, and land cover. By measuring the spatial variability and efficiency of the MARXAN output we conclude that while variations in the construction of weighted indices did not significantly change the results of the optimized reserve design, the inclusion of specific threats altered the solutions. Therefore we believe a thorough investigation of what threats to include in an index is important when considering conservation priorities. More work needs to be done, however, to accurately account for threats that travel across the land / sea interface in order to advance the approach of integrated priority setting.

### **A COMPARISON OF REGRESSION-BASED METHODS FOR CETACEAN-HABITAT MODELING**

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False killer whale (*Pseudorca crassidens*) and whitebelly spinner dolphin (*Stenella longirostris*) populations in the Pacific Ocean are a conservation concern due to interactions with fishing operations. Knowledge of the distribution and abundance of these cetaceans is critical in designing and implementing successful conservation efforts. Spatial cetacean-habitat models that explicitly incorporate temporally dynamic predictors have proven useful in predicting cetacean population density. Our cetacean sighting data were collected during shipboard line-transect surveys and are characterized by a long stretches of trackline with zero cetacean encounters. We suspect that certain techniques are better equipped to model these data than others. Numerous regression-based analytical methods have been used to model cetacean-habitat relationships, but a rigorous comparison of the resulting models is lacking. We conducted a detailed examination of the similarities and differences among spatial models for predicting cetacean density created using three analytical techniques: generalized linear models (GLMs), generalized additive models (GAMs), and classification and regression trees (CART). We found that the model fit and predictive power was similar between GLMs and GAMs, and it was worst for CART.

### **THE EFFECTIVENESS OF THE UNITED STATES ENDANGERED SPECIES ACT: STATISTICAL ANALYSIS BASED ON MATCHING METHODS**

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Diametrically opposed views of the effectiveness of the United States Endangered Species Act (ESA) coexist more than 30 years after the Act's creation. The evidence marshaled to date for and against the ESA suffers from a problem common in analyses of biodiversity protection measures: the absence of a well-chosen control group. We demonstrate how state-of-the-art statistical methods can be used to select such a control group and thereby estimate how species listed under the ESA would have fared had they not been listed. Our results show that listing a species under the ESA is, on average, detrimental to species recovery if not combined with substantial government funds. In contrast, listed species with such funding tend to improve. Our analysis offers not only new insights into a controversial debate, but also a methodology to guide conservation scientists in evaluating the effectiveness of society's responses to biodiversity loss.

### **SWAMPING OUT RARE GENES: HABITAT FRAGMENTATION INCREASES HYBRIDIZATION IN A WOODLAND EUCALYPT**

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Habitat fragmentation can result in changes to population parameters that may promote interspecific hybridization. This represents a genetic threat as populations of rare easily hybridizing species may become swamped by hybrid swarms. This study examined the influence of population size, the distribution of individual trees, and their flowering phenology on hybrid seed production in populations of *Eucalyptus aggregata*. This tree species occupies woodland remnants in southeastern Australia and readily hybridizes with more common related congeners. Relative population size of *E. aggregata* compared with

the common congeners had a strong influence on hybrid production that increased to 34% of seed crops in populations < 40 trees. At the local scale, paternity analysis (SSR markers) found that individual trees occupying less dense stands produced more hybrid offspring. Growth data show hybrid seedlings to be vigorous. However, results of feeding trials indicated that hybrids were twice as prone to insect damage, which could be due to recombination of genes responsible for the production of defense chemicals that differ substantially between the parental species. For in-situ conservation, this suggests that hybridization may result in genetic swamping of *E. aggregata* by its common relatives in fragmented landscapes. For ex-situ conservation, seed crops from such sites should not be used for revegetation as they contain many hybrid genotypes.

**CONTAMINANT-ASSOCIATED IMMUNE ALTERATION IN BLACK-FOOTED ALBATROSSES (PHOEBASTRIA NIGRIPES), NORTH PACIFIC PREDATORS**

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Environmental pollution can pose a significant threat to wild populations through declines in fitness and population numbers. We assessed the relationship between contaminant body burdens and immune function in black-footed albatrosses (*Phoebastria nigripes*), a top marine predator with a large foraging range, in order to elucidate the impact of marine pollution on pelagic species. Blood samples were collected from adult black-footed albatrosses on Midway Atoll, part of the Hawaiian archipelago, and analyzed for organochlorines (e.g., PCBs, chlorinated pesticides) and trace metals (silver, cadmium, tin, lead, chromium, nickel, copper, zinc, arsenic, selenium, and total mercury). Cryopreserved peripheral white blood cells were evaluated for immune function (mitogen-induced lymphocyte proliferation, macrophage phagocytosis). High mercury levels were associated with altered immune function as indicated by a negative relationship between blood mercury concentrations and macrophage phagocytosis. Black-footed albatross organochlorine concentrations were highly correlated within individual birds, and we found a positive association between chlordane pesticides and increased lymphocyte proliferation. Our results give cause for concern for detrimental health effects in pelagic predators exposed to persistent marine pollutants.

**PIGS UNDER THE PALMS, PEST MANAGEMENT AND THE CONSERVATION OF THE SUMATRAN TIGER**

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One of the key factors dictating the continued persistence of large carnivores is the availability of prey items and access to sufficient habitat. Degraded, human dominated landscapes between core areas of primary habitat may provide movement corridors and even much needed supplementary habitat if landscape management practices accommodate and enable such prey species to persist. However, outside national parks prey species within these areas are often agricultural pests. For the Sumatran tiger, wild pigs are thought to be one such pest / prey species. Working within a large oil palm plantation in Jambi, Sumatra, we quantified the spatial and temporal variation in pig damage within the plantation. We found that there was great variation between the perceived and real extent of the damage and that there was a high degree of spatial variability in damage incidents. Incorporated with both population studies and economic analysis of pig damage we are able to inform plantation pest management strategies and provide guidelines and options to enable oil palm plantations to optimally combine conservation priorities into traditional pest management. As conservationists have traditionally explored issues of pest damage with reference to small holder farming practices this represents the first scientifically robust study of pig damage within large oil palm plantation.

**THE ANDEAN BEAR–CATTLE CONFLICT IN OYACACHI: THE BUMPY ROAD FROM THE LANDSCAPE SPECIES MODEL TO AN OPERATIVE COMMUNITY MANAGEMENT PLAN**

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Andean bear predation on cattle in the indigenous community of Oyacachi (inside Cayambe Coca Ecological Reserve, Ecuador) became a serious problem in the year 2000 when a series of continuous attacks started. Oyacachi, EcoCiencia, and the Ministry of Environment carried out a study to understand the pattern of predation events in the area, the perceptions of people about the conflict, and its economic impacts on livestock holders. The research concluded that only 3% of the study area (740 hectares) has high probability of predation, the perception of the community was highly influenced by the large economic losses due to predation, and that the high economic impact that exists is distributed only in 25% of the families. To deal with the conflict a management plan was designed and approved by the community, although there was some resistance because livestock holders were only interested in economic compensation. At the end, the plan included activities like cattle relocation, cattle management for productivity increase, surveillance of critical areas, economic compensation, education, and monitoring of bear populations and attacks frequency. With these activities we expect to reduce attacks and compensate inevitable losses. The challenge is to keep people's will to coexist with wildlife.

**ESTABLISHMENT AND EFFECTIVENESS OF MARINE PROTECTED AREAS: LINKS BETWEEN GOVERNANCE, BIOLOGICAL, AND SOCIOECONOMIC FACTORS**

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The potential utility of networks of marine protected areas (MPAs) as a global biodiversity conservation strategy is currently

limited by challenges to (1) establishment and (2) effective management. To better understand the first issue, we analyze the relationship between national rates of MPA establishment (using MPA Global, a database of the world's marine protected areas, developed from the *World Database on Protected Areas* by the Sea Around Us Project, University of British Columbia) and national governance and development indices. Once established, the second issue (effective management) becomes paramount. MPAs can benefit the species, habitats, and ecosystem processes within them, as well as provide socioeconomic benefits for nearby communities, but only if the waters within the MPA are actually protected. We describe a conceptual model based on the hypothesis that MPA governance shapes the behavior of marine resource users, the biological condition of marine resources per se, and biological and social outcomes (e.g., species richness, individual income). We test this hypothesis with data from sites using the IUCN/WWF/NOAA *How Is Your MPA Doing?* protocols and recommend closer integration of governance, biological, and socioeconomic factors in research and policy.

### **DIVERSITY, DISPERSAL AND SCALE INTERACTIVELY AFFECT PREDICTABILITY OF ECOSYSTEM FUNCTION**

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Theory and experiments predict that biodiversity losses can decrease the magnitude and stability of ecosystem services such as production and nutrient cycling. Most of this research, however, has been isolated from dispersal processes that often create and maintain diversity in nature. Since dispersal mediates common anthropogenic drivers of biodiversity change, such as habitat fragmentation, species introductions, and climate change, it is unclear how those drivers will affect ecosystem services. We tested the interactive effects of mobile grazer diversity and dispersal on the magnitude and stability of ecosystem properties in experimental seagrass communities that were either isolated or connected by dispersal corridors. Contrary to theoretical predictions, we found that increasing the number of mobile grazer species in these metacommunities increased spatial and temporal variability of primary and secondary production. Moreover, connecting patches with dispersal corridors reduced diversity effects on production. However, diversity and connectivity together often increased metacommunity-scale resistance to perturbation (macroalgal blooms). Our results suggest that beta-diversity, or patch heterogeneity of species composition, may affect the predictability of ecosystem function in space and time. Consequently, there may be conservation tradeoffs between maximizing diversity across landscapes and stabilizing ecosystem services.

### **GRADIENTS IN FISH BIOMASS ACROSS THE ITACOLOMIS REEFS NO-TAKE AREA BOUNDARY (ABROLHOS BANK, BRAZIL): BASELINE INFORMATION AND EVIDENCE OF FISH SPILLOVER**

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Extractive Reserves are multiple-use protected areas established and managed with strong participation of local traditional communities. The Extractive Reserve of Corumbau (ERC) was created in 2000, and it is the first Extractive Reserve in Brazil to encompass coral reefs. In 2002, local fishermen, together with representatives of NGOs, universities, and governmental agencies, created a no-take area covering 20% of the largest reef complex within the ERC (Itacolomis Reefs). This no-take area was created to restore fish stocks and to help sustain fish yields on adjacent fishing grounds. We monitored reef assemblages across the Itacolomis Reefs no-take area boundary before and after its establishment (2001 to 2005). Biomass of commercially important reef fishes increased markedly inside the no-take area and also on unprotected sites closer to its boundary (0–1000 m), supporting the idea that density-dependent spillover generated the observed pattern. Despite these positive effects, poaching is still frequently occurring, and the biomass of target fishes at Itacolomis Reefs is still very low when compared to other areas within the Abrolhos Bank. A long-term enforcement strategy, together with a broader enrollment of local communities on management and monitoring actions, is necessary for improving compliance, promoting reef restoration, and long-term sustainability of fisheries.

### **THINKING ABOUT DOLPHIN THINKING: THE IMPACT OF SOCIAL NARRATIVES REGARDING DOLPHINS ON PUBLIC ATTITUDES TOWARD CONSERVATION**

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Aquarium research in the field of animal intelligence and cognition has uncovered a rich variety of dolphin abilities that have been long thought as uniquely human. These findings could alter popular beliefs about a fundamental separation between the quality of human minds and those of dolphins and other animals. This paper will present results from a 2.5 year study on how people think about dolphins and public beliefs about dolphin intelligence. The research sought to document differing social perspectives about dolphins and to understand how these beliefs might influence people's acceptance of the new information about dolphin intelligence emerging from the research community. The study investigated these questions with two different populations: children aged 8–12 among the aquarium-visiting public in the New York metropolitan area and adults among the aquarium-visiting public in the New York metropolitan area. The results of this study demonstrate how cognitive research can be applied to conservation. These results serve the needs of marine mammal scientists by outlining strategies for public dissemination of their research as well as the education and conservation community to understand how to effectively disseminate scientific knowledge about the social and cognitive lives of dolphins to positively impact the public's understanding and commitment to conservation.

### **EVALUATING SPATIAL TOOLS FOR MARINE CONSERVATION AND BIODIVERSITY MAPPING ON AILINGINAE, ATOLL**

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Ailinginae atoll serves as an excellent candidate for conservation because it contains one of the highest levels of endemism for islands in the region. Although Quickbird satellite imagery provided us spatially explicit data on benthic substrate and bathymetry, it did not fully capture the variety of biota that comprise the atoll. To fully capture this biodiversity, a team of marine biologists conducted a series of Rapid Ecological Assessments (REA) on Ailinginae. We combined information derived

from the remotely sensed imagery and the REA as data inputs for 3 different spatial analysis techniques designed to assist resource managers in identifying areas of high species richness to target for protection. First, we interpolated taxa specific species richness using kriging. Second, we conducted a series of simple linear regressions in order to use the coefficients as a predictor of species richness. Last, we utilized a simulated annealing algorithm (Marxan) as a decision making tool to assist in identifying areas of high conservation priority. Although the first two methods still hold promise for interpolating biodiversity at unsampled locations, Marxan was the most effective tool because it allowed us to identify areas of high conservation priority using a combination of both discrete and continuous datasets.

**EDUCATING FOR ENGAGEMENT: HIGH SCHOOL ENVIRONMENTAL SCIENCE CURRICULUM IN A DIVERSE, RURAL, NEW MEXICO COMMUNITY**

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In northern New Mexico's Jemez Valley, local, state, and national interests collide in land management efforts due to its turbulent history, rich cultural and biological diversity, and rapidly approaching urban sprawl. The small, rural community is home to Jemez and Zia Tribes as well as vibrant Hispanic and Anglo populations who will together determine the health and future of this unique landscape. Through a dynamic Environmental Science course at the local high school, students researched and explored their local watershed using both scientific and traditional Indigenous learning models. Examining impacts of ecotourism, Native and non-Native hunting, water use, and waste management, students became more engaged, informed, and passionate citizens of their local community. High school students concluded the course by teaching a field school with younger students. Results of the Environmental Science course showed increased understanding of ecological processes in the region, ability to critically discuss the relationships between human populations and the local landscape, and a stronger sense of agency and interest in engaging proactively with land management decisions. This locally focused curriculum integrating indigenous and scientific knowledge made learning more relevant and realistic for students.

**AMPHIBIAN DISEASE: CAN LANDSCAPE FEATURES OF BREEDING POOLS DISTINGUISH WETLANDS AT RISK?**

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From 1999–2001 in Acadia National Park (ANP), Maine, USA, tadpole die-off events occurred in various small wetlands. Disease events in ANP are unique in their temporal and spatial variability, diversity of pathogens (*Ranavirus* spp., *Ichthyophonus* spp., Perkinsus-like organism) and multiple amphibian species affected: wood frogs (*Rana sylvatica*), green frogs (*Rana clamitans*), bullfrogs (*Rana catesbeiana*), and spring peepers (*Pseudacris crucifer*). We examined landscape attributes of 57 amphibian breeding wetlands of varying hydrology, size, amphibian community, and disease history to determine if there were features specific to wetlands which harbored amphibian die-off events. We developed and evaluated models using logistic regression and model selection criterion (QAICc). High slope position was the most important predictor of amphibian disease, and was present in all competing models. Results also indicated that sites with western aspect and those without a permanent outlet may affect disease susceptibility, suggesting an influence from atmospheric deposition. Conservation and disease containment efforts in ANP should be directed toward higher slope wetlands, especially isolated wetlands without outlets, such as vernal pools. While conservation strategies directly influence ANP wetland management, the diseases and amphibian species present in ANP are widespread and therefore conservation strategies may be instructive for monitoring and conservation efforts elsewhere.

**STABLE ISOTOPE ANALYSES REVEAL AQUATIC FOOD WEB COMPLEXITY AND CONSERVATION CONCERNS AT DIFFERENT SPATIAL SCALES**

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The Bitter Lake National Wildlife Refuge in the southwestern United States includes dozens of saline sinkholes, some supporting populations of endemic fish and macroinvertebrate species. An understanding of the food web interactions in this system may allow refuge personnel to more effectively manage the sensitive species populations, so samples of fish, aquatic insects, snails, amphipods, macroalgae, and macrophytes were collected from eight sinkholes for stable carbon and nitrogen isotope analysis. Contrary to expectations, site-specific differences in carbon sources and trophic levels were observed in conspecific organisms, suggesting that superficially similar aquatic habitat patches separated by as little as twenty meters can support communities with significantly different food web structures. As expected, a non-native fish apparently acts as top predator in one sinkhole, but the trophic role of an introduced marine algae in at least one sinkhole remains unresolved and is therefore also a cause for concern. This study suggests that the scale at which food webs are investigated may determine the degree of trophic complexity perceived in a patchy landscape, and that this complexity must be taken into account when planning conservation activities.

**FRESHWATER HABITAT CONSERVATION IN THE NORTHERN SIERRA NEVADA**

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In 2000, we initiated a study to provide a new coalition of land trusts with a strategic conservation vision for the northern Sierra Nevada region of California. Though the majority of land in this region is publicly-owned, we hypothesized that freshwater habitats were poorly represented in public ownership. Freshwater habitats including wetlands, wet meadows, and alluvial riparian corridors are disproportionately important to biodiversity, and highly threatened by human activity. Spatial analysis revealed that just 15% of the alluvial valley lands where such freshwater habitats occur were in public ownership; however, habitat associations for federal- and state-listed species showed that 78% of listed species occurring in the region are dependent upon freshwater habitats. These findings led to a strategic plan to protect freshwater habitats through the acquisition of fee title and conservation easements. To date, the coalition has protected 26,905 acres of land in the northern Sierra, and in so doing has increased the percentage of protected land encompassing freshwater habitats from 15% to 22%.

This study demonstrates the application of conservation science at a local level, with limited staff and financial resources, to a highly successful conservation initiative.

### **FIDELITY AND DISPERSAL IN THE POND BREEDING AMPHIBIAN *AMBYSTOMA OPACUM*: IMPLICATIONS FOR SPATIAL POPULATION DYNAMICS AND CONSERVATION**

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The spatio-temporal dynamics of amphibian populations and the models that describe them are largely influenced by the frequency of dispersal among breeding sites; however, dispersal has rarely been addressed rigorously in empirical studies. In a 7-year landscape-level investigation, we monitored breeding populations of marbled salamanders (*Ambystoma opacum*) among 14 wetlands in western Massachusetts to quantify dispersal rates, distances, and the degree of natal site fidelity. Upon capture at drift fences, emerging juveniles at all ponds received cohort marks and adults were digitally photographed for individual identification using dorsal pattern analysis. We found that 9.0% of first-time breeders and 3.6% of experienced breeders dispersed to ponds different from their original capture ponds, representing movement distances between 50 and 1400 meters. This dispersal frequency suggested that significant genetic differentiation would be unlikely among breeding populations in our study area. However, returning individuals far outnumbered immigrants at all ponds, indicating that local variables (e.g., hydroperiod, reproductive success) were of primary importance in determining short-term population success. In addition, several breeding ponds remained uncolonized despite their proximity to established populations, potentially indicating some level of active habitat selection. We discuss these results and their implications for metapopulation dynamics and conservation in pond-breeding amphibians.

### **ARE NATIONAL PARKS ENOUGH? THE CONSERVATION VALUE OF LIGHTLY PROTECTED MANAGEMENT AREAS IN EAST AFRICA**

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Although it is widely agreed that strictly protected areas (SPAs) denoting the highest levels of restricted resource-use are the best strategy for conserving biodiversity, the majority of land managed for conservation receives only moderate protection. In Africa, as elsewhere, marginally protected areas are often considered to be relative conservation failures because they contain so few charismatic large mammals, the conventional hallmark of effective conservation on the continent. To evaluate the effectiveness of the existing protected area network it is necessary to evaluate the consequences of different conservation management strategies for the biodiversity of multiple species groups. Here we document patterns of species richness and community structure of five taxa (small mammals, amphibians, butterflies, birds, and trees) in three lesser protected resource management areas of western Tanzania and compare them with a well protected national park. We show that species richness does not decline along a gradient of decreasing conservation protection. In contrast, the community structure and species composition of most taxa differ markedly among well and lightly protected areas. Our data reinforce the need for conservation planners to move away from the independent management of isolated protected areas and move towards environmental conservation at the scale of entire landscapes.

### **BROWNFIELDS, GREEN CITIES, AND THE FUTURE COLOR OF CONSERVATION**

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Important linkages exist between urban environmental justice and biological conservation. An increasing majority of humans live in urban areas, making these population centers valuable sources of future environmental leaders and conservation action. Because many models of environmental behaviors relate an individual's potential environmental action to direct experiences with nature, more research is needed on quantity, quality, and distribution of urban green space. I review studies from the past two decades, and present my work in Honolulu and Wellington, New Zealand, which utilizes satellite imagery, census data, and GIS tools to analyze spatial patterns of urban green space and socioeconomics. In nearly all cases, poorer neighborhoods and those with higher percentages of minorities have less access to green space. Because of the well-documented ecological, social, and psychological benefits from close proximity to urban green space, widespread inequities in access concern environmental justice activists. Inequitable urban green space can also limit participation in environmental action, making it relevant to conservation practitioners. Fortunately, urban restoration, particularly brownfields conversion, can improve distribution and increase overall quantities of urban green space. I highlight case studies from cities with greenways programs, which provide more equitable access to urban green space while increasing ecological connectivity within urban ecosystems.

### **CONSERVATION BEYOND BORDERS: ENVIRONMENTAL ATTITUDES OF SMALL-SCALE FISHERS ALTER FAVOURABLY THROUGH CO-MANAGEMENT ENGAGEMENT**

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The bottom-up governance of marine resources through co-management policy frameworks is promoted as essential in the alleviation of global mismanagement of marine fisheries. Such policies are designed to encourage changes in fishers' practices, but do not guarantee long-lasting positive changes in their attitudes towards the marine environment. Therefore if policy incentives are withdrawn, fishers might revert to previous destructive behavioral patterns. We show that small-scale fishers' attitudes towards environment and conservation issues in Chile alter favorably through participation in a marine co-management regime which grants territorial user rights to fishers (TURFs). Attitude shifts depended upon distinct subsets of environmental concerns. Fishers' concerns regarding environmental and resource quality increased with the length of time they

had been engaged in co-management. However, attitudes towards biodiversity conservation, in relation to financial considerations, changed more slowly. Favorable attitudes towards the conservation of natural resources of commercial value were held by fishers irrespective of the length of time of engagement. Importantly, subtidal assessments of biodiversity showed that co-managed grounds (TURFs) are effectively more biodiverse than open-access grounds; thus, changes in attitudes appear to promote conservation benefits. Understanding fishers' attitude shifts, increases our ability to guide sustainable governance-society interactions.

**COST-EFFECTIVE CONSERVATION: ALLOCATING RESOURCES TO MONITORING AND MANAGEMENT FOR MARINE RESERVES IN THE GULF OF CALIFORNIA**

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It is generally established in the literature on marine reserves that, from an economic standpoint, benefits will exceed costs. What is less resolved is the probability of making the "wrong" decision regarding reserve establishment when data are limited and uncertain. We apply a decision-theory framework to optimally allocate conservation resources between improving data on population status and establishing a reserve for species conservation. Our objective is to maximize net economic benefits given the constraint of a population growth rate that will permit sustainability of resources. Our approach is to explicitly consider the benefits and costs of management decision and how management approaches should react to monitoring data. We illustrate our decision framework using a retrospective analysis of a 7-year dataset on the leopard grouper (*Mycteroperca rosacea*), along with data on costs and benefits associated with fishing, tourism, monitoring, and enforcement of reserves in the Gulf of California, Mexico. We then show how such decisions may vary with quantity of data.

**CONSERVATION OF WILD TIGERS IN TRANSBOUNDARY ASIA**

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Factors that influence the persistence of large mammal populations are numerous and include large home range size, human impact, and habitat fragmentation. Because large mammals are extremely mobile, disperse long distances, and require relatively large areas to persist, they are particularly likely to cross international borders and thus be influenced by transboundary management. A recent analysis of priorities for the conservation of wild tigers, *Setting Priorities for Conservation and Recovery of Wild Tigers*, highlighted the importance of transboundary areas for tiger conservation. Varying political structures and management regimes in adjacent countries may have a strong impact on the patterns of movement and persistence of tigers in any given landscape. Here we present an analysis of how human population density and infrastructure development affect the areas in which tigers are found, we discuss the ecological and social factors underlying the importance of transboundary tiger populations, we review efforts to effect conservation between and among nations that share populations of tigers, and we identify priority transboundary tiger populations and discuss the potential for their persistence.

**A PATCH-BASED SPATIAL POPULATION VIABILITY ANALYSIS OF BANK SWALLOWS (*RIPARIA RIPARIA*) NESTING ALONG THE SACRAMENTO RIVER, CALIFORNIA**

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Bank swallows (*Riparia riparia*) are a California state-listed threatened neotropical migratory songbird species that nests in colonies on earthen banks along the Sacramento River (California). To assess the viability of this population, this paper presents a patch-based population viability analysis (PVA) that incorporates the effect of environmental stochasticity, density dependence, habitat loss, and spatial habitat structure. Potential habitat patches were modeled from a GIS dataset of river bank height. These patches were input into a PVA accounting for population dynamics within patches (e.g. fecundity, juvenile survival, adult survival, and carrying capacities) as well as dynamics between patches (occupancy and migration rates). Using baseline parameters the PVA estimated the population to have a 5% probability of extinction within the next 50 years. Juvenile survival was found to be a highly sensitive parameter, as was the spatial structuring of patches, but only if the between patch movement distances of returning birds were less than 15 km. Bank revetment (i.e. habitat loss) was found to have increased the extinction probability from 1% to 5%. The results of this research gives continued support for this species being a California listed threatened species, and point to removal of bank revetment as a management action that could increase the viability of this population.

**COMMUNITY CONSERVATION AGREEMENTS FOR SEA TURTLE NESTING BEACH PROTECTION**

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Pacific leatherbacks are the most endangered sea turtle and only a dozen major nesting beaches remain. As many of the communities near these nesting beaches struggle to meet their basic needs, the economic sacrifice required to protect turtles can undermine the acceptance and sustainability of conservation unless these efforts are accompanied by tangible community benefits. A long-term community conservation agreement (CCA) is one option for addressing this issue. A CCA delivers a well-defined package of annual benefits to local communities in exchange for concrete verifiable community commitments to conservation. We estimated the current annual costs of beach protection activities in several sites. Household surveys were conducted in 2005 in a village adjacent to the largest remaining leatherback nesting beach in the Pacific (Jamursba Medi) to gain insight into socioeconomic conditions and community incentives for conservation. The surveys revealed that education is the top priority for villagers and that subsidizing these costs in exchange for the community's provision of conservation services

would add relatively little to current project costs. Our data suggest that covering long-term recurrent costs (including community benefits) is possible and affordable, particularly through the creation of trust funds. Trust funds would enable conservationists to make yearly agreements with communities as far into the future as is necessary to achieve long-term conservation.

**FROM DEPENDANT TO COMPENSATION: PROCESSES THAT DRIVE THE RECOVERY OF A DEPLETED POPULATION**  
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The recovery of a depleted population depends to a great extent on the interactions between life history strategies and ecological processes. Using data from a 10-year study, we show the processes that affected how a population of queen conch (*Strombus gigas*) recovered in the Florida Keys archipelago. We describe the progression of the recovery from its initial stages where it was at critically low densities and was dominated by dependant processes resulting in limited reproductive encounters. As the population density increased, the proportion of the population engaged in reproductive encounters also increased; however, the area occupied by the population remained relatively constant. In 1999, when the maximum density was achieved (approximately 750 conch per ha), compensatory processes predominated and the area occupied by the population expanded rapidly with a concurrent and significant shift of the population into less-favorable habitat. These processes help to explain recovery of endangered species and may provide guidance to managers on how best to design protected areas.

### **A DECISION SUPPORT SYSTEM FOR REGIONAL MARINE PROTECTED AREA PLANNING IN CALIFORNIA**

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Marine protected area planning efforts typically require a variety of data and decision support tools useful to a wide array of stakeholders with varying technical skills. In California, the Marine Life Protection Act (MLPA) calls for the establishment of a managed network of marine protected areas (MPAs) for the state of California with the primary goal of ecosystem protection. The MLPA Initiative, a public-private collaboration, organized a regional stakeholder group and a Science Advisory Team (SAT) to develop and evaluate alternative MPA network designs for the Central Coast region. We describe the key data inputs, decision support tools, and analyses used by the stakeholders and SAT in the planning process. The decision support system included a geodatabase and Web-accessible mapping and decision support tools to support marine gap analysis and the evaluation of alternative designs based on habitat representation and other MLPA goals. Lessons learned during the Central Coast pilot project will guide refinement of the tools and approaches to stakeholder-driven regional MPA planning. As California will be the first state in the United States to implement a managed network of MPAs, our decision support system may serve as a model for similar efforts in other state or federal processes.

### **A STITCH IN TIME SAVES NINE: AN EFFECTIVE NOVEL APPROACH FOR PROACTIVELY IDENTIFYING HARMFUL "SLEEPER WEEDS"**

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In a world without borders, early detection of harmful invasive plants is essential. Treating incipient weed populations before they become intractable reduces treatment cost and protects sensitive natural systems. While ecologists have developed numerous approaches to predict invasibility (e.g. life history modeling, climate matching), these methods require expertise and resources unavailable to land managers. We urgently need methodologies that bridge the gap between laboratory and field, and apply invasion science to the pragmatic identification of sleeper weeds. I present a new method for identifying sleeper weeds that uses a well-supported principle: the best predictor of whether a plant will become invasive is whether it has invaded elsewhere. My technique successfully analyzes aggregate data derived from worldwide invasive plant lists (readily available off the internet), correlating taxon-specific citation rankings with easily obtained local incidence values. Application of this technique to a regional flora successfully flagged most of the species previously identified as "red alerts" by exhaustive expert review, and flagged several additional taxa overlooked by the more resource-intensive technique. These results validate a key theory in invasion biology. This approach offers a powerful method for any land manager with access to the internet to identify the sparsely-abundant introduced plant taxa that are likely to become tomorrow's widespread harmful invaders.

### **PATTERNS OF GENETIC RELATEDNESS IN A POACHED POPULATION OF AFRICAN ELEPHANTS (*LOXODONTA AFRICANA*)**

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Widespread poaching in the 1980s potentially altered the demographic structure of matrilineal elephant groups in many populations by decreasing the number of old, adult female kin. Using non-invasive genetic and observational techniques, we examined the patterns of genetic relatedness and group cohesiveness among adult female elephants in a heavily poached population to detect the demographic signature of such a disturbance. We observed intra-group cohesiveness and inter-group associations and collected dung samples from over 85 elephant family groups over a 25-month period in Mikumi National Park, Tanzania. Fecal microsatellite DNA analysis was used to determine degree of relatedness among adult females within groups. Cohesiveness and relatedness within groups differed greatly. Some groups maintained a consistent membership of only close relatives, while others consisted of only non-relatives. Some groups also displayed a more fluid composition, with adult females changing adult female partners frequently. These findings differ from what has been described about African elephant social structure by other researchers focused on more protected populations, and may have implications for adult female elephant reproductive output, stress physiology and competitive behavior.

**DO SMALL MAMMAL PEST SPECIES IMPACTS INCREASE ON FARMS WHEN ADJOINING LANDS ARE CONVERTED TO HABITAT?**

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Previous research has demonstrated that horticultural restoration of floodplain lands on the Sacramento River is successful in providing breeding and / or foraging habitat for special-status fish, bird, bat, and insect species. Yet there is concern among local landowners that restoration sites are causing increased pest species impacts on farmers that adjoin these sites. We investigated this by conducting studies of small mammal distribution and abundance at four habitat types (agricultural, young restoration, older restoration, and remnant riparian) distributed over 73 miles on the middle Sacramento River. Three sampling methods were used: live trapping, visual surveys, and analyses of barn owl pellets collected from nest boxes. Preliminary results suggest that small mammals are highly responsive to local habitat conditions with different species showing peak abundances in different habitat types. Although certain orchard pests (voles, gophers, ground squirrels) had high abundances in young restoration sites, they rapidly declined as the sites matured. In fact, older restoration sites and remnant habitats typically had far fewer small mammal pests present than did orchards. One concern, from a biodiversity standpoint, was the increase in exotic black rates (a songbird nest predator) that was observed as the restoration sites matured.

**THE LAST OF THE TRANSBOUNDARY WILD AREAS: OPPORTUNITIES FOR CONSERVATION AND INTERNATIONAL COOPERATION**

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Transboundary approaches are critical for conservation planning as they allow natural ecosystem rather than arbitrarily drawn political boundaries to be considered. Although the large scale of human disturbance of the Earth's ecosystems has left few large and undisturbed areas remaining, conservation of these last "wild" places may in some cases be the only and / or most cost-effective conservation strategy. We conducted a global GIS analysis to find the last large and undisturbed transboundary areas using a map of human influence developed by Sanderson et al. (2002); we analyzed the level of inclusion of these areas and the level of representation of their biomes in protected area (PA) networks. We identified 104 transboundary wild areas involving 61 countries. At least 6 areas contain high plant and vertebrate diversity. Most areas are deserts and moist broadleaf forests. A high fraction of these areas are virtually unprotected; further, 4 of their biomes are critically under-represented in PA networks. We propose that the wild areas identified here can be used to select sites for future PAs. Inclusion of these areas in PA networks can serve the dual purpose of achieving effective conservation and providing opportunities for international cooperation.

**MODELING HABITAT CHARACTERISTICS OF NORTH ATLANTIC RIGHT WHALES (*EUBALAENA GLACIALIS*) IN THE GULF OF MAINE**

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Despite decades of protection, the endangered North Atlantic right whale has failed to recover due in large part to collisions with ships and entanglement in fishing gear. As part of a broad effort to reduce anthropogenic threats to large whales, we investigated the relationship between the distribution of right whales and the physical conditions in the Gulf of Maine. The National Marine Fisheries Service conducted year-round, standardized aerial surveys in the Gulf of Maine between 2002 and 2005. Sightings from these surveys were coupled with static and satellite-derived physical variables to identify quantitative relationships between the distribution of right whales and physical habitat characteristics. Our preliminary analysis, using spatially explicit techniques, indicates that several habitat variables are significantly correlated with right whale distribution. These include depth, distance to shore and sea surface temperature. Understanding how the physical environment influences the distribution of right whales will help to assess the usefulness of existing time / area management programs designed to reduce the co-occurrence of whales and potentially hazardous fishing gear. This study will provide resource managers with a more complete profile of right whale habitat usage and aid in selecting optimal management measures.

**INCORPORATING CATASTROPHIC RISK ASSESSMENTS INTO RECOVERY PLANNING FOR PACIFIC SALMONIDS**

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Catastrophic die-offs are not commonly incorporated into endangered species recovery planning. Natural (e.g. landslides, floods) and anthropogenic (e.g. toxic leaks and spills) catastrophes pose a challenge for listed Pacific salmonid ESUs (evolutionarily significant units) recovering from precariously low population levels. To spread risks among Puget Sound Chinook salmon populations, recovery scenarios recommended for ESU-wide viability require at least 2 viable populations of historical life-history types in 5 geographic regions. We examined these viability recommendations for 22 populations of the threatened Puget Sound Chinook salmon ESU by overlaying geospatial information about catastrophic risks on Chinook salmon distribution in Puget Sound watersheds. We categorized relative catastrophic risks among populations, analyzed similarities in risk scores among regions, and compared risk distributions of population groups selected using recovery scenario recommendations with those of randomly selected population groups. Risks from individual catastrophes varied among populations, but overall risk from catastrophes was similar within regions; thus, recovery scenarios had lower risk than random scenarios. Recovery planning can promote viability of Pacific salmonid ESUs across the landscape by incorporating catastrophic risk assessments, thus identifying the spatial and life-history diversity critical for populations to respond to environmental change or rescue severely depleted or extirpated populations.

**DOES EXCLUDING CATTLE FROM RIPARIAN AREAS IMPROVE BIRD RICHNESS AND ABUNDANCE? AN EXPERIMENTAL TEST**

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Worldwide, riparian habitat is being lost at an alarming rate. In California, 90% of all riparian woodlands have been degraded, due in part to inappropriate livestock grazing. One common solution to overgrazing is to exclude cattle from riparian areas. However, this can be exceptionally expensive and can promote invasives. An alternative is to allow cattle access to streams during designated times of the year. No consensus exists as to which method is most effective because few if any studies directly compare these two approaches on the same system. To address this, we experimentally compared the effects of total exclusion vs. seasonal usage on sycamore and cottonwood-willow riparian forests of California's Central Valley foothills. Over 7000 breeding season observations of 94 avian species revealed that native species richness and density was generally greater in year-round exclusion sites compared to sites where winter grazing was permitted. One exception was the richness and density of ground nesters, which declined in both treatments over time. In 2005, climatic fluctuations led to a decline in overall native species abundance, with most species declining more sharply in seasonal exclusions. Overall trends suggest that year-round livestock exclusion is more favorable to avian populations than seasonal exclusion.

**CONSERVATION OF FISH AND WILDLIFE THROUGH THE FARM BILL**

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Congress authorized \$17 billion dollars for private lands conservation through the 2002 Farm Bill. This unprecedented amount of funds for conservation on private lands is important because approximately 70 per cent of the land base within the United States is privately owned. Hence the conservation of biological diversity must include private lands. Prior to 1985 the Farm Bill focused on agricultural subsidies and price supports but during the last 20 years there has been an increasing recognition that conservation programs for private lands must be included. This has been exhibited by the growing number of conservation programs and increased funding during the last four Farm Bills. Presently the Farm Bill includes restoration, enhancement, and easement programs that affect over 30 million acres. This presentation will discuss the evolution of farm bill conservation programs, provide a synopsis of each program, discuss how priorities are assigned to dispersal of funds, and summarize program accomplishments. In addition, the importance of better understanding the effects of Farm Bill program on environmental resources and efforts underway to accomplish this will be discussed.

**INTACT NATURAL HABITAT PROTECTS VINEYARDS FROM LETHAL PIERCE'S DISEASE IN NAPA, CALIFORNIA**

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Research on vectored crop diseases has focused on the disease triangle, which is limited to three species and the interactions among them: the crop plant, pathogen, and vector. Failing to consider the ecosystem and landscape context can lead to ineffective management practices. For example, in northern California, Pierce's disease of grapevines, which has caused substantial economic damage, is vectored by a native insect. Anecdotal reports reflect the belief that Pierce's disease occurs primarily near riparian habitat; consequently, growers are extirpating riparian vegetation and applying pesticides to riparian corridors, despite no evidence that these practices reduce disease incidence. We present a conceptual model of how the components of a mixed agricultural and wild landscape interact to affect disease incidence. We also present results from our landscape scale investigation of the spatial distribution of Pierce's disease. We found no Pierce's disease in vineyards that situated in a landscape dominated by natural habitat. However, when vineyards were in a landscape dominated by both agricultural and urban habitats, Pierce's disease occurred; furthermore, in this landscape context, disease was most likely to occur in vineyards adjacent to riparian habitat. These results suggest that where large areas of natural habitat remain intact, vineyards are protected from disease, but when natural habitat becomes sufficiently reduced and fragmented, Pierce's disease increases.

**HOW ARE WE SAVING SPECIES IN THE 21ST CENTURY?**

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For more than a decade, conservationists have been grappling with how to prioritize their conservation efforts. Although preventing species extinction is one of the foremost goals of any conservation organization, species conservation per se has been de-emphasized over time. Recognizing that preserving species is a central goal of conservation, we explore the variety of approaches conservation organizations have used for setting priorities for species conservation. Our review includes an overview of species conservation priority setting as background to providing an overview of current activities in this arena. Our analysis also focuses on how species conservation approaches are put into practice, and on the range of outcomes desired. In particular, we focus on a relatively unexplored question: what precisely about species do we wish to conserve? For example, the goal may be ensuring that a population persists globally, or more specifically within a protected area, or we might seek to conserve species such that populations fulfill their ecological role within a community. Our hope is to start a new conversation regarding priorities in species conservation, and to explore multiple avenues by which we can collectively move forward to achieve our goals in this century.

**ECOSYSTEM-LEVEL CONSEQUENCES OF SPARTINA INVASION IN WEST COAST ESTUARIES**

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The eastern cordgrass *Spartina alterniflora* has been introduced in several estuaries in the western North America resulting in

significant impacts on native communities in California and Washington. We have documented the impacts of *Spartina alterniflora* and its hybrids in at several levels including changes in physical processes such as light transmission, water flow and sediment deposition as well as changes in organismal diversity and function. We documented increases total organic matter, chl a, silt / clay fraction, soil temperature, and porewater sulfide and ammonium. *Spartina* invasion has generally resulted in greater above and belowground storage of C and N relative to open mudflat of native plants. Using manipulative enclosure / enclosure experiments and addition of inorganic nutrients and stable isotope tracers, we documented substantial changes in community structure and ecosystem function following *Spartina* invasion. Native species diversity in mature stands of *Spartina* were strongly reduced, while several introduced species became more abundant in invaded areas. *Spartina* invasion also produced a dramatic shift in food web structure from a largely microalgal-based system dominated by surface feeders to a largely detrital-based system dominated by subsurface feeders. We discuss the consequences of these changes for higher trophic levels including geese and shorebirds.

**IMPROVING CONSERVATION PLANNING IN PERU AND BOLIVIA THROUGH THE APPLICATION OF NEW TOOLS AND DATA**

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Regional analyses are critical for identifying sites needing conservation action, but these studies are often hampered by the lack of data and data standards, and the inability to access existing data. Working with local partners, we have applied new tools to fill data gaps and provide new analyses of conservation priorities on the east slope of the Andes and adjacent lowlands in Peru and Bolivia. Using a new classification system for ecological systems of South America, we used remotely sensed data and ground-truthing to create a standardized and accuracy-assessed map for this region. To identify centers of endemism, we modeled the distributions of over 500 endemic bird, mammal, amphibian, and plant taxa. The species distribution models used locality data (developed collaboratively with local and international natural history museums) and geographic information on climate, land cover, and elevation. All this biological and ecological information was integrated into NatureServe Vista, a recently-developed decision support tool, to identify conservation priorities and assess the effectiveness of the current protected area network.

**DO ARTIFICIALLY INCUBATED TUATARA (REPTILIA) SURVIVE AND GROW AS WELL AS THOSE INCUBATED NATURALLY?**

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Artificial incubation of eggs is an important tool for conservation of reptiles. The method is used for obtaining individuals of a rare species that are not easily sourced directly from wild populations, for example, due to the threat of harvesting adults on population viability. Artificially incubated young are used to start new populations of tuatara (*Sphenodon* spp.), rare endemic reptiles of New Zealand. We investigate survival and growth of artificially incubated juvenile tuatara compared to those incubated in natural nests up to five years post-hatching using a generalised linear model. Larger juveniles were more likely to survive. Survival from hatching to five years of artificially incubated juveniles (77 for males,  $n = 112$ ; 73 for females,  $n = 179$ ) was intermediate between survival of naturally incubated males (91,  $n = 86$ ) and lower survival of naturally incubated females (66,  $n = 50$ ). Artificial incubation of tuatara allows sex ratios to be manipulated as a result of temperature-dependent sex determination, and hatching success is double that found in nature. The low survival of naturally incubated females and the effect of global warming on increasing the proportion of male hatchlings may mean artificial incubation will play an important role in supporting natural population viability for tuatara in the future.

**MARINE CONSERVATION IN LATIN AMERICA: A REVIEW OF MARINE PROTECTED AREAS**

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In Latin America, where the deterioration of coastal ecosystems and the exploitation pressure for marine resources are increasing dramatically, the establishment of marine protected areas (MPA) seems to be a promising management tool to ameliorate the degradation of marine ecosystems. My goal was to analyze the current situation of marine conservation in this region of the world by reviewing, in existing databases, the number of marine protected areas (MPA). I found 1016 MPAs in Latin America, covering an area of 523,621 km<sup>2</sup>, which makes up 24 of the global marine sites protected and 28 of the global marine area protected; 59 marine reserves (areas set aside from extractive activities) were identified in this region of the world, encompassing an area of 9663 km<sup>2</sup>. The majority (61) of MPAs have been established in the Caribbean region, but the major representation (58) of the area protected is found in South America. The west coast of Latin America is less represented in terms of number of MPAs. Although the number of protected areas is not a measure of marine conservation effectiveness, the commitment of biodiversity conservation represented by the number of MPAs established in Latin American countries is remarkable.

**SOCIO-ECONOMIC MONITORING OF THE CHANNEL ISLANDS NATIONAL MARINE SANCTUARY RESERVES AND THE LOCAL CALIFORNIA SPINY LOBSTER FISHERY**

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The recent establishment of the Channel Islands National Marine Sanctuary Reserves in 2003 requires managers to monitor and report on the social and ecological impacts. However, there is much debate regarding the fundamentals of reserve monitoring design. The extent to which social and ecological impacts should be considered, the quality of baseline data, and the selection of measured variables to foster adaptive learning are some issues that raise the most concern. In this study we use a Before-After Control Impact Study design to assess the socioeconomic impacts of marine reserves on the California spiny

lobster (*Panulirus interruptus*) fishery of the Channel Islands and the Santa Barbara coast. We first constructed a database of California Department of Fish and Game lobster logbook data and commercial landings receipts from the 1998–1999 to the 2004–2005 lobster seasons to query for before-and-after geographic, individual and group trends in production, earnings, and effort. We then interviewed local trappers to define causal factors for the observed trends. The database, interview process, and reports from this study will be used in an adaptive manner to better inform California lobster fishery management decisions and reserve design. In addition, this study provides an example of a marine reserve monitoring methodology that can be tested for other fisheries within the CINMS Reserves.

### **A DEEP-SEA CORAL CONSERVATION STRATEGY: USING GIS TO MAP CORAL DISTRIBUTION, HUMAN THREATS, AND MODEL PREDICTIVE CORAL HABITATS IN UNITED STATES WATERS**

Guinotte, John, LANCE MORGAN, and Fan Tsao. Marine Conservation Biology Institute, Bellevue, WA, USA, lance@mcbi.org

The distribution and physiology of deep-sea corals is poorly understood by the scientific community and the ecosystems they form are arguably an under-appreciated component of marine biodiversity. Deep-sea coral ecosystems are home to a host of diverse communities, provide ancient archives of global climate change, and provide habitat for numerous marine organisms, including important commercial fish species. Deep-sea corals have untold value to the pharmaceutical industry, but fundamental questions addressing their basic biology and importance to fish remain unanswered. In order to develop a conservation strategy for these habitats, MCBI created a GIS database of deep-sea corals in United States waters and mapped their distribution in conjunction with potentially threatening human activities (e.g. bottom trawl fisheries, oil and gas exploration, etc.). Findings reveal deep-sea corals are widely distributed in United States waters, but cluster in specific areas along the continental shelf break. Bottom trawl fisheries threaten deep-sea coral ecosystems in many regions and current management strategies, focused primarily on fisheries, do little to protect these complex benthic habitats. Predictive habitat modeling using the KGS mapper application was used to identify areas likely to harbor deep-sea coral ecosystems in United States waters. Modeling results will be beneficial to future exploratory cruises and will aid in understanding the importance of environmental variables to deep-sea coral survival.

### **HUMAN-ELEPHANT CONFLICT AROUND MIKUMI NATIONAL PARK, TANZANIA**

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Crop production is the principal economic activity in the local communities surrounding Mikumi National Park (MINAPA), Tanzania. Wildlife predation upon these crops is thought to be a key constraint on income generation. This project made the first quantitative assessment of this problem, with a focus on Human-Elephant Conflict (HEC). Five villages bordering MINAPA were selected, and within each village representatives recorded data on the frequency, distribution and severity of crop-raiding for one year, using forms based on the data collection protocol of IUCN's HEC Taskforce. HEC was documented in all five villages throughout the study year. Both spatial and temporal variation in crop raiding were evident, and are potentially related to rainfall patterns, food and water resources, distance of villages from the park boundary, boundary-village interface type, and elephant density and movement patterns. This study has documented the existence of HEC around MINAPA and has demonstrated that local communities and MINAPA are willing and able to collaborate to monitor this problem. However, a multi-year study is needed to allow a full assessment of the temporal and spatial patterns suggested by this study. Only then can an assessment of causal factors be made, allowing effective mitigation measures to take place.

### **THE SPATIAL STRUCTURE OF FOREST SONGBIRD REPRODUCTIVE ACTIVITY IN A MANAGED FOREST LANDSCAPE**

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In the northern hardwood forest of New Brunswick, Canada, industrial forest management alters both within-stand vegetation and landscape structure, which in turn may affect ecological process such as forest songbird reproductive success. We predicted that spatial structure in songbird reproductive activity would be more likely as forest management created a patchy environment. We used a systematic and spatially-explicit study design to determine whether spatial structure was present in forest songbird reproductive activity on three study grids (218–306 ha) of varying silvicultural intensity. Depending on the bird species and the study grid, reproductive activity was spatially autocorrelated over distances of up to 804 m. As silvicultural intensity increased, spatial structure in reproductive activity was more likely. Our results demonstrate that studies must be carefully designed to detect and, when present, integrate spatial dependence in point samples of bird reproductive activity.

### **GEOGRAPHIC PATTERNS OF INTROGRESSIVE HYBRIDIZATION BETWEEN INTRODUCED RAINBOW TROUT AND NATIVE YELLOWSTONE CUTTHROAT TROUT**

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Genetic extinction of native species as a result of introgressive hybridization with introduced species threatens many salmonid fish populations in the western United States. This is a particularly important concern for the Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), whose numbers have declined dramatically in both abundance and distribution as a result of introgression with introduced rainbow trout (*O. mykiss*). We sampled over 1200 trout from the South Fork of the Snake River (SFSR) watershed in southeastern Idaho. We measured the extent of the introgression of rainbow trout (RBT) genes into native gene pools of Yellowstone cutthroat trout (YCT) by using nine species-specific co-dominant markers. We also used mitochondrial DNA (mtDNA) haplotypes to determine the directionality of the hybridization. We found low levels of RBT introgression into YCT gene pools, with the majority of hybrids occurring in main-stem sections of the SFSR and in lower elevational reaches of certain tributaries. RBT introgression appears to be influenced by dispersal distance from sites of stocking origin and the degree of tributary flow / access to the main-stem river. These results have important management

implications for the preservation of the Yellowstone cutthroat trout and similarly threatened native fishes.

**GENETIC STRUCTURE IN THE DESERT TORTOISE: CONSERVATION IMPLICATIONS**

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The ability to manage and conserve populations effectively requires historical and present information about population structure and dynamics. Genetics can be used (a) to identify natural structure within and among populations, (b) to determine the historic migration among populations, and (c) to evaluate the extent to which conservation strategies are sufficient to maintain ecological processes. The desert tortoise (*Gopherus agassizii*) is a long-lived, wide-ranging, rare, and elusive species of the Mojave Desert of the southwestern United States. Population characteristics of the desert tortoise make it an ideal species for inferring population processes from genetic data. We have used genotype data from highly variable genetic markers (i.e. microsatellites) to assess historical gene flow and current migration rates among populations across the range of the Mojave Desert tortoise. Our analyses correct several original preconceptions about structure within the range of this species, and they provide a new basis for conservation decisions. These analyses demonstrate the natural differences among genetic units and suggest areas in which gene flow was common or rare. The results of our study, thus, have important implications for the conservation this rare and cryptic species.

**MODELING THE LANDSCAPE NICHE CHARACTERISTICS OF THE RED DIAMOND RATTLESNAKE (*CROTALUS RUBER*): IMPLICATIONS FOR CONSERVATION PLANNING**

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We model landscape-level niche parameters of the red diamond rattlesnake (*Crotalus ruber*), a California Species of Special Concern, in western Riverside County, California. Using current and historical records, we map known locations of rattlesnakes into a Geographical Information System (GIS). To quantify variation in environmental parameters thought to influence the species' distribution we utilize satellite imagery to describe variation in land cover and addition layers that describe variation in several abiotic parameters. We use a modification of the Mahalanobis D2 statistic to develop a multivariate model that describes combinations of environmental variables associated with the limits to distribution of the snake at the landscape level, and use that model to develop a regional map identifying areas that share the same configuration of variables as those points known to be occupied. We then assess the level of protection provided by future conservation planning efforts to potentially suitable snake habitat relative to efforts currently in effect. A proposed Habitat Conservation Plan for Western Riverside County expands the area of potentially suitable rattlesnake habitat protected from approximately 40,800 hectares to approximately 143,800 hectares, a 3.5-fold increase. However, approximately 110,400 hectares of potentially suitable habitat remains unprotected and threatened by development.

**EVALUATING RESTORATION TRAJECTORIES USING SIMILARITY INDICES: DAM MITIGATION IN THE PACIFIC NORTHWEST, USA**

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Assessment of the effectiveness of ecological restoration is a difficult problem because temporal monitoring data are usually limited by cost. New unbiased estimators of compositional similarity may be useful because they incorporate both relative abundance and unseen shared species. We applied this approach to monitoring data for a dam mitigation project in Washington and Idaho. We chose 12 sites to represent reference conditions for 5 habitats (deciduous forest, floodplain meadow, cattail marsh, shrub, and sedge) and 21 treatment sites, matched to reference sites, to monitor effects of restoration activities (e.g., plantings and weed control). Vegetation and terrestrial vertebrates were surveyed at reference sites for 3 years to evaluate annual variation in community composition. Treatment sites are monitored at 3-year intervals. Avian survey data from 2002–2005 illustrate an issue resolved by the new estimators. From a total of 125 bird species, 26 were observed < 10 times, whereas the most common species was observed 1244 times. Interyear similarities for reference sites averaged 84% (SD = 8%), whereas similarity of treatment sites to matched reference sites averaged 63% (SD = 13%) with the Chao–Jaccard index. Classic Jaccard estimates were typically 25–30% lower. Our combined data suggest that temporal changes due to restoration may be detected by comparing compositional similarity of treated and reference sites as determined by the new estimators.

**GLOBAL THREAT ANALYSIS AND IMPACTS ON MARINE ECOSYSTEMS**

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In the last decade a variety of models have been developed to help guide limited conservation time and money to terrestrial habitats and species deemed most important or critically in need of protection. In most of these cases, understanding and evaluating threats has been critical for deciding conservation priority and determining best conservation actions. Such priority-setting efforts have only just begun on a global scale for marine systems, and there has yet to be a comprehensive and global threat analysis for marine systems. We developed a transparent, repeatable and modifiable method for explicitly describing and documenting how and why different threats affect marine ecosystems that can be applied at any spatial scale. Using literature and expert surveys, we quantified the impact of 38 different land and sea-based threats to 23 marine ecosystems and then mapped these threats and impacts globally. Almost no area of the ocean is unaffected by human activities, and a majority of the oceans are heavily impacted, although the extent and magnitude of effect varies by ecosystem type. These results have broad implications for global conservation and prioritization efforts.

**QUANTIFYING SEABIRD-FISHERIES OVERLAP AND IMPLICATIONS FOR POPULATION-LEVEL BYCATCH RISK**

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Bycatch, or incidental take during fishing, is cited as a significant threat to seabirds worldwide. Although bycatch rates are often documented, population-level impacts are rarely estimated. As a first step to estimating potential bycatch risk, we describe the spatio-temporal overlap between common murre (*Uria aalge*) from a single population and gillnet fisheries in the Pacific Northwest (USA), where murre constitute 75% of the seabird bycatch. In 1999–2001, 48 murre were radio-tagged on Tatoosh Island, the closest colony to the fisheries. Tracking occurred during post-breeding dispersal, when the fisheries were open. We used multi-strata models for live recaptures in Program MARK to estimate movement probabilities to areas varying in fishing pressure. The best model, chosen with AIC, estimates that 70% of murre traveled through and settled in active fishing areas. These areas were open  $137 \pm 1$  SE days annually during the same period. The remaining 30% dispersed to closed fishing areas. The overlap with fisheries suggests that 2450 murre from Tatoosh Island, representing 8% of the Washington state population, are potentially at risk of bycatch. We will derive an index of bycatch risk by incorporating fishing effort. Fishery management solutions are more effective if bycatch impacts are assessed at the population level.

**RANCH METRICS IMPROVE SCALING THE REAL SOCIOECONOMIC IMPACT OF GRAY WOLF (*CANIS LUPUS*) DEPREDATION ON DOMESTIC LIVESTOCK**

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Predator restoration meets stiff resistance where livestock depredations cause fiscal losses. We analyzed ranches affected by gray wolf (*Canis lupus*) depredation from 1995–2004 in the northern Rockies, USA. During this interval, numbers of ranches with livestock depredations scaled to annual wolf population size ( $r^2 = 78\%$ ), about one ranch per wolf pack each year. Approximately 240 ranches experienced one or more depredation episodes, about 0.7% of all cattle / calf and sheep / lamb ranches operating across Idaho, Montana, and Wyoming. Of the affected ranches, 56% requested compensation for only one depredation episode during the entire decade. At least 85% of affected ranches experienced no more than one depredation episode every two or three years. Despite ongoing range expansion in this wolf population, we detected no acceleration in the rate of new ranches experiencing wolf depredation. Depredation costs are consequential for a few individual ranches, but impacts verge on trivial for the livestock industry as a whole. Socioeconomic measures like opinion surveys often target the most disaffected stakeholders. Because such opinion is resistant to modification regardless of facts, we recommend using a variety of policy metrics to accurately reflect the true scope of socioeconomic impacts originating from carnivore depredation.

**MEASURING LOCAL COMMUNITY ECONOMIC VALUES OF CORAL REEFS TO INFORM CONSERVATION POLICY AND MANAGEMENT.**

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Coral reefs are ecosystems with enormous economic, intrinsic, ecological, cultural, and aesthetic values. Comparative valuation studies are needed, especially those focusing on local community values, which are crucial in the context of community management and local co-operation. Advances in economic methods enable monetary estimates of these values, using a combination of methodologies including contingent valuation. The Total economic value (TEV) framework was used to investigate and compare financial, indirect and non-use benefits of a coral reef. An isolated 26 km<sup>2</sup> fringing reef used by a local fishing community in Sulawesi, Indonesia was used as a case study. These reefs had a TEV for this community alone of almost Rupiah 2.86 billion (over £176,000) in 2004, a present value over 20 years of over £1.5 million. This value was primarily made up of benefits associated with fisheries, then income from tourism, then physical protection from waves. Non-use values associated with cultural and spiritual links were the smallest values identified. Nevertheless they were significant compared to household income. Economic estimation of the values communities hold for nature, including financial and non-financial benefits, can be used to demonstrate local and wider significance of natural resources, justify investments and inform policy.

**A MULTIFACTORIAL CHARACTERIZATION OF POND TURTLE HABITAT**

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Many freshwater turtle populations have significantly declined in size and distribution over the past several decades. In order to protect these species, we must first have a better understanding of the habitat variables critical to their survival. The commonly seen painted turtle (*Chrysemys picta*) was chosen for this study in order to help understand its needs, as well as the needs of similar, more cryptic, freshwater turtle species. We (1) used a GIS program, ArcView, to locate local ponds surrounding Bowling Green, Ohio where pond and marsh turtles may be found, (2) performed a presence survey of painted turtles, (3) measured a set of predetermined environmental variables specific to the surveyed areas, and (4) analyzed the relationships between turtle presence and pond characteristics and the relationships between pond context and pond characteristics. We found that the presence of turtles was significantly related to amount of shade, basking locations, and other wildlife at each pond site. We also found that pond context was significantly related to these same variables. A trend was found between turtle presence and pond context; no turtles were found at residential ponds. This study demonstrates that a complex suite of variables characterize occupied pond turtle habitat.

**DEMOGRAPHIC CONSEQUENCES OF BUFFER ZONE DIAMETER FOR POND-BREEDING AMPHIBIAN POPULATIONS**

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Pond breeding amphibians depend on terrestrial as well as aquatic habitat to maintain viable populations. Some states have begun to develop criteria for maintaining terrestrial buffer zones around wetlands. However, determining the appropriate diameter has been difficult. Estimates based on data from the literature suggest that core terrestrial habitat for amphibians

extends up to 290 m from the shoreline. This area includes 95% of the adult population. However, the question most often asked by land managers is what is the minimum terrestrial area necessary to maintain a viable population? Using data available in the literature we constructed a stochastic stage-based matrix population model to determine the potential impacts of different sized areas of core terrestrial habitat on the population growth rate and time to extinction for populations of pond-breeding frogs. We found that buffer diameter influenced the probability of extinction of local populations, with extinction probabilities as much as six times greater for populations with buffer zones of 150 m than 1000 m. Although it is not possible to determine the exact buffer zone diameter that will ensure population persistence, our models demonstrate the demographic consequences of insufficient terrestrial habitat and highlight areas of research necessary for more accurately delineated buffer zones.

**MANAGEMENT TECHNIQUES FOR CONTROL OF MOLASSES GRASS (*MELINIS MINUTIFLORA*) IN THE BRAZILIAN CERRADO**

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In the Brazilian Cerrado molasses grass (*Melinis minutiflora*) is considered to be one of the principal invading species and is creating problems in conservation areas. The study was conducted in the National Park of Brasilia, Brasilia, Brazil with the objective to test the effectiveness of different management techniques on the capacity of molasses grass to recuperate ground cover and biomass. Treatments used were: (1) fire (before and after flowering) and (2) fire + herbicide. The fire treatment was applied at the beginning and at the end of the dry season (May 2003 and September 2003) and the fire + herbicide treatment (same fire schedule with herbicide application in January 2004 and March 2004). The use of fire only was not too effective in the reduction of molasses grass from the study area since it recuperated 78% (May fire) and 31% (September fire) of its initial coverage. However, when combined with herbicide, the recovery was less than 1% for both treatment dates. When biomass was considered the results showed a recovery of 32 and 20% respectively of the initial values in the only burned plots and < 0.5% in the combined fire + herbicide treatment. The reduction in ground coverage by molasses grass after fire + herbicide treatments apparently facilitates the recuperation of native species since species richness increased in these plots.

**STRATEGIC PLANNING: SETTING CONSERVATION PRIORITIES IN POBITORA WILDLIFE SANCTUARY, INDIA—LAND OF HIGHEST DENSITY OF ONE HORNED RHINO IN THE WORLD.**

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Situated at the northeastern part of India, Pobitora is a little Garden of Eden. The Sanctuary hides many salient features of worldwide importance; it is the rhino habitat par excellence and has the highest concentration / km<sup>2</sup> of one horned rhinoceros (*Rhinoceros unicornis*). Here the rhino is threatened by poaching and habitat loss. To facilitate the best use of limited conservation resources, we created an objective, ecology-based method for identifying priority areas that incorporates both habitat representation and landscape-level features. Our method captures the range of ecological habitats where they occur, accounting for ecological, demographic, and behavioral differences. Our analysis is hierarchical. We divided the rhino range into distinct bioregions and identified habitat types within each. We then delineated rhino conservation units throughout the bioregions and ranked the units based on habitat integrity, poaching pressure, and rhino population trends. One feature emerging from the study showed that protected areas cover only small areas of rhino conservation units. If the long-term prospects for rhino conservation are to improve, poaching must be stopped and protected areas increased in number, linked, and buffered by natural habitats. The method presented here can be adapted readily to improve conservation strategies for other mammalian species as well.

**THE EFFECTS OF HISTORIC TRANSLOCATIONS AND HABITAT FRAGMENTATION ON THE GENETIC STRUCTURE OF A PROTECTED FISH SPECIES, THE WHITE SANDS PUPFISH**

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The conservation genetics of rare species is often complicated by population history and anthropogenic habitat fragmentation. We examined the genetic structure of White Sands pupfish (*Cyprinodon tularosa*), a protected species with native and non-native populations subjected to considerable habitat fragmentation. This species is restricted to four sites in southern New Mexico, Malpais Spring, Salt Creek, Lost River, and Mound Spring. Earlier work established that populations at Lost River and Mound Spring were introduced from Salt Creek. We used 12 microsatellite loci to study the effects of historic translocations and habitat fragmentation on population structure. Considerable genetic variation was explained by variation among populations ( $F_{ST} = 0.379$ ). By contrast, very little variation was observed between habitat fragments (within sites;  $F_{SC} = 0.019$ ), despite considerable barriers to upstream fish movement. We observed a significant decrease in heterozygosity and allelic richness in the Lost River population compared to its source population. A similar trend was observed for the Mound Spring population. These reductions in genetic variation suggest historic bottlenecks for the recently introduced populations. We discuss conservation implications in terms of replenishing genetic diversity for the refuge populations at Mound Spring and Lost River.

**LANDSCAPE CONSERVATION PLANNING AND SOURCE–SINK DYNAMICS IN NORTHERN GRIZZLY BEAR POPULATIONS**

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Analyses of landscape patterns have largely remained isolated from population dynamics of species within these landscapes. We link grizzly bear metapopulation dynamics to landscape and population management scenarios in the northern Rocky Mountains of British Columbia through population viability analysis (PVA) to assess responses to hunter harvest and to current and potential future landscapes. Metapopulation structure is estimated based on population data from similar regional habitats.

Under current conditions, PVA predicts the west Rocky Mountain population functions as a source to east Rocky Mountain and Boreal Forest Plateau populations. We evaluate the adequacy of legislated protected areas and the recommendations of a conservation area design to maintain grizzly bear populations. Assuming high mortality outside of protected areas, populations are predicted to decline, even if legal harvest is eliminated and movements across landscapes are not reduced. Under the conservation area design scenario, including reductions in connectivity to recommended corridors and high mortality outside of core areas, populations are maintained. We varied assumed connectivity and found metapopulation declines are predicted under low and very high dispersal, with high dispersal resulting in "migrational meltdown." These results emphasize the importance of understanding spatial dynamics of populations when making landscape and population management decisions.

### **INTERACTIONS BETWEEN CRUSTACEANFEEDING FISHES AND THE INVASIVE CRAB *HEMIGRAPUS SANGUINEUS* IN LONG ISLAND SOUND**

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The expansion of the invasive crab *Hemigrapsus sanguineus* into shallow subtidal habitats of Long Island Sound makes this species more widely available to the crustacean-feeding guild of fishes. The objectives of this study were to determine if *H. sanguineus* provides a new food source or replaces native prey resources for nearshore fishes. Gut content analyses were performed on individuals collected from the field (e.g., tautog [*Tautoga onitis*], cunner [*Tautoglabrus adspersus*], and other species) in order to determine the relative importance of native and introduced prey items in the food habits of fishes. In order to determine the degree of selectivity of fishes to native and introduced prey taxa, *H. sanguineus* and other native prey items were concurrently offered to fishes held in recirculating aquaria in the laboratory. We found that *H. sanguineus* is both a common prey item, occurring in 82 of the guts sampled ( $n = 38$ ), and an abundant prey item. Laboratory experiments show that *H. sanguineus* is preferred over native prey items (Chi square,  $p = 0.05$ ). Results reported here suggest that predation pressure exerted by crustacean-feeding fishes could play an important role in the biological control of this invasive crab.

### **RESEARCHER-COMMUNITY COLLABORATIONS IN A CRITICALLY THREATENED CHIHUAHUAN DESERT BIODIVERSITY HOTSPOT IN MEXICO**

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Scientists have long recognized the importance of Cuatrociénegas (<http://www.desertfishes.org/cuatroci>), a Chihuahuan Desert oasis in Coahuila, Mexico, as a hotspot of evolution, biodiversity, and endemism. Despite federal protection for over a decade, however, the area's integrity remains threatened by complex biotic and socioeconomic factors. A 2004 meeting of researchers working in the area sparked collaborations with interested local residents to benefit both conservation and the local community. A cooperative effort between the Desert Fishes Council (DFC), a United States-based NGO, DeSuValle, a local NGO, and the local Protected Area office later established a scientific research station to further facilitate research and interactions among researchers and between researchers and the local community. It also helps connect managers (via researchers, the station, Web site, and email lists) to a larger community of individuals willing to contribute wide-ranging skills to address management challenges. Exemplifying conservationists' high interest level in the area and benefits of cross-border collaborations, the 37th annual meeting of DFC in November 2005 was the group's largest ever (250 mostly foreign participants), generating substantial direct local economic benefits and culminating in continued support of the research station and acceptance by the group of a local invitation to meet there again in 2008.

### **USING PREDICTED LAND COVER CHANGE TO PREDICT CHANGES IN BIODIVERSITY IN THE CENTRAL PUGET SOUND, WASHINGTON, USA**

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Models that predict land use and land cover change and resulting change to biodiversity are needed to support regional planning and conservation efforts. Our approach links urban development, land cover change, and bird diversity and explores dynamic interactions in the rapidly urbanizing landscape of the Central Puget Sound, Washington, USA. We use a microeconomic development model of human behavior (UrbanSim) coupled with a land cover change model (LCCM) to predict land cover change. The LCCM includes measures of the present land cover class of the focal cell, its spatial context and the spatial pattern of development and biophysical elements at three spatial scales. The LCCM predicts potential land cover change in 4 year intervals for 20 years into the future, which are then used as input in bird diversity models generated from 5 years of extensive field studies across the urban and land use gradients. Results indicate that changes in land cover can be expected to continue the conversion of bird communities dominated by native forest species to those dominated by synanthropic species. Local bird diversity on developed sites increased, but regional diversity declined as developments aged due to biotic homogenization.

### **NOVEL SPATIAL METHODS FOR PREDICTING CENTERS OF ENDEMISM OF ANDEAN BIRDS**

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Conservationists often target centers of endemism for land protection because of the opportunity to protect many range restricted species at once. However, the information and methods used to identify these centers are often incomplete or biased, leading to inaccurate estimates of where they occur. Spatial models that better reflect underlying factors causing aggregations of endemic species are beneficial by eliminating these errors. We developed novel predictive models of endemism centers for a dataset of the distributions of 87 bird species restricted to the eastern slope of the Andes in Peru and Bolivia. The regression models are based not only on contemporary environmental variables, but also on historical factors that may have influenced speciation events. Most historical factors, such as dispersal barriers, are difficult to represent spatially, so we derived predictor

layers to act as surrogates. To reduce bias caused by unevenly distributed collecting, we predicted distributions of the target species using a dataset of 2200 localities where the species have been recorded. The resulting maps, generated by relating indices of endemism to spatially derived predictor variables, more objectively identify centers of endemism and provide useful guidance to conservation initiatives in this region.

**PERFORMANCE INDICATOR IMPORTANCE IN MPA MANAGEMENT: ANALYZING STAKEHOLDER PREFERENCES USING THE ANALYTIC HIERARCHY PROCESS**

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Stakeholder objectives in MPA management are frequently incompatible with each other due to the variety of stakeholders that have an interest in how MPAs are managed. Stakeholders place varying importance on criteria for successful management and will judge performance against their own set of priorities. Measuring stakeholders' preferences in MPA management can therefore be an important factor in defining compromise positions in decision-making. This paper considers the development of a representative performance indicator hierarchy for the Egadi Islands Marine Reserve, Italy. Data were obtained from a pairwise comparison survey using the analytic hierarchy process to investigate preferences of stakeholder groups for performance indicators in evaluating MPAs. The implementation of the AHP in this setting provides a useful tool for quantitative analysis of performance criteria amongst diverse groups involved in or affected by the MPA management process. The study revealed that using quantitative information to describe stakeholder preferences is innovative in the field of MPA management and that although there seem to be five key stakeholder groups, none are homogenous in prioritizing performance indicators. The variability found in responses shows this clearly. With respect to this, the AHP framework has shown to be particularly strong by providing quantitative information that allows links and divergences of preferences both between and within established stakeholder groups.

**STREAM NETWORK TOPOLOGY MAY AFFECT FISH ASSEMBLAGE RESPONSES TO STRESS**

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Understanding how local and regional factors affect biotic responses to stress is a fundamental challenge in conservation biology. Numerous studies have identified local determinants of biotic responses to stress, but regional influences remain poorly understood. Here, we explored the hypothesis that the spatial configuration of streams within watersheds (i.e., stream network topology) affects fish assemblage structure and resiliency by regulating refugia and recolonization opportunities at the landscape scale. First, we quantified stream network topology for 55 sites in western Virginia (USA) based on the size and proximity of confluent streams. Second, we characterized fish assemblage structure and environmental conditions within sites using data from the U.S. EPA's Environmental Monitoring and Assessment Program. Third, we partitioned the regional effects of network topology from local environmental conditions using logistic and multiple linear regressions for species presence-absence and assemblage-level metrics. When controlling for local environmental conditions, topological factors were significantly related to local species richness and mean reproductive age ( $p < 0.05$ , respectively). These results suggest that stream network topology may affect fish assemblage responses to environmental stressors by regulating refugia and recolonization opportunities at the landscape scale.

**COMPARISON OF TRAWLED VS UNTRAWLED MUD SEAFLOOR ASSEMBLAGES OF FISHES AND MACROINVERTEBRATES AT COQUILLE BANK, OREGON**

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We ran manned-submersible transects at Coquille Bank, off Oregon, over mud seafloors 183 to 361 m deep. The shallowest transects were untrawled, whereas deeper transects were heavily trawled. Differences between trawled and untrawled demersal fish and epibenthic macroinvertebrate assemblages were striking. We observed 23% more fish over untrawled seafloors, and there were 27 fish species on untrawled bottoms, but only 19 species on trawled bottoms. Regarding invertebrates, density of individuals was over 6 times greater on untrawled bottoms. Nonetheless, we observed 11 taxa on trawled seafloors and only 6 taxa on untrawled bottoms. Although differences between trawled and untrawled areas were confounded by non-overlapping transect depths, the observed species are known to occur over all depths studied. Differences in species composition and relative abundance can be explained by relative resistance to, as well as attraction to, physically disturbed habitats. The dominant fishes and macroinvertebrates on trawled seafloors are known mobile scavengers that may aggregate along trawl tracks. Sea pens that dominated untrawled bottoms are slow-growing, long-lived species that are likely to recover slowly from physical disturbance. We therefore conclude that the observed differences between trawled and untrawled communities were the result of groundfishing activities rather than local environmental differences.

**USE OF DISTINCT FORAGING HABITATS BY THREATENED PINK-FOOTED SHEARWATERS: IMPLICATIONS FOR INTERACTIONS WITH FISHERIES**

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The Pink-footed Shearwater (*Puffinus creatopus*), a Chilean endemic, has IUCN vulnerable status due to its restricted breeding range and small numbers. Breeding populations in the Juan Fernandez Islands are threatened by introduced mammals, including predation and competition for burrows. There is also concern about interactions with commercial fisheries (i.e., bycatch, competition) at sea. To determine foraging locations and habitat use patterns, we deployed satellite transmitters during the chick-rearing period in four years (2002–2005). The tracked shearwaters primarily traveled eastwards to the Chilean continental shelf, but also exploited oceanic waters. Oceanographic characteristics differed between these two trip destinations,

with shelf areas characterized by shallower, colder and more productive waters. In spite of interannual variability in the use of oceanic and shelf waters, the tracked shearwaters repeatedly visited certain areas year after year. The Talcahuano region, identified as a foraging destination for birds from the Juan Fernandez Islands, is also an important feeding area for shearwaters breeding on Isla Mocha. This hotspot falls within the region with the highest commercial fishing activity in Chilean waters. By integrating shearwater tracking, diet, and demographic data with fisheries information, we are developing the comprehensive perspective needed to assess potential fisheries impacts on this threatened species.

### **PLAYING FOR KEEPS: PRIORITIZING CONSERVATION FOR MAXIMUM BIODIVERSITY RETURN-ON-INVESTMENT**

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With limited resources and seemingly limitless challenges, conservationists have to make hard choices. How should conservationists set priorities in order to achieve maximum feasible biodiversity conservation? Maximizing the biodiversity return-on-investment is one way to do so. We report an initial global parameterization of a biodiversity return-on-investment optimization model that integrates species-area curves and cost-per-unit-area data. Accounting for both the marginal biodiversity benefit and the cost of conservation investments suggests a very different prioritization among terrestrial ecoregions than would a traditional hotspot analysis based on high species-per-area concentrations.

### **CITIZEN MONITORING OF DECOMMISSIONED ROADS IN THE CLEARWATER NATIONAL FOREST**

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Citizen science is a powerful way to monitor natural systems while encouraging a stewardship ethic for the monitored resources. We have created the first citizen-based monitoring program that focuses on the ecological recovery of decommissioned roads. Wildland roads can cause a number of negative ecological impacts and decommissioning may mitigate those impacts. In response to an intensive road decommissioning program by the Clearwater National Forest (CNF) and the Nez Perce Tribe, we developed a protocol for citizen scientists to monitor decommissioned roads for aquatic and terrestrial health on the CNF. Monitoring methods for aquatic sampling include pebble counts, temperature measurement, and collection of macroinvertebrates. Terrestrial sampling includes erosion pins, vegetation surveys, camera stations, and track plates. This season, we had 50 citizen scientists contribute 300 hours of volunteer time. Using track plates and remotely-triggered cameras, we have captured tracks or pictures of bears, cougar, wolf, coyote, fisher, deer, elk, moose, squirrels, chipmunks, turkeys, and voles. Additionally, it appears that wildlife use dropped sharply in autumn concurrent with the hunting season. Continued monitoring by citizen scientists will allow us to collect important data that would otherwise not have been recorded and will help guide future management on the CNF.

### **MEASURING PERFORMANCE OF INVASIVE PLANT ERADICATION EFFORTS IN NEW ZEALAND**

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Eradication is often promoted as an important strategy for managing new incursions of invasive species. New Zealand's Biosecurity Act of 1993, still the world's leading model for biosecurity legislation, has enabled local governments to pursue regional eradication of more than 70 different invasive plant species. The Act is strongly influenced by new public management doctrine and its emphasis on specific management objectives, annual plans, and performance measures. In order to evaluate eradication efforts as well as performance measures associated with them, I assembled up to ten years of annual reports from 15 local bodies, conducted unstructured interviews with more than 50 biosecurity officers, and compiled case summaries for more than 90 eradication efforts. I found significant variation among local bodies in eradication outcomes, with some making substantial progress towards regional eradication of targeted invasive plant species. Political factors explain much of the variation, with funding and leadership playing central roles. Most struggled to develop adequate performance measures demonstrating progress towards eradication, which can require many years of persistent efforts due to the role of seed banks. I therefore developed alternative performance measures that may help biosecurity staff to evaluate progress, improve eradication efforts, and communicate their successes.

### **PREDICTING BIODIVERSITY PATTERN USING MULTI-SPECTRAL SATELLITE IMAGERY**

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Species occurrence information that is needed to plan for conservation is not usually available. If pattern in species variation could instead be linked statistically to remotely sensed variation, then this variation could be predicted over relatively large regions. Canonical correspondence analysis (CCA) is used to link plant species data and multi-spectral AVHRR satellite imagery in Uganda; nine forward-selected variables explain ~29% of the variation in the species data (~76% of the possible variation they could explain). This CCA captures more of the plant species data than two other widely used biological classifications of the region. Coefficients derived in the CCA are used to predict scores for all pixels in the regional image, with a (jack-knifed) predictive accuracy of ~95% for those sites used directly in the CCA. The same coefficients are used to predict species variation in Cambodia, which lacks detailed species data. The predicted pattern compares favorably with WWF ecoregions. It is also assessed using limited species data, where the use of canonical coefficients derived using rarer Ugandan species appear to better fit the Cambodian species data (a dataset of rarer bird species). Satellite image analysis represents a useful tool to "fill in the gaps" between known areas. It boosts the spatial resolution and extent of biological information, but at the cost of biological resolution (species lists for known areas are reduced to multivariate scores).

### **CONSERVATION STRATEGIES FOR COUGARS IN THE LAND OF OZ: FROM MODELS TO MANAGEMENT**

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The conservation of wide-ranging carnivores depends critically on planning efforts that consider the habitat requirements of a species at multiple spatial scales. To maximize their utility, these efforts should rely on models constructed and validated using empirical data collected at scales relevant to animal behavior. In southern California, cougar (*Puma concolor*) populations persist in areas increasingly dominated by human influence. Often, these populations are only tenuously connected by habitat features, and man-made barriers to movement are common. To model suitable habitats, core areas, and landscape connectivity for cougars in this region, we applied data from field studies to a 35,000-km<sup>2</sup> landscape that included all of Riverside County. Results from these studies included information on cougar response to vegetation, topography, and roads at three spatial scales. Although our models identified sizable amounts of suitable habitat, many of these areas provided few key resources, were highly fragmented, and were separated by features that inhibited cougar movement. Circuit-theoretic models of connectivity identified multiple pathways where landscape resistance was minimized by the preservation of important core areas.

#### **CATALYZING COMMUNITY CONSERVATION: A GUIDE TO DEVELOPING SOCIALLY SUSTAINABLE PROJECTS**

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Although in recent years community-based conservation projects collectively have been criticized we have differentiated a direction that has shown success in catalyzing over 20 projects in the past 21 years. This paper is a practical guide for practitioners to catalyze successful community conservation projects. The paper discusses ten phases in catalyzing a community conservation project (1) Identify the project through a preliminary site visit that will result in an initial proposal and attempt to raise seed money. (2) Acquire a support coordinator and initiate the creation of a local managerial group. (3) Begin training the local community group. (4) Gather information about the community, the biology, and conservation problems of the area and working maps. (5) Develop community out reach to the general public, the community at large, and the local committee and staff through newsletters, posters, a Web site, videos, presentations, pamphlets, and word of mouth. (6) Develop a management plan and an operation plan. (7) Develop infrastructure such as trails, an office, and an education center for continuity of the project. (8) Implement the plans. (9) Formalize the plans and components. (10) Plan and execute the termination of the advisory role.

#### **PROTECTION AND RECOVERY OF NATIVE SPECIES AFTER A RAT ERADICATION ON A CALIFORNIA ISLAND**

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Rats (*Rattus* spp.) have been introduced to more than 80% of the world's island groups and have been implicated in 40–60% of all bird and reptile extinctions as well as extinctions of native rodents. It is possible to completely eradicate invasive rats from islands using a rodenticide, but this has not previously been attempted on islands with endemic rodents. We eradicated *Rattus rattus* from Anacapa Island, California in 2001–2002 to protect native seabirds and endemic deermice. Rats were poisoned with two helicopter broadcasts of rodenticide (25 ppm brodifacoum). This was the first aerial eradication in North America. Endemic rodent populations were protected by holding a minimum viable population in captivity and releasing them after rats were eradicated. Since the eradication, the Xantus's Murrelet, a small seabird, has increased nesting attempts by 80%, and hatching success by more than 90%. Another small seabird, the Cassin's Auklet, recolonized the island and is breeding successfully. The endemic deermouse is at or above pre rat eradication numbers. The ongoing recovery of the Anacapa ecosystem further demonstrates the power of rat eradication as a conservation tool and the applicability of this tool to islands with endemic rodents and other sensitive non target species.

#### **CONSERVATION WITHOUT PARTICIPATION: SOCIO-ECONOMIC IMPACTS OF THE ESTABLISHMENT OF THE NANDA DEVI BIOSPHERE RESERVE, INDIAN HIMALAYAS**

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We explore the effects of changes in management of the Nanda Devi Biosphere Reserve (NDBR) over 23 years on the local community through an analysis of trends in socio-economic status and wild food use of two villages in the reserve. Using Participatory Rural Appraisal methods and questionnaires, we show that the closure of the core zone of the reserve in 1982 continues to influence the fortunes of the local Bhotiya people. Socio-economic impacts include an ongoing emigrational trend, reduced average annual income, a socio-cultural change from a subsistence-barter economy to a market based one, and a decline in both animal husbandry and the wool industry. Households whose livelihoods include a substantial component of wild food gathering are also the wealthiest, with complex interactions between access to wild resources and ownership of other livelihood assets. There are indications of positive socio-economic developments linked to recent alterations in the management of the reserve towards a more people-centered approach. However people still hold overwhelmingly negative attitudes towards the reserve and its management, despite having a strong conservation ethic. This study illustrates how exclusionist policies may have long-term impacts, alienating local communities and thus undermining any environmental successes they may have achieved.

#### **SONGBIRD RESPONSES TO RIPARIAN RESTORATION: A SUCCESS STORY**

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Riparian habitats are among the most degraded in North America; in California's Great Central Valley over 98% of the riparian habitat has been lost. PRBO Conservation Science has been conducting intensive monitoring of riparian bird populations since 1994 at restored and intact remnant riparian sites to evaluate the success of riparian restoration projects along the Sacramento, San Joaquin, and Cosumnes Rivers. Following restoration, vegetative structure and complexity increased. Restoration activities appear to be successfully providing habitat for a diverse community of landbirds. For revegetated plots in some regions, year since planting was a strong predictor of abundance trends for many landbird species. We found songbird nest success correlated with large scale weather patterns at some sites. In 2005 we detected a breeding pair of Least Bell's Vireos (a riparian obligate endangered species) in a horticultural restoration plot near the San Joaquin National Wildlife Refuge; this species had not bred in the Central Valley since the mid 1900s. This nesting record, and the overall increase in riparian-associated bird abundance in restored habitat in the Central Valley, is further evidence that restoration conducted within an adaptive management framework can contribute to species and ecosystem recovery.

### **CONFLICTS AND WILDLIFE HARVEST IMPACTS WITHIN AND ADJACENT TO THE EXTENSION OF SAPO NATIONAL PARK, LIBERIA**

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During a lull late in Liberia's 14-year civil conflict, the government agreed to extend the boundaries of Sapo National Park, Liberia's only national park by nearly 50% to almost 500,000 acres. The civil and economic collapse of Liberia had far reaching impacts on the traditional cultures and rural economies of the villages on the perimeter of the park. In 2004-2005, we conducted a participatory rural assessment of 20 communities adjacent to the extension to evaluate potential land-use and livelihood conflicts. With severely limited access to education and health care, few jobs, poor transportation network, and a lack of markets for agricultural products, most communities identified the bushmeat trade as among the top two income sources. Focal interviews with household heads confirmed findings from our longitudinal studies of hunting and bushmeat markets regarding the economic importance of the wildlife harvest. Economic pressures also resulted in a large-scale incursion into the core of Sapo National Park for bushmeat, elephant ivory, and gold mining. We provide estimates of the total biological and economic impact of the wildlife harvest around Sapo National Park, and make recommendations for sustainable conservation and development.

### **DISTRIBUTION OF RARE VERNAL POOL ORGANISMS ACROSS GEOLOGIC FORMATIONS AND SOILS IN EASTERN MERCED COUNTY, CALIFORNIA**

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For three rare invertebrates (vernal pool fairy shrimp, midvalley fairy shrimp, vernal pool tadpole shrimp) and a rare plant (succulent owl's-clover) associated with vernal pools, we evaluated relationships between species distribution, geologic formation type, and soil type at a regional scale. Our analysis used GIS data sets data from extensive biological surveys and wetland mapping in eastern Merced County, California, which had previously been conducted by several consulting firms in support of a regional conservation plan and development of the University of California Merced campus. Except for vernal pool fairy shrimp, species were strongly associated with some soil types (particularly Redding gravelly loam); associations with geologic formations, however, were largely due to species being associated with just one of the soil types occurring on that formation. Therefore, although both soil types and geologic formations (i.e., geomorphic surfaces) have been considered strong influences on vernal pool ecosystems (and vernal pools have even been classified on the basis of geologic formations), the distributions of these species apparently are influenced by attributes of particular soils, or strongly correlated variables, but not by other attributes of geologic formations.

### **ECOLOGICAL THRESHOLDS AND ENVIRONMENTAL REGULATIONS**

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It is easy to name some important ecological thresholds, e.g., in forestry the time of a stand-replacing fire, or in limnology the date when a lake's surface freezes, but metrics for most ecological processes and structures are characterized by continua along which it is difficult to identify clear thresholds. At what age does a forest go from being mature to old-growth? At what productivity level does a lake go from being mesotrophic to eutrophic? Often the constraints of language imply thresholds where none exist. Unfortunately, the structure of most environmental regulations reflects an implicit belief that ecological thresholds are widespread. For example, a law that prohibits cutting trees within 10 meters of a stream is implicitly assuming that there is an ecologically significant distinction between 10, 9, or 11 m. In practice the legal limit is usually an arbitrary limit, a compromise between opposing parties whose primary virtue is simplicity. Such laws oversimplify complex ecological realities, and often generate a narrow band of compliance (all stream buffer zones are 10.5 m wide). It would be preferable to design regulations that achieve environmental protection while allowing or encouraging flexibility that reflects ecological realities (e.g., by creating incentives for buffers wider than 10 m).

### **DETERMINANTS OF SPATIAL ASSEMBLAGES OF BIRD COMMUNITIES ON URBAN PATCHES**

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Ecological processes responsible for the spatial assemblages of breeding bird communities have largely been investigated in natural landscapes but rarely in urban landscapes. Yet, as cities are rapidly growing all over the world, understanding these processes has become determinant in order to plan relevant management policies to maintain bird diversity. Using capture-recapture approaches, detection / non-detection data to estimate parameters of communities dynamics (species richness,

extinction rate and occupancy rate) and a modified Sorenson similarity index, we investigated the role of patch characteristics and the geographic distance separating patches in determining similarity between breeding bird assemblages on 67 patches in the suburbs of Paris, France, in 2003. We also examined whether bird assemblage differences may be due to differences of sensitivity to urbanization between sedentary and migratory species. This study suggests that the presence of an urban gradient in the study area is responsible for the spatial distribution of patches with different local characteristics, which affects the shape of the local bird communities. Interestingly, this might partly be due to a difference of sensitivity to urbanization between sedentary and migratory species.

**DIPLOMATIC IMMUNITY AND TRAFFICKING OF ENDANGERED SPECIES: WHAT'S THE CONNECTION?**

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Illegal trafficking of wildlife is estimated to be worth between \$6–10 billion dollars per year, and is believed to be the third largest type of illicit trade after arms and drugs. Incidents of smuggling of endangered species by diplomats have been documented in the past few years. This study investigated international policy governing this issue, the nature and extent of trafficking by diplomats, as well as responses by national and international actors. It was found that while reported occurrences of trafficking by diplomats are low, prosecution of offenders is rare. Policies and actions are being taken to address this trafficking, though it is too early to indicate how effective they will be.

**PARTICIPATORY PLANNING FOR PARK OUTREACH AND RECREATION IN THE BAHAMAS**

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Participatory methods engaged key stakeholders in park outreach, education, and recreation planning for Abaco National Park, Bahamas. The goal is to protect the endangered Bahama parrot and pineland habitat, and to increase the flow of benefits from the park to Abaco residents and visitors. We conducted a programmatic needs assessment using a nominal group technique to collect data from six stakeholder groups: neighboring residents, community leaders, environmentalists, teachers, hunters, and tourism industry representatives. Each meeting explored opportunities and threats to the park and consisted of six stages: (1) presentation of issue, (2) individual reflection and brainstorming, (3) documentation of ideas, (4) consolidation of ideas, (5) ranking of ideas, and (6) compilation of results. Subsequent group meetings developed a vision statement for the park and involved group members in participatory mapping to spatially identify current and desired future recreational uses. Results were combined with ecological information to provide managers with priority strategies and content.

**USE OF HABITAT VARIABLES AT MULTIPLE ECOLOGICAL SCALES TO PREDICT KOALA OCCURRENCE IN THE CITY OF BALLARAT, VICTORIA, AUSTRALIA**

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A combination of natural habitat and anthropogenic impacts are likely to be determinants of koala presence. However, conservation to date has relied primarily on models of natural habitat, with limited consideration given to the effects of landscape alteration, configuration, and associated factors such as the proximity to roads. The goal of this study was to apply established knowledge about the ecological history and habitat preferences of koalas in the City of Ballarat, Victoria, Australia to develop a set of nested a priori predictions concerning the influence of habitat loss and landscape variables on the presence / absence of koala. A priori predictions were grouped into three levels of organization: stand-level (< 1 ha), patch level (100s ha) and landscape level (100s to 1000s ha). Logistic regression and hierarchical partitioning analysis were applied to the models to rank alternative models and associated explanatory variables. A multi-level model was found to best predict the presence of koalas by the proportion of the landscape containing primary habitat, the proportion of the landscape containing primary and secondary habitat, soil type, tree size as measured by diameter at breast height, density of forest patches, the mean nearest neighbor distance between forest patches, distance from road, and road density. This research can help to inform future landuse and conservation planning and will assist with priority setting for habitat protection and restoration.

**A CRITICAL ASSESSMENT OF ENDEMIC BIRD AREAS IN THE AMERICAS**

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Many birds, indeed many species in general, have small ranges that make them inherently vulnerable to extinction. Concern for such vulnerable species is exemplified by the Endemic Bird Areas (EBAs), identified by scientists at Birdlife International in the mid-1990s. We analyzed data on bird ranges in the Americas and find 776 species with breeding ranges smaller than 50,000 km<sup>2</sup>, the maximum range for inclusion in an EBA. Nearly all of these occur in Central and South America. Most occur within the EBAs. However, more than 100 of these species were absent from the original EBA analysis. As well, many of the species used to identify the EBAs appear to have ranges larger than previously thought. In light of these results, we present possible revisions to the EBAs. Some previously overlooked areas should be of higher priority for research and conservation. We also recommend the downgrading of some EBAs in favor of other areas with higher concentrations of endemics.

**ADVANCING THE KNOWLEDGE BASE FOR GLOBAL-SCALE CONSERVATION BIOGEOGRAPHY—EXPERT-BASED HABITAT MODELS OF THE DISTRIBUTION OF TERRESTRIAL VERTEBRATES**

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Range maps characterizing the extent of occurrence of species have become the basis of a number of influential studies in

broad-scale ecology and conservation. However, they clearly overestimate species' true occurrence with potentially significant effects on perceived ecological patterns and conservation. Expert-based, deductive habitat models provide a transparent way of eliminating false presences from the known extent of occurrence for groups such as birds for which core ecological information is obtainable. Here I link up habitat preferences for all 9900 bird species to a global land cover classification in 1 km<sup>2</sup> resolution. Using a global distribution database based on extent of occurrence maps I clip from the geographic range every pixel that is clearly deemed as unsuitable. I test the success of this method in yielding a more realistic estimate of the area of occupancy by comparing the resulting distributions to known presences. Even a cautious and conservative use of the method helps to dramatically improve the quality of species distribution maps. I illustrate the consequences for select ecological patterns and their perceived determinants. Additionally, I analyze the effect of past human encroachment on species geographic ranges and demonstrate how type and quality of range maps affects the outcome.

### **THE EFFECTS OF SEX AND SEASON ON CORE HABITAT USE BY GRAY TREEFROGS: IMPLICATIONS FOR MANAGEMENT OF FORESTED HABITAT FRAGMENTS**

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Formerly continuous natural landscapes are becoming increasingly fragmented from human land-use activities. Determination of the effects of fragmentation (and habitat patch size reduction) on local population dynamics is an important step towards developing strategies to minimize the interruption of natural processes within remnant habitat patches despite continued land conversion. Pond breeding amphibians are an appropriate group in which to investigate the effects of fragmentation on natural populations due to their natural history and concern regarding apparent global amphibian population declines. We monitored gray treefrog movements through terrestrial habitat adjacent to breeding ponds using artificial arboreal refugia. Results indicate that females travel further from breeding ponds than males, and the distribution of males during the breeding season is biased towards breeding ponds. The data illustrate the importance of habitat directly adjacent to breeding sites, and indicate that habitat loss resulting in small fragments may have a greater negative impact on females than males. We suggest that predictions regarding the effects of patch size reductions based on estimates of core habitat use require detailed information than is typically available to avoid underestimation of the proportion of individuals directly affected by habitat alteration.

### **MITIGATION STRATEGIES FOR BATS IN BRIDGES**

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The effectiveness of bat mitigation projects for bridges in California is known for only about half of 22 mitigation plans implemented over the last 5 years. Successful mitigation requires assessing the bat usage of the habitat, adequately predicting the potential impacts to bats and bat populations, executing the mitigation plan, and monitoring appropriately. The use of small bat houses for lost day and maternity roosts typically does not work for most species, especially for foliage roosting bats such as the highly migratory hoary bat (*Lasiurus cinereus*), a species that often breeds in Canada and winters in the United States. Replacement roosting habitat should provide bats with a similar search image and mimic the temperature regimes of the original roost to increase the likelihood that displaced bats will utilize new habitat. Two promising mitigation strategies for the loss of bridge roosting habitat include cast-in-place crevices, such as a bridge that attracted over 15,000 Mexican free-tailed bats two months after it was completed, and closure pours with crevices created by attached panels, such as is found on another rebuilt bridge in Sacramento Valley, California. A protocol for assessing the effectiveness of bat mitigation for bridges will be presented.

### **LEAST COST PATH CORRIDOR ANALYSIS FOR EVALUATION OF LYNX HABITAT CONNECTIVITY IN THE MIDDLE ROCKIES**

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Population fragmentation and isolation are primary concerns for conservation of large carnivores. In the middle Rockies region of southeast Idaho, southwest Wyoming, northwest Colorado and northeast Utah. Another concern is connectivity of newly established lynx populations in western Colorado with existing populations in the northern Rockies. We used GIS weighted distance and least cost corridor identification techniques to delineate landscape routes offering the best chance of success for lynx moving between "lynx core patches" within Wyoming, Utah, and Colorado. Core patches include unroaded or very lightly roaded boreal forest types large enough to support at least one lynx home range. Using ARC/GRID to create 100 m<sup>2</sup> cost surfaces of movement, landscape permeability between patches was modeled based on land cover, road density, topography, and human population density. The results indicate probable movement routes between core patches, as well as critical barriers, bottlenecks and filters where corridor routes intersect high-risk habitat. This analysis will be used to assist our conservation partners identify priority areas for wildlife habitat acquisition, easements, management attention and other forms of habitat protection.

### **LIVING LINKS: THE INDO-PACIFIC MARINE CORRIDORS AND MPA NETWORKS IN INDONESIA—MANAGING CRITICAL HABITATS FOR HIGHLY MIGRATORY OCEANIC WHALE SPECIES**

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The Savu Sea is positioned at the nexus of two oceans and includes marine corridors of regional importance for the Indo-Pacific. Its main passage, Ombai Strait, is shared between Indonesia and East Timor. An extensive 4-year cetacean survey and research program has been conducted to investigate the area's ecological significance for oceanic cetaceans and assess the sustainability of a traditional sperm whale fishery. A total of 18 cetacean species were identified over 51 field days and 367.0 hours, covering 2916.4 nm and 112 acoustic listening stations. An exceptional relative abundance of cetaceans was recorded during 336 encounters, as well as rare apex predator-prey interactions (orca-sperm whale attack). Satellite tagging results on Indonesia's sperm and blue whales indicate that (a) their movements range 1000s of km and (b) these narrow, yet deep-sea passages function as multi-species migratory bottlenecks. A large-scale Marine Protected Area (> 1,000,000 ha) is under

development for the Savu Sea to better manage the increasing local pressures on these sensitive habitats and migratory species. This initiative would boost the representation of “deep-sea yet near shore” habitat in Indonesia’s MPA networks, and may be used as a model for ocean passages in Papua New Guinea and the Solomon Islands.

#### **MAPPING THE GEOGRAPHY OF CONSERVATION SOLUTIONS**

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There is no shortage of global conservation priorities vying for attention and support, each justified on the basis of real threats to significant biodiversity. Instead of protracting arguments about how to prioritize the priorities, we propose a paradigm shift in how we think about and map conservation priorities by redefining priorities as the intersection of “problem maps” and “solution maps” where significant conservation problems coincide with the ingredients for effective conservation action. Solution-mapping enhances traditional priority-setting analyses by factoring in attributes of the human socio-economic, cultural and political systems that affect how conservation gets done, and how effective are its outcomes. Our proposition is motivated by three observations: important conservation problems exceed the resources available to address them immediately; human socio-economic, cultural and political systems strongly influence how conservation gets done and the likelihood of success; and different conservation organizations have different skill sets and resources that they can implement most efficiently and effectively. Organizations can maximize their impact by mapping the conditions under which their strategies would be most effective, and prioritizing places where their solution map coincides with significant conservation problems. We show how solution-mapping can more sharply focus conservation priorities and reveal outstanding “solution gaps.”

#### **SEASCAPE-LEVEL CORRELATES OF CORAL COMMUNITY STRUCTURE**

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A suite of physical and biological factors structure coral reef communities at local scales. Recently, studies have addressed the role these factors play in shaping communities at global and regional scales. Conservation planning and implementation, however, typically take place at the seascape scale (10s–100s km). We used redundancy analysis (RDA) to assess the role of a suite of physical and biological factors in explaining coral community structure at the seascape scale. We examined the relationship between community structure, measured in detailed field surveys of coral species at nested spatial scales across the Bahamas archipelago, and a suite of measured and modeled environmental variables. A model taking into account only longitude, latitude, depth, vertical relief, and grazing intensity explained 46% of variation in coral community structure. Location has an overriding effect at this scale, suggesting that historical effects and ongoing disturbance may be important. Depth, vertical relief, and exposure act with grazing to mediate biological interactions, e.g. coral–coral and coral–algal competition. Models of community responses to environmental variation could be used to refine predictive approaches based on mapping of remotely sensed benthic habitats, particularly within individual islands or island systems.

#### **VILLAGE SIZE AND FOREST DISTURBANCE IN BHADRA WILDLIFE SANCTUARY, WESTERN GHATS, INDIA**

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Habitat fragmentation, land cover change, and biodiversity loss are often associated with village communities in protected areas, but the extent and intensity of such impacts are often inadequately assessed. We record resource use and depletion by human inhabitants by conducting ecological surveys in six villages and social surveys in all 13 villages in India’s Bhadra Wildlife Sanctuary (492 km<sup>2</sup>). We examined the occurrence of 10 regionally specific ecological indicators that encompass several aspects of human activities. Thirty transects with 180 total sampling locations recorded the occurrence of these habitat disturbance variables. High correlations between variables led to the use of principal component analysis to derive an effective summary index that reflected disturbance intensity and determine village ecological impacts spatially. A generalized linear model was fit to determine the rate at which disturbance decreases as we move away from village centers. Our model indicates that village size class, distance from the village, and proximity to other villages were significant predictors of the disturbance index. We estimated that an average area of 23.7 km<sup>2</sup> of the forest surrounding the six focal villages was altered by human activities. These six villages have directly impacted 8–10% of this protected area.

#### **ASSESSING POPULATION DYNAMICS OF SECRETIVE LANDSCAPE SPECIES: LONG-TERM PHOTOGRAPHIC SAMPLING OF TIGERS IN INDIA**

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Rigorous assessment of population dynamics of large, solitary, secretive carnivores that inhabit difficult terrain and show long-range movements poses serious challenge to their conservation. Attempts to do so in tropical forest regions have been usually based on weak methodologies. We estimated annual population size and other difficult-to-estimate parameters such as survival, transience, recruitment, and temporary emigration in a wild tiger population. We employed photographic capture sampling protocols in a field study covering ~200 km<sup>2</sup> area in Nagarhole, India, that spanned 10 years and involved > 5700 trap-nights of effort, leading to photographic captures of 74 individual tigers. The resulting capture histories were analyzed in a likelihood-based, robust design capture-recapture sampling framework. A statistical model that incorporated transience, temporary emigration and behavioral response to trapping fitted the data well. Tigers > 1 year age had annual survival rates of 77% and

the population had an estimated temporary emigration of 10% and an average annual rate of population change of 3%. Our results indicate that a combination of high population densities and realization of their high reproductive potential can permit tiger populations in relatively small reserves to persist and thrive even in the face of relatively high mortality rates.

### **MODELING GRAZING CAPABILITY AND CAPACITY FOR BIODIVERSITY CONSERVATION AND LIVESTOCK PRODUCTION ACROSS LARGE, PUBLIC-PRIVATE LANDSCAPES**

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We describe a spatially-based landscape method for determining ecologically-compatible livestock grazing levels using available data. Our objective was to develop models that formalize decision-making regarding stocking rates and provide means by which management scenarios could be compared. We demonstrate this method for a private sheep-ranch operating in a public-private land matrix in south-central Idaho, USA. We estimated grazable area and potential forage biomass production using two separate, sequential analyses, capability and capacity. Capability, land physically able to sustain livestock use without leading to severe environmental degradation, was mapped from slope, hydrography, erosion potential, and land cover. Capacity, potential livestock forage biomass within capable areas once ecological factors are considered, was calculated within capable areas using estimates of biomass production adjusted for factors such as ecological condition and wildlife needs. The utility of this approach is not predictions of forage biomass at any given location, but that it makes explicit myriad, subjective decisions necessary to determine livestock stocking rates in a geographical context, and that allows the influence of those decisions to be viewed across a landscape. This can provide stability to ranching operations and help translate monitoring data into management actions that protect, or help restore, rangeland ecological integrity.

### **SUSTAINING PEOPLE AND LANDSCAPES: COMBINING ECOLOGICAL AND CULTURAL VALUES TO GUIDE LAND MANAGEMENT**

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For cultures that historically and currently depend upon landscapes and natural resources for not only basic subsistence, but for cultural sustainability, there is a pressing need to use both ecological and cultural information to guide land management. In northwestern British Columbia, the Taku River Tlingit First Nation (TRTFN) combined ecological analyses with traditional ecological knowledge to produce a conservation area design for their 4.1 m ha territory. Additionally, extensive data on historic land uses, contemporary resource use patterns, and current community values for land uses provided spatially-explicit data of cultural values. Combining the ecological and cultural data provided dynamic scenarios allowing the TRTFN to evaluate potential synergies and trade-offs between ecological protection, cultural protection, and economic opportunities. The analyses show a strong overlap between historical land use patterns and areas of high ecological values, while more contemporary land uses shifted to regions with road access near the only settlement in the territory. These analyses are being used to develop land designations in the TRTFN land use planning process, with scenarios protecting 30% to 60% of the territory identified for sustaining cultural and ecological values.

### **ASSESSMENT OF HABITAT CONDITIONS FOR RIPARIAN BRUSH RABBITS ON THE SAN JOAQUIN RIVER NATIONAL WILDLIFE REFUGE IN CENTRAL CALIFORNIA**

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We assessed habitat conditions for riparian brush rabbits (*Sylvilagus bachmani riparius*) on the San Joaquin River National Wildlife Refuge in central California. The rabbits were reintroduced on the refuge in 2002 as part of a controlled propagation and recovery program. The objective of this assessment is to discern whether there are quantifiable differences in the habitat characteristics of high use and low use areas for the brush rabbits on the refuge. To do this, we developed a set of habitat classes, collected field information on the distribution of those classes, and used multi-spectral satellite imagery and GIS to assess the distribution and extent of each habitat class in the parts of the refuge used by the brush rabbits. We also studied how representation of the habitat classes was affected by a major wildfire that swept across the refuge in July 2004. We estimated that 30 of the analysis area contained highly suitable habitat and 7 contained moderately suitable habitat. We estimated that the 2004 fire burned 53 and 44 respectively of the areas of highly and moderately suitable habitat. The methods used in this analysis can be applied to assess habitat conditions for other reintroduction sites.

### **INSIGHTS INTO THE CIRCUMSTANCES LEADING TO THE EXTINCTION OF THE BLUE ANTELOPE, DERIVED FROM MODELING OF HISTORICAL MAMMAL DISTRIBUTION AND ABUNDANCE**

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The extinction of the blue antelope (*Hippotragus leucophaeus*) in 1800 is a unique event in southern Africa, as it represents the only extinction of a large mammal in this subregion in the last 350 years and the first recorded African large mammal extinction in historic times. The extinction process is poorly understood. We review what is known about the species, and present new insights into the conditions that may have led to its extinction, derived from the modeling of the potential distribution and abundance of the medium- and large-sized mammals that historically occurred in the Cape Floristic Region. Our results indicate that this species was restricted to a single population in a limited area (4300 km<sup>2</sup>) at the time of European colonization in the 17th century. The species' population is estimated to have been less than 400 individuals at that time. We suggest that this population was not viable and was already vulnerable to stochastic demographic and genetic processes, and that hunting pressure by European colonists was not the primary driver of extinction, but may have hastened the end.

**GROWTH PERFORMANCE OF CEPHALOSPHAERA USAMBARENESIS SEEDLINGS: EFFECT OF CANOPY COVER, OTHER TREE SPECIES, AND HERBACEOUS PLANTS**

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The study was conducted in Amani Nature Reserve, Tanzania. The reserve has evergreen sub-montane forest type. *C. usambarensis*, a tall rain forest tree endemic to Usambara Mountains of Tanzania, was the study species. The study objective was to examine the growth performance and abundance of *C. usambarensis* seedlings. The effect of canopy cover, other trees species and herbaceous plants and habitat variation was analyzed. Three study sites with different disturbance histories were chosen. Temporally sample plots were established 30 m apart along a chosen direction for both the first and second sites. In the third site, plots were selected without following a specific direction. Canopy cover, counts of *C. usambarensis* seedlings, other trees and herbaceous plants, and measurements of leaf length, breadth, and stem diameter of *C. usambarensis* seedlings that had no more than one branching level were determined. Spearman rank correlation, simple linear regression, and Mann-Whitney were used to test the significant effect of these factors. The study revealed that canopy cover and other trees have significant effect on the abundance and growth performance of *C. usambarensis* seedlings, while herbaceous plants have none. Habitat variations also have no effect on abundance nor on growth performance of *C. usambarensis* seedlings.

**CONSERVATION EASEMENTS IN CONTEXT: A QUANTITATIVE ANALYSIS OF THEIR USE BY THE NATURE CONSERVANCY**

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Conservation easements have become the principal tool that land trusts use to preserve habitat and open space. However, conservation easements have been criticized because their use has evolved so rapidly that it is difficult to assess their value. Here we discuss temporal trends of easements usage with an analysis of data from 119 easements held by The Nature Conservancy spanning 8 states and 20 years (1984–2004). Our results suggest that the development of easements as a strategy appears to mirror advances in conservation science. Ninety-six percent of all easements have identified biological targets, 84% were within TNC priority sites, and 79% were adjacent to other protected areas, suggesting that easement attributes were consistent with strategic conservation. Temporal patterns also indicated that easement usage has become more strategic as easements were more likely to be larger and more likely to have a management plan that includes components to protect biological targets. Although 92% of all easements have been monitored for compliance in the last three years, only 26% have at least one target that was monitored quantitatively. Further analysis of the data will highlight important areas for improvement in the use of easements for protecting biological diversity.

**THE ECONOMIC VALUE OF AMAZONIAN RAIN TO AGRICULTURE IN SANTA CRUZ, BOLIVIA**

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The conservation of the Amazon forest ecosystem provides important ecosystem services to South America's agricultural heartland. Humidity from the western Amazon is transported to the Rio Plata basin via a climatic system known as the South American Low Level jet (SALLJ). This wind system is responsible for the overwhelming majority of precipitation that falls on the alluvial plain of Santa Cruz, Bolivia. A simple GIS and agro-economic model is used to estimate the impact of reduced precipitation regimes on soybean yields in Bolivia's most important agricultural region. A 10% reduction in yield would decrease the economic value of Bolivia's annual soy harvest by as much as \$100 million dollars, representing approximately 5% of the nations annual export income. Decreases in precipitation caused by regional climate change due to global warming or deforestation will negatively impact the economy of the region and provide the countries of South America with a straightforward economic reason for conserving the Amazon ecosystem.

**URBANIZATION ACROSS THREE LEVELS OF ECOLOGICAL ORGANIZATION IN THE HUDSON RIVER VALLEY OF NEW YORK STATE**

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Urbanization in New York's Hudson Valley is considered from the landscape, ecosystem, and molecular perspectives. We ask: (1) What changes occur at each level of organization as the region urbanizes? (2) Do such changes vary with urban typology? Aerial photography of an Albany pine bush landscape revealed a doubling of fragments and a two-thirds reduction in mean fragment size between 1970 and 2000. A species-area model hindcasts a 20 percent decline in plant richness with decreasing fragment size. Additionally, aircraft-acquired hyperspectral *Lythrum salicaria* (an invasive) densities varied directly ( $r = 0.77$ )  $p^2$  polygons in Saratoga and Orange Counties. At the ecosystem level, wetlands draining watersheds dominated by suburban development and traditional villages were compared. Factor analysis revealed that invasive plant abundance, runoff and planktonic food-chain efficiency were associated with urban landscape features—buffer width and imperviousness—that vary with typology. At the molecular level, DNA-fragmentation frequencies (comet assays) in fish cells differed as a function of dominant urban typology in the watershed. Comet frequency was 15–20% and 0–5% in fish from suburban and traditional watersheds, respectively. Our results suggest that relatively benign alternatives to suburban typologies exist.

**A COLLECTIVE UNDERSTANDING OF THREATS TO FOREST RESOURCES OF THE MIDWEST DRIFTLESS AREA**

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Oak forests are declining throughout the midwestern United States, largely being replaced by later successional forest types. The goal of our research was to identify the salient conservation issues related to forest change, as perceived by forest resource practitioners. We conducted interviews (N = 30) of foresters, forest planners, ecologists, and loggers in the Driftless Area of the midwest. Using a qualitative analytical methodology, we identified a range of interrelated social, ecological, and economic factors that may influence future conditions. Forest practitioners cited three key changes to the forest resources: (1) a decrease in timber quality, (2) a decrease in oak species, and (3) an increase in the parcelization of private forest land. They noted that as parcelization occurs, large-scale management efforts aimed at improving timber quality and encouraging oak regeneration are less likely to occur. Practitioners also identified several causal factors that contribute to changing forest resources, including the high-grading of timber, the spread of invasive plants, an increase in forest land value, and a change in private landowner demographics. These complex and compounding factors challenge the way that forest practitioners encourage landscape-level forest conservation and management in a region in which the majority of forest land is privately owned.

### **MISSION BLUE AND CALLIPPE SILVERSPOT BUTTERFLY DISTRIBUTION AND HABITAT CHANGES ON SAN BRUNO MOUNTAIN, 23 YEARS OF MONITORING**

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The San Bruno Mountain Habitat Conservation Plan was created in 1982 to provide a mechanism for balancing development with endangered species protection on a 3400-acre open space area near San Francisco. In combination with other land acquisitions, the HCP resulted in the protection and management of over 2800 acres of habitat for the endangered Mission blue (*Icaricia icarioides missionensis*) and Callippe silverspot (*Speyeria callippe callippe*) butterflies. Both butterflies utilize low-growing herbaceous host plants found within coastal prairie grasslands. Thomas Reid Associates, technical author of the HCP, has monitored the endangered butterflies on San Bruno Mountain for the past 23 years. Habitat management has focused primarily on controlling non-native invasive plant species in the conserved areas. Analysis of 19 years of butterfly data by Travis Longcore and the University of Southern California GIS Laboratory suggests that the butterfly populations are stable, however specific areas within the conservation area have shown declines over time. These declines are associated with a reduction in grassland extent as a result of native coastal scrub expansion (i.e. brush succession). The results point out the importance of controlling native brush within sensitive grassland habitats.

### **THE INFLUENCE OF LIFE-HISTORY STRATEGY ON EFFECTS OF GRASSLAND FRAGMENTATION AND MANAGEMENT ON MIXED-GRASS PRAIRIE BIRDS**

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The dramatic decline in population sizes of many species of prairie birds may result from management practices across a range of spatial scales, from local to landscape. The relative influence of management at each spatial scale varies by species, but the mechanism explaining species-specific differences is unclear. We determined whether life-history strategies explained the relative influence of landscape structure (amount and fragmentation of grassland), compared with more local habitat characteristics, on densities of 17 prairie bird species in Alberta, Canada. Sixteen landscapes consisting of dry mixed-grass prairie, wetlands, and agricultural lands were surveyed using 207 point-count plots from 2000 to 2002. The importance of landscape structure was influenced by territory size, but was independent of other life-history characteristics. This was consistent with the relative abundance of prairie songbirds studied in Grasslands National Park of Canada in Saskatchewan in 2005. Our results suggest that regional variation in effects of habitat management on some species may be explained by an interaction between landscape structure and life-history strategies. Territory size may be useful for predicting the appropriate spatial scale for habitat management that is needed to conserve prairie birds.

### **BALD EAGLE MIGRATION AND HABITAT UTILIZATION IN CALIFORNIA'S SAN JOAQUIN VALLEY**

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The advent of satellite telemetry has vastly expanded our knowledge of migratory pathways and habitat utilization of large migratory birds such as the Bald Eagle (*Haliaeetus leucocephalus*). A five-year telemetry study done at Millerton Lake (on the San Joaquin River in California's San Joaquin Valley) elucidated previously unknown migratory pathways for the population of Bald Eagles that winter on and around the lake. Telemetry data indicate that most, if not all, of these birds breed in the northern parts of Saskatchewan and Alberta and at Great Slave Lake in Northwest Territories of Canada, flying distances of up to 2700 km one way on migration. Local telemetry data indicate that surrounding rangeland and open space in the San Joaquin Valley are much more important to winter foraging and survival than was previously understood. This study underlines the critical importance of understanding utilization patterns in both summer- and wintering habitat of species ranging over vast areas, and the importance of international conservation efforts aimed at habitat preservation. Although recovery objectives for the Bald Eagle are being met in some parts of its range, intense human population pressure in California's Central Valley is contributing to the habitat destruction and the disappearance of open space and rangeland at an alarming rate. The protection of key wintering habitat in the San Joaquin Valley is essential for the long-term recovery of this species in this part of its range.

### **GROUP HUG FOR LAKES: THE DETERMINANTS AND EFFICACY OF SOCIAL CAPITAL IN LAKE ASSOCIATIONS**

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Problems associated with the management of common property resources have been addressed by regulation, privatization, and community driven conservation with the latter recently gaining currency in academic and management circles. Social capital (i.e. shared norms of trust, understanding, and behavior) is thought to allow communities to work more effectively

toward an environmental goal. Using data from a survey of over 100 Minnesota lake associations, my research attempts to improve our understanding of the role of social capital in community driven conservation by answering two questions. First, what are the determinants of social capital? Second, do varying degrees of social capital explain the effectiveness of community conservation? Specifically, I use participation rates in lake associations as a proxy for social capital in regression analysis to explain water quality differences among lakes. The results show that social capital is explained by a variety of social, institutional and environmental factors including lake area, relations with local government, the use of an association newsletter, and the amount of seasonal housing. Furthermore, there is evidence of a statistically significant but small effect of social capital within lake associations on lake water quality.

**AN INTERNATIONAL COMPARISON OF INCENTIVES TO POACH SAIGA ANTELOPES IN POST-SOVIET CENTRAL ASIA**  
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Although the Critically Endangered saiga antelope (*Saiga tatarica*) has declined precipitously due to poaching over its entire range, the socio-economic context of hunting varies considerably. We carried out a two year study of livelihoods and hunting behavior in 4 sites in Kazakhstan, Kalmykia (Russia) and Uzbekistan, using participatory methods and questionnaire surveys to collect data on livelihood opportunities and attitude to saigas. There are marked differences between locations. In Kalmykia, there is an active market for saiga products, with participation depending on proximity to the road network, modulated by public awareness and conservation actions. In Kazakhstan, Ustiurt has open access commercial hunting, while Betpak-dala's saiga population is depleted and in a post-hunting phase. In Uzbekistan, the region is primarily populated by industrial workers who moved in within the last 30 years. There is neither a culture of extensive hunting nor of environmental awareness. We use Generalized Linear Models to examine factors affecting whether households poach or not in each location, including wealth, possession of a motorbike, and length of residence in the area. We make recommendations for engagement with local people in each location, and discuss the importance of detailed local understanding in formulating conservation policy.

**PSEUDORICHNESS, COMMUNITY COMPOSITION, AND ECOLOGICAL PREFERENCES OF OSTRACODA (CRUSTACEA) IN LAKE ABANT (BOLU, TURKEY)**

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Aquatic habitats are under the threats of human activities in Turkey where such threats change both ecological conditions and species composition. Overall, reduction in the quality of habitat composition may tend to increase numbers of generalist species over native specialists. This phenomenon called "pseudorichness" is supported with a critical increase in the total numbers of colonial bacteria, as well. Total of 16 ostracods were described from Lake Abant (Bolu, Turkey) and its environs between 2001 and 2003. Two species, *Psychrodromus fontinalis* and *Eucypris pigra*, are new records for the region. Three major clustering groups (UPGMA) were recognized based on species occurrences and ecological preference. The ecological requirements of each ostracod showed some distinct characteristics with certain tolerance levels to different ecological variables. Cosmopolitans tend to have wide ranges of tolerances over sensitive species. About 82 % of the relationship between species and environmental variables was explained with CCA. Accordingly, water temperature, dissolved oxygen, and conductivity were the three most influential factors on the species composition. Spearman correlation showed a significant positive relationship between numbers of individuals and both dissolved oxygen and numbers of species. Results suggest immediate attention from both national and international organizations.

**CORRIDORS, ELEPHANT MOVEMENTS AND SOCIAL ISSUES IN WESTERN GHANA**

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Conservation and long-term survival of West African elephants will need information on their distribution and numbers, ability to connect fragmented habitats as well as taking into consideration the social issues in these areas. An examination of the elephant distribution map for the region shows the Bia / Tano block (the study area) to be the largest area of elephant habitat remaining in the subregion. Field and social surveys were conducted in this region to determine the distribution and numbers of elephants determine their movement patterns and assess communities' attitude towards corridor creation in the range. It was realized that the elephants in the study area were fragmented into two separate populations. The Goaso elephants less than 50 individuals were restricted and moved between two abutting forest reserves northwards—Mpaemeso and the Bia shelter belt. The Bia population was also distributed in the southern part of the Bia Conservation Area and number between 125 and 250. There was absolutely no sign of movement between the two populations. Although it is possible to connect the forest reserves in the Goaso range, most of the affected farmers will only give up their lands if they are adequately compensated. The development and the large human densities in towns between the two ranges make the creation of corridors almost impossible. Interesting, most of the communities expressed willingness to undertake afforestation programs especially in degraded forests.

**HUNTER BEHAVIOUR, CHANGES IN CATCH PER UNIT EFFORT AND INFERENCES FOR SUSTAINABILITY OF HUNTING IN A LONG-TERM CAMP ROTATION SYSTEM**

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There are concerns about unsustainable hunting of bushmeat in Central Africa. Hunters are the critical link between demand and supply of bushmeat and thus understanding of hunter decision-making in response to changes in prey availability can

inform management. However, most studies of hunter behavior have concentrated on pursuit hunting, rather than trapping, the most common form of hunting in Central Africa. Spatially- and temporally-explicit data on measures of catch and effort, from hunter interviews, hunter follows and an offtake survey, were collected over 15 months for a long-term hunter-camp rotation system in continental Equatorial Guinea. Different measures of trapping effort were compared; time expended and distance travelled were found to be less important in predicting trapping success than the number of effective traps. Traditionally, "catch per unit effort" (CPUE) uses time as the measure of effort, but a constant catch per day trapping at camps masked subtle decreases in other measures of CPUE, as trappers compensated by increasing the number of traps and/or moving them further from camp. By switching back-and-forth between camps, CPUE across the overall hunting zone remained constant, with fallow periods allowing replenishment of prey. In terms of hunter returns the current system may be sustainable.

### **IDENTIFYING NON-BREEDING HABITAT IN MOBILE SPECIES: SEASONAL ELEVATIONAL MOVEMENT IN A HAWAIIAN HONEYCREEPER**

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In Hawaii, endemic forest bird management currently focuses on the habitat protection of high-elevation areas (1530 m). Breeding bird surveys find that most species are nearly extirpated from low-elevation habitat, likely due to introduced mosquito-borne disease. However, little is known about non-breeding behavior, movement, and habitat in the potentially mobile species, including the 'I'iwi (*Vestiaria coccinea*). To begin to address these questions, I fitted individual 'I'iwi from a high elevation (1920 m) breeding population on the eastern slope of Mauna Kea with radio-transmitters and tracked movements using ground and aerial telemetry. A total of 69 'I'iwi were fitted during 2003 and 2004; of these, 37 were detected away from the breeding site (1 km). Non-breeding season movement had strong directional and elevational components and, in both years, nearly 50 of the detection points were in mid-elevation (900–1530 m) habitat. Although previously unrecognized, the mid-elevation forest is an important non-breeding habitat for high-elevation populations. Long-term high-elevation population persistence most likely will depend on mid-elevation forest resource protection and management, necessitating cross-agency and private landowner cooperation. These results demonstrate that an understanding of the non-breeding behavior of mobile species is critical for appropriate long-term conservation planning.

### **INTRODUCED RATS INDIRECTLY TRANSFORM ISLAND INTERTIDAL COMMUNITIES**

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Invasive species on islands are known to have direct deleterious effects on native species primarily through predation. Examples of indirect, cascading effects are rarer, especially on a community-wide, landscape level. The introduction of rats (*Rattus norvegicus*) onto many of the Aleutian Islands in Alaska provides an opportunity to conduct a large-scale natural experiment to test for differences between invaded and non-invaded islands. I tested the hypothesis that, through chick predation, introduced rats significantly limit the number of marine birds that forage in the intertidal. Thus, intertidal invertebrates are released from heavy foraging pressure by the birds. It was expected that an increase in herbivory by higher numbers of invertebrates would cause reductions in fleshy algal cover further altering the intertidal community. I surveyed the rocky intertidal on several Aleutian Islands (8 with rats and 15 without) during summers 2002–2004 and analyzed USFWS survey data to assess differences in bird densities between islands. Herbivorous invertebrates were significantly higher on islands with rats while the percentage of intertidal area covered by fleshy algae was half that of islands without rats. Densities of birds that forage in the intertidal are an order of magnitude lower on islands with rats. My results demonstrate a rare example of a landscape level trophic cascade induced by an invasive terrestrial predator with repercussions into a marine community.

### **ASSESSING THE IMPORTANCE OF FRONTAL ZONES ON THE DISTRIBUTION OF UPPER TROPIC LEVEL PREDATORS OFF CAPE HATTERAS**

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Effective conservation of top-level marine predators requires a comprehensive understanding of their distributions and of the underlying biological and physical processes that affect these distributions. We investigated the spatial distribution of marine mammals off Cape Hatteras, NC, in relation to the positions of the shelf break and Hatteras frontal system. To assess the influence of these features on the distribution of marine mammals, we conducted transect surveys with fine-scale oceanographic sampling in August 2004. We derived the daily position of the Hatteras front from temperature, salinity, and pressure data collected by a Scanfish and a ship-mounted acoustic current Doppler profiler (ADCP). Simple Mantel's tests illustrate that the influence of bathymetry, distance to shelf break, slope and distance to front vary on a daily basis. Pure partial Mantel's tests show that slope, while accounting for all other environmental variables, is the only consistent influence on marine mammal distribution. Thus, we conclude that the shelf break, a static physical aspect of the environment, is the most important variable in patterning marine mammal distribution off Cape Hatteras. This finding enables consideration of spatially explicit approaches to the conservation of marine mammals and other upper trophic level predators in this region.

### **PRIORITIZING ACTIONS WITHIN OFFSET / MITIGATION POLICIES THROUGH CREDIT ASSIGNMENT UNDER UNCERTAINTY**

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Offset and mitigation policies are being adopted in various nations to deal with loss of biodiversity and ecosystem function. Developing these policies is complicated by large uncertainties in each step of the process (e.g., detection probabilities for endangered species, restoration success). We model the process as a functional sequence of (i) screening for endangered species, (ii) assessing habitat values, (iii) choosing offsets / mitigation, (iv) restoration, and (v) protection of offset. Given numerous uncertainties within each step, we build a model for determining the relative contribution of the various pieces under

specific political and economic environments with unknown degrees of uncertainty. Uncertainties and outcomes in each step are modeled by increasing/decreasing species persistence probabilities as a common currency among all actions. We explore and aggregate regions of the uncertainty space and use infogap analysis to provide guidance on which steps in policy demand particular emphasis under what classes of uncertainties and background conditions. The result of our research is a transparent model of the relative impacts of sequential decisions in biodiversity policy under unknown amounts of uncertainty. It can be used in a variety of economic and political situations and the model and its R source code are freely available.

**VALUES AREN'T THE PROBLEM: VALUE SIMILARITY AMONG STAKEHOLDERS INVOLVED IN ENVIRONMENTAL DISPUTES**

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It is often assumed that environmental values, specifically the absence of strongly held environmental values within the population, serves as a significant barrier to conservation initiatives. This assumption was tested in a province-wide study of values associated with forests and forestry conducted in the province of British Columbia, Canada. Face-to-face interviews (semi-structured) were conducted with 300 people from 20 communities. The sampling approach included maximum variety sampling and quota sampling. Participants were selected from 15 different stakeholder groups (e.g., trappers, community leaders, forest company executives). From these interviews, a forest values questionnaire was developed and administered to the sample. Quantitative analyses (N = 173) demonstrated universal support for conservation values such as "maintaining healthy populations of wildlife and fish" and ensuring the "continued existence of ecosystems," for social values such as ensuring the "continued existence of smaller cities/towns around the province" and maintaining "provincial economic stability," and for personal values such as the importance of "being able to provide for yourself / your family" and "spending time outdoors." These findings suggest that there is strong public endorsement of values associated with both environmental and social security and, thus, that the absence of environmental values is not the central barrier to conservation initiatives.

**ASSESSING CONSERVATION PLANNING APPROACHES IN A CHANGING CLIMATE**

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Climate change poses a unique challenge for conservation planners. Most scientifically informed conservation planning is based on the current distribution of biodiversity. Climate change is likely to drastically alter species distributions, the composition of communities, and the functioning of ecosystems. Therefore, areas selected to protect today's biodiversity may no longer protect biodiversity in the coming century. We asked how climate change will affect the distribution of vertebrate species and how this information can inform conservation planning. We used climate-envelope models to predict potential climate-induced geographic range shifts for 2627 species of birds, mammals, and amphibians in the western hemisphere. We built the models with data on current species ranges and 39 bioclimatic variables representing average climatic conditions from 1961–1990. We predicted potential future ranges based on climate-change projections for 2070–2098 from the Hadley Centre's UKMO-HadCM3 general circulation model. Our models predicted significant shifts in the distributions of many species. Species turnover rates were highest in the Amazon Basin and the Atlantic Forest of Brazil—reaching 90% in some areas. We discuss the implications of these results for conservation planners and explore alternative methods for selecting conservation areas that better protect biodiversity in a changing climate.

**NICHE-BASED DISTRIBUTION MODELS TO THE RESCUE OF RARE SPECIES**

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Rare species preservation is a central issue, yet their ecology and distribution is often insufficiently defined. Our goals were to demonstrate that spatial models are useful tools to (1) improve our ecological knowledge of rare species and (2) enhance our capacity of detecting new populations. We developed a multi-resolution approach combining several modeling methods and data sets. Field work was used both to provide an independent validation dataset for evaluating the models and for improving them in a second modeling step. We tested this approach on three endangered alpine species and five common species as control. The studied area was an alpine landscape, which strongly varied in topography, climate, and land use. Results showed that the probability of species' occurrence was overall largely superior within the areas predicted suitable than outside. The model-based sampling was particularly successful for one rare species, for which six new populations were found. Here, the combined multi-resolution model reached better results than each single model. This approach can be reiterated by conducting additional modeling and field steps. Such adaptive procedure has the potential to improve our knowledge of rare species ecology and management, and support the discovery of new populations of conservation interest.

**THE IMPORTANCE OF CONSERVATION ATTITUDE AND PAST CONFLICT ON ILLEGAL FOREST RESOURCE HARVESTING IN THE PROTECTED AREAS OF SULAWESI (INDONESIA)**

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Besides habitat loss in protected areas (PAs), overexploitation of tropical forest resources through cryptic disturbances can also exacerbate the biodiversity crisis. Therefore, it is pivotal to understand the attitudinal effects on conservation and resource harvesting. We evaluated the significance of perceptions of PAs, interactions with PAs, and sociodemographic variables on conservation attitude, as well as their effects on illegal resource extraction in PAs on Sulawesi. Mixed-effect regression analyses showed that the most important predictors of support for PA across thirty-three villages from eight PAs included the involvement of PA management, presence / absence of PA-human conflict, perceived sustainability of forest resources, and two sociodemographic variable (i.e., residency and education level). Notably, community management and reconciling land-rights

conflicts within the PAs may be promising in promoting favorable conservation attitude. Ordination and correlation analyses revealed that the rise in the illegal activities (e.g., wildlife hunting and logging) are significantly affected by negative conservation attitude and past conflict with PA, highlighting that fostering positive support for PAs and resolving land rights issues may alleviate extraction pressures. Furthermore, the disparity in the resource extraction patterns among the villages across all PAs and at individual PAs stressed the significance of adopting site-specific conservation strategy.

### **DEER, PEOPLE AND PARKS: A "WICKED" WILDLIFE MANAGEMENT PROBLEM**

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Controversies have surrounded management of white-tailed deer (*Odocoileus virginianus*) in National Parks in the northeastern United States for over two decades. The biological dimensions of deer management have been well-researched in parks, but the human dimensions have not been examined thoroughly. This study focused on understanding the human dimensions of deer management to yield insights that could improve communication and resolve conflict. We spent three weeks at each of three parks and conducted at least 60 semi-structured in-depth interviews with stakeholders living in or near each park. While impacts from deer experienced by stakeholders were relatively similar between parks, the language and context used to describe impacts were dramatically different. These case studies indicate that deer management is a "wicked" problem; i.e., a problem characterized by scientific uncertainty about cause-effect relationships and social conflicts over goals. Although managers historically have focused on decreasing deer numbers to alleviate deer-related impacts, stakeholders also talked about abundant deer populations within parks as a symptom of anthropogenic activities outside parks. Expanding the dialogue of deer management to a regional scale may reveal alternate approaches to affect population dynamics, create opportunities for partnerships and fulfill recent National Park Service mandates for increased civic engagement.

### **INCORPORATING SYSTEM DYNAMICS IN RESERVE DESIGN**

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Systematic conservation plans are beginning to account for the dynamic nature of ecosystems by incorporating variables such as population dynamics, landscape change, and ecological uncertainty. Our goals in this paper are to evaluate the efficacy of conventional conservation planning methods under natural disturbance dynamics and to demonstrate the usefulness of spatially-explicit, dynamic simulation models in reserve design. We developed a spatially-explicit, dynamic simulation model, CONSERV that simulates forest succession and fire and we used CONSERV to evaluate the efficacy of potential conservation networks. We designed 6 reserve scenarios for the Mackenzie Valley, Northwest Territories, Canada, with varying conservation targets and levels of connectedness and ran 100 CONSERV simulations of 250 years for each reserve scenario. We tracked the ability of each reserve scenario to maintain initial conservation targets through time, given landscape change. No reserve scenarios maintained all of their initial targets throughout the simulations, but some initial targets were over-represented throughout the simulations. Given the availability of spatially-explicit, dynamic simulation models (e.g., LANDIS, SELES, TARDIS, CONSERV), we argue that systematic conservation plans should undertake dynamic reserve evaluation prior to reserve implementation.

### **A COMPARISON OF THE PREDICTIVE ACCURACY OF SPATIALLY AND NON-SPATIALLY EXPLICIT SPECIES DISTRIBUTION MODELS**

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A key element of conservation planning for any species is to precisely understand where that species occurs. The goal of our research was to assess, for four songbird species (blackburnian warbler, Canada warbler, purple finch and sedge wren), the potential to improve predictive models by comparing novel spatially-explicit statistical methods (geographically-weighted regression and auto-logistic regression) to traditional statistical and simulated range map methods (logistic regression and minimum convex polygons, respectively). We found that the minimum convex polygon (MCP) approach generally resulted in very low predictive accuracy, except for the sedge wren which was already geographically restricted to a small portion of the study area. Non-spatially explicit logistic regression models were an improvement over MCPs, but assumed that spatial relationships were constant through space, and that observations were independent of each other regardless of proximity. The first assumption was not tenable as geographically-weighted regression models led to a general improvement in predictive accuracy, suggesting that ecological relationships were not spatially constant. Finally, auto-logistic models failed to improve overall predictive accuracy, although the autocorrelation parameter was significant and suggested that local occurrence was, in fact, related to the presence of neighbouring conspecifics.

### **SITE FIDELITY AND MOVEMENT OF FISHES IN CALIFORNIA'S CHANNEL ISLANDS AS DETERMINED BY A LARGE ACOUSTIC RECEIVER ARRAY: IMPLICATIONS FOR RESERVE DESIGN**

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Precise information on the movement of coastal fishes among California's Channel Islands, between the Islands and the mainland, and across the boundaries of marine reserves is critical for their successful conservation and management. Since 2000, we have surgically-tagged more than 224 fish with acoustic transmitters. Tagged fishes were tracked by 98 acoustic receivers deployed on the seafloor throughout the islands and sites off the mainland. California sheephead (*Labridae*) and kelp bass (*Serranidae*) were tagged to investigate their movements relative to the boundaries of the State Marine Reserve at Anacapa Island. Data collected to-date indicated that little movement of either species occurred out of the reserve, while many fish tagged outside the reserve moved into the reserve. Giant sea bass (*Polyprionidae*) and white seabass (*Sciadidae*) were tagged prior to the designation of the reserves to investigate any inter-island movement and movement between the islands and the mainland. Wide inter-island movements have been recorded for both species, while white seabass were also recorded

at the mainland receivers. Both species have been recorded within reserves. This ongoing project is providing vital data to state and federal managers and will ultimately yield important ecological data on each tagged fish species.

**DO STRESS AND OBESITY DRIVE BIRTH SEX RATIOS AFTER TRANS-CONTINENTAL REINTRODUCTIONS OF BLACK RHINOCEROS? IMPLICATIONS FOR THE WORLD HERD**

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Species recovery is primarily limited by female numbers. Aberrant male-biased birth sex ratios (BSRs) are common and problematic. We use long-term datasets from both captive and wild populations to describe extreme male-biases in black rhinoceros (*Diceros bicornis*) BSR that are coincident with both cross-continental translocation and captivity. The BSR of pregnant mothers in early-gestation when subject to the stress of capture and translocation were strongly male-biased (2.7 m per f) compared with those in late-gestation (1.0 m per f), indicating that stress induces female-biased mortality of young embryos. Improved conditions after release also drove BSRs towards male-biased extremes, particularly for mothers already pregnant at capture (i.e., up to 85% calves were male). The data support Cameron's (2004) hypothesis that hyperglycemia during early gestation, caused by stress and food (glucose) surplus to requirements in this circumstance, is the mechanism of BSR adjustment in mammals, with important implications for management. Male-biased BSRs might be reduced by selecting non-pregnant mothers for translocation and captivity, and feeding prospective mothers glucose-poor and low-fatty acid diets, temporarily lowering their body fat, and managing for reduced stress during a relatively short period around and after conception to augment trans-continental species recovery programs.

**RISK OF PATHOGEN EXPOSURE AND INFECTION OF ENDANGERED HAWAIIAN MONK SEALS IN THE MAIN HAWAIIAN ISLANDS**

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A recently established and increasing population of endangered Hawaiian monk seals (HMS) in the main Hawaiian Islands (MHI), while encouraging, may be exposed to a broader range of human and animal pathogens than conspecifics in the Northwestern Hawaiian Islands. We studied the movements of HMS in the MHI relative to potential exposure to diseases in near-shore marine habitats. Twenty-one HMS were captured and disease screened. Movements of 10 were monitored using satellite transmitters. Seals spent considerable time in near-shore waters close to human population centers, agricultural and livestock ranges, and sources of water runoff and sewage dispersal potentially exposing them to several diseases. All seals tested negative for canine adenovirus, calicivirus, morbillivirus, Phocine Herpes Virus, *Leptospira* sp. and feline / canine heartworm antigen / antibody. Six seals tested positive for *Chlamydia*, five demonstrated positive titers to *Sarcocystis neurona*, four to *Neospora caninum* and four to *Toxoplasma gondii*. Fecal cultures showed approximately half positive for *E. coli* O157, no *Salmonella* sp. and one with *Campylobacter* sp. Use of coastal habitats overlapped substantially among some seals; several seals moved among islands to beaches where they were seen with other seals, highlighting the possibility of infection of conspecifics by diseased seals throughout the MHI.

**INTERANNUAL VARIABILITY IN THE CONTRIBUTION OF SALT MARSHES TO THE PRODUCTION OF AN ESTUARINE MARINE TRANSIENT**

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The nursery function of a habitat is usually defined as the contribution per unit area of individuals that recruit to adult populations. Yet rather than displaying traits of long-term residency in specific areas, previous multiple (C, N, and S) isotope studies indicate juvenile weakfish (*Cynoscion regalis*) recruited to the Delaware Bay, USA appear to take advantage of varying combinations of the entire habitat mosaic during their first year, with individual fish residing at various locations for only brief periods. This suggests that any measure of the importance of specific estuarine habitats to the production of juvenile *C. regalis* must be interpreted in the context of their rapid movements among, and relatively short residence times within individual habitats. Subsequent stable isotope studies reveal the relative proportion of weakfish utilizing salt marsh habitats for the preponderance of their juvenile period vary widely from year to year. These results should be considered when the goal of conserving or resorting estuarine habitats is to enhance the production of marine transient species such as *C. regalis*.

**THE INFLUENCE OF WATER, VEGETATION, AND HUMAN ACTIVITY ON ELEPHANT**

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The successful management and conservation of African elephant populations is important for three reasons. Human-elephant conflict over resources accounts for hundreds of deaths annually across Africa. In small fragmented populations, elephants often exhibit unusual population dynamics that many argue negatively impact other species. Elephant populations continue to decline on a continental scale. An understanding of how elephants move through and interact with African landscapes on a variety of temporal and spatial scales is critical to efforts to devise successful management strategies for African elephants. We outfitted sixteen elephants with Geographic Positioning System collars in three southern African countries across a large rainfall gradient. We analyzed elephant movement data across both daily and yearly timescales to explore within-day and seasonal interactions with remotely sensed data on humans, water, and vegetation. We found that movements among water and foraging resources and efforts to avoid humans drive elephant within-day behavior. The spatial distribution of these resources

varied greatly across our study area and influence movement patterns accordingly. Seasonal migrations are driven by the spatial configuration of permanent water and seasonal water and forage as well as the presence of humans and fences.

### **IMPROVING PARAMETER ESTIMATES USED IN PVAS WITH DATA FROM ZOO POPULATIONS: THE MISIONES, ARGENTINA JAGUAR (*PANTHERA ONCA*) POPULATION**

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Jaguars (*Panthera onca*), like many top predators, are considered a threatened species throughout their range. Managers who strive to prevent the further decline and extinction of jaguar populations need models to project estimates of population viability. Unfortunately, jaguars are cryptic and found at relatively low density making data collection in the field exceedingly challenging. Data from zoo populations can help address this challenge by providing detailed, comprehensive life-history information for jaguars. We extracted age and sex specific survivorship and fecundity data from 30 years of zoo data on jaguars to serve as baseline data. We then modified the data to fit expected effects of field conditions as a result of a two-day workshop with jaguar field biologists. Here, we present the methods and results of an individual-based, spatially-explicit model parameterized with these data to estimate jaguar population viability in the Misiones region of Argentina. The country's Administration of National Parks will use the model as a decision analysis tool to select management decisions that best facilitate jaguar conservation. Our work showcases the potential of life history data from zoos to augment future conservation work of rare and threatened species.

### **CONSERVATION EASEMENTS VS CONSERVATION ACQUISITION: THE ILLUSORY DICHOTOMY**

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Connecting conservation research to conservation practice can be challenging. This is reflected in the assumption, often seen in the academic and popular press, that the outright purchase of lands for biodiversity protection is a far better conservation strategy than conservation easements, which may allow residences, ranching, logging, or other human activities. Using The Nature Conservancy's recent survey of 119 of its conservation easements from eight representative states, we link research results with practitioner experience to evaluate how easements are used as a conservation tool in their landscape context as an alternative to, in concert with, or even following acquisition. The real world limitations of acquisition—in availability from willing sellers, community issues, and limitations of funding for purchase and management—are contrasted with the advantages that conservation easements bring to these issues. Similarly, the limitations of easements as agreements based on informed projections about future conditions are explored and considered in the context of the presumed greater flexibility provided by acquisition in the long run. Finally, we explore the implications of a mosaic of public and private acquisitions and conservation easements as a practical approach for the protection of large natural areas.

### **IMPACT OF SPIRITUAL BELIEFS ON THE PROTECTION OF THE AMAZON RIVER DOLPHIN IN NORTHERN PERU**

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The vast Amazon River and its many tributaries are the lifeblood of inhabitants of the jungle regions of northern Peru and is home to the Amazon River Dolphin (*Inia geoffrensis*), known to local people as the "boto," the largest of four species of river dolphins and an Appendix II Cites species. It breeds, hunts, and raises its young in conflict with humans maneuvering boats overloaded with timber and coal and shallow dugout canoes carrying fishermen from village shores where their wives and children wash and bathe. The culture of tribes that have inhabited the region for hundreds of years is deeply intertwined with the rainforest ecology and includes beliefs about dolphin spirits that are objectified in stories, shamanic rituals, dances, and art. We interviewed members of six tribes and mixed race communities regarding how those beliefs affected their interaction with the dolphin when conflicts arose and found that the dolphin is considered to be a powerful spiritual entity and not to be harmed. Since we found that these belief systems may be hundreds if not thousands of years old, we believe that dolphins will continue to be protected, even as westernization pushes growth deeper into the region.

### **CITES RELATED SHIFTS IN THE LIVE SEAHORSE TRADE: LOS ANGELES AS A CASE STUDY**

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International regulatory controls under CITES appear to have effected considerable change in imports of live seahorses to Los Angeles, a major global entrepot for the aquarium trade. Of the 34 species of seahorses, at least 22 are traded live, for ornamental display. Habitat degradation, direct exploitation and capture in non-selective fishing gear have exerted pressure on seahorse populations. In November of 2002, CITES listed all seahorse species (*Hippocampus* spp.) on Appendix II to address concerns regarding local population declines and the expansion of the live and dried seahorse trades. In October 2005, Project Seahorse investigated the impacts of this CITES listing on the live seahorse trade through semi-structured interviews with aquarium importers and wholesalers in Los Angeles. Our results indicated that the CITES listing produced noteworthy shifts: the two dominant source countries pre-CITES banned or restricted exports, aquacultured animals became more prevalent in trade, the size of the animals in trade decreased, re-export from the United States ended, prices doubled, and volumes of animals traded dropped to approximately half their pre-CITES levels. From this study, we infer that the aquarium trade is responsive to regulation of species for conservation purposes.

### **A NEW METHOD FOR ESTIMATING POPULATION DENSITIES FOR PRAIRIE DOGS (*CYNOMYS* SPP.)**

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The black-tailed prairie dog (*Cynomys ludovicianus*) is an ecologically pivotal species in grassland habitats. Due to the declining range of this species, accurate assessments of local population size are essential. Most previous attempts at prairie dog population estimation have been based on indices of abundance such as burrow counts and active animal counts that may not reflect actual population sizes. We provide the first attempt to use robust mark-resight methodology to estimate prairie dog population size and density. Our study colonies are urban habitat fragments in Denver, Colorado as well as control data from two unfragmented colonies in northeastern Colorado. Our mark-resight methods are feasible and reveal extremely high densities (65–195 prairie dogs / ha) for isolated prairie dog colonies compared to control sites (22.5–26.5 prairie dogs / ha). These elevated densities are likely the result of low dispersal in the urban matrix—an example of the “fence effect.” We use the new beta-binomial estimator (BBE) for population estimation. This estimator has more precision than other, previously used mark-resight estimators such as Bowden’s estimator, and we show the BBE to be more accurate than traditional counting methods for prairie dogs. We expect that mark-resight methodology will be used to provide robust population estimates, and hence help guide conservation efforts, throughout the range of the black-tailed prairie dog.

#### **GABON’S NATIONAL PARK SYSTEM: BASELINE WILDLIFE AND HUMAN IMPACT SURVEYS**

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During 2004–2005 six of the new National Parks in Gabon were surveyed for large mammals and human sign. The objective was to assess distribution and relative abundance of both within each park, and, where possible, animal density. Buffer zones were also surveyed at some sites. Most parks were systematically sampled over their whole surface area; one had only exploratory visits. All staff were trained together to ensure standard procedures were followed. Methods used were standard line transects plus recces, or recces alone at sites where animal densities were known to be low. There were worryingly low numbers of apes and other large mammals in two parks; these results were not attributable to hunting. Results from the other parks generally showed the classic correlation between wildlife abundance and increasing distance from roads and villages. This was also influenced by the degree of law enforcement present. At one site, an area outside present Park boundaries was shown to be a good refuge for elephants. The data collected is the baseline for the park monitoring system, and thus allows informed conservation management decisions. Results have already been used to alert park management authorities to the vulnerable and / or important parts of each site.

#### **REACHING BEYOND THE BOUNDARIES: A DISCOURSE ANALYSIS OF PERCEPTIONS IN BIODIVERSITY CONSERVATION**

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Protecting and conserving biodiversity by means of protected areas is an important objective, yet there is no agreement on the best way to achieve this. In this study, I use discourse analysis to inquire into the beliefs, principles and assumptions that underlie the ideas of how to best achieve biodiversity conservation through protected areas. Over 300 definitive statements about biodiversity conservation were extracted from a range of books, journal articles, and editorials. These statements were then categorized to extract some of the underlying themes in the debate. The discourse analysis indicate at least five fundamental underlying categories pertinent to the disagreement: (1) key actors involved in successful biodiversity conservation, (2) obstacles or causes for failure, (3) policy prescriptions, (4) underlying ethical assumptions, and (5) a vision for the future. This paper describes the method and findings of this discourse analysis and it also provides recommendations on ways to resolve disagreement. The contribution of the study is to gain a deeper and more comprehensive understanding of the different perceptions in the disagreement about biodiversity conservation. The aim of this work is to provide workable solutions for conservation biology that reach beyond existing boundaries formed of different perceptions and positions.

#### **ARE WILDLIFE VALUES CHANGING IN THE UNITED STATES?**

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Cultural change theorists contend that human values change in a predictable way as society moves through agrarian, industrial, and post industrial phases. We apply this notion in proposing an explanation of wildlife value shift in the United States. Theorists suggest that human values shift in response to changes in mode of economic production, demography, technology, and environmental forces. More specifically, it has been proposed, and empirically tested, that as societies move from industrial through post-industrial phases, values shift from focus on material well being, safety, and security to emphasis on belongingness, environmentalism, quality of life, and actualization needs. We argue that wildlife value orientations have shifted in a pattern that is consistent with those trends, i.e., there is a shift from utilitarian to mutualism value orientations. Using data described in presentation 1, we examine the relationship between (1) wildlife value orientations and overall materialist values, (2) wildlife value orientations and environmentalism, and (3) wildlife value orientations and variables representing driving forces of shift (education, urbanization, income). Hierarchical linear analysis revealed significant effects supporting these proposed relationships.

#### **MULTI-TAXONOMIC PATTERNS AND THRESHOLDS OF BIOLOGICAL DIVERSITY ALONG A GRADIENT OF HUMAN DEVELOPMENT**

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Urbanizing environments offer promise and peril in conserving local biological diversity. Human development negatively impacts the capacity of native ecosystems to support indigenous species through multiple mechanisms. Conversely, interspersions of native ecosystems in developed areas have the potential to enhance the ability of urbanizing areas to maintain some complement of native species diversity, thereby reducing the fragmentation of local populations. We studied changes in the composition and structure of a diversity of species, including landbirds, small and large mammals, ants, and vascular plants along a development gradient in the forested landscape of the Lake Tahoe basin. We sampled 72 to 124 sites ranging from 0 to over 70% developed. All taxonomic groups exhibited erosion in biological diversity at higher levels of development, but the type and magnitude of response varied widely among groups. Bird and ant species richness declined with development, whereas small mammal, large mammal, and plant species richness did not show a directional change along the development gradient. Abundance patterns did not follow richness patterns for each taxonomic group, owing largely to the varied responses of individual species. Thresholds of development and key environmental parameters appeared to have a pronounced influence on community composition and structure.

### **AMIGOS DE LOS MONOS: A PRIMATE CONSERVATION AND NGABE CULTURAL PRESERVATION INITIATIVE**

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Punta Burica of southwest Costa Rica boasts four non-human primate species, an indigenous territory of the Ngabe people, and large tracts of primary rainforest on which both the monkeys and humans depend upon for their survival. This region has been identified as a conservation priority; however, it remains unprotected, with an increasing pressure from humans for resource extraction. The objective of Amigos de los Monos is to create a sound conservation initiative that values the ecological and cultural integrity of this region by using the resident endangered monkeys as flagship species to generate interest and funds to the area. A network of key Ngabe collaborators is currently working on gaining wider support for the initiative among their community members. Preliminary contact with MINAE, the environmental agency of Costa Rica, has been established with a positive outlook. Outreach for Master's and / or Ph.D. students has consummated, with one student secured for this coming summer. Students will live with the Ngabe people during the course of their study, thus creating conservation oriented jobs in the reserve. Financial and institutional support is currently being sought so that the larger goals of developing a field station and hiring locals for monitoring the forest may materialize.

### **SAVING THE FAMILY JEWELS: PRIORITIZING SPECIES IN A NATIONAL CONTEXT**

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Conservation priority-setting is strongly affected by species rarity, even if the rarity is an artifact created imposed by political boundaries subdividing ranges. We demonstrate this problem using the birds of the United States and Canada, and confirm that examining a country in isolation from its neighbors results in selecting areas nearer to international boundaries. We show for the first time that this results in areas selected for species relatively far from their range centers, and near to range edges, patterns that have been associated with lower probabilities of persistence. Prioritizing species with the highest proportion of their range within the country overcomes the problem: selected areas for species are near to the range center and far from the range edge, with a higher expected probability of persistence. We also examine this problem for a more complicated situation, species distributions within the many nations of Europe. Again, if countries prioritize species with the largest proportion of their ranges within the country, selected areas do tend to be nearer range centers, except for rare cases in which species have very extended (e.g. linear) range geometries. Last, we map the degree to which priority-setting will be affected by the artificial boundaries within Europe.

### **COLLABORATIVE MODELING TO SUPPORT BIODIVERSITY CONSERVATION ACROSS OWNERSHIP BOUNDARIES: THE MANITOU FOREST MODELING PROJECT IN MINNESOTA**

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Increasingly, biodiversity conservation strategies emphasize collaboration across large, multi-owner landscapes. Although logically appealing, this approach presents numerous challenges. It requires unprecedented coordination among landowners with potentially divergent goals and values. Landowners must collectively evaluate cumulative effects of site-level actions, and find creative solutions to management conflicts. We are using several modeling tools to address these challenges in Minnesota's Manitou landscape, a 40,000 ha area identified as a conservation priority by The Nature Conservancy. Model results inform an ongoing partnership of major landowners that work to integrate biodiversity and forest management. Using TELSA, a spatial simulation model, we explored the importance of landowner coordination for restoring large patches of mature forest. Over a 120-year simulation, coordination resulted in a 10-fold increase in mean patch size of mature forest (14 to 145 ha) compared to a no-coordination scenario. We also used FVS, an individual tree-growth model, to compare traditional even-aged harvest methods with an alternative "multi-age mixed wood" prescription. Results suggest the alternative prescription substantially increases structural and compositional diversity, while producing 85% of the timber volume of the even-aged prescription. Managers will test the alternative prescription on the ground and increase coordination in managing for mature forest.

### **FIRE AND GRAZING EFFECTS IN CALIFORNIA VERNAL POOL GRASSLANDS**

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California's Central Valley grasslands represent one of the most invaded ecosystems in the United States with the cover of non-native plant species often exceeding 85 percent. Vernal pools are seasonal wetlands that occur within these grassland systems and serve as a refuge for native species that have adapted to the pools seasonally flooded and desiccated environment. At four

sites in the Sacramento Valley I studied whether landscape-scale processes such as fire and grazing can promote native species cover and richness in the pools while reducing exotic species cover. Initial results indicate that fire added to a grazed system maintains native species cover while reducing exotic species cover in the vernal pools at some sites. At all sites one year after spring prescribed burn treatments, exotic grass cover was lower in burned versus unburned pools. In contrast, exotic forb cover was higher in burned pools than the unburned pools across all sites. At the two highest productivity sites, native species richness was 20–40% higher in burned versus unburned treatments. Native diversity did not differ among burn treatments at the lower productivity sites. These results highlight the tradeoffs associated with using prescribed fire as a management tool in this invaded system but provide compelling evidence for using prescribed fire to maintain native vernal pool plant communities at sites with higher productivity.

**EVIDENCE-BASED RISK ANALYSIS: LEARNING FROM OUR EXPERIENCES WITH GENETICALLY-MODIFIED CROPS**

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In 2005, genetically modified (GM) crops were grown on 90 million hectares globally. Any activity affecting such vast amounts of land may either help or hinder conservation efforts. For example, insect resistant GM crops ("Bt crops") may harm nontarget organisms. However, discussions regarding potential risks of GM crops have generally neglected the accumulated wealth of relevant data. We will report results from a meta-analysis assessing the effects of Bt crops for nontarget invertebrates. Our analyses focus on 65 field experiments and 78 lab experiments. Methods for these experiments vary, and researchers have found both significant and non-significant effects on non-target organisms. A common problem, however, is small sample size (sample sizes range from 1–150, but nearly 70% of comparisons have < 6 replicates) and low statistical power of individual studies. Beyond simply summarizing measured effects, we asked which non-target species and community or ecosystem metrics provide the most useful indicators of risk, what types of measurements (growth, survival, reproduction, etc.) are most reliable, and how consistent results are across assays for similar transgenic modifications. To encourage future evidence-based GM plant risk analyses we have constructed a queryable database that that will be accessible over the Web.

**ASSESSING SUCCESS OF REINTRODUCTIONS OF THE ENDANGERED LONG-LIVED SARGENT'S CHERRY PALM (PSEUDOPHOENIX SARGENTII)**

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The 1991–1994 reintroductions of Florida endangered *Pseudophoenix sargentii* to thirteen sites in the Florida Keys represent a rare example of a successful multi-agency long-term effort to conserve a long-lived palm. To assess reintroduction success, we compared wild and reintroduced population demographics. The wild population had good survival from 2000–2004 (94%), has increased almost 7-fold since 1991, but still has few plants. The recent wild population growth is attributed to good seedling recruitment and removing the greatest threats. After 14 years, reintroductions had 43% survival, increased total plants in the wild by 27%, and expanded the distribution. Success varied with location and original transplant size. At some historic sites reintroductions failed indicating that these microsites were inappropriate for sustaining *P. sargentii* today. Greatest success and plant growth occurred in rockland hammocks and the tops of coastal berms. The largest transplants had the greatest survival, while the smallest had the lowest survival. No reintroduced plants are currently reproductive, transitions between stages are extremely slow, and plants may require > 30 years to mature. Due to the longevity of the species, institutional dedication to long-term monitoring will be required to assess whether the populations are self-sustaining.

**SOCIAL IMPACTS OF MARINE PROTECTED AREAS: A GLOBAL REVIEW**

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Marine protected areas (MPAs) are one of the primary policy instruments used to conserve marine ecosystems. Relatively little research has examined the positive and negative social impacts of MPAs, yet social "performance" often determines the extent of local, national, and international political and financial support for MPAs. Based on a literature review and analysis of unpublished field data, this study reviews current social scientific knowledge regarding MPA social impacts. Numerous patterns and trends emerge, including: MPAs transfer the benefits of resource use within and among resource user groups, fishermen with fixed gear or informal fishing territories are more significantly affected by MPAs than transient fishermen employing mobile gear, MPAs often induce community-level demographic change, the social performance of MPAs subsequently shapes MPA evolution. "Successful" MPAs frequently spur site expansion, while "unsuccessful" MPAs often fuel efforts to revoke MPA designations. Four aspects of MPA governance, decision-making arrangements, resource use rights, monitoring and enforcement systems, and conflict resolution mechanisms, appear to play pivotal roles in shaping the social impacts of MPAs. These findings provide (1) a framework for designing MPAs that deliver positive social and biological outcomes and (2) the foundation for more sophisticated research on the social impacts of MPAs.

**THE DISTRIBUTION AND CONSERVATION STATUS OF RESTRICTED RANGE VASCULAR PLANT FAMILIES**

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Many decisions about where to invest scarce conservation resources are based on species' distributions. Such choices rarely involve conservation of higher taxonomic uniqueness. New maps of global plant species richness are available, but higher taxon uniqueness has not been adequately addressed. We analyzed range restricted vascular plant family distributions to add a new metric to the designation of global biodiversity priorities. Working with a list of families of limited geographic distribution, we searched records from online botanical databases and the U.S. National Herbarium to determine family range sizes. 67 plant families (15% of total) in 31 orders (52%) comprising 100 genera (0.75%) and 353 species (0.13%) are considered range restricted as defined by presence in 5 or fewer ecoregions; 44 families appear to be endemic at the country or ecoregion level.

Interestingly, these include monotypic and species-rich examples and exhibit similar patterns of distribution in or adjacent to Mediterranean ecosystems and on relictual Gondwanan islands or continental areas. Only 18 families include species that have been assessed on the IUCN Red List. Thus, these geographically restricted families require further study to clarify their risk of extinction. Extended to genera, such analyses will refine our ability to conserve unique evolutionary lines.

### **A STEP FORWARD IN MITIGATION OF FRAGMENTATION BY HIGHWAYS: PREDICTABILITY OF TERRESTRIAL VERTEBRATE USE OF CROSSING STRUCTURES**

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Wildlife crossing structures are frequently included among mitigation measures of highways to restore habitat connectivity, playing an important role for vertebrate conservation. However, no trial has been done to predict which species will use planned structures. In this study we test the possibility to predict vertebrate use of crossing structures on a highway (A231, north-central Spain) from a source dataset composed of four monitoring periods (2001 to 2003) with 91 crossing structures carried out on a different highway (A52, northwest Spain). Data from 40 crossing structures (70,300 km away from source data) monitored during two sample periods in 2003-2004 were used for cross validation. A total of 15 vertebrate taxa (660 species trackdays) also present in source data were recorded on A231 highway. The frequency of crossing through different structure types (5 types of wildlife and nonwildlife engineered passages) was highly predictable (ANCOVA test,  $p < 0.001$ ) and unbiased among species ( $p = 0.752$ ). However, prediction accuracy for individual species was conditioned by minimum number of observations from them (either in source or validation datasets, Spearman  $r$ ,  $p = 0.026$ ). In conclusion, it is possible to optimize crossing structure design during road planning using monitoring data from sites sharing a significative vertebrate fauna.

### **COLLECTIVE ACTION FOR SUSTAINABLE MANAGEMENT OF CPR (COMMON POOL RESOURCES) IN TWO REGIONS OF COLOMBIA**

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We present results from research carried out in two regions of Colombia: Pacific Coast (*Afrocolombian communities*) and Andean Zone. We utilized experimental economics, system dynamics, and participative methodologies in order to analyze collective action, endogenous and external rules, and the role of regulatory agencies in the sustainable management of CPR such as marine fauna and water. In the Pacific Coast there is an important development of conservation collective actions; there are endogenous norms developed by CPR users. There is an important level of articulation between communities and the agencies in charge of formal regulation. In the Andean Zone, there are few conservation collective initiatives. There are very few endogenous norms and the external rules (from governmental agencies) are not efficient. The comparative analysis let us to identify some elements and strategies that do or do not facilitate the CPR management. Such characteristics have a key role in the possibilities to develop the necessary synergies between governmental agencies in charge of regulation and communitarian self government initiatives to generate sustainable benefits and conservation of CPR. It is evident from the study that variables as reciprocity and trust are fundamental for the successful design and enforcement of norms and rules for CPR management.

### **CAN AVERSIVE CONDITIONING EFFECTIVELY REDUCE HUMAN-BLACK BEAR CONFLICTS?**

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As the occurrence of food-conditioned and human-habituated bears increases worldwide, so do human-bear conflicts. Conflicts are often resolved by killing the "nuisance" animal. Lethal control solves immediate problems, but it is not a long-term solution, is losing acceptance with the public, and puts entire populations of rare species at risk. Aversive conditioning, a non-lethal means of dealing with nuisance bears, is generating interest. Anecdotal evidence points to short-term successes, but limited published research questions the long-term effectiveness. Aversive conditioning may be a politically appealing strategy that simply doesn't work, and may even be hindering progress and creating new problems. To evaluate aversive conditioning, biologists in Sequoia National Park used non-lethal projectiles, including slingshots and rubber slugs, on 36 black bears over 1000 times for four summers (2002-2005). Aversive conditioning was successful in getting the eighteen bears with the least exposure to human food to abandon unwanted behaviors. None of the eighteen bears that were classified as "problem bears" abandoned unwanted behaviors, but in some cases, behaviors were modified to an acceptable level. These results are now being used to inform the Park's bear management program on how to redirect efforts to be more effective in the future.

### **BIOSAFETY ISSUES AND POLICIES IN CHINA**

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With 22 percent of the globe's population and declining arable land for agricultural production, China is preoccupied with pressures on food security. As a mega-diversity country, China also is conscious of the extent to which increased productivity through use of GMOs may put indigenous species at risk. We report on three issues in China's developing biosafety regime, based on transgenic research now being conducted on 47 plant species, understood through interviews with participants and surveys of the scientific literature (primarily in Chinese): (1) Impediments to identification of risk to biodiversity because of problems in integration and coordination of national and provincial bureaucracies and capacity-building needs including upgrading biotechnology knowledge (which China seeks to satisfy partly through active involvement in international conventions such as the Cartagena Protocol). (2a) Conflict between needs to promote endemic species through genetic engineering and conservation of indigenous species such as rice from contamination. (2b) Conflict between the desire to learn new techniques and approaches in biotechnology while avoiding exploitation of China as a LMO testing ground for multinational corporations. (3) The alignment of China's strategic plan to promote its own technology while developing laws, regulations, and

policies that optimize learning from advanced nations.

**CREATING A SOCIAL SCIENCE RESEARCH AGENDA FOR PROTECTING BIODIVERSITY IN THE CHICAGO REGION**

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Chicago Wilderness (CW) is an alliance of over 185 public and private organizations working together to study, restore, protect, and manage the biodiversity in the Chicagoland region. Many of the goals in the recently completed CW Strategic Plan are related to the human dimensions of biodiversity conservation. In early 2005, a group of social scientists met to discuss how to create a research agenda to support the strategic goals. A subgroup worked with a consultant from Organizational Research Services (ORS) to design an iterative process to summarize existing research and identify gaps in order to prioritize future research needs. A key component of this process was the creation of a theory of change / logic model for mapping such research in relation to the desired CW outcomes and showing the interrelationships between the activities. This presentation will share the resulting model and discuss the steps of the process, including the challenges of working with scientists from different disciplines. Examples will be provided for how the model (1) helps identify underlying assumptions, (2) allows better measurement of key variables, and (3) serves as a tool for communicating the role of the social sciences to broader audiences, including biologists, policy makers, educators, and communicators.

**A CHARACTERIZATION OF PELAGIC HABITAT OF LOGGERHEAD (CARETTA CARETTA) TURTLES IN THE NORTH ATLANTIC OCEAN**

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For many species of marine turtle, the characteristics that define pelagic habitat have yet to be fully identified. A better understanding of these habitat characteristics is critical to reduce high seas fisheries interactions with turtles, especially since the status of many turtle populations has placed them on the threatened or endangered species list. To gain a more thorough understanding of pelagic loggerhead habitat, we analyzed sea surface temperature, sea surface height anomaly, and chlorophyll a values for sites where loggerhead turtles were caught during scientific longline cruises and commercial longline fishing operations in the central north Atlantic. The data were collected between 1997 and 2002, year-round. We analyzed the same oceanographic data for satellite-tracked loggerhead turtles from the eastern north Atlantic, and compared habitat definitions derived by the two different data-collection methods. The analyses indicated that both satellite tracked and incidentally caught turtles were located near oceanographic features such as fronts, possibly due to the high concentrations of prey items at those features. This work showed that satellite tracking and fisheries data can be successfully integrated to identify important pelagic habitats for marine turtles, an approach which can be applied to populations in the Pacific Ocean as well as the Atlantic.

**TRIALS WITHOUT TRIBULATION: ACTIVE LEARNING FOR CONSERVATION MANAGEMENT**

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Active adaptive management is a process in which current management actions are used to help learn how to manage ecological systems. However, it is often difficult to judge the benefits of learning relative to those of current management. We examine the situation where a manager can allocate effort to discrete units (e.g., areas for revegetation, or animals for reintroduction) and the outcome is measured as success or failure (e.g., the revegetation is successful, or the animals survive and breed). We assume that the manager has two possible management options from which to choose, but is uncertain about which is best. We further assume that there is an annual budget that may be allocated among the two options, and the manager must decide on the allocation. We use Bayesian updating of the probability of success of the two options and stochastic dynamic programming to determine the optimal strategy over a specified number of years. The management objective, costs and level of certainty about the success of the two options, and the timeframe of management all influence the optimal allocation of the annual budget. These results can be used to determine how best to manage ecological systems in the face of uncertainty.

**RESTORATION OF A COMMON MURRE COLONY USING SOCIAL ATTRACTION**

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Direct restoration of seabird populations after oil spills has been rarely attempted. A colony of Common Murres (*Uria aalge*) at Devil's Slide Rock, California was extirpated after the 1986 Apex Houston oil spill in central California that killed 6300 murres. With 1994 litigation settlement funds, we used social attraction techniques to recolonize this rock. In 1996, 12 plots of murre decoys (adults, eggs, chicks) and mirrors plus two vocalization-broadcast systems were deployed to attract murres to the rock. Small numbers of murres attended immediately and six breeding pairs fledged three chicks in 1996. Colony growth was slow in 1996–1998 but expanded rapidly in 1999–2005, with a high of 190 egg-laying pairs in 2004. In 2000, we began reducing decoys, with only 20% left by 2005. In 2002, focus shifted to adaptive management to increase murre densities in established areas. Chicks fledged per pair averaged 0.65 (range 0.32–0.77) from 1996–2005, similar to other nearby colonies. Numbers are still well below 1979–1982 levels (1200–1500 pairs) but colony growth is expected to continue without social attraction. This first successful restoration of murres using social attraction has demonstrated that direct seabird restoration is feasible under suitable conditions with sufficient effort.

### **WHAT'S PAST IS PROLOGUE: LAND-USE LEGACIES, PRESENT-DAY FRAGMENTATION, AND INVASIVE SPECIES**

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While non-native invasive species often have detrimental effects on human and natural systems, the relationship between land-use legacies, present-day fragmentation, and invasive species presence is not well understood. We examined 148 field sites throughout western Massachusetts for non-native plant species. Almost half (49.3%) of sites had at least one non-native plant present. We used logistic regression to model the probability of non-native occurrence for four species: barberry (*Berberis thunbergii*), bittersweet (*Celastrus orbiculatus*), glossy buckthorn (*Rhamnus frangula*), and multiflora rose (*Rosa multiflora*). Bedrock-type was the most important predictor of non-native plant presence, with calcareous sites being more likely to have non-native plant species. Local land-use legacies was also an important predictor of whether a site would have a non-native plant species, with sites that were more intensively modified more likely to have a non-native plant species. Finally, the structure of the current forested landscape is important, with sites that are surrounded by more forest less likely to have a non-native species. Our results stress that the likelihood of a non-native plant species is a complex function of both past and present land use.

### **CURRENT POPULATION AND CONSERVATION STATUS OF THE CRITICALLY ENDANGERED DWARF CARNIVORES OF COZUMEL ISLAND, MEXICO**

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To better understand the population biology and conservation status of the endemic and endangered pygmy raccoon (*Procyon pygmaeus*) and dwarf coati (*Nasua nelsoni*), the island-wide presence of these species was identified, and for the pygmy raccoon we studied several populations in depth between 2001–2003. Trapping was conducted for > 3500 trap nights in 10 locations of varying habitat types. We found pygmy raccoons only at three sites, despite what appears to be suitable habitat elsewhere on the island. A total of 78 individuals (38 males and 42 females) and a single adult male dwarf coati were captured. Using mark-recapture models and density estimates, the current population of pygmy raccoons on Cozumel Island is estimated to be fewer than 194 mature individuals at this time. Currently, the IUCN has listed both the dwarf coati and pygmy raccoon as Endangered. However, our research indicates that these species clearly warrant the criteria of Critically Endangered due to their restricted range and small population numbers. Our results indicate that the Cozumel coati is in danger of eminent extinction, is extremely rare on Cozumel Island, and in need of immediate conservation protection.

### **THE "POWER" OF SCIENCE: CONFRONTING TYPE II ERROR UNDER THE ENDANGERED SPECIES ACT**

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In conventional research and hypothesis testing, the benefit of doubt belongs to the null hypothesis, while the burden of proof rests with the alternative hypothesis. This conservative paradigm, which stems from the institutional assumption that Type II error (i.e., failing to detect a significant effect) is preferable to Type I (i.e., erroneously claiming a significant effect), is prudent when the scientific community can afford to replicate experiments many times. It can break down in endangered species management, however, when officials must make decisions with only the "best available data," and a Type II error may permit extinction. Accordingly, I argue that power analysis, which provides unbiased estimates of Type II error probability, should be instituted in all Endangered Species Act reviews. To substantiate this claim, I apply power analysis to a recent review of endangered species management in the upper Klamath Basin (southern Oregon), in which a failed hypothesis test was used as evidence against the need for protective action, despite the fact that Type II error probability exceeded Type I by an approximately 12x margin. I then conclude that hypothesis tests are an adequate basis for endangered species decisions only when they incorporate sufficient statistical power.

### **HABITAT USE OF WHITEBARK PINE (*PINUS ALBICAULIS*) FORESTS BY CLARK'S NUTCRACKER (*NUCIFRAGA COLUMBIANA*): IMPLICATIONS FOR RESTORATION**

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Whitebark pine (*Pinus albicaulis*), a keystone species in subalpine forests of the western United States and southwestern Canada, is in danger of local extirpation due to the introduced pathogen white pine blister rust (*Cronartium ribicola*), advancing succession, and mountain pine beetle (*Dendroctonus ponderosae*) upsurges. Whitebark pine depends upon Clark's nutcracker (*Nucifraga columbiana*) to disperse its seeds. Restoration treatments (thinning, prescribed burning) aimed at enhancing regeneration rely either on nutcracker seed dispersal or on planting rust-resistant seedlings. Nutcrackers, however, may be absent in heavily damaged whitebark pine forests. Our objective was to determine whether the frequency and timing of nutcracker occurrence, and thus dispersal potential, was related to forest conditions. We conducted nutcracker surveys and measured various stand attributes over a four-year period in 16 stands varying in degree of rust-induced mortality and live-tree crown damage. We found mean nutcracker occurrence was positively and linearly related to live whitebark pine basal area, and at the time of seed dispersal, to predispersal seed survival. In addition, overall nutcracker frequency increased in years with greater cone production. Working with restoration practitioners, we established a framework for differentiating sites with a high likelihood of nutcracker dispersal from those where restoration planting is needed.

### **INCORPORATING MULTIPLE PATHWAYS INTO CONNECTIVITY ANALYSIS AND CORRIDOR DESIGN USING CIRCUIT THEORY**

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New models from electronic circuit theory allow efficient analysis of connectivity in complex landscapes. The models can improve over least cost path approaches because they have clearer theoretical foundations and incorporate all possible pathways linking patches or points in a landscape. We'll describe how circuit theory can be used to (1) predict effects of landscape pattern on gene flow among animal populations, (2) predict patterns of animal movement and mortality during dispersal, and (3) identify important habitat patches and movement corridors for conservation under different land use scenarios. Because the models take advantage of efficient algorithms, large landscapes can be accommodated on modest desktop computers. We'll provide examples from ongoing efforts to identify corridors and maintain connectivity among mountain lion populations in southern California.

**TRANS-ATLANTIC LEARNING: SHARED CONSERVATION APPROACHES FROM NORTH AMERICA AND AFRICA**

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Though similar community-based conservation schemes have been widely implemented in both developed and developing nations, too often they are characterized as unique approaches. Few attempts have been made to consolidate and communicate successes and failures on both global and local levels so that future programs can benefit from these experiences. Kellert et. al. (2000) found a number of similarities and important comparisons between community conservation efforts in Kenya, Nepal, and North America. Nevertheless, conservationists seeking to augment their conservation efforts by drawing from other experiences often identify opportunities for learning based on similarities in ecosystem or socio-economics. This isolationism results in a failure to incorporate key learnings from other local conservation efforts and hence repetitive mistakes that might otherwise have been avoided. The authors believe there are specific opportunities to learn from the methods of organizations working in globally distinct areas. This presentation offers a comparative view of community focused conservation approaches in Pennsylvania (USA) and Tanzania as an example of the potential for building positive long-term organizational relationships and collaborative educational opportunities at a global level, focused on conservation at a landscape scale.

**HOW DOES HABITAT FRAGMENTATION AFFECT RANGE SHIFTS IN SPACE AND TIME?**

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Climate change is expected to have a large impact on the future geographic distribution of a variety of species. Range expansion is predicted to be fastest in regions where landscape structure (or the spatial configuration of habitat) enhances dispersal and should lag behind in regions where habitat is highly fragmented. We tested this hypothesis by examining the northern range dynamics of the Hooded Warbler (*Wilsonia citrina*), a species listed as threatened in Canada because of their relatively low peripheral population sizes in this country. We used historic occupancy records (1966–2004) in southern Ontario and analyzed fourteen, 20 x 20 km regions having different degrees of habitat fragmentation (4 to 37% forest cover). A graph theoretic approach was used to evaluate habitat fragmentation and landscape connectivity. Matrices of the distance between species occupancy records in space were correlated with temporal distance matrices, and correlogram analysis was used to examine the scale (or distance class) at which spatio-temporal correlation breaks down. We found some evidence for a relationship between the strength of spatio-temporal autocorrelation and the pattern of temperature change in this region using crosscorrelation analysis. This study provides evidence supporting the role of landscape fragmentation in limiting species range shifts in response to climate change.

**MELDING PLANNING AND OPPORTUNITY DRIVEN CONSERVATION USING ADVANCES IN SPATIAL DATA MODELS**

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Conservation organizations invest heavily in science-based conservation plans that often result in static reports and maps that identify priorities at the time the plan was completed. Typically 60% or more of the time and effort in planning is spent on data compilation and management. Advances in spatial database models can provide planners a tool for efficient and transparent data collection, update, and re-evaluation. In particular, we show how a seamless link between the spatial database (geodatabase) and site-selection algorithms adds functionality and efficiency to several aspects of conservation planning, including evaluation of unanticipated conservation opportunities, dynamic update and refinement of regional data, and development of context-specific conservation strategies. The integration of two separate technologies allows us to merge systematic planning and opportunity, two dimensions of conservation that have often been at odds with one another.

**USING SPECIES DISTRIBUTION MODELING TO ASSESS AVIAN CONSERVATION NEEDS IN THE TEMPERATE FOREST OF CENTRAL CHILE**

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Central Chile constitutes the northern limit of the South American temperate forest, and concentrates the highest species diversity and economic activities in the country. There is little information available about bird species habitat requirements and their level of protection in the current National Protected Areas System. Bird point counts were carried out in more than 140 points representing 6 native vegetation types within the temperate forest. Habitat requirements for birds were characterized using a general additive modeling strategy, with local vegetation measurements and climate as predictors. A model was built for each species separately and it was then used to build a large scale GIS model of habitat suitability for each species in the region. A variety of climate, productivity, and forest characteristics available on a GIS were used as the predictor variables. We built and compared several indexes of conservation priority based on the sum of habitat suitability of individual species. We considered all species together, or divided in groups reflecting different vulnerabilities to climate and vegetation variables. Areas for conservation are somewhat different according to the group of species studied, and they don't match the priority sites

currently defined, particularly in coastal areas.

### **CONSERVATION OF BIODIVERSITY AND ECOSYSTEM FUNCTION IN CORAL REEF SEASCAPES**

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The design of effective networks of marine protected areas (MPAs) requires an understanding of how the mosaic of marine habitats across marine landscapes, or seascapes, supports marine biodiversity and the ecological functions and services critical to human well-being. Information is generally lacking, however, on how the structure and functioning of communities vary across seascapes, and whether reserves are effective in maintaining or restoring key ecological processes. In The Bahamas, we combined field ecological and ethnographic surveys, and statistical and mathematical modeling to link communities to habitats, examine how different players in the ecosystem—with their associated ecological and socioeconomic roles—are distributed across space, and investigate the performance of existing reserves in restoring ecological functions and services. Results show that specific combinations of habitat types need to be preserved to maintain productivity and resilience of coral reef seascapes, and that protection in marine reserves results in increased biomass of top predators, enhanced grazing by herbivorous fishes, a process that is crucial for maintaining suitable habitat for coral recruitment and recovery from disturbance, and increased diversity of the ecological functions performed by coral reef assemblages. These insights are guiding the development of models for MPA network design.

### **ASSESSING THE CONSERVATION BENEFITS OF SENSITIVE LAND DEVELOPMENT**

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In the United States, innovative approaches to land development such as limited development projects and conservation subdivisions have been advanced as a way to conserve nature while meeting human demands for development; yet, there has been little critical evaluation of the conservation effectiveness of these practices. To address this deficiency, we created a multi-criteria evaluation method that uses a coarse filter and mesofilter approach to measure the conservation success of such integrated land use projects. The method's eight indicators quantify a project's positive and negative impacts to terrestrial and aquatic ecosystems on the site and in the larger landscape. We used this method to assess ten conservation and limited development projects in the eastern United States that were conducted or facilitated by conservation land trusts. The assessment revealed that these projects cost-effectively protected unique and threatened resources, including rare species and ecological communities. It also underscored the method's utility for helping conservationists, developers, and land use planners to design, improve, and evaluate integrated land use projects that contribute meaningfully to conservation.

### **EXPERIMENTAL CONTROL OF A NATIVE PREDATOR AND BREEDING SUCCESS OF A THREATENED SEABIRD ON SANTA BARBARA ISLAND, CALIFORNIA**

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Predation by native deer mice (*Peromyscus maniculatus elusus*) is considered one of the greatest threats to the nest success of Xantus' murrelet (*Synthliboramphus hypoleucus*), a small, burrow-nesting seabird. Reduction of mouse predation has been proposed as one way to increase reproductive success on Santa Barbara Island (SBI), where 95 of the known United States population nests. Between February and June 2004, approximately 1650 mice were translocated from the murrelet colony to the opposite side of SBI, reducing mouse population density significantly relative to a control site. During mouse removals, fewer eggs were preyed upon by mice (14.5) than the average (37.8) between 1993–2003. Productivity was high during mouse removals, with 1.38 eggs hatched per nest. Hatching success was not markedly higher than the historical average, but this may be due to reasons for nest failure other than predation, most importantly abandonment. Although mouse removal was successful at reducing mouse abundance on the murrelet colony, it is unclear whether it improved nesting success. Mouse removals may reduce egg predation, but, because other factors are likely important in ensuring the persistence of murrelets, the most effective conservation approach will incorporate efforts both on land and at sea.

### **NEGOTIATING FOR NATURE: LESSONS LEARNED FROM THE IMPLEMENTATION OF CONSERVATION INCENTIVES AGREEMENTS IN CAMBODIA**

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This research examines the application of conservation incentives agreements, negotiated between NGOs and local communities in a Protected Forest in Cambodia. I review the origins and design of this policy (based on direct payments), then assess its performance in the face of field realities, highlighting the importance of local context, as well as the operational links between social and ecological realms. Research explores the socio-economic impacts of incentives agreements: first in order to assess their potential for poverty alleviation, and second to elaborate on the institutional requirements for successful implementation. Findings, based on ethnographic methods and case studies indicate that (i) Negotiating agreements with "the community" is a critical moment in policy implementation. The existence of formal representative institutions within communities is necessary, but attention must be paid to institutional legitimacy in order to achieve desired results. (ii) The micro-politics of community institutions makes decision-making and negotiation highly variable between sites. These factors

also affect the local distribution of effort and benefits resulting from incentives agreements. (iii) Incentives agreements work best when the "conservation services" provided are easily measured (fixed targets). Measuring changes in people's behavior or conservation targets across large areas is expensive and difficult.

#### **THE CONTRIBUTION OF REPRODUCTIVE TECHNOLOGIES FOR MANAGEMENT OF CONSERVATION PESTS**

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Reproductive technologies, normally used to augment reproduction of threatened or endangered species, can equally contribute to development of new options for conservation pest management. These technologies are, for example, being used to develop fertility control for New Zealand's two key introduced mammal pests, the brushtail possum and the stoat. Methods for monitoring and manipulating possum and stoat reproduction have been developed to evaluate various agents (e.g. chemicals, proteins, peptides, and other antigens) for their ability to disrupt key reproductive stages and hence prioritize those suitable for fertility control. Hormone treatment and artificial insemination are now routinely used during the breeding season to screen reproduction-based vaccines for possum biological control. Recently a new hormone treatment protocol was found to be reliable for use outside the breeding season, at least doubling the period during which fertility vaccines can be tested in future possum trials. For stoats, along with establishment of a captive breeding colony, reproductive technologies like sperm preservation, artificial insemination, embryo culture, and non-invasive reproductive hormone monitoring have been developed. These will be the key techniques for testing fertility control agents targeting stoat reproductive function in the future.

#### **DOES SEX CHANGE INFLUENCE FISH RESPONSE TO PROTECTION?**

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Sex change is widespread among marine fish, and occurs in many species that are fished heavily. It has been hypothesised that sex change may increase a species' susceptibility to recruitment failure through overfishing, although evidence to support or refute this hypothesis remains sparse. However, given that this hypothesis is based on the question of whether sex change impairs recruitment under conditions of intensive fishing, it is prudent to question whether sex change also reduces a species' ability to recover once fishing has been stopped. If so, sex change may affect a species' response to the implementation of marine protected areas (MPAs), a widely-used marine conservation tool. I compared the ratio of abundances of fish with different reproductive modes inside and outside MPAs, using meta-analyses of data from 15 studies on 399 species. There was no difference in the responses to protection by fishes with different reproductive modes. Overall, both sex-changing and non-sex-changing taxa were approximately twice as abundant within marine reserves. Within sex-changing taxa, only female-first sex changers were significantly more abundant within protected areas. My results support existing evidence for the effectiveness of MPAs as a fisheries conservation tool, and show that this efficacy is not influenced by the reproductive mode of the taxa being protected.

#### **SNP DISCOVERY AND GENOTYPING IN NON-MODEL ORGANISMS: EXAMPLES FROM CETACEANS**

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Molecular analyses of natural populations provide valuable insights into social structures, movement patterns, population structure, and evolution. Every molecular marker, however, has technological and analytical limitations. These limitations can render them inadequate for some questions and can constrain our ability to provide adequate information for management. The bigger the molecular tool box available to conservation geneticists, the more versatile and powerful our ability to answer important questions for conservation and management. We have used two approaches to develop a novel set of genetic markers, single nucleotide polymorphisms (SNPs), to study population genetic structure of sperm whales and bowhead whales. For sperm whales, we identified 37 novel SNPs in 21 sequences, and developed genotyping assays for 21 independent SNPs. These loci have been used in pilot study to investigate population structure of sperm whales in the eastern Pacific. We compare results from SNP analyses to results obtained from mtDNA and microsatellite analyses of 160 individuals from 3 populations to investigate their relative power to detect population structure. All three marker types produced significant  $F_{st}$  values, but varied in patterns of population structure. SNPs provide complementary data to mtDNA and microsatellites in these populations, and provide some technical and analytical advantages.

#### **ADAPTIVE CLUSTER SAMPLING OF RARE SPECIES**

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To effectively manage rare species, accurate monitoring data are critical. When organisms occur in clusters, and these clusters are relatively rare across the landscape, estimation of population size may be inaccurate or inefficient by standard methods. When such populations exhibit great temporal variability, the accuracy and efficiency of long-term sampling is even more challenging. The Missouri Bladderpod (*Lesquerella filiformis*) is a federally threatened winter annual that exemplifies such a sampling problem. Known only from a few counties in Missouri and Arkansas, this species occurs in dense aggregations and exhibits dramatic population fluctuations among years. We employed a two-stage adaptive cluster sampling approach to monitor this species for the past seven years, and developed software to estimate population parameters based on this sampling design. We also tested the relative efficiencies of different sampling methods by simulation. Our results indicate that when population size fluctuates dramatically, a phased approach for determining design factors (e.g., initial sample size and adaptive criteria) may be necessary, based on a predictor of within-year density, a rapid assessment, or a pilot study. Such an

approach may be useful for the monitoring and management of other rare species that exhibit high degrees of spatial aggregation or temporal variability.

### **SPEARFISHING IN THE PACIFIC ISLANDS: CURRENT STATUS AND MANAGEMENT ISSUES WITH CASE STUDY IN FIJI EXPLORING THE ROLE OF MPAS**

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Spearfishing is growing in importance in the 22 countries and territories of the Pacific Islands. It was almost insignificant in the region prior to the introduction of diving goggles in the middle of the twentieth century but has become one of the major components of inshore fishing effort in the Pacific Islands. Data show that spearfishing contributes greatly to inshore overfishing, mainly due to the use of scuba in spearfishing, and night spearfishing. Results from our study demonstrate that spearfishing effort must be managed along with other forms of inshore fishing; attempts at restricting only spearfishing are not likely to be successful, as fishing effort may be easily transferred to other small-scale fishing methods. In Fiji, the establishment of MPAs covering 30% of the total traditionally-owned fishing grounds may prove effective in sustaining inshore fisheries without relying on difficult to enforce, contemporary / Western gear and catch restrictions on fishers. Ongoing surveys of target fish species inside MPAs and control sites, combined with fish landing surveys and intensive monitoring for compliance in the communities of our study site, will test the effectiveness of MPAs in sustaining inshore fisheries, while allowing current levels of spearfishing. This study provides important guidelines for marine reserve design.

### **WHERE CAN I GO TO FIND AMPHIBIANS? EXPLAINING AMPHIBIAN OCCURRENCE IN YELLOWSTONE NATIONAL PARK USING TOPOGRAPHICALLY DERIVED LANDSCAPE VARIABLES**

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A fundamental goal in conservation biology is to understand processes leading to current patterns of species occurrence (i.e., presence and abundance). Habitat occupancy by amphibians is of particular conservation interest due to current global declines with 40% of species threatened with extinction. However, due to the stochastic nature of these systems, informative fine-scale models of amphibian occurrence have been somewhat elusive. The goals of this study are to explain and predict occurrence of two amphibian species (*Pseudacris maculata* and *Bufo boreas*) in Yellowstone National Park using topographically derived deterministic variables. We found significant first and second order spatial variation in both dependent and independent variables violating the assumptions of many analytical methods. Using two spatially informed nonparametric models (Random Forests and Most Similar Neighbor) we were able to explain and predict amphibian occurrence with a high level of support (83-91% of the variability explained). *Pseudacris maculata* occurrence is driven by moisture gradients, while the *B. boreas* abundance is explained by similar variables with the addition of site specific characteristics. Finally, quantifying landscape influence on amphibian occurrence is important for identifying conservation priority areas and understanding species limits to prevent future declines.

### **SIMULATIONS COMPARING THE PERFORMANCE OF TECHNIQUES USED TO ASSESS VARIABLE IMPORTANCE: IMPLICATIONS FOR ANALYSIS OF NOISY ECOLOGICAL DATA**

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Determining the relative importance of predictor variables is of practical relevance to biologists concerned with the allocation of limited resources to conservation. However, correlation among independent variables makes it difficult to identify the unique contribution of each predictor variable to the response variable, and the use of various indices to assess variable importance is poorly understood. We used Monte Carlo simulations to evaluate the performance of zero-order, partial, and semipartial correlations, standardized regression coefficients, Akaike weights, and independent effects under progressively more complex circumstances that incorporated multicollinearity and spurious variables. Zero-order correlations, semipartial correlations, standardized regression coefficients, and independent effects performed equally well when the predictor variables were uncorrelated. However, only independent effects correctly partitioned shared variance between the predictor variables and the dependent variable in the presence of multicollinearity, and detected the concomitant decrease in model  $r^2$  that resulted from this redundancy. Conversely, only zero-order correlations identified the inclusion of a spurious variable in the model. Given that no technique performed well under all circumstances, we suggest that zero-order correlations and independent effects should be used jointly to identify the most important variable to target to achieve a desired conservation outcome.

### **PARADISE DISPUTED: AN EVALUATION OF DECISIONMAKING AND MORAL AUTHENTICITY IN HAWAII'S LAND USE COMMISSION**

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Disputes between conservation and development regarding land use are often chronic, complex, value-laden, and difficult to resolve. Further, the arenas used for resolution, such as courts or roundtables, can be dysfunctional or ineffective in their processes and results. Arenas for environmental dispute resolution that successfully exhibit functionality and effectiveness are therefore instructive to conservation practitioners and policymakers. One such functionally effective arena is Hawaii's Land Use Commission (LUC). The LUC is a state-institutionalized decision making body that has resolved environmental disputes for 45 years and preserved 96% of Hawaii's land base while promoting economic growth. The LUC's ethical foundation was the focus of my research into the reasons for this functional effectiveness. Using in-depth interviews, archival overviews, and surveys, I analyzed the LUC's history, structure, process, and four decisions from 2000–2002. My theoretical lens was Moral Authenticity, a component of Authentic Arena Theory. Authentic Arena Theory is a new, interdisciplinary, and diagnostic framework I

developed for building and evaluating environmental decisionmaking arenas. I concluded a critical ingredient of the LUC's long-term functional effectiveness was the depth and solidity of its moral foundation. An arena with a strong moral foundation therefore appears to be one of the factors that supports more sound, wise, and enduring conservation decisionmaking.

**VALUING ECOSYSTEM SERVICES FOR USE IN COST-BENEFIT ANALYSES: SUSTAINABLE DEVELOPMENT IN THE HEART OF BORNEO**

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Economic valuation of ecosystem services is not typically incorporated into cost-benefit analyses of sustainable development options. Here, I calculate costs and benefits associated with large-scale oil palm plantations that are proposed for an intact forest area in the interior of Borneo. Oil palm plantations are expected to generate significant financial revenues, but these should be compared to opportunity costs, i.e., ecosystem service benefits associated with standing forests. I calculated the economic value of three types of ecosystem services: carbon storage, insurance values (against catastrophic fires), and local-scale services (such as watershed services). Oil palm plantations are expected to generate \$7–20 billion in profits; these would primarily benefit large agribusinesses. In contrast, standing forests in the region were valued at \$1–7 billion. Carbon storage services dominated the aggregate value and accrued to the global community. Fire insurance services were a national and regional level benefit, while local ecosystem services, though small in overall value, were high relative to locals' incomes. This estimate of the economic value of forests in the heart of Borneo is a lower bound because many services were not considered. Valuation of ecosystem services can be used in cost-benefit analyses to highlight tradeoffs among stakeholders when considering development options.

**ASSESSING THE SUSTAINABILITY OF AGROFORESTRY SYSTEM: A STUDY FROM NORTHEASTERN HILL FORESTS OF BANGLADESH**

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Khasia ethnic community of Bangladesh have been living as forest villagers in northeastern hill forests of Bangladesh since early 1950s, and have been practicing betel leaf based agri-silvicultural type of agroforestry system on forest department's granted land. Taking a sample forest village of the Sylhet forest division as a case study, this article empirically examines the sustainability of agroforestry system. By investigating 15 indicators, findings of the study indicate that the agroforestry system is sustainable not only in ecologically and economically, but also in socially and institutionally. Cultural beliefs, skilled manpower and long experience, buoyant markets as well as necessary institutional support make the agroforestry systems sustainable that helps Khasia people to sustain their living. However, some institutional issues such as land tenure and the problems with regular renewal of agreement should be resolved for better outcomes of their livelihoods and forest conservation.

**CAN WE CONSERVE BIODIVERSITY WITHOUT REALLY TRYING? CAPTURING NON-TARGET BIODIVERSITY USING COMMUNITY-BASED REPRESENTATIVE RESERVE DESIGNS**

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A stated goal of many conservation organizations is to conserve all viable native species and community types in portfolios or networks of protected sites. Accomplishing this goal requires capturing many types of diversity (e.g., genetic diversity within species, individual rare species, general species diversity, and community diversity) in conserved areas as well as maintaining processes that will yield sufficient probabilities of persistence of that diversity through time. Complementarity-based reserve selection algorithms provide an appealing approach to prioritizing sites for conservation because they are objective and efficient and they ensure representation of target features in the minimum number of sites. Typically data are lacking for all but vegetation community and a subset of species distributions and it is assumed that representing natural communities can act as a surrogate for representing other non-targeted types of diversity. This assumption is not well tested. We evaluated how well reserve networks selected to represent vegetation community diversity also represented modeled distributions of ~500 vascular plant species and genetic diversity within four endemic plant species by calculating the proportion of total diversity present in the study area that was included in reserve networks representing varying percentages of the study landscape.

**ARCHAEOLOGY OF THE KERINCI SEBLAT NATIONAL PARK, INDONESIA**

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The region of Serampas in the highlands of Sumatra has been largely incorporated into the Kerinci Seblat National Park, the second largest conservation area in Indonesia. A recent archaeological survey of the region, conducted with assistants from two resident villages, resulted in the documentation of three megaliths, 39 abandoned village sites, and numerous other archaeological remains dating back to at least the 12th century AD. The abandoned village sites, which are primarily located on hilltops and other strategic locations, have retained a significant physical presence in the landscape, being marked by grave mounds, economically valuable tree species, and moats, measuring 1–10 m in depth. This physical evidence of long-term human habitation suggests that Indonesian national parks do not protect original ecosystems, as defined by Indonesian law, but rather discursively construct them from landscapes shaped by the interactions of humans and biophysical forces. Politically, the government's discourse of "pristine" nature has served to obfuscate the historical role of local communities in managing resources inside the park and delegitimizes their current customary claims, creating enemies out of potential allies. The challenge for conservation biologists, therefore, is to construct protected areas that incorporate humans. My presentation will suggest several ways to do that.

**UNDERSTORY PLANT RESPONSES TO THINNING AND BURNING IN PONDEROSA PINE FORESTS OF EASTERN WASHINGTON, USA**

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Fire-adapted forests across the interior Northwest are increasingly susceptible to damage from insects, pathogens, and stand-replacing fires following decades of fire suppression. As a result, managers are employing thinning and underburning to reduce fuel loadings and to restore the stand structure, species, and processes that historically characterized these forests. However, the consequences of these activities for understory plant communities are not well understood. We examined the effects of thinning and burning on understory plant composition and richness in ponderosa pine forests of eastern Washington. Data were collected in 70 stands in the Colville, Okanogan, and Wenatchee National Forests. Stands represented one of three types of restoration treatments (or a control) conducted 3–20 yr before sampling: thinning, burning, thinning plus burning, or no treatment. Neither thinning nor burning had an effect on species composition or on the cover or richness of native plants. In contrast, non-native plants showed small, but highly significant, increases in both cover and richness in response to thinning and / or burning, with the greatest increases associated with the combined treatment. Although thinning and burning may promote invasion of exotic plants in these forests, our data suggest that increases in their abundance and diversity are limited.

**THE RAKIURA TITI RESTORATION PROJECT: MITIGATION OF THE COMMAND OIL SPILL INJURY BY ERADICATION OF RATS FROM SOOTY SHEARWATER BREEDING COLONIES IN NEW ZEALAND**

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We present an example of international and cross-cultural collaboration to mitigate the effects of an oil spill on a trans-equatorial migratory seabird, the Sooty Shearwater (*Puffinus griseus*), called titi by the Rakiura Maori, indigenous people of southern New Zealand. Migratory seabirds face a multitude of human-related threats when at sea (e.g., marine pollution, fishery bycatch) and at their nesting islands (e.g., habitat disturbance and non-native mammalian predators). In September 1998, an estimated 1400 to 15,000 shearwaters were killed in coastal Californian waters during their non-breeding migration by oil leaked from the negligent T / V *Command*. The Rakiura Titi Restoration Project seeks to repair the oil spill injury by eradicating invasive non-native rats (*Rattus* spp.) from four breeding islands in New Zealand: Taukihepa (939 ha), Rerewhakaupoko (86 ha), Mokonui (30 ha), and Pukeweka (3 ha). This restoration project is co-managed by US trustee council and guided by Rakiura Maori who are the kaitiaki (environmental guardians) of this taonga (treasured) species. Rakiura Maori value titi for their cultural, economic, and spiritual importance. Because titi are ecologically important as a keystone species in the titi island ecosystem, this project is expected to result in multi-species benefits to endemic insects, native birds and plants.

**POST BREEDING MOVEMENTS AND FISHERIES OVERLAP OF BLACK-FOOTED ALBATROSS (2004–2005)**

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The endangered Black-footed Albatross (*Phoebastria nigripes*) is susceptible to longline fisheries bycatch across the North Pacific Ocean. Yet, little is known about the movements and threats faced by individual albatross at sea, especially during their post-breeding dispersal (July–November). We used satellite tracking to investigate albatross movements, habitat use, and overlap with longline fisheries during 2004 and 2005. We tagged 18 birds from the Hawaiian breeding population off central California, and tracked their movements for 748 albatross / days, with individual deployments ranging from 22–57 days. All birds ventured outside of the U.S. EEZ, with one traveling to Hokkaido (Japan), over 7300 km from the tagging site. Overall, five birds traveled west of the international dateline, and three birds ventured into territorial waters of four other range nations (Canada, Japan, Mexico, Russia). On average, the tagged birds spent > 50% of their time in the high seas, where international longline fleets operate. We also calculated the spatial overlap between albatross post-breeding movements and summer-time pelagic longline fisheries, using historical 5 degree x 5 degree effort data from the Oceanic Fisheries Program. Our results indicate that post-breeding Black-footed Albatross do not remain within California waters, but range widely across areas targeted by pelagic longline fisheries from multiple nations.

**FOREST DISTURBANCE AND UNDERSTORY BIRD COMMUNITY STRUCTURE AND COMPOSITION IN THE USAMBARA MOUNTAINS, TANZANIA: A 16-YEAR STUDY**

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I compared understory bird community structure and composition among primary, slightly disturbed, and moderately disturbed forest in the East Usambara Mountains in Tanzania. Comparisons were conducted at two spatiotemporal scales: short-term, conducted in 1999 and 2000, in which treatments (disturbance levels) were replicated; and long-term, conducted from 1989–2004 along the same disturbance gradient of a subset of the short-term sites. I used capture-recapture models to assess the probability of detection and estimate species richness and population growth rates. Over the short- and long-term surveys estimated species richness did not vary significantly among disturbance levels. However, temporal variability in species richness and the relative abundance of guilds did vary greatly among disturbance levels yet was contingent on survey length. Terrestrial insectivores were the guild most adversely affected by forest disturbance. Population growth rates for the more common species of terrestrial insectivores between 1989 and 2004 did not vary significantly among disturbance levels and for these species were significantly < 1.00 indicating the recovery time for terrestrial insectivores in slightly and moderately disturbed forest is very long. These results illustrate the importance of protecting primary forest in the Eastern Arc Mountains.

**FRESHWATER ECOREGIONS OF THE WORLD: A NEW MAP FOR FRESHWATER CONSERVATION**

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Conserving freshwater biodiversity requires freshwater-specific information sources and planning tools. To address this need, we have developed a first-ever global map of freshwater ecoregions, synthesized data for all units, and run a series of threat assessments. For each ecoregion we have compiled freshwater species data (fish and amphibians) and information on geography and climate, major freshwater and terrestrial systems, and any special biodiversity features. Several innovative threat assessments, including analyses of river fragmentation, runoff regulation, and water abstraction, will provide new status evaluations of freshwater systems across the globe. Working with groups of experts from around the world, over 450 ecoregions were delineated. All ecoregions have been categorized into one of twelve major habitat types. Of the 11,500 fish species documented, about forty percent are considered endemic to one ecoregion and approximately thirty-two percent of 3900 documented amphibian species are considered endemic. The global map will be the basis of an educational tool and will be posted on an interactive website. Freshwater ecoregions of the world promises to be one of the most comprehensive global syntheses of freshwater biodiversity data, providing standardized and current information that can inform conservation at global, continental, and ecoregional scales.

**DUNG BEETLE RESPONSE TO TROPICAL FOREST MODIFICATION: A GLOBAL REVIEW AND META-ANALYSIS**

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Landscape conversion remains the primary threat to biodiversity, but despite thousands of empirical studies syntheses of biodiversity's responses to these threats remains elusive for most taxa. We conduct an empirical literature review and meta-analysis of the impacts of tropical forest modification on scarabaeine dung beetles, a cosmopolitan and diverse taxon involved in several key ecological functions. We assessed dung beetle community response to a gradient of increasingly human modified habitats that included intact forests, selectively logged and secondary forests, poly- and monospecific agroforestry systems, annual monospecific crops, pastures, and clear cuts. Across 26 studies worldwide, dung beetle species richness, evenness, and community similarity (relative to intact forest) declined with increasing simplification of vegetation physiognomy, while total beetle abundance demonstrated little pattern. Secondary and selectively logged forests supported communities similar to those in intact forest, while cattle pastures and clear-cuts supported extremely impoverished, uneven communities with low similarity to intact forest. Variability in dung beetle response is associated with landscape context. Communities were less impacted when modified habitats were small in size and / or were located in close proximity to sources of disturbance-tolerant colonizing species. These results highlight the importance of landscape-level conservation and suggests future research priorities.

**THE CONSERVATION MOSAIC: A MULTINATIONAL APPROACH TO SEA TURTLE CONSERVATION IN THE CALIFORNIAS**

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The conservation mosaic is a model program for social change and the protection of highly migratory species. The goal is to reduce poaching and bycatch of endangered sea turtles. Preliminary results indicate positive changes in partner communities, increased numbers of sea turtles on nesting beaches and foraging grounds, and an emerging "sea ethic." Over the past decade we have developed this approach to sea turtle conservation in the Californias (United States and Mexico) through the integration of three strategies: (1) facilitate the growth of a diverse international network of fishermen, students, teachers, activists, researchers, funders, managers, indigenous community members, and other coastal citizens, (2) draw on these relationships to understand threats, generate new knowledge, and develop practical solutions, (3) empower local leaders to communicate and share these solutions through an array of resonant media. The novelty and effectiveness of our methodology is based on an integrated, innovative approach informed by regular evaluation and monitoring. We have adapted and exported the conservation mosaic model to community-based projects focused on leatherback turtle conservation in Indonesia and shark conservation in the eastern Pacific.

**GRAFT, DRUGS AND STEAL: THE ELEPHANT IN THE CORNER OF MARINE CONSERVATION**

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Narco-trafficking and associated impunity, corruption, and criminal behaviors are increasingly obvious, yet largely undocumented factors in environmental, biodiversity, and conservation management, literature, and discourse. In many Latin American biodiversity hotspots the multi-billion dollar narcotics industry is a major economic, political, and social force influencing key conservation actions. The link between trafficking of drugs and wildlife has been explicitly established. This illicit economy and related culture undermine efforts to protect the environment. During two decades of marine conservation and sea turtle recovery efforts in northwestern Mexico researchers have encountered obstructions related to narco-trafficking. On Mexico's Baja California Peninsula, trafficking of sea turtles is intimately related to trafficking of narcotics—from hunting of turtles to their transport and sale. Law enforcement agents are unwilling to intervene for fear of retribution from drug traffickers. Additionally, drug-trafficking impedes marine conservation by making field research unsafe. Case studies and examples will promote (1) conversations around a topic that has remained off-limits, (2) understanding of narco-industry related barriers to conservation, (3) conservation actions and programs with improved chances of success.

**ECONOMIC AND ECOLOGICAL BENEFITS OF REVEGETATING FOLLOWING FIRE IN THE SAGEBRUSH STEPPE ECOSYSTEM**

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Synergies between wildland fire and invasive weeds in the Great Basin sagebrush steppe ecosystem are resulting in the loss of native vegetation, less predictable forage availability for livestock and wildlife, and increased costs and risk associated with firefighting. Understanding the costs and benefits of restoration in this region is critical for informing management. This study employs a Markov chain model of vegetation dynamics to examine the economic and ecological benefits of post-fire revegetation in the Great Basin sagebrush steppe. The analysis is based on a parameterized state-and-transition model of vegetation dynamics for Wyoming big sagebrush community in the Great Basin. This conceptual model was formulated into a quantitative, predictive Markov chain model that links vegetation change, management options, and associated costs. Simulation results were used to identify cost-efficient strategies for achieving ecological goals. Results show that aggressive post-fire revegetation has lower management costs long term than less aggressive management and most effectively slows the spread of invasive weeds. This information could help land managers in the Great Basin justify expenditures on revegetation in the face of budget constraints. In turn, increased revegetation efforts following fires should increase ecological benefits and decrease long-term economic costs in this region.

**BUT, EVERYBODY'S DOING IT! USING SOCIAL NORMS TO PROMOTE CONSERVATION**

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Although a majority of people believe that most people approve of conservation, survey research has shown that many people underestimate the conservation efforts of their fellow citizens. These low descriptive norms may create an obstacle to action in cases where people correctly perceive that participation from a majority of others is necessary to effectively address the problem. In a series of laboratory and field experiments we found that providing people with descriptive normative information indicating that a majority of people were conserving increased conservation efforts among study participants. Furthermore, we find that if we provide information about other students, participants generalize and apply their new beliefs to faculty, state residents, US citizens, and even their friends. While a longitudinal study shows that normative beliefs that have been experimentally induced do degrade over a one month period, the increase in behavioral intention scores remain relatively constant over the same period.

**REDUCING SEABIRD BYCATCH IN LONGLINE FISHERIES USING A NATURAL OLFACTORY DETERRENT**

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Longline fisheries throughout the world have frequent and often fatal interactions with seabirds. We experimentally tested one possible solution to seabird-fisheries interactions that was proposed by a New Zealand longline fisherman, and involved dripping school shark (*Galeorhinus galeus*) liver oil on the ocean surface behind fishing vessels. We tested the efficacy of shark liver oil in reducing the numbers of seabirds attending fishing vessels and the number of dives seabirds executed in pursuit of pilchard (*Sardinops neopilchardus*) baits. We conducted trials in northern New Zealand where seabird assemblages include the globally vulnerable black petrel (*Procellaria parkinsoni*). Shark liver oil was effective in reducing both seabird numbers and dives on baits, compared to canola oil and seawater control treatments. Comparisons of seabird responses to shark liver oil and vegetable oil suggest that shark liver oil acts as an olfactory deterrent for seabirds. Although shark liver oil is a natural product, introducing large amounts of this oil into the marine environment may be problematic, and for species that may not find it repulsive, feather fouling could be an issue. Our future work will investigate the effective ingredient(s) in shark liver oil that repel seabirds and alternative deployment strategies.

**INVASIVE WEED MANAGEMENT AND THE FORMATION OF NEW ALLIANCES AND NEW DIVISIONS WITHIN THE ENVIRONMENTAL MOVEMENT**

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The U.S. environmental movement is not united. Movement organizations subscribe to widely diverse goals, membership bases and tactical strategies which are in turn changing over time. Recently the management of invasive weeds has led to the development of both new alliances and divisions within environmental movement organizing. How and why have these dynamics emerged? What are the bases for emerging alliances and divisions? We use interviews and content analysis to examine new conflicts and coalitions on local, statewide and national levels. In communities across the West, ranchers and environmentally inclined land management groups that have differed sharply over grazing practices or the proximity of cattle to stream habitat now stand side by side as members of invasive weed coalitions. On state and national levels anti-pesticide groups mobilize against increased pesticides use for invasive weeds and the role of chemical companies in shaping the "invasive weed agenda." These organizations may find themselves on opposite sides of the table with other large environmental NGOs who promote herbicides as part of weed management strategies. We conclude that both conflicts and collaboration concerning invasive weeds signal important developments, reflect new dimensions of the environmental constituency and have in turn important implications for conservation biology.

**POPULATION STATUS AND RECOVERY TRENDS FOR ENDANGERED SPECIES LISTED PRIOR TO 1980**

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The success of the federal Endangered Species Act at achieving recovery of federally protected species has been a focal point in political discussions of legislative changes to the Endangered Species Act. However, there have been few comprehensive efforts

to assess the overall success of conservation efforts to recover threatened and endangered species. To address this question, we compiled and analyzed the best available data on the population statuses and trends for 260 animals and plants listed as threatened or endangered under the Endangered Species Act before 1980, a group that includes some of the most highly imperiled species with the longest conservation histories. We found that although most listed species have not reached the population levels identified as recovery criteria in recovery plans, the statuses of the majority (74%) of these species have significantly improved since the time of listing, the majority (79%) of these species are now stable or steadily improving, and the population trends for these species tended to change from declining to stable or improving at approximately the time of listing.

**LONG-TERM DEMOGRAPHIC TRENDS ON HIGH-DIVERSE BENTHIC COMMUNITIES IN THE NW MEDITERRANEAN SEA**  
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Long-term data series in marine ecosystems are scarce. This study focuses on decadal demographic processes of a set of key species (sponges, cnidarians, bryozoans, tunicates) dwelling in dimly lit habitats in the northwestern Mediterranean Sea. For this purpose, we analyzed two long-term photographic series of permanent plots monitored yearly in two study areas: the Medes Island (Catalan coast, northeastern Spain) and Riou Archipelago (Provence coast, southeastern France). These rocky benthic communities are highly diversified and structured and they are dominated by long-lived animals and coralline algae. Different parameters of population dynamics for 20 species (growth, fragmentation, fusion, recruitment, and mortality rates) were analyzed using the computer program Arc/View (ESRI) geographical information system (GIS). For example, we documented over 13 years a population of the soft coral *Alcyonium acaule*, which showed very low growth and recruitment rates and a high episodic mortality event (summer 2001). This monitored population did not recover over the following 4 years. Overall, we conclude that this information offers a solid baseline data over long-term period that can be exploited for effective management for conservation of biodiversity and the successful management of marine benthic communities in view of predicted climate change.

**AGRICULTURAL LAND-USE, RURAL CULTURE AND THE CONSERVATION OF MACKINDER'S EAGLE OWLS IN CENTRAL KENYA**

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I studied a population of Mackinder's eagle owls (*Bubo capensis mackinderi*) that breed adjacent to and forage in agricultural fields in central Kenya to assess the effects of agricultural land-use practices and local attitudes on owl ecology and conservation. Owl diet consisted of 89 mammals, 8 birds, and 3 insects, reptiles, and crustaceans. Small mammal density was very low, averaging 6.5 per ha in farmland and 0.46 per ha in grassland. Human agricultural activity amplified the effect of rainfall on small mammal populations. The total number of small mammals trapped correlated positively with the proportion of small mammals in the owls' diet. Nesting success was 58 and resulted in 1.25 chicks per successful pair. Fifteen percent of adult and juvenile owls are known to have been killed during the past two years. Sixty-one percent of farmers surveyed said the presence of owls near their farms was either "bad" or "neutral" for them despite the fact that 60 of them knew that owls eat farmyard pests such as rats, rabbits, and birds. The impacts of human activities combined with negative human attitudes towards owls remain significant impediments to owl conservation in human-dominated landscapes in Kenya.

**EFFECTS OF HYDROLOGY AND LANDUSE ON AMPHIBIAN BREEDING POTENTIAL AND COMMUNITY STRUCTURE IN THE PRAIRIE POTHOLE REGION**

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Natural and anthropogenic stressors can have synergistic negative effects on amphibians, and climate change is expected to exacerbate many stressor effects at the population level. The objectives of this study were to quantify the effects of land use and hydrology on amphibian breeding success and community structure in the Prairie Pothole Region (PPR) of the United States. Amphibian communities were identified and breeding success evaluated along with physical and chemical parameters in 149 seasonal and semipermanent wetlands distributed across five PPR ecoregions. Daytime surveys, nighttime calling surveys, and water quality sampling was conducted at least three times during the 2003–2005 breeding seasons. Seasonal wetlands were shallower, warmer, and more likely to have breeding *Rana pipiens* (northern leopard frog) than semipermanent wetlands. However, seasonal wetlands also dried faster than semipermanent wetlands, as depth decreased 1.5 times faster. Additionally, the percent of sites dry during the breeding season, hydroperiod, and rate of depth change varied across years. We also found regional and treatment-dependent variations in stressors, amphibian richness, and breeding success. Predicted warmer and drier climate conditions may accelerate wetland drying and force breeding amphibians into marginal habitats, thus exacerbating the effects of stressors on amphibian populations.

**CLUSTERED NETWORKS OF MARINE AND WATERSHED RESERVES FIND THE BALANCE FOR PEOPLE AND ECOSYSTEMS IN KUBULAU, VANUA LEVU, FIJI**

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Larger, nearshore MPAs are not an option in Fiji as many local people rely heavily on being able to harvest marine resources from nearby coastal ecosystems, and the size of units for fishing rights ownership are relatively small. However, 30% coverage of the total fishing ground with science-based placement of MPAs may be necessary to achieve marked fisheries benefits. The Kubulau District MPA Network is the first community-based initiative in Fiji to implement an ecologically-functional marine reserve network, that is, an aggregation of reserves that are sufficiently clustered, sizable, numerous, and well-placed such that the complex interacts ecologically and provides synergistic fisheries benefits well beyond that of the additive individual contributions of each single reserve. This approach changes the purpose of traditional reserves from smaller, temporary

protected areas that increase target species for periodic harvest to permanent source pools for spillover of larger fish, attraction of roving predators to better feeding grounds, and eventual enhancement of reproduction in habitats adjacent to reserves. This clustered MPA network is also designed to minimize hardship to communities and to maximize compliance. Forest watershed reserves and conservation practices are also being implemented to support ecosystem-based management.

### **DESIGNS FOR PROTECTING AMPHIBIANS IN MANAGED HEADWATER FORESTS IN THE US PACIFIC NORTHWEST**

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Headwaters comprise the majority of US Pacific Northwest forest landscapes, and harbor a diversity of endemic species. Thinning of young managed stands is being used on federal lands for wood production, fuels reduction to reduce risk of severe fire, and accelerated development of late-successional forest conditions. Thinning with headwater stream riparian buffers and upslope leave islands holds promise for species retention. Specifically, our research examines the effects on instream, bank-dwelling, and upslope amphibians of four riparian buffer widths (6, 15, 70, and 145 m on each side of streams) and three sizes of upslope leave islands (0.1, 0.2, and 0.4 ha circular patches) within a thinned forest matrix (50–80 yrs), which reduced Douglas-fir stands from about 600 trees per hectare (tph) to 200 tph. Instream amphibians were not affected by joint buffers and upslope thinning in years 1 and 2 post-treatment, while some effects were seen on bank and thinned upslope salamander species abundances. Larger leave islands retained habitats and fauna. We are tracking stream species' responses through year 5 post-thinning and propose to follow the study through a second entry of thinning, reducing stands to about 80 tph.

### **ESTIMATING LAND PRICES AND OPPORTUNITY COSTS OF CONSERVATION IN A MEGADIVERSITY COUNTRY**

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Cost-effective conservation interventions require reliable estimates of costs and benefits. Recent studies have given less priority to land purchase and opportunity costs even though these are critically important for guiding reserve expansion, and in ensuring equitable off-reserve conservation agreements. We used data on 174 recent land purchases to produce a modelled surface of land price across Western Cape Province, South Africa, an area of global conservation importance. In our model, mean annual precipitation, percentage of untransformed land, property area, and topographic diversity were the most significant predictors of overall land price. Observed land prices varied by more than four orders of magnitude (from US\$15 / ha to 178,000 / ha expressed per unit area of farmland). Modelled land prices were highest in vegetation types previously classified (because of their biological importance and degree of conversion) as Critically Endangered. The estimated annual opportunity costs of retaining natural vegetation on farms in potentially arable areas ranged from US\$0 to 8300 / ha / yr, and were again highest in Critically Endangered vegetation types and lowest in the Least Threatened vegetation types. This positive co-variation between biological priority and cost means that explicitly incorporating costs into planning will be essential for attaining optimal returns from conservation investments.

### **BIODIVERSITY CONSERVATION UNDER ARMED CONFLICT IN COLOMBIA. PROTECTED AREAS STRATEGY FACING DISPUTED TERRITORIES**

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As megadiverse country Colombia gathers geographical regions as diverse as Amazonia, Andes, Caribbean, Choco, and Orinoco. Such diversity under endemic sociopolitical conditions puts the country among the main potencies in matter of biological exploration and poses a great challenges to its conservation. What happens when the main wild areas are controlled by illegal armed groups as disputed territories? Which are the state strategies and politics to face these problems? And specially, how has adapted the conservation of biodiversity in the field of war against drugs and terrorism in Colombia? From a sample of the System of National Parks of Colombia, this paper identifies the relationships existing between conservation and governability in the context of armed conflict, extending in the adaptation strategies among environmental institutions. In conclusion, biodiversity conservation in Colombia has generated fields of tension where negotiations occurred in various senses, in which environmental institutions and conservation programs are considered as military objectives. Although biodiversity conservation mission have searched neutrality across armed actors, its relationship with "resistance" discourse and social movements in political contexts such as strategies anti-drugs have been inevitable. Finally, the paper emphasizes the outdistancing between planning-management of protected areas and local realities in war context.

### **LANDSCAPE SCALE CONSERVATION AND SCIENCE BASED LAND MANAGEMENT ACROSS BORDERS IN CENTRAL IDAHO**

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A major global challenge is managing lands adjacent to formally protected areas for conservation. To ensure the conservation of biodiversity dependent on designated natural areas, it is also essential to secure adequate protection in neighboring areas of more intensive human land use. In the western United States, ecosystem-level conservation requires the integrated management of state, federal, and private lands. We present here the results from five years of a systematic approach to landscape scale conservation in the Northern Rockies. Lava Lake Land & Livestock, L.L.C., a private company, is working with multiple agencies to accomplish conservation across the million acre Pioneer Mountain / Craters of the Moon Region in central Idaho. This approach includes comprehensive conservation planning, scientific surveys, the development of ecologically sound land use practices, monitoring, and restoration. Results to date have been accomplished through private lands protection,

habitat restoration, predator-friendly livestock management, participation in public lands management, noxious weed management, and careful livestock management including the use of GPS collars. In order to assess the effectiveness of these conservation efforts, a monitoring program has been implemented to evaluate trends for identified conservation targets with a focus on the aspen, sagebrush steppe, and riparian ecosystems.

**FRAGMENTED FOREST OF CEBU ISLAND, PHILIPPINES: CONSERVATION STATUS AND PROSPECTS FOR RECOVERY**  
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The island of Cebu in central Philippines has long been regarded to have lost its forest habitats and most of its endemic species with only 80 ha of forest left in the central highlands. This study verified the conservation status of the remaining forest fragments and determined the presence of endemic and threatened wildlife of Cebu. An island-wide survey was initially conducted in 1999 where a total of seven widely separated forest fragments were identified. These forest patches were resurveyed from 2000 to 2004 using mist-netting, line transects, and informal interviews. Out of the 14 endemic bird taxa in Cebu, 10 were rediscovered within these sites. The Critically Endangered Cebu Flowerpecker (*Dicaeum quadricolor*) was sighted in three of the seven sites. New records of endemic fruit bats and flying foxes were added to the island as well as the rediscovery of the Philippine Bare-backed Fruit bat (*Dobsonia chapmani*), a supposedly extinct species. The results of the survey were used to determine the priority key conservation sites for the island and in designing the management plan for each forest patch.

**LANDSCAPE-SCALE RISK ASSESSMENT FOR CURRENT AND FUTURE UV-B EXPOSURE OF ALPINE AMPHIBIANS OF THE PACIFIC NORTHWEST**

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Increasing ultraviolet-B radiation (UV-B) has been proposed as a leading explanation for declining amphibian populations for almost ten years. Our ability to make conclusions about UV-B impacts has been limited by understanding how results from a variety of single experimental sites relate to the effect of UV-B more generally across many sites. I present results from a series of field experiments testing the importance of UV-B for hatching success of two species of montane amphibians, *Ambystoma macrodactylum* and *Rana cascadae*, at sites spanning a gradient of UV-B exposure. Using existing variation in the concentration of UV-B attenuating optical color present in the water at different amphibian breeding sites, I find that ambient levels of UV-B only negatively affect amphibian egg survival in the clearest sites when compared to embryos shielded from UV-B. When evaluated across a large number of breeding sites for each species, I find that 0.4% of *A. macrodactylum* and 0% of *R. cascadae* embryos are exposed to doses of UV-B exceeding lethal levels in our field experiments. I then forecast the potential for future changes in UV-B, optical color, and the timing of breeding to impact species at the broad spatial and temporal scales relevant to conservation.

**EDUCATION, OUTREACH, AND ADVOCACY: A CASE STUDY COMPARISON OF COMMUNICATION STRATEGIES FOR MARINE CONSERVATION**

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Education, outreach, and advocacy all contribute to the ever-growing conservation movement and many leading marine conservation organizations have found them to be highly effective for raising awareness of their cause. However, there is a general lack of understanding between the differences of approaches and a limited appreciation of how various organizations are implementing them. These three approaches to conservation are generally used as a way to communicate for social change, instill a sense of stewardship, and create a political voice within communities that have a direct impact on conservation, both locally and worldwide. In the face of limited resources, international conservation groups working in important marine regions, may implement education, outreach, and advocacy as independent approaches or combined in a three-part conservation mosaic: (a) Education: to share new knowledge, (b) Outreach: to network this knowledge from a grass-roots level, and (c) Advocacy: to bring networks of individuals and organizations together to create solutions through a social movement. This study highlights the fundamental differences between approaches and goals for communication strategies and offers case study examples featuring marine conservation programs from Galapagos Islands, Costa Rica, Mexico, Micronesia, and the United States. The purpose of this study is to highlight results of each approach, and present tried and tested successful strategies to be adopted by other organizations.

**SUSTAINING THE CONSERVATIONIST: THE PSYCHOLOGY OF WORKING WITH ENVIRONMENTAL DEGRADATION**

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The emotional investment in environmental activism makes it difficult to set limits on personal work and "involvement in the cause" because the stakes for humankind and their animal brethren appear so severe. The altruistic commitment to environmentalism can become all-consuming of time and personal resources, creating a psychological challenge for conservationists. The obstacles and opposition to pro-conservation social change are severe, complex, highly political, and often well-funded. It is often too much for environmentalists to bear the burden of "not acting" and seeing the deleterious effects that ensue. To recognize these burdens, and the grief and pain associated with the routine evidence of environmental degradation, is to experience overwhelming and debilitating emotions. This paper proposes that it is essential to develop individual and organizational well-being in the midst of these realities. Conservation cannot be successful without highly functioning, creative, courageous, collaborative, and resilient conservationists. We view the lack of attention to creating healthy conservationists is a critical omission in fostering sustainability of the natural world. This paper will focus on the psychology of

sustaining the conservationist and an interdisciplinary overview of key social science considerations necessary to support ongoing commitment to protecting the environment.

### **MODELLING THE EFFECT OF TRAFFIC NOISE ON ACOUSTIC COMMUNICATION IN BIRDS**

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Birds use acoustic signals for a variety of social and biological purposes, such as attracting and bonding with mates, defending territories, indicating distress or hunger, and warning of danger from predators. Traffic noise may interfere with acoustic communication in birds by reducing the distance over which a signal can be detected, a phenomenon known as acoustic interference. Field studies in Europe have shown reduced densities of some bird species in habitats close to roads, while another species appears to be changing the characteristics of its song in urban areas subject to anthropogenic noise. However, the mechanisms underlying these responses have not been clearly elucidated. I will present a model of the effect of traffic noise on the distance over which acoustic signals of varying frequency (pitch) can be detected by a conspecific bird, based on the frequency distribution of traffic noise, the structure of the avian auditory system, and the attenuation of sound in open forests. The model demonstrates that birds with higher-pitched calls or songs will experience less acoustic interference from traffic noise than birds with lower-pitched signals. The model predicts the relative effect of traffic noise on the calls of forest-dependent birds in southeastern Australia.

### **ECOLOGICAL AND SOCIOLOGICAL DIVERSITY OF PRIVATE PROTECTED AREAS IN THE LITTLE KAROO, SOUTH AFRICA**

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Private protected areas (PPAs) can play a crucial role in meeting national and international conservation objectives, but their diversity needs to be systematically examined and characterized. Research investigated 50 private nature reserves, game farms and conservancies in the Little Karoo, South Africa. Ecological and sociological characteristics of PPAs were assessed through a multi-level analysis integrating questionnaire surveys, in-depth interviews, and GIS analyses. The PPA network captures a greater proportion of the land area than do statutory protected areas, as well as a greater and more diverse representation of vegetation types. Good connectivity is further evident across portions of the landscape. The growth of PPAs is a recent phenomenon driven by strong conservation motivations, in half of cases unconnected to economic considerations. PPAs are highly individual in their requirements, and closely dependent on the variable personal attitudes and circumstances of their owners. Universally-applicable incentive measures required to safeguard the permanence of these areas should consider the preference of landowners for financial assistance, as well as formal recognition as protected areas. Results are expected to aid strategic, spatially explicit conservation plans for the region, as well as more general policies for the promotion of private conservation efforts.

### **BIODIVERSITY INFORMATICS: BRIDGING THE GAP BETWEEN POLICY AND SCIENCE**

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Within the past five years, the biological community has recognized biodiversity informatics (the provision and integration of information on biodiversity) as providing a vital societal benefit in today's shrinking world. Biodiversity informatics increases access to and usability of scientific data and information, allowing decision makers to better utilize biological research and science when drafting environmental policy. Decision makers increasingly must employ science from numerous sources when making decisions, integrating complex biological and associated data from diverse disciplines and sources. Utilizing this information requires solving not only technical hardware and software problems, but also difficulties in dealing with different methodologies, data formats, scales, and variability. Addressing these information-based challenges requires new technologies, standards, protocols, and, most importantly, cooperation. Biological Informatics networks and applications that have been developed in the past several years, such as the Inter-American Biodiversity Information Network and the U.S. National Biological Information Infrastructure, hold the promise of promoting and streamlining decision makers' access to important biological research. This presentation discusses the benefits and challenges in the field of biodiversity informatics, and provides examples of some of the solutions being developed by organizations globally as they work together to meet those challenges.

### **EFFECTS OF FOREST HARVESTING ON JUVENILE AMPHIBIAN DISPERSAL**

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In 2004 and 2005, we studied the effects of forestry on juvenile wood frog dispersal in Maine. Four landscape-scale replicates of four forestry treatments were centered on breeding ponds. A total of 8632 emerging juvenile wood frogs were captured at encircling drift fences and marked. Animals were recaptured at drift fence / pitfall arrays at 16, 50, 100, and 150 m from the ponds. The results indicate that juvenile wood frog select higher quality habitat when dispersing although all treatments showed similar patterns in temporal captures. This selection reduces density in poorer quality habitats such as clearcuts. Clearcuts do not reduce landscape permeability for juvenile wood frogs, however, and appear to be suitable habitat, albeit of a lesser quality. The highest abundance of juvenile wood frogs settled at a distance of 100 m. This result is contrary to many dispersal models where the highest frequency of dispersers is found closest to the source, and may have important implications when defining the minimum area of terrestrial habitat required for amphibian populations. Our study forms the first landscape-scale evaluation of how forest treatments influence juvenile amphibian dispersal, and provides evidence that both density of conspecifics and habitat quality can influence dispersal of juvenile amphibians.

### **COLLABORATION IS NOT INTUITIVE: KEY LESSONS LEARNED IN THE FIRST TWO YEARS OF THE PACIFIC MARINE ANALYSIS AND RESEARCH ASSOCIATION**

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The Pacific Marine Analysis and Research Association (PacMARA) was formed in early 2003 to address science questions and analyses identified as necessary for ecosystem-based management (EBM) in the Canadian northeast Pacific. Due to the broad nature of EBM, it was understood that PacMARA would have to be collaborative, multi-sector, and trans-organizational. While collaborative approaches to science have been well explored in the theoretical literature, there is still a sobering lack of experiential information. After two years in operation, PacMARA has learned many lessons that may provide valuable information for similar groups. These include, among others: (1) focus on values and principles to build broad support first, before looking at specific candidate projects, (2) recognize that some groups and people will use collaboration to win, (3) acknowledge legitimate fears, as some risk more from collaboration than others, (4) don't expect one's organization to solve all collaboration problems surrounding EBM, and (5) through specific projects, build upon existing (formal or informal) partnerships, while bringing in previously excluded parties. Formal multi-sector collaboration is still not intuitive. This presentation will share practical experiences, which may prove useful, and hopefully make it easier for others.

**PREDICTING SPECIES' DISTRIBUTIONS FROM SMALL NUMBERS OF OCCURRENCE RECORDS: A TEST CASE USING CRYPTIC GECKOS IN MADAGASCAR**

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Techniques that predict species' potential distributions by combining observed occurrence records with environmental variables show much potential for application in conservation biology. Some of the most promising applications relate to species for which occurrence records are scarce, yet minimum sample sizes required to yield useful predictions remain difficult to determine. Here we developed a novel jackknife validation approach to test ability to predict species' occurrence when *Uroplatus* sp. that are endemic to Madagascar. Predictions were based on 20 environmental data layers and were generated using two modeling approaches: Maxent and GARP. We found high success rates and statistical significance in jackknife tests with sample sizes as low as 5 when the Maxent model was applied. Results for GARP at very low sample sizes (< ~10) were less good, although predictive performance generally increased with number of occurrence records. Our analyses demonstrate that biogeographical information extracted from small numbers of occurrence records may be of great value in conservation biology, for example in targeting field surveys to accelerate the discovery of unknown populations and species.

**HOW ORANGE-CROWNED WARBLERS RECONCILE CONFLICTING PRESSURES BETWEEN AVIAN PREDATORS AND HABITAT DESTRUCTION BY FERAL PIGS**

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Introduction of alien species to islands can negatively affect native vegetation and animals. Our study of nest site selection in the Channel Island race of Orange-crowned Warbler (*Vermivora celata sordida*; hereafter OCWA), an endemic subspecies, reveals potential conservation concerns resulting from feral pig disturbance to the understory vegetation. We contrasted nest site selection of OCWA on Santa Cruz Island, where feral pig disturbance to the understory vegetation is extensive and Island Scrub Jay nest predation is present, vs. OCWA populations on nearby Catalina Island where feral pigs have been removed and avian nest predators are absent. Based on experimental results from Catalina Island, we predicted that OCWA should nest on the ground in response to avian nest predators. A comparison of height and vegetation features between OCWA nests from both islands resulted in lower mean nest height on Santa Cruz (0.77 m 0.9) than on Catalina (1.55 m 1.42). However, feral pig disturbance on some Santa Cruz territories may have forced OCWA to nest above ground, a stratum more exposed to visually oriented jays. In fact, daily survival probabilities are significantly lower on Santa Cruz (0.910.02) than on Catalina (0.970.005). Our results indicate that OCWA are likely to benefit from the feral pig eradication currently going on Santa Cruz, and we suggest that the warbler could be used as an indicator species of understory vegetation health on this island.

**SPRING MIGRATION AND SUMMER BREEDING SEASON HABITAT USE OF RIPARIAN BIRD COMMUNITIES IN THE CINCINNATI METROPOLITAN AREA**

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We examined patterns of habitat use by birds at local and landscape levels during the 2002 migratory and breeding season at 71 riparian plots along an urban gradient. We explored how the variation in different land covers at four scales (50, 100, 250, and 500 m) affected abundance, richness, and evenness of four migratory guilds (en-route Neotropical migrants, resident Neotropical migrants, short-distance migrants, permanent residents) using linear regression. As development increased, riparian woodlands tended to be narrower and composed of fewer native trees and shrubs. Neotropical migrants were the most sensitive to levels of urbanization and short-distance migrants the least. Exotic species abundance strongly correlated with urbanization and narrow riparian forests. Results during migration suggest that en-route Neotropical migrants are less influenced by measures of urbanization and prefer streams with native trees, compared to resident Neotropical migrants who appear highly sensitive to human disturbance. This finding suggests that small areas of riparian habitat may be critical during the migration for long-distance migrants. Preliminary analyses revealed potential seasonal differences in habitat selection. During the migratory season, tree cover within 250 to 500 m of the stream best described native birds measures. During the breeding season, measures of urbanization around 250 m of the stream were most significant.

**IS LOVE OF NATURE IN THE US BECOMING LOVE OF ELECTRONIC MEDIA? 16-YEAR DOWNTREND IN NATIONAL PARK VISITS EXPLAINED BY WATCHING MOVIES, PLAYING VIDEO GAMES**

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After fifty years of steady increase, per capita visits to United States national parks have declined since 1988. This decline, coincident with the rise in electronic entertainment media, may represent a shift in recreation choices with broader implications for the value placed on biodiversity conservation and environmentally responsible behavior. We compared the decline in per capita visits with a set of indicators representing alternate recreation choices and constraints. Spearman correlation analyses found this decline in national park visitation to be significantly negatively correlated with several electronic entertainment indicators: hours of television, video games, home movies, theater attendance, and internet use. There were also significant negative correlations with oil prices, foreign travel, and Appalachian Trail hikers. Income was significantly positively correlated with foreign travel but negatively correlated with national park visits. There was no significant correlation of mean number of vacation days and federal funding actually increased during this period so both were rejected as probable factors. Park capacity was also rejected as limiting since both total overnight stays and visits at the seven most popular parks rose well into the mid-1990s. Multiple linear regression of four of the entertainment media variables as well as oil prices explains 97.5% of this recent decline.

### **CONSERVATION AND MANAGEMENT OF SAN MIGUEL ISLAND DEER MICE**

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San Miguel Island (SMI), a 4342 ha island in Channel Islands National Park, has long been invaded by non-native black rats. Rat eradication by aerial rodenticide application is planned, but endemic San Miguel Island deer mice (*Peromyscus maniculatus streator*, PMS) are vulnerable to the rodenticide. PMS are the primary prey of the Critically Endangered (IUCN) Channel Island fox. Consequently, a viable population of PMS must be removed and captive-held during the rat eradication, and reintroduced after eradication is confirmed. To determine how many PMS to capture and where to capture them from, I sequenced 758bp of mtDNA COX2 gene of 72 mice collected on SMI, Prince, Santa Rosa, Santa Cruz, and three Anacapa islets; compared 15 cranial and external morphological traits; and conducted a PVA. Results show no SMI mice to be closely related to mice from other islands. Two sites (Pt. Bennett and dry lake bed) were responsible for 39% of all SMI haplotypes, and these sites should be sampled and reintroduced separately. Surprisingly, mice from Prince islet were much more closely related to mice from Santa Cruz (45 km away) than mice from San Miguel (1 km) or Santa Rosa (11 km). PVA shows at least 750 PMS need to be captured and held.

### **GROWTH PRESSURES ON SENSITIVE NATURAL RESOURCES IN THE TWIN CITIES METROPOLITAN REGION**

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In the next quarter century, growth pressures in the Twin Cities metropolitan region will be intense as over one million new residents and 500,000 new homes consume unprotected, sensitive natural areas. This GIS based regional assessment was conducted to (1) examine socioeconomic changes and potential natural resource impacts and (2) provide recommendations to address trade-offs between future growth and conservation. Sensitive land and water habitats and groundwater availability were analyzed in the context of social and economic factors, including changes in population, urbanized land area, number and size of new housing subdivisions, commute times, job locations, community types, and local fiscal capacities. Growth scenarios suggest that regional growth will be most intense at the fringes of the 7-county core region and just beyond in the four "collar counties" where groundwater is an additional constraint to growth. Because most communities in the path of growth have modest or below average tax capacities, they will be challenged to conserve land and water resources. Additionally, if growth continues in the form of large lot, low-density development, almost all remaining unprotected sensitive natural areas will be developed. Future conservation will require strategic regional scale planning, conservation cost-sharing, and additional resources to bridge gaps in information, analyses, and technical assistance to communities.

### **THE PROMISE AND PERIL OF TRANSBOUNDARY PROTECTED AREAS**

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Species, ecosystems, and environmental services are increasingly threatened, degraded, and stressed. In response, transboundary protected areas have been promoted as innovative models for conserving global biodiversity, promoting peace and reconciliation, and improving local livelihoods. Two transboundary initiatives, the Great Limpopo Transfrontier Park and the proposed Selous-Niassa Wildlife Corridor, are analyzed using the policy sciences framework. Results indicate that transboundary initiatives can link fragmented habitats to promote the flow of species and genetic material, increase resiliency to stochastic perturbations, and expand the exchange of information and cooperation across political and geographical boundaries. However transboundary initiatives also impart distinct challenges, including overlapping and competing institutional authorities, rigid bureaucracies, and diverse political constituencies and values. Moreover, border regions are characterized by heterogeneous and highly mobile populations, illicit economies, and often a distrust of state intervention and authority. Sustainable transboundary conservation will depend upon developing new, context specific decision-making mechanisms, effective leadership, and robust constitutive processes. Success will require not only traversing geographical borders, but cognitive, institutional and disciplinary boundaries as well. Until conservation biologists are conversant with the ecological, institutional, social, and political contexts of transboundary conservation, our actions will be neither effective nor just.

### **USING ABUNDANCE AND BEHAVIOR AS TOOLS FOR ASSESSING A MANAGEMENT STRATEGY FOR AN ENDANGERED BUTTERFLY**

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The Karner blue butterfly (Karner) (*Lycaeides melissa samuelis*) has been a federally endangered species since 1992. The Karner is unique because the species always has two broods per year, and the larvae are specialists on wild blue lupine (*Lupinus perennis*). Karners have recently been reintroduced into Ohio oak savannas, and in order to sustain this community, prescribed burning and mowing have been employed. The current management regime divides each site into three management units based on the number of lupine stems. A third of the site is burned, mowed, and unmanaged each year. We

used Karner surveys and behavioral observations of females to identify how Karners responded to these management treatments. Our results showed no significant management unit differences in male or female abundance during the first brood. The second brood resulted in significantly more males and females in burned areas than the other two treatments. We analyzed Karner oviposition rates separately. Female Karners oviposited significantly less frequently in unmanaged areas compared to burned and mowed areas. Our results demonstrate how intensive monitoring of at-risk species can help provide valuable assistance to adaptive management. In this situation, burning previously unmanaged areas will have minimal impact on the Karner population.

**MAYBE SIZE DOES MATTER: COASTAL GRASSLAND RESPONSE TO MANAGEMENT-SCALE FALL BURNING, SHADING, AND SUPPLEMENTAL SEEDING**

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Fire is commonly used in grasslands to stop woody encroachment or meet the habitat needs of conservation targets. At Cascade Head Preserve in Oregon, we use fall burning to preserve grassland habitat for the federally listed Oregon silverspot butterfly. However, previous small-scale research indicated that some European grasses increase with fire, making it difficult to burn without exacerbating non-native species problems. We designed an experiment using management-scale fires and varied available fuel (mowing before burning) and fire frequency (one versus two burns). We also combined two restoration treatments with fire to deter non-native species: native seeding and shading for one year followed by native seeding. We measured percent frequency by life stage and seedling density to assess the plant community response to treatments. Frequency data revealed no clear advantage of burning more frequently or mowing before burning. However, some species responses differed between previous small-scale burns and the management-scale burns. But in neither case did it appear that burning alone would maintain butterfly habitat. Seeding of native species, possibly in combination with shading in areas dominated by non-natives, may be required to restore this grassland. These results illustrate the difficulty of extrapolating burn research results from small-scale experiments.

**FACTORS AFFECTING ANURAN COMMUNITY STRUCTURE ALONG AN URBAN-RURAL GRADIENT**

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Although habitat loss and fragmentation have been cited as important factors in amphibian population declines, we have only a rudimentary understanding of the impact of urban development on amphibian communities. The goal of this study was to apply a multivariate, community-level perspective to amphibian conservation ecology in an urbanizing landscape. We examined anuran community structure in relation to wetland vegetation and landscape composition at 63 sites in central Iowa, USA, an agricultural region undergoing rapid conversion to suburban development. We conducted biweekly anuran call surveys during the spring and summer of 2005 to determine the abundance of study species at each site. Additionally, we quantified wetland habitat and landscape structure using a combination of field sampling, aerial photos, and GIS. Urban density had a significant effect on anuran abundance and diversity, especially for species requiring upland habitat outside the breeding season. Overall, landscape composition and configuration had a greater effect on anurans than the availability of breeding habitat. This indicates that dispersal ability, rather than habitat availability, may be limiting abundance and diversity in areas of human settlement. Our study underscores the importance of a regional approach to amphibian conservation to maintain connections among populations in fragmented landscapes.

**DIFFERENCES BETWEEN MARINE COMMUNITIES ON ANTHROPOGENIC STRUCTURES AND NATURAL ROCKY BENCHES AND IMPLICATIONS FOR CONSERVATION**

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Jetties, breakwaters, and armored shorelines constructed of riprap occupy approximately 30% of southern California's coast. Riprap usually consists of large quarried boulders, or concrete blocks, and is easily colonized by benthic organisms. It is one of the most common coastal construction materials and can persist for centuries. Despite extensive distribution in both space and time, such anthropogenic structures have received very little scientific attention. Structures composed of riprap mimic natural rocky benthic habitats, yet artifacts of construction may cause marine communities growing on riprap structures to differ from their natural analogs. If riprap communities are sufficiently different from natural ones coastal ecosystem patterns and processes could be drastically altered. Even if no differences are detected between substrate types, some species populations and ecological processes could be drastically augmented. I quantitatively compared diversity and community composition of several communities from both riprap and natural intertidal benches. While diversity did not significantly differ between most sites, community composition often did with some species occurring in significantly greater abundances on riprap. These results suggest that riprap structures have potentially positive effects on biodiversity and should be considered for conservation and management of marine ecosystems.

**THE FARMER AND THE OIL SHEIK: THE SHIFT FROM FOOD TO BIOENERGY PRODUCTION IN GERMANY'S COUNTRYSIDE AND ITS IMPLICATIONS FOR LANDSCAPE-LEVEL CONSERVATION**

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Triggered by concerns about climate change and by effective financial incentive schemes, renewable energy supply from biomass (bioenergy) is a rapidly growing business in central Europe. It is estimated that 1/3 of Germany's agricultural land will be used for bioenergy supply by 2030. This implies considerable impact on biodiversity, ecosystems, landscapes, and land-use systems, especially through an expansion of crop area and an anticipated intensification of land-use. Consequently, conflicts with issues of landscape-level conservation are arising. This paper sketches the effects of bioenergy use on nature and landscape conservation in agricultural landscapes. It presents a case study from Uckermark county in eastern Germany where multifaceted interactions between bioenergy production and nature conservation in large protected areas can be observed. It is

demonstrated that renewable energy production is not only a threat, but can also be a chance for landscape-level conservation, as conservation in central Europe mainly depends on the existence of low-intensity farming systems and on a continuous removal of nutrients. Finally, some principles for conservation-oriented bioenergy use will be derived.

### **LIMNOLOGICAL ENVIRONMENT OF NORTHERN LEOPARD FROG (*RANA PIPIENS*) TADPOLES; IMPLICATIONS ON GROWTH STRATEGIES AND WETLAND MANAGEMENT**

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We characterized northern leopard frog tadpoles environment using a limnological approach, from eggs deposition to metamorphosis, in two wetlands. One of them was a natural fluvial lake bank heavily influenced by water level fluctuations and the other was a water level controlled wetland constructed and managed primarily for waterfowl. Natural wetland was characterized by lower water level, light, and nutrient conditions of lower quality for algae, lower availability of food, and higher tadpole density. Differences were especially evident during the second half of the development. Development period in the natural wetland was shorter and metamorphosis significantly smaller and lighter than those from the managed wetland. Repetition of the same pattern from size at metamorphosis data, collected in similar natural and managed wetlands, permit us to generalize the fact that water level controlled wetlands can produce longer and heavier frogs with higher survival chance. In a context where local populations survival depend on the recruitment and metapopulation structure, managed wetland could be used as an effective tool in northern leopard frog conservation.

### **INTRODUCING *CRASSOSTREA ARIAKENSIS*: USING SOCIAL SCIENCE TO MANAGE FISHERIES AND PREDICT CHANGE**

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*Crassostrea virginica*, the native oyster of the Chesapeake Bay, has been reduced to less than 1% of historic populations. This trend is caused by several factors, primarily overharvesting and disease. The results are unbalanced Bay ecology due to loss of primary filter feeders and disruption of fishery operations. Responding to this decline, industry leaders and watermen proposed introduction of a nonnative oyster species, *Crassostrea ariakensis*, to restore the fishery and ecosystem function. Planning for this introduction has been underway for several years and extensive scientific research has been completed to determine the feasibility of introduction. I evaluate global historical data of similar nonnative oyster introductions and the events leading to those actions. The social, economic, and political elements of placing nonnative oysters in the Chesapeake Bay are evaluated to determine constraints to introduction of *C. ariakensis*. These reviews yield vast similarities in practices and social conditions relating to nonnative oyster introductions. I draw correlates between *C. ariakensis* and other similar cases to isolate common trends in social behaviors. Social and communications theory can be used to predict outcomes of environmental issues and to guide stakeholder behaviors by identifying specific traits of those groups and monitoring change over time. Based on this information I make recommendations for the inclusion of social science monitoring in fishery management plans to better predict future needs and to develop communications plans to address new developments such as the introduction of a nonnative species.

### **GIS-BASED NICHE MODELING AS A TOOL FOR MULTISPECIES CONSERVATION PLANNING**

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Ecological niche modeling incorporates species occurrence data and Geographic Information Systems environmental variables into a powerful tool for identifying suitable habitat for species over large spatial extents. We briefly describe a multivariate statistical modeling approach, partitioned Mahalanobis D<sup>2</sup>, which identifies a minimum (rather than an optimum) set of habitat requirements for a species. It is based on the assumption that the constant environmental relationships across a species' distribution (i.e., variables with a consistent value over the species range) are most likely to be associated with limiting factors. Using partitioned Mahalanobis D<sup>2</sup>, an index of habitat suitability is calculated representing the standardized difference between values of a set of environmental variables for any point and the mean values for these variables at points where the species occurs. We illustrate this approach with models constructed for plant, reptile, and bird species in southern California's western Riverside County's Multiple Species Habitat Conservation Plan. We provide independent evaluation of species models and present examples of models predicting community richness developed from species niche models. These "community" models identify lands with the potential to support multiple species of interest. We evaluate alternative reserve configurations and their effectiveness at conserving diverse natural communities.

### **RE-CONNECTING GRIZZLY BEAR POPULATIONS ACROSS PUBLIC AND PRIVATE LANDS IN THE U.S. ROCKY MOUNTAINS: AN EMERGING FRAMEWORK**

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Conservation of small, isolated populations of grizzly bears (*Ursus arctos*) in the U.S. Rocky Mountains will likely depend on either intrusive management or reconnection with other subpopulations through linkage habitat. Since reconnection necessarily involves range expansion, proposals for linkage habitat usually mobilize opposition from people who prefer reductions rather than expansions of large carnivore populations. Our methods rely on a sequential, practice-based framework for linkage habitat conservation, emphasizing small-scale, community-driven efforts that begin on the periphery of occupied grizzly habitat. We used a systematic approach that emphasizes understanding the social and ecological context and involves local people in research, planning, and applied conservation efforts. Preliminary results from case study work relying on this framework in the Blackfoot Valley, Montana suggest that human-grizzly bear conflicts have been reduced by 84% from 2003–2005 and that dispersal events for grizzlies may be increasing. In the Gravelly Range, Montana, proactive, participatory conservation has

facilitated grizzly recolonization as evidenced by habitat reoccupancy by breeding females. Inclusive decision-making processes, non-lethal deterrent strategies, education and outreach, and front-and backcountry attractant security have helped transcend ownership boundaries as well as improved political and ecological prospects for re-connecting grizzly bear populations.

**SPECIES' RESPONSES TO FRAGMENTATION AND HABITAT LOSS: A GLOBAL CROSS-TAXONOMIC META-ANALYSIS**  
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We compiled studies of patch occupancy for several hundred terrestrial invertebrates, birds, and mammals from around the world to identify factors that best predict species' responses to patch size and isolation. Logistic regression and incidence functions were used to determine the effects of area and isolation on each species. The median patch size for a 95% probability of occurrence of area-sensitive invertebrates, birds, and mammals was 0.01 ha, 31 ha, and 1332 ha respectively, and mammals had the largest variance in minimum area requirements. Mammalian area requirements were influenced strongly by body size, whereas area requirements for birds and invertebrates were best predicted by the degree of diet and habitat specialization and ability to tolerate secondary habitats. Species responded differently to patch area and isolation: birds were more sensitive to patch area but less sensitive to isolation than invertebrates and mammals. Across taxa, species with greater dispersal distances were the least affected by isolation, but dispersal ability had no effect on area sensitivity. These broad, taxon-specific "rules-of-thumb" may help land use managers predict the community-wide impacts of habitat loss and fragmentation in areas with limited species-specific data.

**USE OF LIVE FENCES BY BIRDS IN A SUBANDEAN RURAL LANDSCAPE: IMPLICATIONS FOR CONSERVATION**

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Extensive tropical forests transformation into rural landscapes makes it crucial to understand the role of different landscape elements to conserve native species, in highly transformed regions. Live fences have been proposed as small-scale corridors to enhance functional connectivity. Yet their actual use by native birds in tropical landscapes is poorly understood. We sampled birds in 18 planted live fences differing in plant composition and landscape location at Salento, a subandean locality in Colombia. We found 75 bird species at those fences. Floristic composition was the factor contributing the most to explain bird diversity and abundance at fences. Other factors such as vegetation height, basal area, and distance to remnant forest were not related to bird species richness and abundance. However, connection to forest fragments was the main factor influencing bird movement along fences. Two thirds of those bird species present at fences came from the original forest, used fences on a regular basis, and moved along them to reach different landscape elements. Therefore, live fences used as landscape management tools have the potential to increase retention of native bird species in highly transformed regions, especially if they are managed to achieve this purpose.

**A NATIONAL REVIEW OF PRIORITY SETTING AND DECISION MAKING BY LAND PROTECTION PROGRAMS**

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States, counties, and municipalities across the United States authorized over \$30 billion dollars for land protection between 1994 and 2005. Academic conservation planning research has provided a variety of theory and tools for prioritizing the allocation of such funds for land protection; however, little is known about actual decision making and priority setting processes. We considered 406 programs approved by voters in 1996, 2000, and 2004. We identified 75 that protect water quality or wildlife values and a subset of 19 that use explicit evaluation criteria. We investigated each of the 19 programs in detail including interviews with program staff. In most cases, wildlife and watershed protection values are evaluated in the context of other criteria; most commonly contiguity to other open space, land management constraints, financial concerns, recreational opportunities, and threat. Programs expressed contrasting views on the future of their programs: some are moving from qualitative to quantitative systems based on their desire for more defensible and transparent decision making. Others are moving to balance existing quantitative systems with more flexible rules that allow room for expert judgment. This review suggests a gap between academic tools for conservation planning and the nature of decision making on the ground.

**THE GHLT CONNECTION: A PROJECT TO PROMOTE CONSERVATION AND FOREST LINKAGE IN SOUTHERN BAHIA, BRAZIL**

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Most of the remaining forests of southern Bahia, Brazil are privately owned and disappearing rapidly. The GHLT Connection is a newly initiated project that uses an integrated approach combining skills of a broad array of experts from many countries and input from stakeholders to create a management strategy for endangered golden-headed lion tamarins (GHLTs), endemic to southern Bahia. By creating a conservation action plan for a species that requires large amounts of forest for survival, our efforts to conserve the species link directly to forest conservation and improved habitat linkage. We utilize a modeling approach that incorporates landscape dynamics and population demographics to prioritize forest fragments as well as the regions between for conservation or regeneration to maximize the long-term survival of GHLTs. The project, in collaboration with other regional conservation programs, will use results to guide outreach targeting the creation of private reserves. Conservation outputs include information on the current state of GHLTs across their entire range, a proposed action plan for GHLTs that can be followed by public and private sectors, increased understanding of the use of GIS in population modeling, and enhanced technical capacity of local researchers to use these innovative tools for conservation.

**A MULTI-SECTOR FRAMEWORK FOR ASSESSING COMMUNITY-BASED FOREST MANAGEMENT: LESSONS FROM MADAGASCAR**

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Community-based forest management (CBFM) in Africa may take multiple forms, depending on the land tenure systems, forest-use norms, wood demand, and social organization in a given locality. In this paper, we propose an analytical framework for assessing the effectiveness of CBFM programs in responding to local interests. Nature, Wealth, and Power is an analytical framework that was developed from experiences in natural resource management in Africa. We adapt the framework to People, Nature, Wealth, and Power (PNWP), and use it as a lens to conduct an initial assessment of the responsiveness of contractual forest management in the Menabe region of Madagascar to interests held by communities, the state forest agency, and conservation non-governmental organizations (NGOs). Our assessment is based on interviews conducted with forest users, forest agency staff, and NGO employees in 2004. We found CBFM in Menabe to respond more consistently to People- and Nature-related interests than to Wealth- and Power-related interests. Also, we found this management mechanism more responsive to community and NGO interests than to forest agency interests. More research is needed, but our results indicate the PNWP framework holds promise as an effective policy and programming tool for designing, implementing, and evaluating community-based forest management initiatives.

**USING REMOTE SENSING TO PREDICT PATTERNS OF AVIAN COMMUNITY COMPOSITION IN THE TROPICAL COUNTRYSIDE**

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The future of biodiversity in the tropics increasingly depends not upon reserves but on the unprotected agricultural countryside. The characteristics of the countryside that promote biodiversity preservation remain, however, largely unknown, especially at the local scale. In part this is due to a lack of effective and rapid techniques for assessing animal community composition in regions of high land-cover heterogeneity. Over seven years in Costa Rica, we monitored the countryside avifauna across a wide gradient of climate and land cover. We also measured landscape composition in these same regions, by using the three metrics that result from a tasseled-cap transformation of Landsat ETM+ data (a standard remote-sensing technique). For all study sites, we found that these metrics significantly correlated with overall species richness, as well as with richness within several families. Intriguingly, across study sites, there were large variations in the specific metric that significantly correlated with a given component of community composition. These satellite-derived metrics of landscape, which are easily and quickly generated, have been little used by conservation biologists. They have great potential for illuminating what factors are most critical for preserving avian diversity in the countryside.

**DYNAMIC RESERVE-SELECTION METHODS TO MAINTAIN SPECIES' SPATIAL HABITAT REQUIREMENTS**

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Quantitative methods exist to identify reserve networks that are fixed in space based on current habitat patterns. Over time however, these static reserve networks may cease to exemplify those target attributes for which they were originally selected due to natural and anthropogenic disturbances. Therefore a dynamic approach to reserve-selection, wherein spatial habitat criteria are periodically reassessed, may better maintain habitat requirements. Implementing dynamic reserves without considering adjacency constraints has been shown, however, to produce highly fragmented reserve networks with low-quality home ranges. To address this unsustainable outcome, we compared the following additional constraints on the dynamic reserve selection process: (1) protecting additional habitat adjacent to the optimal reserve network, (2) protecting areas that are capable of meeting habitat requirements during future re-assessment periods, and (3) protecting core reserves that are static and dynamic reserves to serve as stepping stones. We used a spatial, stochastic model of a forest region in Quebec that simulates succession, fire, and harvesting to show that maintaining a static core reserve network with dynamic stepping stones was the most successful strategy to maintain high-quality home ranges in a well-connected reserve network. This research also demonstrates the importance of protecting areas that are capable of becoming viable habitat in the future.

**DOCUMENTING SAN DIEGO COUNTY'S FLORA: A PARTNERSHIP BETWEEN THE PUBLIC AND SCIENTIFIC COMMUNITIES**

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San Diego County, California is an internationally recognized hotspot of biological diversity that is being threatened by urbanization. Even so, the floristic diversity has not been fully documented, leaving land managers with a limited amount of scientific data along with mounting responsibilities for conservation and informed decision-making. Crucial decisions made here affect biodiversity nationally, and need to be based on comprehensive, scientifically sound, information. We created a novel "parabotanist program" that has trained 300 volunteers from the community how to properly collect plant specimens and record field data. Herbarium specimens last indefinitely, preserving physical samples of our plant diversity and acting as a valuable data source. We developed a new Web site to assist parabotanists ([www.sdplantatlas.org](http://www.sdplantatlas.org)) and designed a streamlined system for online data submission and delivery of specimens to the museum. Incoming specimens are verified by a professional botanist for quality control and include geographic coordinates to permit plant distribution mapping. Over 15,000 specimens (including 130 new county records) have been added to the herbarium and the publicly searchable online database. Through the training program and resulting specimen collection, the public becomes a stakeholder in regional natural history, and everyone derives educational, scientific, and public policy benefits.

**THE EFFECT OF SPATIAL SCALE ON CETACEAN-HABITAT MODELS**

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Scale dependence in species–habitat relationships has been documented for terrestrial species and seabirds. Research into the effects of scale on cetacean–habitat relationships is more limited and has produced ambiguous results. We explore the effects of spatial resolution on cetacean–habitat models using eight years of cetacean and habitat data collected in the eastern tropical Pacific Ocean. Specifically, we develop generalized additive models (GAMs) for four species at spatial resolutions ranging from 10 km to 160 km. For each species, the ecological patterns in the models built at the different resolutions were similar: the same variables frequently appeared at multiple resolutions and had a similar functional form. Additionally, we found that interannual habitat variability has a greater impact on our ability to predict cetacean distributions than the spatial resolution. While these results did not suggest a single best spatial resolution, the percentage of explained deviance was higher at the larger resolutions. It seems likely that this result is the outcome of a change in the signal-to-noise ratio when the data are pooled in larger segments. The ecological and statistical aspects of our results suggest that resolutions between 10 and 160 km may occur within a single domain of scale in the ETP.

#### **PROTECTED AREAS AND HUMAN DISPLACEMENT**

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Increasing attention is being drawn to the claims that the creation of protected areas has involved displacement of human populations and displacement of their traditional resource use and cultural practices. Strong claims are being made about the moral and logistic costs of such actions and about the needs to redress past actions. Many international funders have developed policies on displacement in other contexts but the conservation community has been largely silent. We reviewed the literature on human displacement and protected areas and developed a taxonomy of these critiques and the evidence buttressing them. We also reviewed the policies that have been promulgated by other organizations regarding human displacement and provide a context for recommendations for the conservation community to address this poorly recognized debate.

#### **WILL BEES BE LEFT BEHIND BY TRADITIONAL CONSERVATION PLANNING IN RAPIDLY CHANGING LANDSCAPES?**

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Native bee pollinators are one of the key providers of ecosystem services, yet rarely are they targets of conservation planning. We sampled species richness of bees, birds, and forbs in oak woodland habitats of Sonoma and Napa counties, California, and asked whether conservation aimed at birds and plants will also capture bee diversity. We examined landscape features within 1 and 5 kilometers of each sample location to assess the role that recent rapid habitat conversion may play in patterns of biodiversity. We found that bird and forb richness were especially unreliable predictors of bee species richness. Landscape variables used in conservation planning such as amount of natural habitat, amount of habitat conversion, agricultural or urban edge, road density, and number of parcels were also generally poor predictors of bee richness. Because of their essential role in pollination, a preeminent ecosystem service, new approaches to rapidly assessing bee diversity need to be implemented to ensure that they don't fall through the cracks in conservation planning.

#### **PRECIOUS CARGO: THE EXPERIMENTAL TRANSLOCATION OF LAYSAN TEAL FROM LAYSAN ISLAND TO MIDWAY ATOLL**

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*Anas laysanensis*, a critically endangered duck, was previously widespread in the Hawaiian archipelago, but was restricted to a single population on a remote rat-free atoll (4 km<sup>2</sup>). Evidence suggests that the Laysan teal's range contraction is attributed to the introduction of rats and coincident with human colonization (12-1500 ybp). The population has fluctuated from approximately 100–600 birds in the last decade, and is vulnerable to environmental and population stochasticity and catastrophes. The establishment of additional populations will reduce the species risk of extinction; however, the hyper-saline ecosystem upon which the teal depend on Laysan is found no where else in the Hawaiian Islands. Midway Atoll, a highly altered ecosystem, was selected for the first experimental translocation for an "insurance" population because of its successful rat eradication, ongoing habitat restoration, and logistic feasibility of post release monitoring. We reintroduced a small conservation population in October 2004 and 2005. Forty-two mostly juvenile, non-siblings were captured and transported 2 days by ship. Translocation survival was 1.0 and annualized post-release survival is 0.95 to date. We documented successful nesting in 2005, despite a highly male skewed sex ratio (6:14) and inexperienced females. We believe that monitoring the source and translocation populations will be paramount for understanding their dynamics and behavioral flexibility for successful restoration.

#### **USING CONSERVATION GIS TO DETECT OAK SAVANNAS AND OAK BARRENS IN NORTHWEST OHIO**

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Human activities have reduced the midwest North American grasslands, including oak savanna and oak barrens, by more than 99%. The Oak Openings of northwest Ohio is a mosaic of globally-significant ecosystems and has more listed species than any other region in the state. Agriculture, drainage, and fire suppression have reduced its area by half, underscoring the need to locate and prioritize appropriate habitat for acquisition and conservation. A key step to conserving rare habitats is to identify their current or potential locations. However, planners and land managers often have difficulty in implementing regional conservation efforts due to a lack of detailed ecological knowledge or a lack of habitat quality data. We used ArcGIS 8.3.0 to build a predictive habitat model to detect oak savanna / oak barren remnants or restorable habitat by determining relevant

ecological characteristics from remnant patches. Characteristics considered covered a broad range: biological, geological, spatial, and climatological. Data use was constrained to sources typically available to land managers. Single-variable (e.g. soil type, elevation, slope, or slope position) predictive models reduced the search area to a range of 12–74%. However, combining these models into a multivariate model further reduced the search down to as low as 1.87%. This research produces a quantifiable habitat model that more simply and systematically locates and prioritizes conservation at a landscape scale.

### **EFFECTS OF HABITAT QUALITY AND PATCH ISOLATION ON THE DECLINE OF NEW ZEALAND ROBINS IN A FRAGMENTED LANDSCAPE**

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Species may disappear from fragmented landscapes both because habitat quality declines and because species fail to recolonize isolated fragments. Without data on survival, reproduction, and dispersal from multiple fragments, it is impossible to assess the relative roles of these factors and therefore to project responses to management. From 2002–2005, we collected such data for New Zealand robins (*Petroica australis*) in remnants of native forest on private land in the central North Island. The data give little indication that vital rates of robins were affected by measurable habitat characteristics of fragments, or that vital rates were correlated with size or isolation of fragments. However, there was a strong negative correlation between isolation and probability of occupancy, and data from 60 radio-tracked juveniles suggested that isolated patches would rarely be reached. Projections from an individual-based spatially explicit simulation model constructed from our data suggest that management aimed to reduce isolation, i.e., strategic translocation or planting, could improve the status of the species in this landscape.

### **ENVIRONMENTAL EFFECTS OF THE COFFEE CRISIS: A CASE STUDY ON LAND USE IN AGUA BUENA, COSTA RICA**

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The last 15 years have seen the most dramatic and prolonged collapse in coffee prices in modern history. In response to this “coffee crisis,” many coffee farmers have been forced to abandon their land or change to other crops, including cattle pasture. This study looks at the environmental effects of the crisis at a local scale, focusing on the district of Agua Buena in southern Costa Rica. Interviews with 59 farmers were used to assess the nature and extent of land-use change on coffee farms. The interviews support the conclusions that, in the study area, farmers are responding to the crisis by changing from coffee to other crops, with cattle pasture representing 64.3% of converted area plantain and vegetable crops 15.3%, and land abandonment representing 14.8%. Unpublished research on birds in the region has shown changes in community composition, and reductions in taxonomic richness and diversity, when coffee is converted to pasture. Interview responses also suggest that widespread conversion to pasture may put pressure on the area’s forest fragments for fuel wood. The study concludes that low coffee prices have had important environmental effects in the study region, and that new economic solutions are desirable to mitigate these effects.

### **LANDSCAPE EFFECTS ON CROP POLLINATION SERVICES: ARE THERE GENERAL PATTERNS?**

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Crop pollination is an ecosystem service of enormous economic value, and there is increasing evidence that wild pollinators contribute significantly to production in several crops. In particular, several studies have investigated the importance of native habitats to pollinator communities and pollination services, but to date no meta-analysis has been conducted to evaluate emerging patterns and lessons. Here we compile data on 20 such studies (representing 16 crops on five continents) and use hierarchical Bayesian models to estimate the general relationship between pollination services and isolation from native habitats. We find that, while the relationship varies widely among studies, pollinator visitation rates show a general and significant exponential decline with increasing distance from native habitats. We also examine pollinator richness and fruit or seed set, and we compare relationships between tropical and temperate crops, and between annual and perennial crops. The emerging general relationships we find can be used to predict consequences of past or future land use change on pollinators and crop productivity.

### **TEMPORAL, SPATIAL, AND ECOLOGICAL PATTERNS OF BIOINVASIONS IN THE MEDITERRANEAN SEA**

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The Mediterranean Sea is a hotspot of marine bioinvasions. We analyzed existing datasets for temporal, spatial, and ecological patterns of fish, decapod crustaceans, and mollusc invasions in the Mediterranean. Most species (65–95%) originate from tropical areas, mainly from the Indo–Pacific. The highest number of aliens occurs in the eastern basin, most probably due to its proximity to the Suez Canal, and the more favorable conditions in the Levant basin for tropical species. The recent eastern Mediterranean climatic transient phenomenon may have contributed to an accelerated westward spread of Red Sea species. In fish, the average number of invaders per decade in the second half of the 20th century was 3.6 greater than in the first half, in crustaceans it was 1.7 greater, and in mollusks 5.2, indicating an accelerated invasion rate. Most species that invaded until the 1950s are already considered established. Nonetheless, the number of studies on ecological impacts of these invasions is alarmingly low. The majority of fish invaders in the Mediterranean are spawning, shallow water, benthic carnivores, which makes sense ecologically. With the expected increase in human population, in trade, and in global warming, and with the expected expansion of its prime invasion vector, the Suez Canal, the arrival and establishment of more invaders is certain. The future of the Mediterranean seems therefore grim and it calls for extensive research on impacts and management needs.

**PRIVATE USE AND BIODIVERSITY PROTECTION ON THE NATURE CONSERVANCY'S CONSERVATION EASEMENTS**

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Conservation easements are one of the primary tools for conserving biodiversity on private lands and can provide habitat connectivity across ownership boundaries. However, little is known about the level of protection ensured by conservation easements at the local or landscape scale. Analysis of 119 conservation easements held by The Nature Conservancy in 2005 compared the permitted extent and intensity of residential and commercial uses with the objectives of each easement including biodiversity conservation and threat reduction. At the site level, 70% of sampled conservation easements permitted residential or commercial use and 61% allowed some additional structures—with only 62% of these restricting structure size or building area. Larger and more recently established easements had a higher intensity of permitted structural development than older easements on smaller properties ( $p < 0.0001$  and  $p = 0.0192$ ). 46% of the easements support ranching, forestry, or farming, and these working landscape easements were more likely to serve as buffers to enhance biodiversity in the surrounding area ( $p = 0.0021$ ,  $OR = 4.84$ ). Contrary to some public expectations, we demonstrate that easements usually provide an intermediate level of biodiversity protection along the gradient from complete protection to unrestricted human use.

**EVALUATING SUSTAINABILITY OF BUSHMEAT HUNTING AT THE LANDSCAPE SCALE**

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Hunting to supply the bushmeat trade in central and west Africa is thought to be widely unsustainable. However, many studies fail to address sufficiently the issue of long-term sustainability, using only localized depletion, temporary declines, or snapshot comparisons between two sites to demonstrate the effects of hunting. In order to address this issue more rigorously, harvest patterns need to be assessed at a landscape scale incorporating the spatial and temporal dynamics of both prey and hunter. We evaluate the spatial and temporal dynamics of bushmeat hunting at a landscape scale based on a 12 month field study in Equatorial Guinea. We combine data on mammal abundance from transect surveys with spatially and temporally explicit data on hunting effort and success from direct observation and hunter recall. This combination allows us to model wildlife depletion in space and time, and hence to make inferences about long-term sustainability at the landscape level. We make recommendations for the management of hunting and conservation of biodiversity in Equatorial Guinea.

**COMMUNITY-BASED AFRICAN WILD DOG CONSERVATION IN THE BIODIVERSITY HOTSPOTS OF SOUTHEASTERN KENYA: RESULTS OF A BASELINE ATTITUDE SURVEY**

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In community-based conservation projects baseline social assessment data are often lacking, but are essential to monitor the effectiveness of education programs and adapt to changing conditions and expectations. Working with local people, a project was recently launched in the Biodiversity Hotspots of southeastern Kenya to study how endangered wild dogs and people can coexist with the aim of empowering communities to develop and implement conservation solutions, and raise awareness of the importance of the environment and wildlife. A baseline survey assessing attitudes about wild dogs, other large predators, and the environment was conducted by trained community representatives. Reports of livestock depredation also were recorded. People in 31 villages from three tribes, the Somali, Pokomo, and Aweer, were interviewed. Attitudes were generally negative because of concern for livestock and / or personal safety (75.5,  $n = 102$ ). Concern for the environment was strong (92.9,  $n = 114$ ), but the role of predators in the ecosystem was not generally understood. A majority of those interviewed (56,  $n = 112$ ) wanted only livestock killers eliminated, or predators moved to a sanctuary / zoo or left alone. Improved husbandry practices, verification of livestock losses, and community-driven education programs are important for wild dog conservation in the region.

**STATE FRAGILITY AND BIODIVERSITY: STRATEGIC CONCERNS AND EMERGING RESPONSES**

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Nation state fragility has become a defining concept driving international aid and donor assistance across the globe. Governments, including those that are major donors for biodiversity conservation, have increasingly adopted a fragility lens to shape foreign policies and programming. As such, the importance and role of biodiversity conservation needs to be fully integrated into fragility analysis and appropriate programmatic responses. We describe progress towards this integration and lay out some steps to strengthen the conservation elements. Through an analysis of over 20 fragility assessments that have been conducted in various countries by the US Agency for International Development and partners, we discuss lessons learned regarding how biodiversity and natural resources both drive and / or are impacted by fragility. We describe the major ways that biodiversity is threatened within fragile states—jeopardizing ecosystems, livelihoods, economic development, and health—by showing how dimensions of fragility intersect with specific threats. We categorize responses to these multiple threats in terms of actors / partners involved, integration of elements, and potential to address root causes and draw conclusions with respect to the efficacy of responses. Finally we show how mobilization for conservation and sound natural resource management can contribute to better governance even within volatile situations.

**ARMY CUTWORM MOTH HABITAT AND GRIZZLY BEAR CONSERVATION IN THE GREATER YELLOWSTONE ECOSYSTEM**

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Army cutworm moths (*Euxoa auxiliaris*) (ACMs) are important food for grizzly bears (*Ursus arctos horribilis*) in the Rocky Mountains. ACMs oviposit at low elevations in the Great Plains and intermountain west. After emerging in June, adult moths migrate to alpine areas in the Rockies. Here ACMs consume flower nectar nightly, aggregating in talus daily. Bears eat millions of ACMs; in 30 days they can consume about half their yearly calories. The US Fish and Wildlife Service conservation strategy for Yellowstone grizzly bears allows bears to expand into biologically suitable and socially acceptable areas. This strategy uses GIS to monitor bears, ACMs, and the three other major bear foods in the Greater Yellowstone Ecosystem (GYE). Thus, we developed alpine ACM habitat models in the GYE to create a tool for scientists and managers to identify potential ACM habitats into which bears may expand. We developed models using attribute data extracted from 490 bear locations and 5000 random points generated in GIS. Model variables were topographic features and individual TM bands. We determined a testing ratio and divided the data into k-fold cross-validation groups. Elevation, aspect, rate of change in slope, and bands 1, 2, 3, 4 were significant variables.

### **BIODIVERSITY SCIENCE—WHAT WE KNOW, WHAT WE DON'T KNOW AND WHERE DO WE GO FROM HERE**

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With as many as 80% of extant species yet to be discovered or described in any detail, our knowledge of existing biodiversity is far from complete. Yet knowing how much biodiversity there is on Earth, and perhaps more critically, how it is changing and why, are fundamental goals for the new millennium. Any significant advances in the field of biodiversity science will depend on a synthetic framework that allows us to identify the lesser known species, ecosystems, and geographical areas, optimize the allocation of our limited time and resources, and prioritize among the projects. To identify the gaps in our knowledge of biodiversity on Earth, we reviewed the literature and evaluated the scientific knowledge of biodiversity along four axes: (1) Taxonomic: scientific knowledge is not distributed equally among different taxonomic groups. (2) Ecological: scientific knowledge is not distributed equally at different ecological scales. (3) Geographic: scientific knowledge is not distributed equally among different regions in the world. (4) Biological realm: scientific knowledge is not distributed equally among different biological realms. By considering one or more axes simultaneously, we identified gaps in biodiversity knowledge and formulated key questions to advance / stimulate future research in this field.

### **ARE VERTEBRATES IN THE TROPICAL ANDES WELL PROTECTED?**

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We analyze the geographical distribution of 4897 species of amphibians (1420 spp.), birds (2742 spp.) and mammals (735 spp.) in the tropical Andes (Bolivia, Colombia, Ecuador, Peru, and Venezuela), and assess the proportion of their range included in natural protected areas (IUCN categories I, II, and III). Our objective is to identify species that are either absent or marginally present in these areas, with an emphasis on endemics and threatened species. By overlapping the ranges of these species, we identify gaps in the protected areas network, which could then be used as target sites for future finer-scale conservation planning. Amphibians have both the highest number of endemics (1056 spp) and threatened species (455 spp.), while Peru contains the highest richness of amphibians (58% of total), birds (49%), and mammals (55%). Although 13% of all species combined is absent from protected areas, 71% of them can be considered insufficiently protected. In fact, 97% of amphibians, 62% of birds, and 61% of mammals fall in this latter category. Peru includes the most significant gaps detected: in the north, there is a simultaneous protection gap for amphibians, birds, and mammals, while its coastal areas are keys for both birds and mammals.

### **ASSESSMENT OF ECOSYSTEM EXTINCTION RISK AT MULTIPLE SPATIAL SCALES**

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Numerous schemes exist for ranking ecosystems in terms of their conservation priority. Most use categories that express the urgency of needed conservation actions. This is in contrast to current trends in species red listing, which explicitly seek to avoid confounding risk assessment (a scientific process) with priority setting (a societal process). Here, we specifically avoid this problem in our assessment of the extinction risk of terrestrial ecosystems in a 6500 km<sup>2</sup> area in northern Venezuela, using a system analogous to the IUCN Red List of Threatened Species. Assessments were performed at scales that ranged from natural divisions of space (ecosystem types, watersheds), through human constructs (states, municipalities), to fully arbitrary units (grid cells). We classified land cover using satellite images taken in 1986 and 2001, and quantified changes at the spatial scales mentioned above, focusing on natural vegetation (deciduous, semideciduous, and evergreen forests). We show that because extinction risk depends on the scale of the analysis, a high probability of extinction does not obviously lead to higher conservation priority. The decision of where to invest limited conservation funds should consider our results, but also include information on biological uniqueness, global importance, legal and logistical context, and the public's preferences.

### **LAND USE CHANGE AND ITS IMPACT ON THE BUTTERFLIES OF THE "LA TULA" WATERSHED, PUERTO RICO**

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In the island of Puerto Rico the transformation of formerly agricultural lands and second growth forests into urban developments currently represents a major threat to its biota. Using butterflies as an indicator of habitat conditions we asked how species composition varied in a landscape mosaic that included agricultural fields, pastures, orchards, second growth forests, and residential areas. In each of 40 sampling stations in an area of 138,890 ha at La Tula watershed we censused butterflies, quantified land use types, and described vegetation composition. The ordination of the butterfly and environmental

data separated the sampling stations into two groups. The first included stations where we registered *Eurema leuce*, *Heliconius charitonia*, *Drias iulia*, and *Calisto nubila* and that were dominated by trees or were adjacent to them. The second group included stations in which *Pyrgus oileus*, *Ascia monuste*, *Eurema lisa*, and *Phoebis sennae* were common and that were dominated by agricultural fields, pastures, and residential areas. Kriging of the ordination scores further revealed the importance of forest cover along the La Tula creek for the dispersal of butterflies across this landscape mosaic. The rapid expansion of urban areas in Puerto Rico is likely to have a negative impact on its biota.

**POPULATION MANAGEMENT OF THREATENED TAXA IN CAPTIVITY WITHIN THEIR NATURAL RANGES: LESSONS FROM ANDEAN BEARS (*TREMARCTOS ORNATUS*) IN VENEZUELA**

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Threatened taxa in captivity within their natural ranges can make important contributions to conservation, but these may be compromised by the inappropriate application of population management goals developed in other contexts. We conducted demographic, genetic, and population viability analyses on the captive population of Andean bears (*Tremarctos ornatus*) in Venezuela to investigate the management of within-range captive populations in general, and to better integrate this population into the conservation of Andean bears in particular. We found that although the present population is small and not internally self-sustaining, incorporation of confiscated wild individuals has resulted in low inbreeding, with moderate gene diversity and a high probability of future persistence. However, past imports from extra-range populations have been from over-represented lineages of unknown origin, which have mixed with under-represented Venezuelan ones, reducing the value of the Venezuelan population as a source for founder stock. Our analyses indicate that the incorporation of wild recruits is a major factor influencing proxy measures of conservation value, and distinguishing within- from extra-range populations. Our results imply that, contrary to conventional wisdom, internal self-sustainability can be a misguided goal in within-range populations, which furthermore may not be suitable as destinations for surplus captive animals from elsewhere.

**"THEY EAT RHINOS": CONTRASTING AND CHANGING PERCEPTIONS OF BUSHMEAT IN TWO MAASAI SECTIONS OF SOUTH EASTERN KENYA AND IMPLICATIONS FOR CONSERVATION**

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This research compares perceptions of bushmeat across three areas with contrasting land tenure / use situations and access to tourism and conservation economic benefits, in two Maasai sections in the Amboseli Ecosystem, Kenya. Maasai have been portrayed as "ecologically noble savages," and their proscriptions on eating wildlife suggested as explanation for locally persisting wildlife populations. Within a context of demographic and socioeconomic changes, I tested the hypotheses that (1) members of the Kisonko and Matapato sections, and of different groups within each section, have different attitudes towards bushmeat, and that (2) respect for food taboos is decreasing. Semi-structured interviews were conducted in a random sample (n = 192) stratified by land use, age, and gender. Matapato Maasai, who have historically eaten wildlife for survival and have no access to tourism benefits, have positive attitudes. Kisonko Maasai, nearby protected areas, reject bushmeat, seen as fit only for non-Maasai, children, and women. However, perceptions are changing, accompanying pauperization and market economy integration, which make the bushmeat trade an attractive cash-generating option, and eating wildlife less stigmatized. Thus, generally, local Maasai dietary avoidance of bushmeat is weakening. In a context of increasing bushmeat consumption in Kenya's cities, human-wildlife conflicts and wildlife habitat loss, this represents another threat to Amboseli's migratory wildlife conservation.

**TEMPORAL CHANGES IN SPECIES EVENNESS AS AN INDICATOR OF DISTURBANCE**

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Tree harvesting has been recognized as a key factor that negatively impacts forest sustainability. Quantitative assessments that specifically address the degree of impact of such a disturbance are lacking. Forest Inventory and Analysis (USDA Forest Service) data were used to study harvesting impacts across the state of Mississippi through four forest surveys conducted in 1967, 1977, 1987, and 1994. Encompassing 122,330 km<sup>2</sup> across the state, approximately 5200 permanent sample plots were monitored over a 30-year period. The McIntosh Evenness measure was used to quantify changes in tree species evenness over time. Decreases in the evenness index would indicate a simplification of stand structure over time. Between 1967 and 1994, mean tree species evenness per plot dropped from 0.63 to 0.56 (1.00 indicating perfect evenness of all species). Only 6 counties in Mississippi averaged 0.75 in 1977 but by 1994 only 1 county was in this range. Trends in these data show that harvesting has impacted forests across Mississippi by simplifying stand structure.

**LOCAL AND LANDSCAPE DETERMINANTS OF FOREST HERB DIVERSITY IN HEDGEROWS: A CONSERVATION PERSPECTIVE**

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The comprehensive management of a network of semi-natural habitats outside traditional conservation zones has the potential to mitigate the impacts of isolation and adverse external influences currently impinging on protected areas. In agricultural landscapes, hedgerows can constitute refuges for native flora and fauna and provide connectivity between landscape elements. However, the effectiveness of such functions for poor dispersers and recruiters such as temperate forest herbs is quite variable among hedgerows. We surveyed 117 wooded hedgerows of an agricultural landscape west of Montreal, Canada, to identify spatial, structural, and historical factors likely to favour the presence and abundance of forest herbs in these marginal habitats. Multiple linear regression analysis showed that the age and width of a hedgerow, its degree of isolation, and the frequency of past disturbances significantly influence the richness, abundance, and diversity of forest herbs in hedgerows. We also identified a set of indicator species to be used to predict the habitat quality and consequently the conservation value of various

hedgerows. The results of this study show that both local and landscape factors must be considered when selecting and managing hedgerows for biodiversity conservation.

### **MOLECULAR PHYLOGEOGRAPHY SUGGESTS THAT VERTEBRATE AND PLANT-BASED CONSERVATION PLANS MAY NOT PROTECT HAWAII'S UNUSUAL INSECT FAUNA**

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Approximately 90% of the native insect species in the Hawaiian Islands are endemic. Such high levels should lead to significant efforts to preserve this unique diversity. However relatively few conservation-based studies or resources are focused on Hawaiian insects, perhaps due to the assumption that vertebrate and plant-based conservation planning will preserve endemic insect diversity. I addressed this idea in a study of the Cosmopterigid moth genus *Hyposmocoma*, which may rival or exceed *Drosophila* in terms of endemic Hawaiian species diversity. As one of the greatest radiations in the Hawaiian Islands, *Hyposmocoma* could provide a powerful comparison to Hawaiian *Drosophila* with respect to patterns of diversification, and evolutionary constraints in the broader context of evolutionary theory. Additionally, patterns of diversity in *Hyposmocoma* may help guide the prioritization of regions and habitats for conservation, and the scale at which conservation is most effective. I present a systematic hypothesis, based on sequence from mitochondrial and nuclear genes, for an unusual aquatic group of *Hyposmocoma*. Results suggest multiple invasions and reversions of the aquatic habit-which may be an extremely rare evolutionary scenario due to the constraints of an aquatic lifestyle. Patterns of species diversity are at a finer scale and not closely correlated with native vertebrate or plant species. Riparian degradation appears to have limited the range of many populations.

### **NO SIGN OF THE NEXT GENERATION: AN INVESTIGATION OF DECREASED WESTERN HEMLOCK (*TSUGA HETEROPHYLLA*) TREE SEEDLINGS IN FORESTED IN URBAN PARKS**

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Western hemlock (*Tsuga heterophylla*) tree seedlings are absent in over a dozen urban, forested parks of Portland, Oregon. In rural parks just 30 miles outside of the downtown metropolitan area, *T. heterophylla* seedlings are found in densities of up to 20 per square meter. This discrepancy in seedling recruitment may have serious effects on urban forest ecosystems and forest regeneration. I investigated six abiotic and biotic conditions at three essential stages of tree regeneration: trees, seeds, and seedlings. Findings show highly significant differences in seed rain abundances between parks, with the *T. heterophylla* seed rain in the rural parks measuring thirty-five times higher than seed rain in urban parks. *T. heterophylla* seedlings were strongly aggregated on nurse logs, with 90% of all seedlings present on these "safe recruitment sites." These results have important implications for management of urban parks.

### **ASSESSING THE NON-USE ECONOMIC VALUE OF SIX ENDANGERED AQUATIC SPECIES IN CANADA**

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A choice experiment (CE) was conducted to assess the non-use economic value of several endangered aquatic species in Canada, including Atlantic salmon, Atlantic whitefish, right whale, leatherback turtle, porbeagle shark and white sturgeon. Other CE attributes include changes in population abundance and Species at Risk Act listing status, the probability of conservation program success, and funding mechanism (increased taxes or reallocation of current government spending). Respondents were drawn from a national Canadian internet panel maintained by an international market research firm (n = 2796 completed Web-based surveys). A latent class conditional logit model was used to identify six latent classes that varied according to their marginal trade-offs between CE attributes and by six significant covariates (age, income level, region, perceptions regarding threats to aquatic species at risk, participation in outdoor activities, and total time to complete the survey). The six latent classes exhibited markedly different willingness-to-pay for the conservation of different species. The results suggest that Canadians across the entire country may hold substantial non-use economic values for regionally endangered species. Accounting for national non-use values could have important implications for future listing decisions and the management of regional industries and activities that impact species at risk.

### **EVALUATING NON-INVASIVE HAIR AND SCAT SAMPLING METHODS FOR BOBCAT AND OTHER CARNIVORE SPECIES**

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Due to low densities and large ranges, mammalian carnivores like bobcats (*Lynx rufus*) can serve as indicators of the effects of habitat fragmentation on wildlife populations. Non-invasive sampling methods provide a means for studying species that are difficult to survey using traditional techniques. Focusing on bobcat, we compared the effectiveness of non-invasive hair and scat genetic sampling in field sample collection, species identification, and individual genotyping. We describe a novel hair-snare design and sampling protocol that successfully sampled four sympatric carnivore species: bobcat, mountain lion, coyote, and gray fox, in small urban habitat fragments and large habitat blocks in coastal southern California. Hair snare and scat surveys were both successful at sampling bobcats; however, scat samples were scarce in areas with high human and dog traffic. Hair and scat sampling methods had similar mtDNA species identification success (81 and 87 respectively). Therefore, for studies focused on the distribution and activity of a suite of carnivore species, we recommend combining or alternating hair and scat surveys depending on their effectiveness for each species and site. However, due to a higher genotyping success rate for bobcat scat (85) than for hair (22) samples when using four microsatellite loci, we suggest scat sampling is a better choice for studies that require individual analyses of bobcats.

**ASSESSING THE ROLE OF THE NATIONAL WILDLIFE REFUGE SYSTEM IN CONSERVING AMERICAS BIRD DIVERSITY**

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In response to the National Wildlife Refuge System Improvement Act of 1997, the U.S. Fish and Wildlife Service has developed wildlife, habitat, and biodiversity goals for the National Wildlife Refuge System (the System). One main challenge for the System is to coordinate its efforts towards strategic growth, management, and maintaining biodiversity at multiple scales and with conservation partners. We used bird lists from individual refuges and refuge complexes to assess the representation and redundancy of all bird species at multiple scales across the System. We then analyzed this data using conservation organizations' tools such as priority lists and Bird Conservation Regions. Of the 38 species considered to be of Highest Conservation Concern by the American Bird Conservancy, preliminary results show that 30 have occurred on National Wildlife Refuges. Those species not occurring in the System—mostly endangered species and endemics—could serve as conservation targets for strategic growth. Results also highlight the importance of individual refuges to the conservation of specific birds by Bird Conservation Region. Study results can then be used to identify management strategies on specific refuges as the Refuge System maximizes the role it plays in conserving America's bird diversity.

**SPECIES INTERACTIONS BIAS COMPLEX BUT NOT SIMPLE PVA MODELS**

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Most population viability analyses (PVA) assume that the effects of species interactions are subsumed by population-level parameters. Here, we examine validity of this assumption for five commonly used PVA models. We develop a stochastic, fully stage-structured predator-prey model to simulate time series of prey population vital rates and abundance. We then use simulated data to parameterize 3 demographic and 2 time series PVA models and estimate risk. Model bias is measured as the absolute deviation between estimated and observed risk. Our results highlight three generalities about the application of single species models to multi-species conservation problems. First, most single species PVA models overestimate extinction risk (e.g., conservative estimation) when species interactions cause periodic variation in abundance. Second, demographic PVA models more frequently underestimate risk (i.e., overly optimistic forecasts) than time series models. Finally, a simple time series model (the corrupted diffusion approximation) more accurately estimates quasi-extinction risk than most other PVA models because it successfully partitions variation due to environmental sources and predator-prey cycles.

**REMEMBERING THE GULF: CHANGES IN THE SEA OF CORTEZ SINCE STEINBECK AND RICKETTS**

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One of the most storied ecological expeditions is the 1940 journey of author John Steinbeck and biologist Edward F. Ricketts to the Gulf of California, or Sea of Cortez, on the Western Flyer, a sardine purse-seiner, out of Monterey, California. Steinbeck and Ricketts collected extensively and made detailed notes on the fauna at each site and noted many ecologically relevant observations at and enroute to 19 intertidal sites (15 rocky, 3 sandy, 1 coral) from Cabo San Lucas, Baja California Sur, to Estero Agiabampo on the Sonoran coast of mainland Mexico. Since their expedition, large scale changes are to be expected in the general ecology of Baja California and the Sea of Cortez, potentially due to increased resident population, increased fishing intensity, massive development of tourism-related infrastructure, and climatic change. In an attempt to assess these changes from a historical ecology point-of-view, we repeated the 1940 expedition, to the same intertidal sites and at the same time of year. We illustrate and discuss the difficulties in attempting to repeat past ecological studies for gaining insight into ecological change, but we also demonstrate that, even lacking quantitative data taken with modern statistical approaches in mind, the record set forth by Steinbeck and Ricketts leaves little doubt that large ecological changes have occurred in the Sea of Cortez.

**NEW UNIFIED GLOBAL CLASSIFICATIONS OF THREATS AND CONSERVATION ACTIONS—THE FOUNDATION OF A SYSTEMATIC CONSERVATION SCIENCE**

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There is growing interest in promoting more systematic information sharing and learning between conservation practitioners in and across different organizations. Ultimately, these efforts are about trying to develop a body of knowledge and practice about how to make conservation more effective—to create a science of conservation. An unglamorous yet essential foundation of any science is a standard nomenclature. If we want to create general principles for conservation work, we need a common language. In recent years, the IUCN Species Survival Commission and the Conservation Measures Partnership have each independently developed standard classifications for direct threats and for conservation actions. Over the past year, we have been working to bring together these separate efforts to produce one unified set of classifications. Here we present the results of this work. It is our hope that these standard classifications will help field project teams identify threats and design appropriate actions. More importantly, these taxonomies will allow practitioners to search a database of conservation projects and find projects facing similar threats or using similar actions and thus to learn how, why, and when certain actions succeed in abating particular threats—to facilitate cross-project learning and ultimately develop a full-fledged science of conservation.

**FISHING INDIRECTLY ALTERS CARBON FLOW THROUGH A TEMPERATE COASTAL ECOSYSTEM**

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The reduction of predators by fishing is known to alter coastal food web dynamics and benthic primary production in northeastern New Zealand. We assessed how this decline in top-down regulation indirectly alters carbon flow to primary consumers by comparing stable isotope ratios and growth rates of filter feeders transplanted inside and outside four “no-take” marine reserves. Within the two oldest reserves, increases in previously fished predators have resulted in localized declines of their herbivorous sea urchin prey and a 10-fold increase in kelp biomass. Kelp-derived carbon assimilated by filter feeders within these reserves was 1.6 times greater compared to those transplanted outside. This was not observed in the two younger reserves, where protection status has had no effect on urchin density or kelp biomass. Within and adjacent to all four coastal marine reserves, estimates of kelp contribution to transplanted consumers averaged 59%, suggesting that carbon fixed by macroalgae is a dominant food source fueling secondary production within New Zealand’s nearshore food web. However, growth rates of filter feeders did not differ with protection status. Instead, a strong regional gradient in growth emerged, best predicted by Secchi depth and wave exposure. These results suggest that fishing-mediated alterations of kelp carbon flux play out within a regional oceanographic context.

### **A REVIEW OF COMMENSAL RODENT ERADICATION ON ISLANDS**

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Sixty-four percent of recent extinctions are of island species and most of these extinctions were caused, at least in part, by invasive animals. Commensal rodents (*Rattus* spp. and *Mus musculus*) are likely the most widespread and damaging invasive animals on the world’s islands. However, rodents can be eradicated from islands, after which native species can recover. We reviewed all known commensal rodent eradications from islands to help guide and facilitate future island conservation actions. We found at least 274 commensal rodent eradications on 233 islands, mostly in New Zealand and Australia. The majority of eradications (63%;  $n = 173$ ) occurred on small islands ( $< 50$  ha), with only 13 eradications ( $< 5\%$ ) on islands  $> 500$  ha. The largest successful eradication was on 11,300 ha sub-Antarctic Campbell Island. The most common method of eradication was poisoning with the anticoagulant brodifacoum (64%;  $n = 129$ ). Impacts to non-target animals continues to be a major factor in restricting efforts to eradicate rodents. Relatively few eradications have been on islands with endemic mammals because of their susceptibility to most rodenticides. Impacts from commensal rodent predation and the benefits of eradications have been increasingly documented, demonstrating the power of this biodiversity conservation tool.

### **FISH RESPONSES TO FIVE NEIGHBORING MARINE RESERVES IN THE PHILIPPINES: SIMILARITIES AND DIFFERENCES**

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We wanted to find out whether neighboring no-take marine reserves show similar responses when protected. Reserves are increasingly promoted as a simple, precautionary measure to conserve biodiversity and sustain coral reef fisheries. However, rigorous empirical assessment of their effects has lagged behind theoretical studies. It is, moreover, rare to find simultaneous field studies in a complex of marine reserves. We surveyed changes in fish communities for seven years in five small reserves across the central Philippines. Our transects were located within the reserve (Inside), within a kilometer of their boundaries (Outside) and at three distant reference sites. We only found significant differences between fish communities Inside and Outside the reserve at the two sites with strictest compliance with fishing prohibition, while there were significant differences to distant reference sites in all cases. The strongest responses to reserve protection were found in predatory fishes (groupers and breams) and in butterflyfish. Other abundant fish families showed weak effects of protection. For all taxa analysed, we found significant effects of reserve site and site x treatment interactions. The detection of fish responses to reserves is complicated by potential spillover effects, site-specific factors, particularly compliance, and the difficulty of identifying appropriate reference areas.

### **A SIMPLE MODEL OF CONSERVATION INVESTMENT: THE RUAHA MODEL**

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Unfortunately there is not enough money available for conservation. As a result there is a great premium on making conservation investment decisions that will yield the greatest conservation gain for the least amount of money. Conservation decision-making requires simultaneously considering the efficiencies through which conservation dollars become conservation effort, how that effort translates into threat reduction, and how reduced threats lead to increased conservation targets (e.g. more animals, higher levels of biodiversity, greater ecosystem service, etc.) At each stage in the decision-making process, conservationists can choose among different efforts, threats and / or targets, and in fact the best conservation strategy will require an optimal solution constrained by how much money is available. The Ruaha model is a simple, flexible algebraic framework for fitting real numbers to hard conservation decisions. Various structural relationships in common conservation decisions will be presented. Analysis yields basic threshold investment levels where conservation investments “break even” with respect to conservation gains and highlight the importance of relative efficiency levels in determining the potential gains of different conservation investment strategies. The model is extensible to include imperfect knowledge and the role of monitoring investments in relation to intervention investments in creating optimal conservation outcomes.

**NEW INTERACTIVE PLATFORM FOR ONLINE LEARNING IN ENVIRONMENTAL EDUCATION: THE AYUQUILA RIVER E-CASE STUDY, SIERRA DE MANANTLAN, MEXICO**

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As environmental problems become global and common to distant communities, there is a need for the sharing of experiences of successes and failures in their resolution. Monetary, time and logistical constraints limit personal exchanges that can alternatively be achieved electronically. The Intermunicipal Initiative for the Integrated Management of the Ayuquila River (2000 University Extension Award and 2005 national Local Government Award, Mexico), has been considered an innovative approach for promoting local governance in environmental conservation by linking municipal governments, local academic institutions, NGOs, and federal agencies. Following a "case study methodology" we developed an interactive, online educational platform to present the 20 year history of Ayuquila research, restoration, and community organization. Information is presented at three levels of depth: an introductory 30 minute video presenting problems, stakeholders and actions; an interactive map with the spatial, temporal, and scale components; and a library archive presenting technical articles in PDF format. Each map point delivers one of three types of information (videos, slide shows, or animations) accompanied by explicatory texts. On the same screen the user can get a glimpse of the landscape location of events; their chronology; and the concurrent global, national, and state level events that shaped local history.

**GENETIC STRUCTURE AND LANDSCAPE FRAGMENTATION: PLANNING THE RECOVERY OF A CRITICALLY ENDANGERED SALAMANDER**

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The Santa Cruz long-toed salamander is a member of a polytypic group of five salamanders that range primarily in the western / coastal United States and Canada. The entire distribution of the Santa Cruz taxon is restricted to a matrix of landscape fragments consisting of not more than 14 known breeding populations in the coastal terrace of central California. It is protected by Federal and state endangered species regulations, but recovery efforts are limited by the mosaic nature of the landscape and a lack of understanding of how, or if, to manage the entire range. However, an important element in species recovery is understanding the historical ecology and connection of breeding populations. I will describe the spatial distribution of the Santa Cruz long-toed salamander, and overlay how genetic data (based on multiple sample years and 16 microsatellited DNA loci for all breeding populations) can inform more practical recovery efforts by identifying managements units. My discussions will focus on the status of the species, particularly on how breeding populations are structured due to historical gene flow, recent colonizations and founder effects, and disrupted gene flow. I will also discuss the evolutionary relationships of long-toed salamanders, with attention on the Santa Cruz taxon, and raise the issue of species concepts and the importance for policy and recovery funding.

**EFFECTS OF UVB ON TADPOLE DIETS: CHOICE TESTS AND GROWTH RATES**

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Ultraviolet-B radiation (UVB) (280–320 nm) is high energy light that causes damage across a wide range of taxa and at every trophic level. The earth's surface is experiencing elevated levels of UVB due to anthropogenic depletion of stratospheric ozone. Elevated UVB has been investigated as one of several possible factors contributing to global amphibian population declines, and direct effects of UVB on amphibians have been demonstrated. We investigated indirect effects of UVB on tadpoles mediated by how UVB impacted their food. We grew algae in the field under two light regimes, UVB-exposed (UVB+) and UVB-shielded (UVB-), and tested whether *Hyla regilla* (Pacific treefrog) tadpoles could distinguish and choose between the two food types. We also fed UVB+ and UVB- diets to newly hatched *H. regilla* and *Rana cascadae* (Cascades frog) tadpoles for four weeks and measured their growth. *H. regilla* tadpoles preferentially grazed on the UVB- algae and grew more slowly when fed the UVB+ diet. *R. cascadae* tadpole growth did not differ between the two diets.

**USING GIS AS A TOOL TO PREDICT THE DISTRIBUTION OF NATURALLY FISHLESS LAKES IN MAINE, USA**

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Due to its glacial history and varied topography, the state of Maine may host an abundance of naturally fishless lakes. These lakes provide habitat for a diverse assemblage of species that cannot withstand competition with fish and / or fish predation. Recognizing the ecological significance of fishless lakes, this study was developed to gain a better understanding of their number and distribution in Maine. With over 6000 lakes in the state, and less than one quarter surveyed for fish presence, our objective was to develop a method to remotely assess the likelihood that a given lake is fishless. We used GIS to identify landscape factors (e.g., surrounding slope, connectivity) relating to the fishless condition in two regions of Maine. Based on these factors, stepwise logistic regression was used to estimate the likelihood that a particular lake is fishless. Regression models predict that 121 lakes are naturally fishless in the two study regions. Twenty-four of these lakes were visited to confirm current and historical fish absence using gillnetting and paleolimnological techniques. Models proved to be accurate in predicting the historical condition of fishless lakes. However, fish surveys revealed that many of these lakes now contain fish as a result of stocking activities. This emphasizes the importance of identifying lakes that remain fishless to protect them from future stocking activities.

**DISTINGUISHING EFFECTS OF URBAN DEVELOPMENT AND HUMAN DISTURBANCE ON LANDBIRD COMMUNITIES IN THE CENTRAL SIERRA NEVADA**

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Urbanization presents a suite of challenges to conserving biodiversity. Facets of urbanization that affect the amount and configuration of habitat are known to have clear consequences for native species, while other facets more closely tied to the presence of humans themselves, such as removal of dead wood and wildlife harassment by people and domestic animals, have received less attention in an urbanization context. As part of a multi-taxonomic research effort in the Lake Tahoe basin, California and Nevada, we investigated landbird species composition at 75 sites along an urban–forest gradient in 2003 and 2004 using point counts, habitat measurements, and documentation of human use. We used linear regression and hierarchical partitioning to determine the major urbanization, landscape, and local habitat features affecting various landbird community metrics. We found strong and diverse responses to many facets of urbanization. Nearly all species groups were negatively related to development, human presence, or vehicle traffic, although the strength of response varied by nesting, foraging, and dietary guild. The pervasive influence of development, human disturbance, and vehicle traffic on landbird communities highlights the importance of analyzing effects of urbanization by its components rather than as a single stressor that is less well defined.

**WHERE AGENCIES FEAR TO TREAD: INCORPORATING SOCIOECONOMIC DATA INTO THE DESIGN OF MARINE PROTECTED AREAS IN CENTRAL CALIFORNIA**

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While there is growing recognition that successfully addressing socioeconomic concerns during the process of designing marine protected areas (MPAs) is critical to their implementation and success, the practicalities and data requirements are daunting. Readily accessible information tends to be coarse scale and not originally intended for use in area-based management. We report here on an approach for collecting information on and analyzing commercial fishing use patterns, tying fishermen's expert knowledge to landing tickets, and other agency-collected datasets. We will discuss results from interviews with over 100 fishermen on the central coast of California for a project undertaken in support of California's Marine Life Protection Act Initiative. Using participatory geographic information systems (GIS), we elicited fishermen's knowledge of the fishing grounds and their relative importance for data layers that will be used to assess the viability of network proposal scheduled to be designated in the second half of 2006. We report on methodological and process lessons from this project.

**GENETIC STRUCTURE IN THE ENDANGERED SOUTHERN POPULATIONS OF THE MOUNTAIN YELLOW-LEGGED FROG (*RANA MUSCOSA*)**

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Populations of the Mountain Yellow-legged frog (*Rana muscosa*) have been declining rapidly in southern California and were listed as Endangered in 2002. Since that time, several populations have gone extinct or reached critically low population numbers. The possibility of reintroducing adult frogs from captive breeding or transplant programs is now being considered. Previous work involving mitochondrial DNA suggests very little genetic differentiation between populations in southern California. To improve this estimate of genetic diversity and to guide future management decisions, we analyzed eleven microsatellite loci for evidence of population differentiation. Our analysis includes over 200 adult and juvenile frogs from the San Gabriel, San Jacinto, and San Bernardino Mountains. We used Bayesian algorithms implemented in the programs STRUCTURE and BAPS 3.2 to estimate the number of distinct population clusters. Our results demonstrate that weak population differentiation has occurred between the three mountain ranges. We discuss possible biogeographic scenarios for the relationship of these populations and their connection to the Sierra Nevada.

**RESTORING RESOURCES FOR AN ENDANGERED BUTTERFLY: WHAT DOES A DECADE OF MONITORING TELL US?**

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Changes in land use have resulted in dramatic habitat loss for numerous species. More than 99% of the habitat for Fender's blue (*Icaricia icarioides fenderi*), an endangered Oregon butterfly, has been lost. In 1995, an experiment was initiated at two degraded sites near Eugene, Oregon to investigate methods to restore Fender's blue habitat. The experiment combined 5 soil treatments (tilling, reverse fertilization, solarization, burning, and a control) with 2 planting treatments (50% forb: 50% grass and 10% forb: 90% grass) and 2 weeding treatments (weeding or control). Seeds from 12 native plant species were field collected and sown in September 1995. Plant establishment and cover by native and non-native species was monitored annually from 1996-2005. Analysis of the first five years of the study indicates that solarization promoted sufficient nectar to sustain butterflies at both sites. No treatment provided adequate larval hostplant. We review earlier analyses and ask to what degree long-term conditions can be predicted from the first years of a restoration's progress. This experiment demonstrates a method to quantitatively link habitat restoration to the resource needs of focal species and highlights the importance of using long-term experiments conducted across a range of sites to test restoration methods.

**ECONOMIC CLAIMS OF TRANSBOUNDARY CONSERVATION: REALITY OR RHETORIC? A CASE STUDY OF THE KGALAGADI TRANSFRONTIER PARK**

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The inherently transnational nature of biological diversity provides the primary impetus for transboundary protected areas (TPAs). However, its enthusiastic support stems, at least partially, from expectations of political, social or economic benefits. The socio-political climate of southern Africa makes conservation initiatives that incorporate economic development and poverty alleviation particularly appealing. Not surprisingly, supporters of TPAs often advance visions of increased tourism-generated revenues. However, to date, this assertion has not been objectively assessed. Established in 1999, the Kgalagadi Transfrontier Park, straddling South Africa and Botswana, is Africa's oldest formally recognized transfrontier park and widely viewed as the prototype for regional transboundary conservation. We examine park data on visitation, occupancy and income to assess the tourism performance of the South African side of the park. Preliminary results suggest the Kgalagadi is still far from meeting its income-generation objectives. Two visitor surveys, one conducted in the Kgalagadi and one at Cape Town International Airport, indicate that reasons for underperformance include physical characteristics of the park and insufficient awareness of its existence. Lessons from the Kgalagadi combined with insights into tourist behavior can inform the management and modify the expectations of more incipient TPAs to increase their probability of long-term viability.

**CHOICES AND CHANGE IN THE ARCTIC NATIONAL WILDLIFE REFUGE: ADVENTURES IN INTERDISCIPLINARY EDUCATION ON COMPLEX CONSERVATION ISSUES**

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Among the most contentious and public environmental controversies in recent memory is the question of oil drilling in Alaska's Arctic National Wildlife Refuge. This controversy is not merely a contemporary political and media debate about "oil versus caribou." The Refuge has stood as an iconic wilderness for sixty years. We address the problem of how traditional disciplinary universities can help students address such issues in their full complexity. These issues embody the apparent intractability typical of conservation problems, including scale, wilderness science and policy, values, indigenous human rights, economics, politics, natural resource geology, climate change, and the arts. We used the Refuge as the focus of a profoundly interdisciplinary field course offered by the University of Washington Program on the Environment. Essential features included a wide variety of student levels (from sophomores to doctoral students) and backgrounds (eight departments), meetings with diverse experts and practitioners, and an intense arctic wilderness experience. We outline reasons for the success of this course, including learning goals, the student experience, interdisciplinarity, field and classroom logistics, and budgets. This course models how highly complex, multifaceted conservation issues can be addressed as a transformative part of undergraduate or graduate education, key to preparing future conservation leaders.

**EFFECTS OF DEFORESTATION ON THE PREVALENCE OF BLOOD PARASITES IN AFRICAN RAINFOREST BIRDS**

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The effects of deforestation on health are diverse and are becoming increasingly apparent with the highly publicized recent outbreaks of several diseases spread to humans by animals. Here, we conduct a study of the effects of deforestation on the spread of infectious diseases in African rainforest birds. Over the past 15 years, we have collected more than 5000 individual blood samples from over 200 rainforest bird species in a variety of habitats across Cameroon, Cote d'Ivoire, and Uganda. Significantly, the samples were collected from sites both before and after habitat degradation, permitting a unique examination of the direct effects of human-induced habitat alterations. Using complementary techniques of blood smear analysis and molecular biology, samples are assayed for the blood parasites *Plasmodium*, *Haemoproteus*, *Leucocytozoon*, and *Trypanosoma*. We have obtained results about host-specificity, prevalence and lineage diversity of these diseases in rainforest birds, and also village chickens. Data on one rainforest bird species, the Olive sunbird (*Nectarinia olivacea*) reveals differences in prevalence rates between large contiguous forests and small forest patches. In addition, we use satellite imagery data to predict how changes in forest composition may affect the spread of diseases in the future.

**THERMAL STRESS IS A DRIVER OF CORAL DISEASE DYNAMICS ON THE GREAT BARRIER REEF**

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Changing climate conditions are predicted to increase the frequency and severity of many human, agricultural, and wildlife disease epidemics. Yet little is known about how changes in environmental parameters like temperature affect wildlife diseases in the ocean, particularly at broad spatial scales. To answer this question, we used high-resolution satellite-based sea surface temperature measurements and seven years of coral disease survey data along 1200 km of Australia's Great Barrier Reef. We found a highly significant relationship between the frequency of warm temperature anomalies and the mean number of cases of white syndrome, an emergent disease of Pacific reef-building corals. The relationship was quadratic on a log scale with the maximum number of disease cases at moderate anomaly frequencies. In 2002, the peak year of disease cases, northern and southern reefs had the greatest number of cases whereas the central reefs had the most severe bleaching. Under current climate change scenarios, major thermal stress events like the one in 2002 are predicted to increase over the next few decades. These events will have major implications for the health of coral reef ecosystems because increased temperatures could drive not only bleaching episodes but also disease epidemics.

**DO SOUTHERN CALIFORNIA FISH POPULATIONS DEPEND ON LARVAL SUPPLY FROM MEXICO?**

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Californian populations of many nearshore subtropical species are widely believed to be peripheral sinks, sustained by periodic infusions of larvae swept northward from Mexico during El Niño events. These species, e.g. California sheephead (*Semicossyphus pulcher*), California spiny lobster (*Panulirus interruptis*) and kelp bass (*Paralabrax clathratus*), are important recreational and commercial fisheries in the Southern California Bight and mainstays of artisanal and cooperative fisheries along the coast of Baja California, Mexico. California's management plans for these species acknowledge the state's possible dependence on Mexican sources, but there is actually little direct evidence with which to support or refute ideas on their sources of replenishment. We synthesized diverse types of data to investigate the reliance of Californian populations of subtropical species on Mexican sources for replenishment, and the role of ENSO in connectivity patterns. The findings suggest several potential mechanisms of long distance larval dispersal in both directions across the international border in the California Current and Countercurrent. Nevertheless, genetic results imply that local replenishment is dominant. The results also suggest that the interdependence of Californian and Mexican populations should be an important consideration in management plans of both countries, and that predicted future changes in ENSO will only strengthen this interdependence.

### **SPATIAL ECOLOGY OF FIRE IN AN EAST AFRICAN SAVANNAH: EFFECTS OF BURN SIZE AND PATCHINESS ON THE FORAGING ECOLOGY OF GRAZERS OF VARYING BODY SIZE**

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Maintaining habitat heterogeneity is frequently cited as vital to conservation. Ecologists are increasingly aware that an animal's perception of heterogeneity is scale dependent. Although body size scaling laws have been explored theoretically to explain the coexistence of consumers sharing the same resources, there have been few landscape level manipulations testing these assumptions. We implemented a landscape level prescribed burning project in an Acacia savannah in Laikipia, Kenya in order to better understand how herbivores of varying body size respond to habitat heterogeneity at different scales. In 2004 and 2005 we burned more than 470 hectares across 18 plots varying in their extent (1, 9, and 81 ha) and their burn pattern (continuous, patchy, and unburned) to create a complete factorial design. Across all burned sites we found a significant negative relationship between body size and preference for burned sites as measured using dung counts. MANOVA of dung counts from herbivores ranging in body size from hare to elephant indicated overall significant effects of both burn extent and burn patchiness. Consistent with scaling theory we found high similarities between body size and preferred patch size. Maximizing diversity of herbivores sharing the same resources requires explicit attention to the scale of heterogeneity.

### **RAINFOREST RESERVES FOR CRITICALLY ENDANGERED COMORIAN FRUIT BATS**

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Livingstone's flying fox (*Pteropus livingstonii*) is a critically endangered fruit bat inhabiting rainforests of the Union of the Comoros. Although these rainforests are a biodiversity hotspot and are critical to the survival of the bat, they are completely unprotected. Following recommendations from the national Conservation Action Plan for Livingstone's Flying Fox, we used a collaborative approach to develop specific plans for small community-managed forest reserves that will be beneficial to bat and forest conservation, sustainable, and have broad local and governmental support. At seven target bat colonies, we conducted ecological surveys to identify potential reserve sites which will protect Livingstone's flying fox and other threatened species. In villages neighboring these target bat colonies, we conducted stakeholder surveys to develop feasible and broadly supported plans for siting potential reserves and clarifying rules of use and access. Surveys indicated that widely differing ecological and social conditions at each potential reserve site required that plans be tailored to local conditions. This study strongly emphasized local participation and capacity building, and presents an important opportunity for follow-up conservation action to benefit global conservation priorities. It further presents an interdisciplinary model for conservation of threatened species and ecosystems in developing countries.

### **COUNTING ON TREES: COMMUNITY NEEDS AND CONSERVATION AT THE MAPUTO ELEPHANT RESERVE, MOZAMBIQUE**

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In rural Africa, subsistence needs often conflict with conservation's primary goal of protecting rare and endangered plants and animals. Exclusionary policies in protected areas marginalize already impoverished peoples and can limit conservation success. Local residents at the Maputo Elephant Reserve, Mozambique have traditionally harvested limited amounts of reeds, wood, and fruits within reserve boundaries for personal consumption. However, successful development of a sustainable ecosystem management plan for this reserve requires more detailed information about human resource use and presence. This study investigates local botanical harvest preferences and habitat use. Informants from four communities located within, and adjacent to, the Maputo Elephant Reserve were asked about plant collection purposes, availability, and changes to abundances. Observations and vegetation surveys identified habitat within reserve boundaries potentially affected by human harvesting. Tree species accounted for 90% of preferred plants on wild food, construction materials, and firewood freelists. *Syzygium cordatum* was the most highly preferred and useful tree species for surveyed communities. Informants elaborated on the importance of trees during open-ended interview questions and reported little change to plant resource availability. Most of the locally preferred plant species (in decreasing order) are found in sand forest, woodlands along river floodplains, and bushveld habitats.

### **PRIORITIZATION OF THREATENED MEDICINAL FLORA—A KEY TO CONSERVE SACRED FORESTS IN WESTERN GHATS**

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Sacred forests are unique landscapes in the Kodagu district of Central Western Ghat region managed by local community. These are having their own role in conserving the biodiversity of a region apart from their religious and cultural values. But, these unique landscapes are under threat due to high anthropogenic pressure. The conservation of these sacred forests is necessary to preserve the valuable resources for next generations. Hence, we made an attempt to assess the population status of threatened medicinal tree species in large and small sacred forests under different vegetation types of Kodagu. The simple random sampling technique has been followed to assess the population status of threatened medicinal tree species. There were 27 threatened species were recorded from both the vegetation types. The Shannon–Weiner diversity, beta-diversity, and also structural parameters such as density, basal area size class distribution, and mean height were computed. The result indicates that though there is no significant difference with respect to the diversity between the two vegetation types there was significant difference between large and small sacred forests. With respect to the structural parameters the size class distribution followed an inverted J-shaped curve. The density of the RET medicinal tree species in sacred forests of semi-evergreen vegetation was significantly different from that of moist deciduous vegetation. The conservation strategies recommended are species specific and location specific.

**DSL OR DIAL-UP? RIVER CORRIDORS FOR REGIONAL RAINFOREST CONNECTIVITY IN SOUTH-TEMPERATE CHILE**

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South-temperate Chilean rainforest contains areas of exceptional endemism and is receding quickly as socioeconomic forces spur native forest conversion to fiber plantations and agriculture. International conservation priorities in biodiversity-rich Andean rainforest include restoring ecological connectivity between largely unprotected Coastal Range Forest and Andean Range forest. We conducted biodiversity surveys along river courses spanning the intervening largely deforested valley to locate potential regional corridors for linking mountain ranges. We pre-selected sites on orthophotos (1:20,000) using stratified random samples along 6 major river courses. At each site (N = 122) we censused 13 bird and 1 mammal species and several plant species and vegetation formations representing key habitat components for the vertebrates within 100 m. We categorized dominant land cover types surrounding each point in 1 and 2 km diameter buffers. Classification tree analysis generated predictive models of species presence and absence in relation to biologically relevant patch, landscape, and regional scale predictors. Significant predictors for various species included bamboo density (positive), non-native invasive tree cover along rivers (negative in all cases), land cover types in the buffer, and distance to native forest patches 100 ha or larger. Results suggest that functional landscape linkages cannot rely solely on river margins or forest plantations.

**RECOVERY OF SEMI-ARID GRASSLANDS AFTER RECLAMATION OF OIL ACCESS ROADS**

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Access roads built by the petroleum industry on public lands are reclaimed after use. Though the goal is to restore native plant communities, reclamation seed mixes are often grass-dominated, low in diversity, and historically included non-native cultivars. Is this adequate to trigger recovery of plant biodiversity? How does the current plant composition differ from undisturbed areas or from seed mixes used? We report on a field study of vegetation along 59 roads throughout the Little Missouri National Grasslands (LMNG), reclaimed between 1980 and 2001. The most frequently recorded species on reclaimed road beds are 5 species that are also commonly seeded: 2 native grasses, 2 non-native grasses, and 1 non-native legume. The 5 most frequent species in the surrounding undisturbed area are all native graminoids. Species diversity in the disturbed area is less than half of that of undisturbed areas. Seeding practices are affecting composition in at least two ways: (1) commonly seeded species persist, whether native or non-native, and (2) low diversity mixes combined with dispersal limitations of the surrounding community have yielded a low diversity zone spanning several meters on either side of the reclaimed road. Improvements in restorative practices could prevent this widespread replacement of native grassland.

**THE MESSENGER AND THE MESSAGE: COMBINING TRADITIONAL KNOWLEDGE AND MODERN SCIENCE FOR MARINE CONSERVATION IN FIJI**

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A two-year case-study is presented where two districts within Fiji, both attempting to establish conservation plans for marine resources, are compared. The first community, in the Yasawa Island Group, began conservation activities largely initiated by foreign tourism operators. The second community, in Kubalau District, Vanua Levu, developed marine conservation plans motivated primarily through community concern for sustained resources, assisted by local NGOs. Both communities are resource owners who manage their own fishing grounds. The application of conservation was approached quite differently in each community. Through intensive interviews at both sites, basic environmental knowledge and levels of awareness and understanding of the health of local marine resources, and local conservation measures enacted, were assessed. An analysis of conservation action and compliance within the two study sites showed that conservation success was only achievable with full support and involvement from local communities. Furthermore, conservation messages may be lost when delivered by external groups not properly aligned with community beliefs and objectives. Increased levels of awareness and education of basic ecology, introduced into the Kubalau community by local NGO Fijian scientists, combined with traditional knowledge of the ecosystem, has resulted in increased involvement and compliance of conservation activities.

**DO MAGELLANIC PENGUINS IN THE PACIFIC MIGRATE?**

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Migration enables organisms facing variable environmental conditions to take advantage of resources that predictably shift by season. The migratory Magellanic penguin (*Spheniscus magellanicus*) nests on both coasts of temperate South America. Satellite telemetry shows that penguins breeding at Punta Tombo, Argentina, migrate near the shore in national waters, but

often leave Argentine jurisdiction, crossing a bilateral Argentine–Uruguayan zone and into Brazilian national jurisdiction over a thousand kilometers from the colony. Winter movement of Magellanic penguins nesting along the Pacific coast of South America is largely unknown. In winter, temperate Chilean waters have reduced or absent upwelling and low productivity. We predicted that penguins would stay in national waters, seek out areas of high productivity in northern Chilean waters, and possibly migrate as far as Peru. To characterize Pacific migration, we deployed seven satellite transmitters in February 2006 at Puihuil Reserve in Chile (42S). We used GIS to examine the spatial patterns of penguin movement in relation to chlorophyll a concentrations and sea surface temperature. Migration parameters (travel speed, distance from land, time at sea) are compared between Pacific and Atlantic populations. Fisheries data and management jurisdiction suggest that Chile can protect key areas that penguins use in the winter.

### **SELF-FERTILITY IN INVASIVE CORDGRASS HYBRIDS OVERCOMES POLLEN LIMITATION AND GENERATES RAPID SPREAD**

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Our work illustrates how hybridization between natives and their exotic congeners can contribute to higher spread rates of invading species. We investigated whether increased self-fertility contributes to the rapid spread of San Francisco Bay (SFB) hybrid cordgrass (*Spartina alterniflora* x *S. foliosa*). Both wind-pollinated parent species are virtually self-incompatible, and limited pollen limits seed set. Neither parent species set viable seed inside experimental pollen exclusion tubes in SFB, while hybrids set on average [s.d.], 65 [88] (range: 0 to 313) or  $14 \pm 19\%$  (range: 0% to 76%) self-fertilized seed per inflorescence ( $n = 62$ ). Some recent descendants of this ca. 30 year-old hybrid swarm have colonized unoccupied lower tidal mud and they are more self-fertile than hybrids in a nearby cordgrass meadow on the shore. Molecular progeny tests corroborated high selfing rates in isolated SFB tidal flat hybrids, and greenhouse trials showed no inbreeding depression. Pollen limitation due to low plant density have caused a weak Allee effect in *S. alterniflora* invaded Willapa Bay (~6 year doubling time (DT) over the century of invasion), but such an Allee effect is absent in SFB tidal flats resulting in a much faster DT (~2 years). Increased selfing therefore joins other transgressive hybrid traits contributing to very rapid spread across SFB.

### **BARRIER EFFECTS OF US 331 TO WILDLIFE WITHIN THE NOKUSE PLANTATION–EGLIN AFB CONSERVATION CORRIDOR**

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The Nokuse Plantation serves as an important habitat corridor in northwest Florida connecting Eglin Air Force Base to the Choctawhatchee River Water Management Area. US Highway 331, a major two-lane highway that bisects the Eglin–Nokuse conservation area, is a hurricane evacuation route proposed for widening to four lanes. Multiple survey methods were used to determine effects of the road on presence and movement behavior for suites of wildlife. We conducted surveys five times per week from August 2004 to May 2005. Successful and unsuccessful wildlife crossing locations were determined by performing roadkill and track (larger organisms only) surveys. Mark-recapture was used to determine species presence, habitat use, and movement behavior of small mammals and various herptiles. Roadkill results included 163 individual animals from 29 identifiable species. We recorded 1398 sets of tracks from four faunal groups. Roadkill and track hotspots were identified by taxa. We captured 583 herptiles and 125 small mammals in drift fence traps. Only five recaptures were recorded crossing the road. If the highway is widened to four lanes, we predict its barrier effects will be magnified. To improve habitat connectivity and greatly reduce road mortality, we propose a system of culverts, bridges, and exclusion barriers.

### **DISTRIBUTION PATTERNS OF FLORA AND FAUNA IN THE MEDITERRANEAN CENTRAL ZONE AND IN THE TEMPERATE COASTAL RANGE OF SOUTHERN CHILE**

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Knowledge regarding centers of species richness for the design of conservation areas is one the most important steps in any conservation strategy. In this study, we show GIS analysis of field data generated in two study years in the coastal temperate forests of southern Chile and one year of study in the mediterranean forest and shrub in central Chile. We complemented our data with data from museums and scientific literature. We used environmental variables (evapotranspiration, elevation) and in some cases, land use type as predictors of species distribution; studying the distribution of vascular plants, amphibians, birds, and mammals of the forest. We then generated distributional maps based on geographic location and natural history of each taxa studied. In general, we found more richness in Mediterranean shrub than in forest, and we found less richness in high elevation for all the taxa studied. In the forest we found to a tendency to greater species richness in the northern part of the study area than in the southern part of it. We also observed greater richness of vascular plant species near rivers and differences between both sides of the coastal range, with greater richness in the oriental side. Due to the fact that species in high elevation are not a subgroup of the low elevation species, we propose that conservation actions be done along the whole elevational gradient with emphasis on the oriental and northern sides of the coastal range.

### **APPLICATION OF THE DENNIS–HOLMES POPULATION VIABILITY ASSESSMENT MODEL TO MARINE TURTLE CONSERVATION**

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The Dennis–Holmes model provides an analytical tool for evaluating quasi-extinction risk. The model relies on time series of abundance and calculates the probability of extinction over a set time period based on the size, exponential trend, and year-to-year variance of a population. The minimal data requirement makes this a potentially valuable tool for marine turtles although these abundance time series are for nests or nesting females, and adult females do not reproduce every year. Therefore, an

appropriate multi-year running sum is needed to account for nesting remigration intervals which will provide a population size estimate closer to the number of adult females and reduce some of the variance in annual counts caused by variable nesting remigration intervals. To cope with uncertainty surrounding extinction probabilities, we propose a risk calculation based on the proportion of replicate "populations" that cross a threshold, where each replicate has a mean and variance drawn from the 95% confidence intervals for those estimated parameters. We evaluate the utility and robustness of our approach with simulations of age-structured populations and we demonstrate how this model can be applied to fisheries management and, potentially, as a new status assessment tool for IUCN listing criteria.

**POLLING FOR POACHERS: TESTING A UNIQUE METHOD FOR ESTIMATING ILLEGAL RESOURCE USE IN PROTECTED AREAS**

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Illegal resource use is considered a major threat to conservation in protected areas throughout the world, yet accurately estimating the number of poachers has been difficult. People violating the law often do not identify themselves for fear of retribution and thus effectively quantifying illegal resource use is limited by methodological constraints. I explore the effectiveness of the randomized response technique (RRT) with a population that is largely illiterate to assist park management in assessing the extent of illegal resource use at Kibale National Park, Uganda. RRT is unique in allowing respondents to disclose sensitive information because the interviewer can not ascertain an individual's true response to the incriminating question. I found estimates of illegal resource use when measured via RRT significantly higher than when measured by direct questioning for all resources. For example, when directly questioned only 2.5 of the 251 people surveyed admitted to illegally extracting charcoal, while RRT estimated that 51.6 collected charcoal. This study takes the first step toward developing and testing a potentially powerful tool for conservation priority setting and programmatic evaluation in a developing world setting.

**INDIRECT EFFECTS OF FISHING ON CORAL-REEF FISH COMMUNITIES**

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Changes in relative abundance and shifts in dominance of top trophic-level species may have strong top-down effects on the abundances of other species and on community structure. Throughout the greater Caribbean, intense fishing has depleted populations of Nassau grouper (*Epinephelus striatus*), while populations of the unfished coney grouper (*Cephalopholis fulva*) have proliferated, possibly due to moderated negative interactions between the two species. I experimentally tested the effects of these two groupers on recruitment of coral reef fishes to spatially isolated reefs in the Bahamas. Total recruitment was 2.65 times higher on reefs occupied by Nassau grouper and on control reefs with no grouper than on reefs occupied by coney grouper. Significantly higher recruitment of four common species occurred on Nassau grouper and control reefs. These results show that different species of top trophic-level predators can have profoundly different effects on lower trophic levels. In particular, overfishing of Nassau grouper allows coney grouper to have strong negative impacts on recruitment of other coral reef fishes. To strengthen marine conservation efforts and increase the sustainability of fished populations, fisheries management should include both the direct and indirect effects of fishing on marine communities.

**RECENT ANTHROPOGENIC CHANGES WITHIN THE NORTHERN BOREAL, SOUTHERN TAIGA, AND HUDSON PLAINS ECOZONES OF QUEBEC**

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The main goal of the project is to establish efficient and effective methodologies that can be applied by civil society organizations wishing to use remote sensing and geographic information systems to monitor the extent of anthropogenic change in forests over broad geographic areas. The specific project goal is to identify, analyze, and map anthropogenic changes for the approximate period of 1990–2001 in strategically-selected areas in Canada. The initial study area covers approximately 9% of Canada and 59% of the province of Quebec. By using the image algebra method with Landsat images, we found that: within Quebec's Boreal, Taiga, and Hudson Plains Ecozones, recent anthropogenic change is concentrated in the commercial forest zone (in the southern portion of the province); there are large portions in the north of Quebec's Boreal Ecozone that remain unaffected by recent anthropogenic change; the vast majority of Quebec's Taiga and Hudson Plains Ecozones remains unaffected by recent anthropogenic change; and recent anthropogenic changes are primarily concentrated in areas with tree cover while treeless areas remain mostly unaffected by recent anthropogenic change, with the exception of some roads and reservoirs. The methodology used in this project has utility for monitoring recent anthropogenic change over broad forest regions.

**PRAIRIES UNDER SIEGE: STRENGTHENING THE SCIENCE BEHIND GRASSLAND PROTECTION EFFORTS IN THE NORTHERN GREAT PLAINS**

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Worldwide, temperate grasslands are at great risk of conversion to cropland but have some of the lowest protection rates of any major biome. The native grasslands of the Missouri Coteau contain a unique mix of native grasslands and high densities of prairie pothole wetlands. As a result, the Coteau is the core breeding range of many species of the continent's grassland / wetland dependent birds. However, recent acceleration of native grassland conversion in the Coteau has caused concern among conservation biologists. Current planning tools for protection efforts include spatially explicit models of both breeding bird density and reproductive success but do not include any explicit metrics related to risk of native grassland conversion. Using satellite imagery from 1984 to 2002, we estimated the rate of conversion of native grassland to cropland in the Coteau. The overall rate of grassland conversion was 0.7% per year but loss rates approached 2%/year in some regions. Predictive models indicate factors such as the amount of grassland in the surrounding area and both slope and soil productivity within the 40-acre

are useful predictors of risk of conversion. Ultimately, this information will be combined with models of reproductive success and used to guide efficient grassland protection efforts.

### **THE DEEP-SEA FOOTPRINT OF FISHING IN U.S. ATLANTIC WATERS**

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Human impacts in the deep sea are dominated by trawl and dredge fishing that inflicts extreme physical disturbance to the seafloor. We mapped this fishing activity along with known areas of biogenic habitat, coldwater corals, and fish spawning aggregations to develop potential spatial management measures in New England, mid-Atlantic, southeast, and Gulf of Mexico regions of the United States. In New England and the mid-Atlantic, data with comprehensive geographic coverage but poor resolution showed nearly the entire continental shelf was affected by deep-sea fishing at an average rate of once every month. Higher resolution data, different data sources, and threshold decisions altered this frequency but did not change core areas of the resulting footprint. In the southeastern United States, this analysis also included hard substrate and known spawning aggregation sites. Gulf of Mexico fishing data are limited and rarely spatially explicit. We estimated the spatial extent of this fishery based on minimum and maximum depths commonly fished, excluding known deep-sea habitat features. These results are being submitted to regional fishery management councils as the basis for policy proposals to (1) freeze the footprint of the most prominent human activity in the deep sea (2) close areas within the footprint to protect biogenic habitat.

### **PREDICTING AVIAN RESPONSES TO LANDSCAPE CHANGE IN SAN FRANCISCO BAY: ADDRESSING AND REDUCING MULTIPLE LEVELS OF UNCERTAINTY**

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The acquisition and planned restoration of 6000 ha of salt ponds in San Francisco Bay provides an opportunity to model the effects of large-scale habitat change on avian communities. Opening these ponds to tidal action will restore natural geomorphic processes and create valuable marsh habitat. However, there are trade-offs with the loss of salt ponds that support millions of migratory waterbirds. Thus, a successful restoration will retain enough intensively managed ponds, or equivalent shallow water habitat, to maintain current waterbird numbers, while maximizing the extent and quality of restored tidal marsh. Using a combination of field-collected and remotely-sensed data, we generated a suite of linear models for focal avian species and groups. Multiple years of bird survey data were regressed on multi-scale, GIS-based marsh and pond habitat variables. LiDAR and boat-based sounding data were used to characterize pond bathymetry, while color-infrared aerial photos were used to quantify marsh channels and ponds. Using actual restoration alternatives, we developed site- and landscape-level predictions. We identified key habitat variables whose values would shift dramatically under future restoration, and simplified our models accordingly to reduce prediction uncertainty. Modeling results indicate a diversity of responses across species; optimal restoration strategies depend on the conservation target.

### **MITOCHONDRIAL DNA VARIATION SUPPORTS DISTINCT POPULATION SEGMENT DESIGNATION IN US GRAY WOLVES (*CANIS LUPUS*)**

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With the recent proposals to remove both the western Distinct Population Segment (DPS) and the eastern DPS of North American gray wolves from the federal list of threatened and endangered species, understanding the origin, phylogeny, and phylogeography of gray wolves in North America is more crucial than ever for both management and law enforcement purposes. To better understand these issues, we examined mitochondrial control-region sequence diversity in 539 gray wolves from 21 populations from throughout much of their distribution in North America. While three mtDNA CR haplotypes were commonly observed across all North American wolf populations except southwestern wolves, eight haplotypes were unique to Western wolves and a twelfth distinguished southwestern wolves from all others. Maximum parsimony analysis, analysis of molecular variance (AMOVA) and nested clade analysis (NCA) revealed that control region haplotype variation was significantly correlated with geographic distance. These results support the distinction of the three DPS units currently used by the USFWS for gray wolf management. Moreover, two additional mtDNA CR haplotypes were observed among eastern wolves exclusively. Although similar to coyote mtDNA, they differed significantly from all other gray wolves and red wolves, as well as sympatric coyote populations.

### **DATA BUILDING BLOCKS FOR MAPPING HIGH CONSERVATION VALUE FORESTS IN BOREAL CANADA**

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The boreal forest region of Canada is being developed at a rapid rate. Parties interested in assuring protection of the most important forest regions remaining while striving for ecological sustainability overall are finding it difficult, time consuming, and expensive to assemble and review the necessary contextual data and information about acknowledged forest values. In an effort to standardize local level planning and assessments, particularly with regard to identifying and mapping High Conservation Value Forests (HCVF) according to Principle 9 of the Forest Stewardship Council Forest Certification and Endangered Forests (EF) consistently, we designed and developed a web-based data service that provides the most recent spatially explicit data along with ecoregional summaries for the boreal region of Canada. Currently, this site provides users with nearly 50 separate data themes for 25 ecoprovinces and 98 ecoregions. This case study provides a model for how this same service could be provided elsewhere as HCVFs and EFs are concepts being applied globally. Furthermore, it provides a mechanism for providing important monitoring data and information to assist in forest conservation accountability.

**AN INTEGRATED APPROACH TO PREDICTING THE IMPACT OF HUMAN DISTURBANCE**

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With greater access to the countryside human disturbances is becoming an increasingly controversial issue. For example the United Kingdom government is considering allowing the right of public access to the entire coastline. We twice surveyed 230 km of coastline and mapped all breeding birds, access points, sediment, beach width and other features. We also flew this length on three summer days and filmed the entire shore, then mapped each person's (n = 18,273) location onto GIS. Presence of ringed plover (n = 267), and oystercatcher (n = 226) correlated with shore width, sediment type and human density. Game theory was used to predict the settlement decisions of both humans and birds. A model was devised and tested that determines the spatial distribution of humans in terms of their "willingness to walk" to avoid crowding and the configuration of beach access points. Based upon our detailed demographic and habitat selection studies of ringed plovers we created game theory population models. Disturbance resulted in direct trampling of eggs but more importantly forced birds to use less suitable territories with lower breeding success. Preventing trampling would increase the adult. With this framework it is possible to examine a wide range of possible changes including changes in access, sea level rise or changes in tourist behavior resulting from climate change.

**HABITAT ASSOCIATIONS OF SISKIYOU MOUNTAINS SALAMANDERS AT MULTIPLE SPATIAL RESOLUTIONS IN THE KLAMATH-SISKIYOU REGION AT THE OREGON-CALIFORNIA BORDER**

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To advance the development of conservation plan for rare endemic species at the United States Oregon-California border, we determined habitat associations of Siskiyou Mountains salamanders (*Plethodon stormi*) and developed habitat suitability models at fine (10 ha), medium (40 ha), and broad (202 ha) spatial resolutions using the Geographic Information Systems (GIS) and logistic regression analysis with the information theoretic approach. The occurrence of Siskiyou Mountains salamanders was positively associated with increasing dominance of rocky soils and Pacific madrone (*Abutus menziesii*) and with decreasing elevation and dominance of white fir (*Abies concolor*); these associations were consistent across the 3 spatial resolutions. The negative association of Siskiyou Mountains salamanders with white fir was particularly evident, and the model-averaged statistics projected that 10 decrease in dominance of white fir would increase odds of salamander occurrence by 3.02–4.47 times. We created maps of habitat suitability for Siskiyou Mountains salamanders at the fine and medium spatial resolutions by projecting habitat suitability scores in pixels across the landscape. Our findings and approaches are applicable to selection of priority conservation areas for Siskiyou Mountains salamanders and can be easily adapted to conservation of a wide variety of rare and endemic species.

**ASSESSMENT OF THE EFFECTIVENESS OF FOREST PRACTICES RULES FOR THE NORTHERN SPOTTED OWL (*STRIX OCCIDENTALIS*) IN WASHINGTON**

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Federal listing of the Northern Spotted Owl resulted in changes to Forest Practices Rules for timber harvest on nonfederal lands in Washington state in 1996. These regulations were intended to contribute to species viability in conjunction with efforts on federal lands while balancing the economic needs of private landowners. Few systematic evaluations of regulatory programs for wildlife conservation have been conducted, so our post-implementation assessment of the rules' effectiveness in 2004 is noteworthy. The forest practices rules contained both site-specific and landscape-level planning and protection options. This latter feature represented the best means to conserve Spotted Owls in managed landscapes while also providing flexibility for landowners. With the exception of federal Habitat Conservation Plans largely negotiated prior to rule adoption, minimal planning has occurred in the important owl landscapes. Half of the regulated area lacks long-term conservation plans, and habitat levels are declining. Concomitantly, landowners conducted surveys to demonstrate owl absence that resulted in 11 owl sites losing regulatory protection. The rate of change to absence (i.e., abandoned) status is higher in regulated landscapes than outside them and greater after rule implementation than before. Lack of active conservation planning coupled with loss of regulatory protection of owl sites indicates two of the more significant problems with the rules' structure and application.

**RECOVERY FROM FISHING EFFECTS OF EPIFAUNA ON HARD SUBSTRATES IN THE GULF OF MAINE**

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The Western Gulf of Maine Closure (WGOMC), which prohibits the use of fishing gear capable of catching groundfish, offers a unique opportunity to assess the recovery of the epifaunal community from impacts of bottomtending fishing gear. This study investigates the recovery of epifaunal communities on hard substrates following the designation of a Marine Protected Area. To evaluate recovery, sites of boulder and gravel substrates were sampled, from 1998 to 2005, in areas within and outside the WGOMC. All sampled sites lie within the boundaries of the Stellwagen Bank National Marine Sanctuary which allows fishing activities, but prohibits all other anthropogenic disturbances. For each year of sampling, data was collected by underwater vehicles which acquired still photographs of the seafloor along multiple transects at each site. The epifauna captured in the photographs was enumerated and identified to the lowest possible taxonomic level. For both substrate types, analyses of the enumerated species indicate a shift in epifaunal coverage between sites located within and outside the WGOMC for the years 1998 to 2002. The shift in epifaunal coverage can be attributed to recovery from fishing effects as all sites are subjected to similar ecological disturbances and are otherwise unimpacted by anthropogenic disturbances.

### **WILDLIFE VALUE ORIENTATIONS IN THE UNITED STATES**

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The effectiveness of specific wildlife conservation efforts is dictated largely by human values. This is one of two presentations that will describe a micro-macro level conceptual model, empirical findings, and ongoing efforts of a research program directed at understanding these values. This presentation will focus on the micro level by presenting the wildlife value orientation concept, measurement approach, and results for 19 western U.S. states. It will also explore the predictive validity of the orientations. Data were collected using a mail survey approach with 12,670 respondents allowing generalizations at the state level. Non-response analysis was conducted by telephone with 7600 respondents. Structural equation modeling confirmed 4 wildlife value orientation dimensions: mutualism, utilitarianism, attraction, and concern for safety. Multidimensional scaling revealed the oppositional nature of mutualism versus utilitarianism and attraction versus concern for safety. Between and within states, we found considerable variability among people's value orientations. Those with a utilitarian orientation differed greatly from those with a mutualism orientation on attitudes toward preferred forms of wildlife management. This finding suggests the predictive validity of the wildlife value orientation concept and the foundation for wildlife conflict in the United States.

### **THREATS TO SEABIRD POPULATIONS AND EFFECTIVE CONSERVATION ACTION**

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Seabirds are important marine predators with high metabolic rates and large populations. They play important functional roles at sea through predation and on land by transporting marine nutrients. Most seabird species have experienced dramatic population declines from anthropogenic threats. 102 of the approximately 341 species are in the IUCN's five highest threat categories. Seabirds range widely at sea, but are dependent on small isolated areas for breeding where they can form remarkably dense aggregations. It is at these colonies and in the nearby waters that seabirds are both most vulnerable (66% of the causes of declines in IUCN species accounts were colony-based) and where simple conservation actions such as eradicating invasive animals can have the most benefit. It is also more difficult to conserve seabirds at sea because protection must occur over vast oceanic spatial scales, requiring multinational agreements that are difficult to enforce. This makes non-point source pollutants and fisheries impacts particularly vexing problems. Despite the importance of colony-based threats, most published research on seabird conservation (85%) addresses at-sea threats. Using data and case histories from the California Current System, we demonstrate the efficacy for seabird conservation of a database-driven prioritization of breeding colonies and conservation actions.

### **CONFLICT AND LIVELIHOODS IN THE PROTECTED AREAS: A COMPARATIVE CASE STUDY OF TWO VDCS OF ROYAL BARDIA NATIONAL PARK, NEPAL**

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A study with the objective to understand the conflict and impact on livelihoods was carried out at two VDCs of Royal Bardia National Park, Nepal. Different combinations of qualitative and quantitative methods including household questionnaire survey, direct observations, semi-structured interview and VDC level community workshop were used for the comparative study of two VDCs, Thakurdwara and Shivapur, to understand the impact on livelihood, level of dependence on park resources and the role of development projects. Among two VDCs, Shivapur was found to be most conflicting with the park management authorities, the main causes of conflict were minimum land availability, immigration, heterogeneous ethnicity, and low level of agricultural land holding. Due to low level of land holding 70 of the households were directly dependent on the park for resources such as fodder and fuelwood for which illegal extraction was the only means and main reason of conflict with park rangers. Development projects had been introduced that hardly met the need of communities, pushing poor households into more vulnerable situation thus making continued dependence on national park.

### **USING GRAPH THEORY TO ESTIMATE LANDSCAPE-LEVEL CONNECTIVITY FOR WIDE-RANGING SPECIES**

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Conservation scientists are challenged to develop better understanding of functional connectivity across broad landscapes. Graph-theoretic approaches are emerging as a primary means of modeling and analyzing landscape connectivity. We have recently implemented a graph theory-based set of tools, called FunConn, to develop landscape networks. We compare the results of models developed for three species for Colorado: grey wolf, Canada lynx, and pine marten. We have identified critical locations necessary to ensure long-term landscape connectivity, and we will describe results of how our modeling efforts have been used to inform transportation planning in Colorado.

### **POPULATION STRUCTURE AND DISPERSAL PATTERNS OF PROTECTED AND EXPLOITED GRAY WOLVES IN THE CANADIAN ROCKY MOUNTAINS**

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Wolves (*Canis lupus*) throughout the Canadian Rocky Mountains have experienced local extirpation and recolonization events over the last century, yet little is known of current dispersal patterns and barriers to dispersal that may affect recolonization and source-sink dynamics. The objectives of this study were to delineate subpopulations of wolves along the continental divide in Alberta and British Columbia and to assess the relative proportion of wolves dispersing between subpopulations. Non-

invasively collected DNA samples in conjunction with samples from captured and harvested wolves were used to identify subpopulations and contemporary dispersal events with individual and population-based genetic analyses. Thirteen microsatellite markers were used to characterize the genetic composition of wolves ( $n = 556$ ) from 84 packs within the Canadian Rocky Mountains. Bayesian clustering analysis showed strong subpopulation structure with 3 distinct groups occurring in areas with varying management priorities for wolves. The genetic structure indicates this population is not panmictic and barriers to gene flow exist. Migrants and asymmetric rates of dispersal between subpopulations were identified. Our results show the importance of identifying subpopulations and the relative contributions of migrants from each subpopulation in a landscape with a mosaic of management priorities in two provinces and several national parks.

**NATURAL DISTURBANCE-BASED HARVEST GAP EFFECTS ON CLICK BEETLE ASSEMBLAGES (COLEOPTERA: ELATERIDAE) IN SOIL AND COARSE WOODY DEBRIS IN MAINE'S ACADIAN FOREST**

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Maintaining forest biodiversity and sustainability while meeting economic goals requires management based on sound ecological principals. Although insects mediate many important natural processes within forests, most are still poorly understood. We investigated the effects of two gap harvest regimes, based on natural disturbances, on click beetle assemblages in soil and coarse woody debris (CWD) in Maine's Acadian forest. Using emergence traps, we captured 64 species of click beetles as they emerged during the summers of 2001 and 2002. In the soil study, click beetle composition varied with harvest treatment and gap v. closed forest placement. In the CWD studies, an increase in CWD diameter corresponded to greater abundance overall and for specific species. Decomposing wood was occupied by a succession of species, with certain species more likely found in either early or late stages of decay. Abundance and diversity tended to be higher in the closed forest than in the gaps. Gap size did not influence click beetles in the soil or CWD studies; this may be due to retention trees and abundance of CWD in the gaps. We conclude that conservation of Elateridae within a harvest regime can be facilitated through attendance to CWD diameter, decay class, and distribution.

**APPLIED ACOUSTIC MONITORING: AFRICAN FOREST ELEPHANT POPULATION ESTIMATES FROM KAKUM NATIONAL PARK, GHANA**

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Acoustic monitoring has been suggested as an alternative survey technique for vocal taxa living in habitats not conducive to visual surveys. This study applied a model for estimating abundance of African forest elephants (*Loxodonta cyclotis*) from calling rates to acoustic data from Kakum National Park, Ghana. Kakum harbors a small, closed population of forest elephants. Nine acoustic sensors randomly distributed throughout the 366 km<sup>2</sup> park continuously gathered data for three months. Extracted call rate data were used to estimate local abundance of elephants. A sound propagation model was used to estimate an effective detection radius for the acoustic sensors and extrapolate the abundance estimate to unsampled areas. The resulting estimate falls within the confidence bounds of estimates from recent dung transect surveys suggesting that calling rate is an appropriate index of abundance for African forest elephants. Because acoustic surveys can gather data from larger areas and over longer periods, confidence intervals around population estimates are narrower than those gained from traditional dung transect methods. This study provides the first validation of acoustic techniques to estimate abundance and may prove valuable in other wildlife monitoring efforts.

**DETECTING THE EFFECTS OF INTRODUCED SPECIES: A CASE STUDY OF COMPETITION BETWEEN APIS AND BOMBUS**

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Most assessments of impacts from introduced species rely on correlational data or other indirect measures. Yet few studies have compared the predictions of easily obtained metrics with direct measures of reproductive success or population dynamics. I used data from an experimental test of introduced honey bee (*Apis mellifera*) impacts on native bumble bees (*Bombus* spp.) to address two major questions: (1) How well did observational data on niche overlap and spatial correlations between *Apis* and *Bombus* predict experimental data measuring competitive effects? and (2) How well did impacts measured at the scale of foragers predict effects on reproductive success of colonies? Niche overlap between *Apis* and *Bombus* varied substantially, but reached levels as high as 80–90. Correlations between numbers of *Apis* and *Bombus* foragers were also highly variable, and I detected a significant negative relationship in only one of seven months. In contrast, experimental results showed that mean numbers of *Bombus* foragers increased significantly distance from introduced *Apis* colonies. Experimental data on forager abundances accurately estimated competitive effects on colony reproductive success, but not the observational data. This work suggests that great caution is warranted in assessing invasion impact based on spatial or temporal correlations between invasive and native species.

**MODELLING BIRD SPECIES DISTRIBUTIONS TO INFORM LANDSCAPE PLANNING FOR BIODIVERSITY MANAGEMENT**

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In many landscapes, ecological sustainability and biodiversity conservation will be impossible to achieve without the restoration of large amounts of native vegetation. Prioritization of revegetation efforts requires methods for evaluating the likely biodiversity (and other) benefits of differently reconstructed landscapes. We developed predictive models of the distributions of woodland-dependent bird species across the Box–Ironbark region of Victoria, Australia, an area that has lost 85% of its native vegetation. We used climate, soil and topographic data as predictor variables, so that predictions could be made for currently cleared agricultural areas within the region, assuming mature vegetation were present. We used mixture models that account

for detection errors (false negatives and false positives) in model-building data and Bayesian model averaging to account for uncertainties associated with model selection and data quality. Models were evaluated with independent, newly collected data. Useful predictions were obtained for 50% of the modelled woodland-dependent species. Validated models were used to map the habitat potential, or expected probability of occurrence if mature vegetation were present, for each species across the region. These maps will be used, in conjunction with models of landscape context and dynamics of regrowing vegetation, to evaluate and optimize the biodiversity outcomes of revegetation plans.

### **LINKING INDIVIDUAL BEHAVIOR AND POPULATION HEALTH: A MULTIDISCIPLINARY APPROACH TO PREDICTING RISK OF DISEASE EXPOSURE IN SEA OTTERS**

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Differences in behavior are generally assumed to impact individual survival or reproductive success, and thus affect the dynamics of wildlife populations; however, linking individual behavior to important regulatory processes, such as disease, has proven difficult, and requires a multidisciplinary research effort. We use the threatened southern sea otter (*Enhydra lutris nereis*) to test the hypothesis that risk of exposure to or death from toxoplasmosis, a common disease, can be predicted from individual diet and habitat use patterns. We captured and radio-tagged 155 sea otters in central California from 2000–2004, and screened them for exposure to *Toxoplasma gondii*. We subsequently monitored their behavior and daily locations (using telemetric techniques) until death or radio failure. We measured diet by direct observation, recording > 60,000 feeding dives, and found that individual otters were diet specialists. We measured associations between disease exposure and age, gender, diet, micro-habitat use, kernel home range size, and annual movement distances using multivariate logistic regression. Odds ratios and confidence intervals for significant risk factors were estimated by maximum likelihood techniques. Specific traits significantly increased the risk of *T. gondii* exposure and / or death from toxoplasmosis, both singly and interactively. Our results can be used to maximize the efficacy of conservation efforts for this species.

### **A PRIORITIZED ASSESSMENT OF TRANSBOUNDARY CONSERVATION OPPORTUNITIES IN LATIN AMERICA**

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Transboundary conservation areas (TBCAs) that expand and integrate the management of protected areas, extractive reserves, indigenous lands and private holdings across regional and national political boundaries to enhance biodiversity conservation have become an important conservation approach being used worldwide. In a project supported by the Inter-American Development Bank (IADB), biological, social, institutional and policy criteria were used to prioritize, map and evaluate 10 potential TBCAs in Latin America. The methodology is designed as a user-friendly tool to support the work of local and national governments, NGOs, CBOs, businesses, and donors working with TBCA opportunities. The project has coordinated its efforts with several active TBCA projects in development in Latin America in order to enhance the effectiveness of the methodology. The presentation will provide an overview of the methodology used to select the 10 prioritized sites, and a concise analysis of the 10 sites selected.

### **FOCUSING REGIONAL MARINE CONSERVATION EFFORTS WITH GRAPH THEORY**

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The connectivity, dispersal of larvae to and from marine populations, is of great importance to metapopulation dynamics and local population persistence. Understanding this connectivity between marine populations is key to their effective conservation and management. For many marine species, this population connectivity is determined by ocean currents transporting larvae between distant habitat patches. Recent work has focused on the biophysics of marine larval dispersal and its importance to population dynamics, although few studies have evaluated the spatial and temporal variability and the impact on local connectivity. Here, we use an advection-diffusion approach to model the potential connectivity between coral reefs of the South Pacific. Our series of dispersal simulations compare year-to-year variability in connectedness across the region using several dispersal strategies. This time series of dispersal pathways between reefs is then analyzed using graph theory. A graph theoretic approach is effective for exploring patterns in spatial connections, as well as performing site and pathway importance scenarios. Combining graph-based betweenness metrics, node removal analyses, and neighborhood statistics allows one to identify individual sites which may be particularly important for local connectivity. We identify critical island "stepping stones" and reveal connected upstream / downstream populations, suggesting sites suitable for marine protection consideration.

### **ARE TREES IMPORTANT FOR GRAZING WILDLIFE? LARGE TREES IMPROVING GRASS QUALITY IN AFRICAN SAVANNA**

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In African savannas trees can increase sub-canopy soil nutrients, which in turn might improve grass quality. Hence, large savanna trees could generate attractive feeding sites for grazing wildlife. Large tree cover, however, is declining due to increased logging activities and locally high elephant densities in some protected areas. The immediate consequences for the herbaceous layer have not been assessed. We compared structure and nutrient quality of grasses underneath canopies with grasses in open savanna areas. We combined information along a rainfall and soil fertility gradient in eastern and southern Africa to identify areas where tree crowns affected sub-canopy grass quality most positively. Results showed that in study sites of lowest average rainfall and soil fertility tree canopies significantly improved the grass layer. Grass underneath the canopy contained consistently more crude protein and phosphorus, showed lower stem-leaf ratios of plant individuals and a high abundance of *Panicum maximum*, a highly nutritious fodder plant, than grass outside of the canopy. Now predictions can be made about native grazer species that need to forage underneath tree crowns to satisfy their nutrient requirements. Hence, the

improvement of sub-canopy grasses for grazing wildlife, once quantified, can help identify areas where conservation efforts should be highest.

**PRIORITY CONSERVATION AREAS FROM BAJA CALIFORNIA TO THE BERING SEA**

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From Baja California to the Bering Sea (B2B), the exclusive economic zones of Mexico, Canada, and the United States combined cover 4.8 x 10<sup>6</sup> km<sup>2</sup>, seven ecoregions, and important habitats of 14 marine species of continental concern. Through a series of three workshops over five years, nearly 200 marine scientists, conservationists, and resource managers from all three nations contributed baseline data (geophysical, biological, and sociopolitical) and expert knowledge to an effort to identify priority areas to conserve at this continental scale. GIS analyses of the baseline data and the Collaborative GIS Workshop Method aided the priority conservation area (PCA) identification. Twenty-eight PCAs were selected based on their ecological significance, the anthropogenic threats they face, and the conservation opportunities present. They encompass, among others, major feeding and breeding sites of marine mammals, seabirds, and sea turtles [e.g., Scott Islands (Canada), Magdalena Bay (Mexico)]; areas of high continental endemism [e.g., Patton Seamounts (Alaska), Upper Gulf of California (Mexico)]; zones of complex habitat and high biodiversity [e.g., Midriff Islands (Mexico), Monterey Bay (US)]; and transboundary areas. These PCAs represent a suite of North America's most important marine ecological assets that should be protected through both species-based and place-based measures at local, state and federal levels.

**SHIFTING THE BASELINE BACK: DOCUMENTING COMMUNITY PERCEPTIONS OF MARINE RESOURCES ALONG WITH THE BIOLOGICAL RETURNS OF MPAS**

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We have documented the shifting baseline phenomenon in the marine ecosystem among all relevant age groups, and across a range of geographically distinct Fijian communities. These communities are the owner / managers of their fishing grounds, which represent a spectrum of ecological intactness and fishing pressure, from severely degraded and over-harvested to relatively healthy with abundant marine resources. Interviews are supplemented with underwater biological surveys of relevant target species, and fish-landing records at each site. We use data from our studies as a management tool for conservation efforts in Fiji to demonstrate the usefulness of socioeconomic surveys in the communities and to give a measure of the state of the marine resources available to each community. The results also give recognition to important community members—older fishers whose traditional knowledge and memory of the reef and resources from years past functions to set appropriate targets for local and national conservation efforts to restore reef fish and invertebrates. Two of our sites are located on relatively healthy reefs, in relatively isolated villages. While both sites have seen the baseline shift to a lower state, villagers of one site have witnessed a shifting of resources back to previous levels, after the establishment of a MPA ten years ago.

**IMPROVING RESERVE DESIGN UNDER UNCERTAINTY: ADAPTIVE DECISION RULES FOR THE ACQUISITION OF NATURE RESERVES**

TURNER, WILL and David Wilcove. Princeton University, Princeton, NJ, USA, will.r.turner@gmail.com

Although reserve-design algorithms have shown promise for increasing the efficiency of conservation planning, recent work casts doubt on the usefulness of some of these approaches in practice. Using three data sets that vary widely in size and complexity, we compared various decision rules for acquiring reserve networks over multiyear periods. We explored three factors that are often important in real-world conservation efforts: uncertain availability of sites for acquisition, degradation of sites, and overall budget constraints. We evaluated the relative strengths and weaknesses of existing optimal (minimum set, improved minimum set) and heuristic (greedy richness, irreplaceability) decision rules, and developed a new set of adaptive decision rules that combine the strengths of existing optimal and heuristic approaches. All three of the new adaptive rules performed better than the existing rules we tested under virtually all scenarios of site availability, site degradation, and budget constraints. Moreover, the adaptive rules required no additional data beyond what was readily available and were relatively easy to compute.

**AN ASSESSMENT OF THE STATUS AND TRENDS OF MEDITERRANEAN-TYPE ECOSYSTEMS**

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The mediterranean-type ecosystems of California and Baja, Chile, the Mediterranean Basin, South Africa, and Australia harbor almost 20% of the world's plant species in just 2.2% of the Earth's area. Recent global assessments all conclude that mediterranean regions are priorities for conservation action (e.g., Global 200, Hotspots). To better define the conservation status and needs in the world's mediterranean ecosystems, we have characterized regional-scale land cover data into broad vegetation types and assessed the representation of each type within the existing network of protected areas. The level of protection of mediterranean ecoregions ranged from 16% in South Africa to < 1% in Chile, with significant variations between vegetation types, for example, forests compared to drought deciduous shrublands. We also conducted a threats assessment to identify those areas where conservation action is most urgently needed. Current condition of remaining natural and semi-natural habitat was evaluated with fragmentation indices, while future threats were projected using spatial analyses of a selection of threats experienced across the five regions: e.g., urbanization, invasion of non-native plant species, and conversion to agriculture. Integrating spatial information on threats, existing unprotected areas, and information on conservation opportunity and feasibility, allows the identification of priorities for future conservation.

### **ASSESSING THE EFFECTS OF FISHERY ENTANGLEMENT IN VIABILITY ANALYSES FOR SEA LIONS IN THE GULF OF CALIFORNIA**

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Over the past several decades, California sea lions (*Zalophus californianus*) in the Gulf of California have increased in abundance. However, several breeding colonies have recently started to decline. At the same time, fishing pressure is growing in important sea lion habitats throughout the Gulf. To diagnose the fate of this population, it is important to understand how changes in threats may affect population growth. We use an age-structured population model constructed from 20 years of resighting data from marked animals to examine the magnitude of increased fishing pressure that could be withstood before causing sea lion populations to decline toward extinction. We first use our model to perform elasticity analysis to identify life stages that are most important in population growth. We found that survivorship of the juvenile age class was the most important life stage in population growth. Given that most animals subject to incidental take are also juveniles, we evaluate alternate scenarios for mortality associated with fishing pressure for 13 breeding sites. Levels of increased fishing pressure that can be withstood (measured as number of nets) range from 1000s of additional nets to less than 100. Our results provide conservation practitioners with site-specific guidelines on sustainable fishing rates.

### **LONG DISTANCE DISPERSAL IN EXTINCTION PRONE AMAZONIAN FOREST BIRDS**

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Tropical understory forest birds are highly sensitive to forest loss and fragmentation. Some insectivores are thought particularly susceptible to local extinction as individuals require large areas and therefore do not inhabit small forest patches. But, as modeling bird movements in tropical forests is difficult, much remains unknown. I document dispersal among 30 extinction prone species of forest birds at the Biological Dynamics of Forest Fragments Project (BDFFP) near Manaus, Brazil. From over 18,000 capture records, I develop a mechanistic model that accurately describes bird movement both locally and over large distances. The best model is a mixture of Gaussian and exponential models, incorporating both random and directional movement. Birds with different foraging strategies have fundamentally different dispersal curves. The most extinction prone species move to greater distances, forming "heavy-tailed" curves. By linking sociality, ranging behavior, and extinction, this demonstrates how dispersal shapes a species' response to deforestation.

### **MULTI-TAXA ASSESSMENT OF THE GENETIC IMPACTS OF FRAGMENTATION AND URBANIZATION IN SOUTHERN CALIFORNIA: JERUSALEM CRICKETS (*ORTHOPTERA STENOPELMATIDAE*)**

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Urbanization and fragmentation have significant negative effects on wildlife, including changing behavior, altering community structure, and reducing or even extirpating populations. Even widespread species that persist in urbanized areas may suffer reductions in population connectivity and genetic diversity. We studied the genetic impacts of habitat fragmentation in *Stenopelmatus* Jerusalem crickets in the Santa Monica National Recreation Area (SAMO) north of Los Angeles, California. SAMO comprises many small habitat fragments surrounded by urbanization and adjacent continuous "core" habitats. Although widespread, Jerusalem crickets are large, flightless insects that may have difficulty dispersing in urbanized landscapes. 265 crickets (representing 4 species) were obtained through pitfall sampling of 12 isolated fragments and several locations within core habitat. 620 bases of mtDNA COI gene were sequenced. Jerusalem crickets showed strong demographic and genetic responses to fragmentation. Of the four species, one was absent from all fragments, two had limited distributions in fragments, and one was widespread throughout fragments. In contrast, all four species were found in multiple locations throughout the core habitat area. The widespread species showed genetic fragmentation effects, exhibiting loss of genetic connectivity and diversity among and within fragments. Similar results have been found in lizard populations studied from the same fragments.

### **NON PROTECTED AREAS AT THE ECUADOR-PERU BORDER: DEALING WITH PECULIAR CONSTRAINTS FOR DRY FOREST CONSERVATION**

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Conservation is always a challenge, but it can be even more difficult if national legal restrictions and environmental NGOs agendas do not coincide with local reality. This is the case of southwestern Ecuador, where remnants of the endangered Tumbesian dry forests exist, at the border with Peru. A formal management status for an area of 45,900 ha was analyzed, with the approval of the local people and the support of the Ministry of the Environment, however, land tenancy and protected areas law regulations forced us to discard this option. In spite of that, we continued defining boundaries, to have a concrete territory to focus on, promote it for external support, and to generate a sense or property in the inhabitants. We carried out a participative planning process, identified conservation-development problems, and created a proposals portfolio, but it is evident that a positive people's posture is not enough to maintain biodiversity; we need to handle legal inconsistencies, improve organizational deficiencies, strength civil participation, consider conservation agendas, and include development worries. At the end, we must analyze how laws and specialized agencies can turn into factors that obstruct biodiversity maintenance, instead of promoting it, and how conservation needs to be integrated in a more wide range of local interests, in order to really contribute to preserve dry forests and improve human welfare.

**ASSESSING THE RELATIVE CONTRIBUTION OF PROTECTED AREAS TO THE CONSERVATION OF KEY BIODIVERSITY FEATURES IN MPUMALANGA, SOUTH AFRICA**

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Contemporary conservation planning emphasizes target driven approaches for systematic identification of priority areas for biodiversity conservation. However, the historically unmethodical approach to reserve design has resulted in reserve networks that inadequately or inefficiently protect biodiversity patterns and processes. Moreover, budgetary constraints facing conservation agencies, particularly in developing countries, requires that the maintenance of existing reserves and the delineation of new reserves occurs in the most cost-effective manner possible. Using geographic information systems and associated conservation planning software, we assessed the spatial distribution of 340 key biodiversity features in relation to the existing reserve network in the South African province of Mpumalanga. The province has 161 conservation areas, including the Kruger National Park, falling into 14 different categories of protection status. Results indicate that while, on average, these areas contribute more to provincial biodiversity targets than non-protected areas, a large proportion of biodiversity is found in informally protected areas such as conservancies and heritage sites. For management agencies to succeed in meeting explicit biodiversity goals, it is imperative that resources be redistributed toward priority areas.

**ARE RIVERS IMPORTANT FOR MARINE DOLPHINS? TOWARDS THE CONSERVATION OF TWO LINKED ECOSYSTEMS IN THE CHILEAN NORTHERN PATAGONIAN FJORDS**

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Chilean (*Cephalorhynchus eutropia*) and Peale's dolphins (*Lagenorhynchus australis*) are two poorly known species inhabiting coastal waters of southern Chile, where potential threats (such as aquaculture) might be affecting their populations. Our main goal was to identify important habitats of these umbrella and flagship species to promote strategies towards the conservation of coastal ecosystems in the Chilean fjords. Marine surveys and dolphin group follows were conducted during summer seasons 2003 and 2004 in two fjords of southern Chile. Data included dolphin location, behavior relative to habitat use, environmental variables and conservation threats. Chilean and Peale's dolphins presented marked habitat segregation at a fine scale, concentrating their activities in restricted areas, close to river mouths and shallow waters. Principal Component Analysis showed that habitat segregation was determined by water clarity and sea surface temperature, with Chilean dolphins preferring colder and more turbid waters when compared to Peale's dolphins. We propose that coastal management measures need to consider that these dolphin species seem to depend on different river types for biologically essential behaviors. The perturbation of important watercourses and ongoing alteration of coastal ecosystems could impact occupancy and long-term survival of these dolphins and other marine species depending on habitat at the interface of riverine and marine ecosystems.

**EMOTION 101: APPLYING PSYCHOLOGICAL THEORY AND RESEARCH TO CONSERVATION CONFLICTS**

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Emotion is at the heart of conservation conflicts. Emotional attachment to a natural entity that commonly motivates dedication to a field of study aimed at conservation as well as fervent objections to conservation practices. Emotional responses to ecosystem restoration, by restoration practitioners and theorists as well as the public, are a case in point. After nearly a century of dismissing emotion as an irrational component of cognition, psychologists have begun examining emotion with a more inductive and ethological focus. An evolutionary approach characterizes most current theories of emotion, in which emotions are viewed as functional and adaptive. This presentation will summarize recent psychological and neuroscientific research pertaining to emotion. Examples of conflicts over conservation practices will be used to understand the role played by emotion among scientists, environmental professionals, and members of the public. The major points to be made in this presentation are (1) emotions characterize almost any approach to conservation, (2) emotions are adaptive and often rational, and (3) understanding emotion can provide solutions to conservation conflicts.

**WOODLAND CARIBOU AND LANDSCAPE DISTURBANCE IN ONTARIO: UTILITY OF SPATIAL STATISTICS**

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Logistic regression is frequently used to predict species occurrences and discern thresholds of tolerance, but because species range data are inherently spatially autocorrelated, the significance of relationships may be overestimated. When the fate of a threatened species is in question, it is imperative that predictions are accurate. Woodland caribou (*Rangifer tarandus caribou*) are recognized as threatened in Ontario, and their decline is attributed to habitat alteration due to forestry, road construction and other anthropogenic disturbances. Using a database of caribou presence for northern Ontario, geo-coded to 10 km x 10 km UTM grid cells, we initially constructed univariate logistic regression models for nine disturbance types, with distance to nearest disturbance as the predictor. We used Akaike Information Criterion for model selection and Receiver Operating Characteristic Curves to derive optimal thresholds. We used several methods to overcome the extreme spatial autocorrelation inherent in coarse-scale species range datasets and confirm that the regression results were indeed significant. We repeatedly randomly sub-sampled the data at decreasing subsample sizes to determine where spatial autocorrelation became insignificant to obtain model rankings and parameter estimates for threshold calculation. We also used Monte Carlo restricted randomizations to

derive distributions of coefficients and test statistics with which to estimate significance. These methods provided further assurance that the original results were significant. All methods show logging cuts as having the most significant effect on caribou range occupancy; however, because disturbances such as roads and cuts are not independent, these data can not unequivocally indicate the relative importance of these disturbances.

### **FACTORS PREDICTING ESTABLISHMENT OF INTRODUCED OYSTERS**

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We compiled a dataset of worldwide oyster introductions. Eighteen species of oysters have been introduced 168 times from 31 source countries into 79 recipient countries, usually for the purpose of aquaculture. Oysters have been successfully introduced in at least 24 countries, with unsuccessful introductions in 55 countries. Some "successes" occurred only after several decades of continued introductions or aquaculture propagation. Most (66) oyster introductions involved the Pacific oyster (*Crassostrea gigas*), of which 17 (26%) established, 23 (35%) did not, and the remainder are unknown. Many oyster introductions originated from other introduced populations. Of those, 24% (11 of 44) established, as opposed to 10% (3 of 30) from oysters' native range. Overall rates of establishment for oysters lie at the high end predicted by Williamson's tens rule, which states that 5-20% of species introductions will result in establishment. This higher success rate is probably due to propagule pressure stemming from sustained, intentional introductions, which is expected to have a higher probability of establishing than unintentional introductions. A key question in invasion biology concerns what factors allow new species to establish. Our analyses suggest a particularly strong role for the match between species and environmental traits to predict when and where introduced oysters may most likely establish outside of intended aquaculture.

### **WORDS MATTER: A FUNCTIONAL CLASSIFICATION SYSTEM FOR MPAS ILLUSTRATES THEIR ROLE IN CONSERVING US MARINE ECOSYSTEMS**

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Marine protected areas (MPAs) hold much promise as a multifaceted tool for conserving marine habitats and ecosystems. Their successful establishment and long-term effectiveness, however, continue to be complicated by chronic confusion among stakeholders, scientists, and policy-makers about the purpose and implications of different types of MPAs. At the root of this confusion lies terminology. Official programmatic names for MPAs (e.g. sanctuaries, parks, natural areas, reserves) rarely convey an accurate picture of the site's actual intended function, type of restrictions, or potential effects on ecosystems or human users. In order to provide a neutral common language for considering MPAs, NOAA's National MPA Center has developed a new classification system that uses objective, functional criteria to describe any MPA, independent of programmatic names or value-laden terminology. The classification system uses six descriptors derived from the MPA's legal mandate and management approach: (1) conservation focus, (2) level of protection, (3) ecological scale of protection, (4) permanence of protection, (5) constancy of protection, and (6) restrictions on extraction. When applied to the MPA Center's growing national inventory of marine managed areas, the classification system reveals important trends in the use, purpose, and likely conservation impacts of different types of MPAs in U.S. marine ecosystems.

### **CONSERVATION, POVERTY AND THE MILLENNIUM DEVELOPMENT GOALS—HOW SHOULD INTERNATIONAL CONSERVATION NGOS NEGOTIATE THE MINEFIELD?**

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Much is expected of conservation in reducing poverty and contributing to the MDGs. Yet conservation and poverty are multi-faceted concepts and the linkages between them are complex and variable. As a result, transcending the rhetoric and achieving demonstrable change is challenging. To what extent, then, does international conservation action really contribute to poverty alleviation? To address this question, we explored the portfolio of FFI, a conservation organisation which operates in some of the poorest countries and regions. We examined and categorised the rationale, aims, anticipated results and outcomes of some 30 projects worldwide in relation to poverty and local livelihoods. We found a balance of direct (income, food security, health) and indirect (capacity-building, reduced vulnerability, governance, empowerment) poverty-related elements, and some localised evidence of improved livelihoods. Social responsibility was widely embedded, but a "no net cost" approach to livelihoods does not necessarily yield positive change, especially in the short term. Even where it does, conservation actions rarely reduce poverty in ways that are captured by the MDGs, and it may be unfair, over-simplistic and counter-productive to expect them to. We propose a more honest and appropriate appraisal of where, when, why and how conservation may contribute to other societal goals.

### **ASSIGNING GEOGRAPHIC ORIGIN TO THE LARGEST IVORY SEIZURE IN THE HISTORY OF THE TRADE**

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We previously described a method for assigning African elephant DNA to geographic region of origin. This paper describes the application of this method to determine the geographic origin of the largest ivory seizure in the history of the trade. Over 6.5 tons of ivory were seized in Singapore during June 2002. This shipment originated in Zambia and passed through Malawi and South Africa en route to Asia. The seizure contained nearly 600 whole tusks of widely diverse sizes and weights, plus 42,000 processed pieces. We tested (a) whether the tusks originated from numerous locations across Africa, with stockpiles smuggled into Zambia prior to shipping, or (b) whether pre-shipment transport (smuggling) was more localized, with tusks originating

from areas in close proximity to Zambia—the original shipping locale. Answers to these questions have already enhanced our understanding of how the ivory trade is operating, offering considerable applications of these assignment methods for combating the still burgeoning ivory trade throughout Africa and Asia.

**USING BATHYMETRIC LIDAR TO EXAMINE HABITAT COMPLEXITY OF A CORAL REEF**

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Habitat complexity is a major determinant of fish assemblage structure in the marine environment. However, there are limitations with the current field method of deriving habitat complexity, or rugosity, of a coral reef. Considering the documented importance of the relationship between habitat complexity and fish assemblage structure it is critical to improve methods of calculating rugosity. Improved methods for determining habitat complexity can greatly inform management decisions with respect to marine protected area design and evaluation. The main objective of this research was to determine the most appropriate geostatistical method to interpolate remotely sensed LiDAR (Light Detection and Ranging) bathymetric data for further benthic terrain analysis and calculation of rugosity. The geostatistical methods used in this study were inverse distance weighting, kriging, and conditional simulation. The bathymetric grids were produced at multiple spatial scales and examined in ArcGIS for benthic terrain analysis. This research concluded that conditional simulation was most appropriate method of spatial interpolation used to create a bathymetric surface for calculating rugosity. The results of this research demonstrate the utility of remotely sensed LiDAR data for examining benthic habitat complexity of a coral reef at multiple spatial scales.

**BEYOND REPRESENTATION: GRADIENT APPROACHES TO CONSERVATION RESERVE DESIGN**

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Design conservation reserve networks often use the concepts of representation and efficiency, as exemplified by the use of algorithmic optimization tools such as Marxan. While important, these approaches often fail to capture landscape context and connectivity important for the long-term viability of biodiversity and ecosystem processes, particularly in the face of climate change and increasing human impacts. They also focus on static distributions of known biodiversity targets that often reflect sampling intensity rather than the true distribution of targets. A gradient approach uses known biodiversity data to extract the topographic, geologic, climatic, and geographic variables that define maximum biodiversity turnover (beta diversity) and the positions of species assemblages or communities along these gradients (e.g. niches). Recent advances in multivariate statistics and GIS allow new types of spatially-explicit gradient analyses that can be developed and tested on real landscapes at a range of scales. Gradients, functionally connected in geographic space, become the key coarse filter conservation target. Conservation concepts such as seas-to-summits, riparian-to-uplands, and resiliency to climate change can be quantitatively and spatially analyzed within this framework, as can conservation strategies for filling in the gaps in the protection of gradients, often in the context of public-private lands strategies.

**DEVELOPMENT OF GENETIC STOCKING GUIDELINES FOR CONSERVATION OF LAKE STURGEON IN THE GREAT LAKES**

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Lake sturgeon (*Acipenser fulvescens*) populations in the Great Lakes basin are far below historic population sizes, and several fishery management agencies are interested in promoting species recovery. With increased interest in lake sturgeon stocking, genetic data can provide valuable information for the appropriate selection of donor populations and for monitoring the genetic effects of stocking. We compiled standardized genetic data from different laboratories and analyzed the data to examine genetic relationships between different spawning locations. The results were interpreted in a management context through collaborations with biologists and managers throughout the Great Lakes basin. Seven management units were defined across the Great Lakes basin, and criteria for the identification of priority populations for genetic preservation were established. A decision tree was created to assist managers in selecting appropriate donor populations for stocking sites. Finally, recommendations for the design and implementation of a stocking program were included in the guidelines. The development of the guidelines provides a model for the incorporation of genetic data in management decisions targeting species conservation.

**AMPHIBIAN STATUS ON NORTHWEST CALIFORNIA LANDSCAPES: WHAT IS THE ROLE OF ANTHROPOGENIC DISTURBANCE IN DECLINES OF AMPHIBIANS IN NORTHERN CALIFORNIA?**

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The herpetology research group at the Redwood Sciences Lab, in collaboration with graduate students in the biology and wildlife departments at Humboldt State University, has been studying the natural history, demography, and landscape ecology of amphibian assemblages in aquatic and terrestrial environments of northern California for 21 years. A primary focus of our research has been to study the interactions between amphibian life histories and human land management practices. In this talk I examine several interrelated themes that have emerged from this work. I discuss both individual species, and species assemblages, whose populations have declined on northern California's landscapes in response to anthropogenic natural resource management. Amphibian populations in this region have declined due to manipulations of the natural flow regimes of north coast rivers, introductions of non-native predators, and detrimental forestry practices. I review specific mechanisms that stress populations by exceeding their physiological limits, and/or their fixed, evolved thresholds of ecological niche space, to explain three distinct regional amphibian decline trajectories. I suggest possible modifications to these anthropogenic disturbance regimes that could help reverse on-going declines while still meeting human needs.

**FIVE MILES, OR ONE? HOW SURVEY PROTOCOLS CAN EFFECT LANDSCAPE-SCALE CONSERVATION**

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The U.S. Fish and Wildlife Service recently lowered the bar on a regulatory parameter of relevance to landscape-scale preserve design for endangered species. In revising a survey protocol for a listed frog, USFWS changed the radius of influence an historic locality exerts on the status of adjacent habitat, e.g., how close a locality of interest must lie to a documented frog locality to be considered frog habitat. USFWS reduced this radius from five miles to one. We mapped polygons based on the two radii and known frog localities onto a landscape of private and public lands. Under the five-mile protocol, this landscape (the Santa Cruz Mountains of California) is completely tiled by the polygons. Connectivity between patches becomes an important consideration. Under the new one-mile rule, the landscape fragments into a constellation of discrete habitat patches where small preserves appear sufficient to encompass important habitat, and interstitial regions where frogs have not been observed may be looked upon as noncrucial. Connectivity between patches is no longer a consideration. Which scale best captures the spatial ecology of the species? We recommend that agencies seeking to design surveys apply an appropriate, explicit metapopulation model, such as an occupancy (or incidence function) model.

**LOOKING FOR TROUBLE: UNPREDICTABILITY OF EFFECTS OF TRANSFERRING WATER AWAY FROM IRRIGATION IN THE WESTERN UNITED STATES**

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Western United States irrigation consumes more than 80% of water and is under pressure for substantial transfer away, but with what ecological consequences? Unpredictable effects of de-watering century-old "hybrid" irrigated ecologies threaten important potential reforms in water management and increased resentment of conservation, through collision with unforeseen cumulative effects on partial substitutes for lost riparian and wetlands habitats. To inform policy, literature review was undertaken. It revealed (1) almost no ecological information on relevant subjects and scales, (2) little public control, increasingly-fragmented private ownership, and decreasing regulatory interest, (3) necessity to maintain some un-quantified minima of both extent and connectivity of intact wetlands and riparian zone habitats to support diverse and resilient restoration, as well as the full mosaic of types of habitat, and (4) a disturbing threat of successional catastrophe in regulated-flow regime mainstems which produced a privileged but non-regenerating pulse of cottonwoods and other high canopy which is now senescing, susceptible to invasives, and not self-restoring. Wetlands have been almost completely converted. Absence of predictability needed to achieve acceptance of socio-economically desirable management reform may block progress and significant additional conservation, but there will still be unmitigated adverse impact from conventional transfers. Policy-minded ecologists are urged to consider investigation.

**THE TERAI ARC LANDSCAPE: A PARADIGM FOR MEGAFUNA CONSERVATION IN HUMAN-DOMINATED LANDSCAPES.**

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The grassland and savanna ecosystems along the foothills of the Himalayas support a diverse megafauna, including some of Asia's largest species. Efforts to eradicate malaria since the 1960s have made the region safer for humans, prompting massive migrations, settlement, and cultivation in these productive ecosystems. Consequently widespread habitat clearing has confined the mega-species to small habitat patches within reserves. Despite protection in these refuges the species face an uncertain future because of the inevitable consequences of genetic inbreeding and breakdown of natural ecological and behavioral interactions necessary for long term persistence. The Terai Arc Landscape is an ambitious effort to restore connectivity among the 11 protected areas and remaining intact habitat patches and create a 47,000 km<sup>2</sup> conservation landscape. The strategy entails implementing land-uses in the potential corridors that provide natural resources and economic benefits to the local communities while facilitating wildlife dispersal. After only four years of restoration of degraded corridors, wildlife has begun using them. The support of the local people is evident by the successes of the community-based anti-poaching units and community-initiated negotiations to remove illegal settlers from critical corridors. This project shows that landscape conservation programs for mega-species can be successful in human-dominated landscapes.

**COMPENSATORY MITIGATION CAN RESOLVE ECONOMIC INEFFICIENCIES IN FISHERIES AND BIODIVERSITY MANAGEMENT**

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Eight percent of the global fisheries catch, or 7.2 million tons, is non-target species, including seabirds, marine mammals, and turtles, which are discarded. This "bycatch" mortality is having major impacts on species and ecosystems and there is increasing pressure for sustainable management. Where bycatch cannot be avoided closures have often been used, with costly outcomes for society: e.g a 3 year closure of Hawaii's \$170 million / year swordfish fishery. We meld ecological dynamics and economics to demonstrate that compensatory mitigation—an innovative approach to fishery-conservation conflicts—can facilitate high value uses of biological resources, while making conservation gains for species of concern. We illustrate strategy's effectiveness with a seabird example: fishers could be levied for bycatch, funding conservation actions on breeding islands, such as the removal of invasive mammals—the primary threat to seabirds worldwide. On-island predator control is eighteen times more effective than fisheries closures, and significantly more socio-politically feasible. Transferable bycatch fees also provide individual incentives for avoiding bycatch which increase with endangerment, the most effective mechanism for sustainable management of fisheries. Compensatory mitigation provides an opportunity to constructively address a global conservation concern, circumventing costly and socio-politically damaging battles over fishery-conservation conflicts.

**EVALUATION AND CONSERVATION OF HERITABLE ADAPTIVE TRAIT VARIATION IN MAINE'S ENDANGERED ATLANTIC SALMON, *SALMO SALAR***

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One of the primary concerns surrounding population declines in species at risk is the loss of potentially adaptive trait variation and its implications for fitness and population persistence. Variation at molecular markers has at times been used as an indicator for potential loss of adaptive trait variation. However, theoretical predictions for the fate of quantitative trait variation under population decline are variable and empirical associations between molecular and adaptive trait variation have often proved elusive. Until now, microsatellite variation has been the primary data assessed for genetic variation in populations of Maine Atlantic salmon (*Salmo salar*). In this study we compare patterns of heritable, adaptive trait variation in six populations of Maine Atlantic salmon that have experienced recent population declines. The populations have been listed under the U.S. Endangered Species Act, and are currently managed at the Craig Brook National Fish Hatchery. All of these populations are closely related and most were reared to maturity under similar captive conditions, allowing us to better control for some of the confounding effects that may have limited other studies. Results indicate heritable adaptive differences among these populations, and call for further empirical investigations examining the consequences of outbreeding.

**DO PRIORITY REGIONS PUT CONSERVATION RESOURCES IN THE RIGHT PLACES?**

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Priority areas for conservation are often identified at the scale of large regions. Using data from New South Wales and South Africa we find that there are many low-priority areas in high-priority regions and many high-priority areas in low-priority regions. Given this heterogeneity, we sought to answer two questions. What is the impact of constraining the allocation of conservation resources to high priority regions? What is the impact of directing conservation resources to areas within high-priority regions that are in least need of conservation action? We answered these questions using land use simulations and our objective was to maximize retention of vegetation, recognising ongoing, incremental clearing and reservation. After 20 years we measured the area that the conservation target for each biodiversity feature had been compromised. We find that biodiversity loss is greatest when resources are allocated only to high priority regions, as opposed to an unconstrained allocation of resources according to finer resolution priorities. Next we assessed the impact of different approaches to directing resources within high priority regions by allocating resources to the highest priority areas and to the lowest vulnerability areas. We find that if conservation resources are directed preferentially to low-vulnerability areas then our conservation targets are compromised more extensively.

**THE DECLINE OF AN ENDANGERED WOODLAND CARIBOU POPULATION: LANDSCAPE COMPOSITION AND ADULT SURVIVAL**

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Loss of biodiversity is often attributed to habitat loss, but examples of the direct effect of habitat alterations on population vital rates remain rare. Based on a sample of 291 radiocollared individuals, we estimated female survival probabilities in 10 distinct populations of woodland caribou (*Rangifer tarandus caribou*) in British Columbia, Canada, at two spatial scales. Among populations, female survival was lower in landscapes with higher proportions of younger (i.e., early- and mid-seral) forest stands. Among home ranges, survival declined with reduced availability of mature forests. Corresponding to the "interior wet-belt" ecosystem of British Columbia, our analysis area is mostly associated with a very low fire-return interval, but a history of forest harvest has resulted in landscapes with high proportions of young forests. This we speculate has resulted in greater populations of herbivores that favor such stands, and associated increases in large predator densities. Our results are consistent with an "apparent competition" scenario whereby caribou population declines are due to high predator densities supported by increases in other prey species. Proposed caribou recovery strategies thus need to consider the relationship between reduced adult survival and landscape alteration through forest harvest. We discuss short- and long-term conservation options.

**TOP TEN MOST ENDANGERED RIVER BASINS: GLOBAL CASE STUDIES HIGHLIGHTING THE GREATEST THREATS**

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Freshwater systems worldwide face tremendous pressure from extraction, modification, invasive species, climate change and overfishing. The primary objective of this investigation is to provide an overview of the most serious threats to river basins, to highlight those primary watersheds facing the greatest risk, and to stress the importance of integrated river basin management solutions. Drawing from published literature and field expertise, this study presents the greatest threats to basins, and based on these, the ten most endangered. We focus on watersheds (a) with high ecological importance, (b) affecting large human populations, and (c) providing continental representation. From an evaluation of five international assessments including the Millennium Assessment "Wetlands and Water" Synthesis Report that compiles the work of more than 2000 authors and reviewers, we select five threats, based on their known impact on roughly 225 basins globally. To exemplify these threats, we provide full case studies of the "top ten most endangered" river basins: Rio Grande, Ganges, Salween, La Plata, Danube, Murray-Darling, Indus, Nile, Yangtze, and Mekong. We discuss a host of techniques from payments for environmental services

to clarifying water rights and conclude that integrated, community-based management is essential to the sustainable use of freshwater resources.

### **CHALLENGES OF CONSERVING A WIDE-RANGING CARNIVORE ON COMMUNITY LAND: AFRICAN WILD DOGS IN NORTHERN KENYA**

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The African wild dog (*Lycaon pictus*) is uniquely sensitive to habitat fragmentation. Packs' wide-ranging behavior means that even those living in protected areas are threatened by human activities on adjoining lands. As a result, wild dogs have disappeared from all but the very largest reserves, and today number fewer than 6000. If tools could be developed to encourage coexistence of wild dogs and people, this would improve the effectiveness of protected areas, restore connectivity and might even foster recovery on unprotected lands. A five-year study of wild dogs in the rangelands of northern Kenya shows that coexistence with people is achievable under the right circumstances. Where pastoralist people have retained local traditions, depending on carefully-tended livestock and not hunting wild ungulates, wild dog populations have thrived without damaging human livelihoods by killing livestock. There has been substantial conflict, however, where hunting has depleted wild prey. In the period of the project, the wild dog population has recovered to become globally significant. However, infectious disease probably transmitted by domestic dogs remains a major threat to population viability. This presents a challenge, because domestic dogs also deter predators from killing livestock, reducing the numbers of predators killed by farmers.

### **AN ASSESSMENT OF PROTECTED AREA STATUS AND DISTRIBUTION IN RELATION TO THE HUMAN FOOTPRINT IN THE TRANSBOUNDARY NORTHERN APPALACHIAN ECOREGION**

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The Northern Appalachians ecoregion, spanning the United States / Canada border, has one of the longest histories of post-Columbian human development in North America. Building on the global methodology developed the Wildlife Conservation Society, we mapped the human footprint of the Northern Appalachian ecoregion at a high resolution (90 m<sup>2</sup>) using region-specific datasets to reveal not only the remaining "wild" landscapes and potential ecological linkages within the area, but also to identify potential low-cost opportunities for conservation action. We assess the current system of conservation lands (federal, state / provincial, and private) in this area in terms of the distribution and protection status of the management units in relation to the map of the human footprint. This analysis reveals (a) > 90% of the protected areas (GAP status 1-3) in the ecoregion are characterized by low human footprint scores and (b) 40% of the areas with low human footprint scores have no GAP designation. This analysis highlights the association of protected areas in this region with "wild" landscapes yet also indicates that some landscapes have retained a "wild" character in the absence of regulatory protection.

### **PRINCIPLES AND PRACTICE OF SUBSTITUTION FOR RARE AND ENDANGERED SPECIES IN AMCHI MEDICINE**

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Conservationists in the Nepal Himalaya have to a large extent relied upon the traditional knowledge of the amchis (practitioners of Sowa-rigpa or the Tibetan system of medicine) related to plant ecology, morphology, and regeneration patterns to devise sustainable harvesting guidelines and community-based management of medicinal plants. Furthermore, the principles and practice of substitution in amchi medicine (such as substituting *Delphinium brunonianum* for musk) provide an innovative opportunity to address the threats to rare and endangered species, especially those used in traditional medicines. By studying key medical texts and interviewing practicing amchis, we explored the use of substitutes for rare and endangered species listed in traditional pharmacopoeia. We illustrate the principles behind the use of substitutes and how this is driven by changes within the amchi system, as well as by global forces, including conservation and environmental ethics. We also look at the emerging concept of rare and endangered species among the amchis, reinforced by the realities that they themselves face in preparing medicine due to increasing pressures from trade. We then discuss some of the challenges in promoting substitution at a wider scale and emphasize the importance of engaging with the amchis for conservation.

### **OF TEENS AND TUBEWORMS: DIVERSITY IN HAWAII'S INTERTIDAL ZONE**

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Hawaii's intertidal zone is spatially narrow and low in biomass compared to lush temperate intertidal systems. Perhaps because of this, the prevailing view among marine scientists has been that the intertidal in Hawaii is a species-poor, marginal habitat, unworthy of research or conservation attention. In 2002, when a classroom of 9th graders in Honolulu heard they were going to be the first to carry out a broad-scale survey of their island's intertidal zone, they jumped to their feet and cheered. Since then, junior high and high-school students from four public schools on two islands have been responsible for collecting, identifying and counting over 600 taxa of macroalgae, invertebrates and fish, and they have documented changes in the intertidal zone through interviews with family members, neighbors and beachgoers. For many immigrant students, the surveys were also their first trip to the shore; for many "local" students, it was an opportunity to integrate their knowledge of marine organisms gained from fishing and collecting. Post-project assessments of students showed an increased understanding of

ecological concepts and the scientific process. Professional scientific interest in Hawaii's intertidal zone has also increased, with two major surveys initiated since the beginning of our project.

**INTEGRATING DATA TO ASSESS THE RISK OF ENDANGERED SHORT-TAILED ALBATROSSES INTERACTING WITH TRAWLERS IN THE NORTH PACIFIC**

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In 2000, the NOAA-Fisheries Alaska Regional Office concluded that fisheries using trawl gear were likely to adversely affect short-tailed albatrosses (*Phoebastria albatrus*). A biological opinion completed in 2003 on the effects of the total allowable catch setting process to the endangered short-tailed albatrosses included as a requirement that NOAA-Fisheries continue to work on ways to assess albatross interaction with trawl gear. Our goal was to integrate available data sets to determine the risk of lethal and non-lethal short-tailed albatross interactions with the groundfish trawl fishery. We searched for and compiled information about short-tailed albatross distribution and attraction to fishing vessels from federal agencies, universities, and gray and peer-reviewed literature. We then used data provided by the NOAA Groundfish Observer Program and Regional Catch Accounting System to analyze trawling activity. Bayesian analysis was used to determine the relative risk of interaction among components of the trawl fishery including location, time of year, gear type, and processing mode. Although the overall risk of lethal or harmful interactions is low, the analysis highlights the specific need for improved understanding of (1) bird-trawler interaction rates and (2) the relative attraction of trawler discard types to reduce uncertainty in risk estimates.

**THE EFFECTS OF OFF-HIGHWAY VEHICLES ON AMERICAN MARTENS IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA.**

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The American marten occurs in high-elevation forests that, until recently, have been isolated from year-round human recreational activities. We studied the effects of Off Highway Vehicles (OHVs) on martens at 2 sites (~50 km<sup>2</sup> each), where we contrasted adjacent areas where OHV use was permitted and prohibited. These areas were sampled for marten occurrence using track plates, cameras or snow tracking (depending on season) using 2-km<sup>2</sup> sample units. OHV use was measured using remote sound recorders, trail monitors and observers. Martens were ubiquitous and the proportion of sample units with detections was equivalent in the OHV use and non-use areas in both sites. Two secondary indices, sex ratio and circadian activity, helped interpret these results; for example, martens were largely nocturnal in winter when snowmobile activity was diurnal. OHV use levels that occurred in our study areas does not appear to have significant effects on the pattern of occupancy. The perceived risks may be low, relative to the cost of responding to the disturbance as a threat. We caution that before these results are applied elsewhere that a standard protocol for measuring OHV use be developed so that our conclusions are applied only under similar OHV use levels.

**MANAGING HUMAN-ELEPHANT CONFLICT IN ASSAM: AN INTEGRATED APPROACH USING GIS AND COMMUNITY-BASED MITIGATION**

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The Himalayan foothills of northeastern India provide one of the last remaining strongholds of the endangered Asian Elephant. In Assam, widespread human-elephant conflict results in the loss of both elephant and human lives, and expert groups have listed this region a top priority for mitigation action. Our paper describes a methodology that combines GIS-based research with community-based conflict management. Patterns and characteristics of crop-raiding are recorded, movements of elephants observed and mapped, and historical habits of elephants reconstructed from local knowledge. In tandem with this, we use a participatory approach of engaging communities to construct and maintain low-cost deterrent methods (e.g. tripwire alarms, chilli, etc). Community members help collect observational data and coordinate the deterrent trials, in the aim that these villages may soon take charge of their elephant problems themselves. Our preliminary results suggest that while elephants appear to follow seasonal routes of migration, their habitual movements are highly sensitive to human interventions. While mitigation of acute conflicts is required to help both elephants and people in the short term, region-wide monitoring is essential for a full understanding of the effects of interventions and to assist local authorities in developing long-term protected area and conflict management policies.

**AN IMPROVED METHOD FOR RESTORING ABANDONED GRAVEL PITS IN THE NEW JERSEY PINELANDS**

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When prescribed burning cannot be used for forest restoration, revegetation is often the preferred application. However, restoring native flora in the New Jersey Pinelands where nutrient poor, sandy soils dominate the landscape can be challenging. Without restoration, abandoned gravel pits can take years to recover and current restoration practices typically produce a monoculture of pine trees. We tested an alternative restoration strategy utilizing mulch, fertilizing, and seeding with *Schizachyrium scoparium*. We compared recovery to a disturbed area undergoing natural succession. Density of *S. scoparium* on the restored site was 16.6 indiv / m<sup>2</sup> and 23.6 indiv / m<sup>2</sup> on the natural site. Aboveground biomass was greater on the restored site (0.559 kg / m<sup>2</sup> vs. 0.221 kg / m<sup>2</sup>) but root biomass did not differ (0.104 kg / m<sup>2</sup> vs. 0.071 kg / m<sup>2</sup>). Native pine densities in the restored and reference site were 104 and 96 trees / ha respectively. Total cover was 23% and 36% for the restored and reference site respectively. Nineteen native species were identified on the restored site compared to 14 on the natural site. After four years, the restoration site appears to be following a successional trajectory similar to that of the natural site making this revegetation strategy a useful approach for accelerating natural processes and restoring biodiversity and community structure.

***CONSERVATION WITHOUT BORDERS***

**SOCIETY FOR CONSERVATION BIOLOGY  
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**ABSTRACTS:  
CONTRIBUTED POSTER  
PRESENTATIONS**

**STATUS AND CONSERVATION NEEDS OF THE DUGONG: THE MOST ENDANGERED MARINE MAMMAL OF CAMBODIA AND VIETNAM**

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This research was conducted to locate dugongs and assess the numbers of animals, the location of population groups, and conservation issues affecting dugongs along the eastern Gulf of Thailand in Cambodia and Phu Quoc Island, Vietnam. During four days of aerial surveys in Cambodia we saw no dugongs. We conducted interviews with villagers in 2002 and 2004 along the Cambodian coast. In Vietnam, we interviewed villagers in 2002. In Cambodia, interviews in 2002 and 2004 showed that dugongs are sporadically found in fishing nets, and their body parts are sold for a relatively large profit. From interviews in Phu Quoc Island, we learned that dugongs are regularly found and hunted, again for high profits. Fishers in Phu Quoc mentioned that dugongs were found along the eastern coast of Cambodia. In both countries we recommend that legislation addressing endangered species be created and enforced. In collaboration with the Cambodian and Vietnamese governments and local NGOs, we also recommend the exploration of alternative non-destructive fishing methods and the initiation of an education campaign based on conservation of marine wildlife and the near-shore environment. National management and community-based conservation are necessary in both countries in conjunction with strategies to address overfishing and poverty.

**ECOLOGY AND CONSERVATION OF DAREVSKY'S VIPER (*VIPERA DAREVSKII*) IN THE CAUCASUS**

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The Darevsky's viper is a critically endangered endemic snake species of northern Armenia. Our project started in May 2005 and covered the south-western slopes of the Javakheti ridge. We recorded the location, elevation, and exposure of the snake capture sites; type and climate of the habitats; and size, sex, physiological condition, body temperature, and behavior of captured individuals. We captured 57 individuals, of which 21 were marked by cutting of abdominal scutes and 8 adults were additionally fitted with microchips for radio-tracking. The key habitats were stone lands and mountain moraines with large flat slabs and rocky outcrops at elevations 2300–3000 m. The landscape was subalpine meadow. The snake density was up to 10–12 individuals / ha and the estimate of population size is 250–300. The principal threat is overgrazing. It is essential to include this species in the Red Data Book of Armenia and ensure conservation of its habitats. These measures comply with the national program on establishment of Arpi Lich National Park in northern Armenia. It is also important to fence these areas, mark them with stop signs, regulate the haymaking and grazing rules, raise awareness among local people, and enforce the state control over illegal capturing.

**AN ASSESSMENT OF THE RELATIONSHIP BETWEEN HUMAN ELEPHANT CONFLICT AND CROP DAMAGE COMPENSATION METHODS IN BANNERGHATTA NATIONAL PARK, SOUTHERN INDIA**

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Understanding the status of human elephant interaction is important particularly when huge economic resources are spent on compensation to loss of lives and crop. This study assesses the efficacy of the system of compensation payment for the period 1994 to 2004. The spatial distribution of villages claiming compensation and the status of forest cover close to it were studied. A comparison of habitat usage by elephants and straying into human habitations was also made for different seasons. An average of 546 compensation claims were accounted from 105 villages and 75 of the affected villages were distributed close to fragmented forests. The percentage difference of amount between claimed and assessed was 60 (SE = 3.6) and actual payment made was only 54 (SE = 4.5) of the claim. Our results show a lack of association between elephant distribution, elephant density, villages affected, and the compensations paid during different seasons, even in the preceding years.

**LINKING UNDERGRADUATE TRAINING AND CONSERVATION OUTCOMES USING RAPID BIODIVERSITY ASSESSMENT METHODS**

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To enhance undergraduate training in conservation biology and conservation outcomes, we initiated multi-taxa biodiversity surveys in a private forest reserve of northwestern Costa Rica. The surveys follow the methods of Rapid Biodiversity Assessment Programs (RAPs) and are embedded in a full year course on tropical ecology and conservation. During four 9–10 day stays at the field site, 44 students have conducted individual projects involving netting and trapping of bats and insects and observational sampling of terrestrial mammals, amphibians, reptiles, and birds. Data were used to build species checklists for the study area, assessments of species richness for the various taxonomic groups, their habitat use and preferences, and to calculate diversity and similarity indices among habitats. This information is made available to the reserve owners and contributes to the development of their conservation plans. The quality of student projects is enhanced by the RAP framework and by building on the knowledge acquired from prior field studies. In the longer term, repeated surveys are beginning to lead to the monitoring of target groups.

**LANDSCAPE ASSESSMENT OF TREE COMMUNITIES IN THE MOIST KARST REGION OF PUERTO RICO: USING EXISTING DATA SETS AS A SCALING TOOL IN ECOREGIONAL PLANNING**

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Ecoregional planning is recognized as a major tool in setting conservation priorities in large spatial areas containing thousands of species and natural communities. In tropical regions, assessments are generally done at a coarse scale using ecosystem

targets as surrogates for species, due to the lack of species specific, geospatial distribution data. Existing spatially explicit, large datasets can be used as a mesoscale priority setting tool. The moist karst of Puerto Rico contains one of the island's largest remaining forested tracts. The region is typically considered a single vegetation type in conservation plans and forest classifications, creating a perception that the region is a relatively homogeneous forest. We asked whether there were distinct tree assemblages that would necessitate targeted conservation strategies to insure their protection. Using plot level woody plant community data, we found distinct tree communities in the west, south, and east-central portions of the study area. As planning moves from the coarse scale—with moist karst forest as a target—to selecting sites for conservation action, we recommend that sites be selected in each of these distinct forest zones. We suggest that other datasets are available that can similarly be used for scaling down in ecoregional conservation planning efforts in tropical regions.

#### **WHAT IS THE "BEST" POLICY FOR REBUILDING OVERFISHED POPULATIONS?**

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United States policy requires overfished populations of marine fish to be rebuilt to the target biomass level in 10 years if possible, otherwise in the time it would take to rebuild with no fishing plus one mean generation time. A debate is ongoing about whether this rebuilding time requirement should be replaced with some other rebuilding strategy, such as stricter controls on harvest rates. Most populations can recover within 10 years; the exceptions have very low productivity or are severely depleted. Of the five overfished populations for which rebuilding policies were compared, the swordfish and red snapper were able to rebuild in 10 years, but white marlin, sandbar shark, and darkblotched rockfish were not. For all 5 populations, decision rules which reduced fishing mortality at lower biomass levels rebuilt rapidly. Some rebuilt more rapidly under a fixed rebuilding time requirement and some under a decision rule. The decision rules had the lowest catches while the population was low, but allowed catches to increase more rapidly as the population rebuilt. Thus, there is a trade-off between relatively high catches early in the rebuilding period and higher catches as the population rebuilds to a level that can sustain a larger fishery.

#### **TERRESTRIAL CHARACTERISTICS OF STELLER SEA LION HAULOUTS AND ROOKERIES**

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Steller sea lions range across the Pacific rim from Southern California in the east to northern Japan in the west, where they have continuously occupied terrestrial resting sites (haulouts) and breeding sites (rookeries) for hundreds of years, if not longer. Anecdotal accounts describe Steller sea lions as predominantly occupying exposed, rocky shorelines, but this habitat preference has never been quantified. We compared locations of haulouts and rookeries against a coastline type database to identify and quantify the shoreline preferences of Steller sea lions and to look for other spatial trends in site characteristics. Steller sea lions were found to preferentially locate haulouts and rookeries on exposed rocky shorelines and wave-cut platforms. Shoreline types that were used in lower proportion than their availability included fine-to-medium-grained sand beaches, mixed sand and gravel beaches, gravel beaches, and sheltered rocky shores. No relationship was found between either latitude or longitude of a site and its average non-pup count.

#### **DEVELOPING A SEA TURTLE RECOVERY PLAN FOR A SMALL SCALE COMMUNITY: A COMMUNITY-BASED CONSERVATION AND MANAGEMENT EFFORT AT HELEN ATOLL, PALAU**

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Recovery of migratory sea turtles requires community-based, regional, and international efforts. In remote areas, which are frequent homes to regional subpopulations and essential habitat, local communities are often the users and primary stewards of sea turtles. In an effort to conserve sea turtles for the long-term use and enjoyment by their people, a Hatohebian community group in Palau has engaged in a long-term monitoring and conservation management project within Helen Reef Reserve. Collaborators include the Palauan government and U.S. based partners. Monitoring and data collection efforts by the community include capture-mark-recapture, nesting observations, hatchling observations, collection of tissue samples, habitat assessment, and community cross training. Field time is focused on generating observational information for use in a locally relevant sea turtle recovery plan and building the capacity of the community to implement this plan. Future work will focus on the creation of regional and international alliances that will collaborate on sea turtle conservation and recovery, and the use of satellite telemetry tracking to determine migratory patterns. This project is a model for small-scale community conservation and management of wide ranging species. Results of this effort show that organic community motivation is the key element to successful collaborative endangered species management.

#### **DOLPHINS FOR DEVELOPMENT—A PILOT CONSERVATION PROJECT IN THE MEKONG RIVER**

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Research was initiated in 2001 on the Irrawaddy dolphin population that inhabits the Mekong River. By 2003, it was confirmed that the population was very small (only approximately 170 individuals) with unsustainably high mortalities each year (16–18 individuals) and a high probability of local extinction in the next 15 years. In 2003, the Mekong Dolphin Conservation Project was formed to contribute to the long-term conservation of this population, which was recently classified as Critically Endangered by the World Conservation Union (IUCN). In addition to conservation activities throughout the dolphins distribution, a Dolphins for Development integrated conservation development project (ICDP) was trialed in two Cambodian villages on the Lao / Cambodian border. Although this project has obtained encouraging results, significant challenges exist resulting from the

transboundary location of the site, with three Laos villages situated on the adjacent bank receiving no paralleled activities. Without complemented cooperation at this critical dolphin habitat, conservation activities are severely impeded. Project results emphasised the urgent need for transboundary cooperation with conservation activities, as well as additional support for community-based conservation from local governments and the tourism sector, if dolphins are to survive in the Mekong River.

### **CONSERVATION LEASING AND OWNERSHIP OF MARINE RIGHTS: LEASING KELP BEDS TO EXAMINE THE NURSERY ROLE OF *MACROCYSTIS* CANOPY**

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It has been assumed that strategies for marine conservation must be substantially different than those for terrestrial conservation, in part because it is not possible to "buy the bottom" of the publicly owned oceans. This is an unfortunate misconception. There are significant submerged lands available for lease and ownership in the USA. The Nature Conservancy is exploring the leasing and ownership of submerged lands as a tool for marine conservation for a diverse array of ecosystems. To examine some of the benefits, considerations and strategies of this tool in California, the Nature Conservancy has received approval to lease over 1700 acres of kelp forests within the Monterey Bay National Marine Sanctuary. These beds will be monitored over 3 years to assess the biodiversity supported by the kelp canopy, and the potential impacts of canopy removal on diversity. After the initial sampling season, surveys have demonstrated a significant decrease in the numbers of settled and newly settling juvenile rockfish and invertebrates after experimental kelp canopy removal in comparison to areas of intact kelp canopy. It is our hope that the study of kelp beds as nurseries for juvenile rockfish and invertebrates may illuminate some of the key factors that control the diversity of these nearshore species and suggest best management practices.

### **THE DOMINANCE OF EXOTIC TREE SPECIES IN THE URBAN ENVIRONMENT OF RIO DE JANEIRO, BRAZIL, AND THE NEED OF A NEW GARDENING MODEL**

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Exotic invasive species presently constitutes one of the main problems for conservation. In the present study we evaluated the use of native and exotic tree species at the urban area of Rio de Janeiro City, Brazil and related the density of tree species in each district to their economical index. We also estimated the tree deficit according to the pattern expected if the original gardening plan of the city was followed properly. We sampled a total of 1701 streets of the city recording at each street the tree species and the number of exotic and native tree individuals along 300 m of extent of the street. We found a total of 20 native species and 40 exotic species. Exotic species dominated urban landscape in all districts. The larger districts which had people with higher economical resources were also those having a higher density of trees ( $F_{2,97} = 32.124$ ,  $P < 0.001$ ). Of the 1701 streets sampled, 66% had any tree planted. The total tree deficit estimated for the municipality was of 869,260 trees. A new model of gardening urbanization at Rio de Janeiro City is urgently needed changing in a long term the nowadays model for a model dominated by native species.

### **LINKING MULTIVARIATE HABITAT MODELING INTO ARCGIS WITH THE ARCRSTATS TOOLBOX**

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Predicting habitat for conservation and management requires sophisticated geospatial and statistical analysis. Translation of data formats and coordination of processes between GIS and statistics packages represents a significant hurdle to modern conservation analysis. We developed the open-source ArcRStats toolbox to overcome this obstacle. A Python scripting framework facilitates communication between ESRI ArcGIS and the R statistics package. The currently available multivariate habitat modeling techniques include generalized linear model (GLM), generalized additive model (GAM), and classification and regression tree (CART). Addition of other multivariate techniques are anticipated soon. The ArcRStats toolbox provides a suite of these methods that can be effortlessly linked to required environmental and species input data within the Model Builder visual designer. Prediction habitat maps, diagnostic statistical plots, and summary tables are automatically generated. Examples from terrestrial and marine ecosystems will be demonstrated. The toolbox is freely available (<http://www.env.duke.edu/geospatial>) and customizable, providing a flexible and robust tool for conservation modeling.

### **IS TAXONOMIC DIVERSITY IMPORTANT FOR THE PERFORMANCE OF SPECIES INDICATOR GROUPS FOR IDENTIFICATION OF AREAS FOR SPECIES CONSERVATION?**

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There is an urgent practical need for easily measurable biodiversity indicators that can guide the identification of areas important for species conservation. In this study we used data on the Danish distribution of 950 species of insects, vertebrates, and plants to test whether taxonomic diversity in species groups influence their effectiveness in representing biodiversity. We selected species indicator groups for which we systematically changed the taxonomic diversity in terms of the number of different genera, families, and orders, respectively. We evaluated the performance as the representation of species in the target groups that were independent in species composition of the indicator groups. We measured both the number and the taxonomic diversity (measured as number of genera, families, and orders) of the covered target species. Surprisingly, we found that changing the taxonomic diversity of indicator groups (both at the genus-, family-, and order-level) had no or only slight influence on the effectiveness in representing biodiversity compared to randomly chosen species groups.

### **IMPROVING THE PERFORMANCE OF INDICATOR GROUPS FOR THE IDENTIFICATION OF IMPORTANT AREAS FOR CONSERVATION OF SPECIES**

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Biodiversity indicators are needed to guide conservation planning. However, it is still unclear to what extent indicator groups, as sets of species, can guide the identification of area networks for species representation. Here, using distributional data on sub-Saharan birds and mammals, we aim to identify factors influencing the effectiveness of indicator groups. We selected sets of species, indicator groups, with systematic changes in species composition in terms of (1) the number of threatened, endemic, rare, common, and large species, respectively; and (2) the number of different genera and families. We tested the performance of indicator groups in representing the target groups which, in terms of species composition, are independent of the indicator groups. We find that even randomly selected sets of species perform much better than randomly chosen area networks, and, surprisingly, that changing the species composition of indicator groups only to a smaller extent can improve the performance further.

**PROPOSAL OF A BIOLOGICAL CORRIDOR BETWEEN TWO PROTECTED AREAS IN ECUADOR USING THE LEAST COST PATH ANALYSIS FOR THE ANDEAN BEAR**

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Actually the national protected areas of Ecuador constitute a series of natural patches surrounded by zones with human alteration. Although there is a good 20% of the terrestrial area covered by this protection, it's still not enough for species with wide habitat range areas like Andean bear. That's why we decide to establish of an ecological corridor between two protected areas: Antisana Ecological Reserve and Llanganates National Park, which are separated by 20 kilometers of paramos and montane forests, mainly in private lands. To establish the corridor, we research the conservation status of the natural areas and the land tenure and make a least cost path analysis for the Andean bear in the western portion of Condor Biorreserve. With all this information we define the limits of the proposed corridor and the different zones of the corridor like core area, buffer zone and intensive use area. The least cost path analysis for Andean bear movement was used to confirm the core areas. For the analysis (1:250,000) we used as variables the soil use and vegetation cover, slope, and variety of vegetation. The obtained routes of greater probability for the Andean bear greatly coincide with determined core areas.

**UNDERSTANDING THE RELATIONSHIP BETWEEN TRAIL SYSTEMS AND FOREST USE IN THE KAKAMEGA FOREST, KENYA**

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The Kakamega Forest is the only lowland rainforest in Kenya and is recognized as one of the most important reserves for biodiversity in East Africa. It has one of the world's highest population densities, and agricultural development has resulted in forest islands embedded in landscapes with various types of human activity (e.g. tea plantations, family farms). Trails provide community members with increased access to previously unused areas. The goal of our research was to explore variables that influenced trail patterns into the forest, and to understand if trails influence human use of forest resources. We examined 50 kilometers of forest perimeter, and located 468 trails using GPS. We found that trails range in size from 0.5–6 m in width and are most often found next to family farms (36.1%). We randomly subsampled 44 of the trails for human forest use, and found that use was highest in the eastern half of the study area where most maize for the region is grown. Our research indicates that trails may be a corollary of the type of land adjacent to them. This study will provide knowledge for local educators and managers concerning human-ecosystem dynamics that could allow for more sustainable forest use.

**ECOSYSTEM-BASED MANAGEMENT AT NESTED SPATIAL SCALES IN NORTH CAROLINA AND THE UNITED STATES SOUTH ATLANTIC REGION**

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We present three emerging place-based, science-based management structures for marine and estuarine ecosystems in North Carolina and the U.S. South Atlantic region and discuss the benefits of complementary policies at diverse ecological scales. (1) The South Atlantic Fishery Management Councils Fishery Ecosystem Plan (FEP) and Comprehensive Ecosystem Amendment amends all federal fishery management plans in the region to better protect essential habitats, characterize removals and fishing behavior and effort, and maintain stocks of prey species. The process includes the development of an Ecopath with Ecosim food web model for the regional marine ecosystem. (2) North Carolina's Coastal Habitat Protection Plan emphasizes protection of fish habitats in addition to traditional harvest controls and integrates the work of three previously separate environmental rule-making commissions. (3) The Albemarle-Pamlico National Estuarine Program is developing ecosystem health indicators for the Albemarle Sound estuary and surrounding watersheds. A related planning effort at Environmental Defense is designed to suggest targets for reserves and biological corridors, habitat restoration, fish harvest, and agricultural practices in the Albemarle region while considering likely effects of global climate change on shorelines. We highlight cooperation and partnerships as key to the development of ecosystem-based management at all scales in this region.

**PERSUADING THE PUNTERS: TRAINING BOATMEN AND THE CONSERVATION OF THE AXOLOTL (*AMBYSTOMA MEXICANUM*) AND ITS REMAINING HABITAT, LAKE XOCHIMILCO, MEXICO CITY**

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The remaining wild population of the Mexican axolotl (*Ambystoma mexicanum*), an endangered amphibian, lives in a remnant

habitat, the canals and small lakes of Xochimilco in the southern part of Mexico City. Here it is under considerable pressure from illegal development, pollution, competition and predation by introduced Asian carp and African tilapia, and possibly from collection for food, medicine, and the live animal trade. As part of a multidisciplinary project seeking to conserve this axolotl and its habitat by promoting it as a flagship species, developing nature-oriented tourism, and undertaking conservation education within the local community, a study was made of the local pleasure boatmen (remeros) and the market for nature-guiding. Three guide training workshops were subsequently developed, offered to the remeros, and run. This paper reports on the research, design, and implementation of these workshops and their effects on the attitudes and livelihoods of the remeros. It argues that the approach employed is helping develop a conservation ethic amongst this key stakeholder group as well as precipitating a significant economic incentive for the sustainable use and conservation of the Xochimilco wetland system.

### **HOW DO WE KNOW IF RESTORATION IS WORKING? EVALUATING HABITAT QUALITY FOR AN ENDANGERED BUTTERFLY**

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The Endangered Species Act is under attack, in part due to the absence of clear progress. Similarly, conservation organizations face pressure to answer the fundamental question, "Are our conservation strategies working?" In response to precariously low population numbers of the federally endangered Karner Blue butterfly (*Lycaeides melissa samuelis*) in east-central New York State, USA, aggressive, collaborative habitat restoration efforts were launched. We report on a project that uses The Nature Conservancy's Measures of Conservation Success framework to determine the effectiveness of these efforts. Habitat restoration criteria, based on state and federal recovery plan objectives, were developed to explicitly link habitat restoration goals with the long-term viability of the species. This effort supplements direct population surveys, and evaluates habitat quality based on host plant abundance, nectar diversity, within-patch structural heterogeneity, and patch size and connectivity. These key ecological attributes were measured at 25 habitat patches during 2005 in order to guide restoration in the short-term. Multi-metric analysis suggests adequate size and connectivity for most study patches, but nutrient and structure conditions may need further restoration. Overall, habitat quality scored below ecologically desirable status, but continued restoration is likely to facilitate the butterfly's recovery and long-term viability.

### **WORLDWIDE MASS STRANDING OF SPERM WHALES: LOCATIONS, NUMBERS, COMPOSITION, AND CAUSES**

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The mass stranding of sperm whales (three or more whales) is well documented worldwide because of the size and numbers of these whales. The first recorded mass stranding event (MSE) occurred in 1572 on the coast of the Denmark in the North Sea. We documented 87 MSEs for sperm whales between 1572 and 31 December 2004. The number of animals involved in these MSEs ranged from 3 to 72. Possible explanations for these MSEs include receiving misleading echolocation information, panic in shallow water, and strong social cohesion when a single individual gets stranded. The major regions where MSEs occurred are Tasmania, New Zealand, and the North Sea. These three regions comprise approximately 55% of the total number of mass strandings. During the past 15 years the number of sperm whale MSEs is ca. 30% of the total. Since 1990, anthropogenic events (acoustic disturbances and contaminants) have been suggested for the increase in these MSEs. Possible causes of these MSEs and their recent increase will be discussed, including the above possible reasons along with natural environmental effects.

### **ESTIMATING KARNER BLUE BUTTERFLY POPULATIONS USING DISTANCE SAMPLING**

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Wildlife managers need to accurately assess densities and distribution of animal populations with reliable, cost effective, and accurate methods that are specific to localized habitats. Currently, the monitoring of the endangered Karner blue butterfly (KBB) is not occurring on most sites throughout Michigan, or if done, methods rely on biased walking transect methods that concentrate sampling efforts in areas of highest site quality. An accurate and streamlined method of estimating total number of KBBs in a subpopulation would allow managers to make better decisions involving management actions. Distance sampling was conducted at eleven sites during second brood flight in July 2005. Permanent transects were systematically placed throughout each site every twenty-five meters with the first transect randomly selected. We measured perpendicular distance to all butterflies detected within five meters of transect line. Data were analyzed using Distance Program software using uniform, half-normal, and hazard-rate key functions. Model selection based on minimal AIC. Results indicate that populations vary considerably between sites, ranging from 315 to 1881 individuals.

### **REBIOMA: A WCS INITIATIVE IN MADAGASCAR FOR CONSERVATION PLANNING**

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The current Madagascar Protected Area Network comprises five Strict National Reserves, eighteen National Parks, and twenty-three Special Reserves, covering 1,700,000 ha in total. During the last Parks Congress in Durban, South Africa, in September 2003, the President of the Republic of Madagascar pledged to bring the total area protected to 6,000,000 ha until 2008. The challenge is to best choose the new protected areas in a country where almost each hectare hosts such high endemism. However, our ability to track information needed to use for conservation planning purposes to design these new reserve still lags far behind the collection of the data itself. REBIOMA, a WCS initiative in Madagascar since 2000 related to gathering available biodiversity data to help decision-making on biodiversity conservation, becomes a key part of the process. Since then,

biodiversity data and associated layers of geographic features, socio-economic information, and analytical tools for conservation planning from REBIOMA lead the process to identify priority areas for conservation to let the Malagasy Government decide more easily the first 1 million hectare in 2005 and the rest of potential areas outside current protected areas for biodiversity conservation in Madagascar.

**CONSERVATION STATUS OF THE ARARIPE MANAKIN (*ANTILOPHIA BOKERMANNI*), A CRITICALLY ENDANGERED BIRD FROM NORTHEASTERN BRAZIL, 10 YEARS AFTER ITS DISCOVERY**

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Almost ten years after the discovery of the Araripe Manakin, we present a reevaluation of its conservation status, including population estimates, increased range, genetic data related to variability, habitat evaluation, ecology, reproductive biology and major threats in order to support a Conservation Plan for the species. The Araripe Manakin is a Critically Endangered bird endemic to the moist forests in the slopes of the Araripe Chapada (plateau), in Ceara State, northeastern Brazil. Four years of systematic research and fieldwork have doubled the previous population estimates of less than 250 individuals, and increased the known range from 1 km<sup>2</sup> to 20 km<sup>2</sup>. Genetic analyses of the mitochondrial genes of 46 individuals have shown a low variability in a non fragmented population. Nests were found and monitored for the first time, always above running water, mainly in plants present in the Manakin's diet, and nidification showed a strong synchrony with the rains regime. The reproductive cycle has shown a typical piprid pattern, and incubation period was 22 days. Major threats to the Manakin's habitat are related to moist forest suppression and degradation, and water resource channeling and pollution. A Conservation Plan is being produced with local stakeholders and environmental authorities.

**MULTITEMPORAL LAND USE CHANGE STUDY: A DECISION MAKING TOOL AT SOUTH OF THE CONDOR BIORESERVE, ECUADOR**

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Multitemporal land use change studies are key tools in the process of decision making for land use management for conservation. These studies provide critical information for different applications such as the definition of protected areas and buffer zones, resources allocation, and strategies development. A multitemporal land use research was conducted at Condor Biorreserve, a conservation area of montane forest in Ecuador. This study analyzes the process of land use dynamic that has occurred in the region between 1991 and 2004. A 0.85% of land change (natural vegetation loss) has occurred in this period. This means 35.79 km<sup>2</sup> per year at the whole area. The antropoc areas grow at 8.64% which represents around 16.89 km<sup>2</sup> per year. The more affected areas are those with greater accessibility. The low evergreen montane forest showed the highest chance at the area. This information is being used to prioritize conservation actions in Llanganates National Park. For example, decisions were taken about the most critical areas for implementing control and working with local communities. The information would be used to negotiate with infrastructure project to decrease their impact in the area.

**INSTITUTIONALIZATION OF BAT COUNT PHILIPPINES: TOWARDS A SUSTAINABLE CONSERVATION PROGRAM OF ENDANGERED FLYING FOXES**

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In the Philippines, where < 10% forest cover is left and only a few of these sites are declared as Protected Areas, many of our wildlife species depend on formal protection to escape extinction. So far, the Protected Areas and Wildlife Bureau of the national Department of Environment and Natural Resources is uniquely mandated to manage wildlife and Protected Areas in cooperation with non-government organizations, academia, and people's organizations. To promote the conservation of declining flying-fox populations, our project has initiated a national awareness campaign, capacity building of local communities, and updated the status of the populations and distribution of these endangered species. While flying-fox conservation is growing in the Philippines, this project's sustainability is highly dependent on good representation and partnership with the Bureau. We have recently established a collaborative relationship and are gaining local support from the regional directors of the DENR down to the neighborhood level of each municipality. Linkages with other agencies in the government have become strengthened and many of our project's strategic goals are being met. The number of wildlife sanctuaries and local supporters of flying-fox protection in the Philippines is now anticipated to grow and sustain the conservation efforts started by the project.

***DENDROPHTHORA BERMEJAE*: ABUNDANCE, DISTRIBUTION, HOST AVAILABILITY, THREATS, AND HOPES FOR AN ENDANGERED MISTLETOE**

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*Dendrophthora bermejae* is a newly described endemic plant for Puerto Rico. It is the only endemic Puerto Rican mistletoe in the family Viscaceae and it is confined to a few localities in the southwest, where it is extremely rare. We conducted the first population survey to estimate the abundance and distribution of this species. We also studied the infection pattern and demography of its only known host tree, *Guaicum officinalis*, which is an endangered tree of the Caribbean region. We examined 389 *G. officinalis* trees and found 228 *D. bermejae* plants growing on only 30 trees. *Dendrophthora bermejae* was detected only in trees with trunks that were larger than 8 cm in diameter. Except for one individual, all *D. bermejae* plants were found in unprotected private lands under urban development and agriculture. Furthermore, the areas with more mistletoes had a low abundance of saplings and young trees of host trees, suggesting a demographically old population. We

suggest that *D. bermejæ* is highly endangered and rapid actions must be taken for its protection. Actions should include the legal protection of the species, and education programs and partnerships with local landowners aimed at protecting both *G. officinalis* and *D. bermejæ* in situ.

### **STREAM RESTORATION FOR COHO SALMON (*ONCORHYNCHUS KISUTCH*) IN THE LITTLE CAMPBELL RIVER, BRITISH COLUMBIA, CANADA**

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Coho salmon (*Oncorhynchus kisutch*) populations along the northwest Pacific Coast are in serious decline due largely to habitat destruction in their natal freshwater streams. Adult coho spawn in small streams after returning from two years in the ocean. Following springtime emergence from the gravel, juvenile coho spend a crucial year in their streams before migrating to the ocean. A Rocha Canada ([www.arocha.org](http://www.arocha.org)) has initiated three restoration projects in the Little Campbell River near Vancouver, Canada, via grants from the Pacific Salmon Foundation. Juvenile coho stream habitats have been restored through the work of numerous volunteers and staff. Invasive plants and accumulated sediments have been removed from tributaries and native vegetation has been planted. River gravels have been placed to encourage future spawning and better invertebrate production. Projects are being monitored for increased coho use and for the growth of native and invasive vegetation. These restoration projects engage citizens of the watershed through volunteer opportunities and ecological education; tours of A Rocha Field Study Centre, where one stream project is located; and our native plant nursery, scheduled to expand for more enhancement projects. These small stream enhancements through local community involvement provide an excellent process for renewing watersheds of the world.

### **ECOLOGY AND CONSERVATION OF THE MANED SLOTH (*BRADYPUS TORQUATUS*) IN THE COCOA REGION OF SOUTHERN BAHIA, BRAZIL**

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*Bradypus torquatus* is an endangered species, endemic to a restricted area of the rainforest of eastern Brazil. Southern Bahia harbors some of the largest forest fragments where the maned sloth is found. These fragments are often connected by cabruças (cocoa plantations shaded by native trees). Ecological research on the maned sloth started in southern Bahia in January 2003. Seven animals have been monitored with radio-telemetry in primary forest and secondary habitats, such as logged forests and cabruças. The results have showed a small home range (3–5 ha), especially for sloths that use secondary habitats; predominance of nocturnal activities when compared with previously studies developed in areas of higher elevation; and permitted the identification of 13 different dietary items used by the species. A puppet show on the maned sloth has been used to disseminate information on this research, current threats, and conservation issues related to the local fauna to the nearby rural schools.

### **SURVIVAL RATES FOR ELASMOBRANCHES CAPTURED BY A MULTISPECIES TRAWL FISHERY OFF ARGENTINA**

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Overexploitation of elasmobranches is matter of concern around the world. Waters off Buenos Aires Province (BAP), Argentina, are subject to a multispecies bottom trawl fishery. At Puerto Quequan (BAP), elasmobranches are the main group of fishes landed. Return of selasmobranches to the sea by the trawl vessels has been proposed as a mitigation action, but survival of elasmobranches after being discarded was not investigated. The aim of this study is investigate the survival rate of elasmobranches captured by the trawl fishery. The research was conducted onboard the trawler Punta Mogotes during austral winter and spring 2005. A total of 87 elasmobranches were randomly sampled from the deck and put into a bin that contained running seawater. An stamina index was assigned according three categories (a) alive, (b) immobile but reacting to irritation, and (c) dead, body stiffened but may resume breathing after being placed in seawater. Twelve species were sampled and the survival rate of most of them is quite important. Despite this its continued survival is not guaranteed after they are discarded because they may be consumed or mortally injured by bottom scavengers during the recovery time, which appears to be about 15–120 min.

### **CONSERVATION IMPLICATIONS OF THE GENETIC, MORPHOLOGICAL, AND PHYLOGENETIC VARIATION OF THE BLUNT-NOSED LEOPARD LIZARD (*GAMBELIA SILA*)**

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The blunt-nosed leopard lizard (*Gambelia sila*) is an endangered lizard restricted to central California. In this study, we assess genetic variation and phylogenetic structure, using cytochrome b sequence data, for populations of *G. sila* in order inform conservation efforts. Levels of genetic diversity vary among sites, but all populations have low variation when compared to that found in other studies of reptiles using cytochrome b. Populations with low genetic variation have little morphological variation, and may be constrained in their adaptive potential to environmental change. Phylogenetic analyses lend good support to the existence of three clades that correspond to the northern, southern, and central portions of the species range. We recommend that these three clades / geographic areas be considered management units for the species. After studying the morphology and mtDNA of possible hybrid populations, we recommend that these populations be covered under the Endangered Species Act. Our results will help in conservation planning for *G. sila* and will contribute to a better understanding of the perils that face endangered and threatened reptiles.

### **CONSERVATION OF NINE SPECIES OF THREATENED BIRDS IN THE COLOMBIAN EAST ANDES**

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Eastern Colombian Andes holds one of the most threatened ecosystems of the world, and is considered one of the most fragmented, degraded, and less known ecosystems in Colombia. Despite the area has been reported for endemic bird areas, some bird species have not been reported since 1952. We rediscovered endemic and critical risked *Macroagelaius subalaris*, *Amazilia castaneiventris*, and *Thryothorus nicefori* populations and reported new populations of endangered *Hapalopsittaca amazonina* and *Coeligena prunellei* at Soata, Boyaca, Colombia. Peasant private owners have inhabited this zone and protected around 15,000 ha of robledales (*Quercus humboldtii*) since 1940. However, the area is being increasingly threatened by agricultural and livestock-farming systems and continuous urban expansion. At present, we are fostering a community initiative to constitute a private reserve in order to protect these birds and its remaining habitats.

#### **USE OF AUTOECOLOGICAL DATA TO INFORM CONSERVATION AND MANAGEMENT OF MESQUITE AND ACACIA WOODLANDS IN THE MOJAVE DESERT**

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Mesquite and acacia woodlands are highly important to wildlife in the Mojave Desert, but are severely threatened by diverse human activities. In response, the Clark County Multiple Species Habitat Conservation Plan developed a Mesquite–Acacia Conservation Management Strategy, which uses the best available scientific information to protect and manage these woodlands. The strategy has ranked woodlands for conservation purposes based on their biological value, and has identified conservation actions for high priority woodlands. However, planning was hampered by a lack of data for many species the strategy purports to protect. Comprehensive autoecological data exist for the Phainopepla, a special status bird species dependent on these woodlands. Predictors of habitat (e.g. tree height, density, and food abundance) and landscape (e.g. woodland size, isolation, and elevation) occupancy by Phainopeplas, local population density, and nesting success appear to correlate well with the general requirements of many woodland species, thus were used to rank woodlands and elaborate specific conservation objectives. We discuss pros and cons of this approach to ecological community-level conservation planning, including the use of a focal species that occupies distinct habitats and political jurisdictions at different times of year. We describe the data needed to evaluate the strategy's utility and improve its robustness.

#### **USING MARXAN TO EVALUATE MARINE PROTECTED AREA NETWORK DESIGNS ALONG CALIFORNIA'S CENTRAL COAST**

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Pursuant to California's Marine Life Protection Act of 1999 (MLPA), a governor-appointed task force is evaluating proposals for a state-wide network of marine protected areas, beginning with California's Central Coast. Using data from the MLPA Initiative's California Marine Geodatabase, we identified the depth range and dominant habitat(s) for each square nautical mile of California state waters between Point Conception and Pigeon Point. We then used the simulated annealing tool MARXAN to (1) identify areas of high habitat conservation value, (2) identify networks that would conserve 10%, 30%, or 50% of each habitat while minimizing network area, negative socio-economic impacts, or a combination of those "costs," and (3) evaluate the extent to which the four proposed MPA networks meet conservation targets. Model output maps allowed us to identify specific areas that, if added to certain network proposals, would protect a given habitat (e.g. kelp forest) more evenly across the Central Coast region. While MARXAN analysis is applicable to the Central Coast process only to assist in evaluation, our results suggest that, if used as a network design tool, MARXAN may be even more beneficial earlier in the design process when the protected area network is expanded to California's northern and southern coasts.

#### **THE CONSERVATION OF THE SYRIAN SERIN *SERINUS SYRIACUS* IN LEBANON**

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*Serinus syriacus* is a vulnerable (IUCN RedList) bird species that has a restricted Western Palearctic distribution. Relevant investigation and information on the species' breeding biology and migration patterns in Lebanon are very limited to nonexistent. Within the framework of research for conservation, the project aimed at monitoring the species' migration pattern and studying its foraging sites and threats in the Al Shouf Nature Reserve in Lebanon, functioning as a baseline study. Starting March 2005, a primary screening of the reserve was conducted to identify foraging sites where regular monitoring and ringing activities were executed in collaboration with the local community. The project succeeded in identifying the species' foraging sites and migratory behavior as well as describing a previously undocumented breeding colony in proximity to the reserve. Empowerment of local communities through information sharing and fieldwork involvement ensured a strong foundation for future species conservation plans.

#### **A BAYESIAN APPROACH FOR ESTIMATING DEMOGRAPHIC PARAMETERS FROM A TIME SERIES OF SIZE DISTRIBUTIONS**

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Projection matrices have become popular tools for evaluating the effects of recovery efforts on threatened and endangered species. However, the parameterization of these models generally requires demographic studies of marked individuals, posing challenges for managers who work with species like aquatic invertebrates that are difficult to mark. To address this challenge, we describe a method that infers demographic parameters underlying a time series of field-collected size distributions for an endangered aquatic snail. Our method uses a Bayesian Monte Carlo approach to identify sets of matrix parameters whose projected population dynamics are most likely to produce a pattern of size distributions that are consistent with the observed

time series. When tested on a simulated two-year data set, the method returned estimates that exhibited reasonable accuracy, but poor precision. However, longer data sets were helpful in reducing uncertainty. We believe that with continued development, this method will be a useful tool in the viability analysis of any species for whom counting and measuring is easy, but directly measuring demographic rates is difficult.

### **DEMOGRAPHICS OF *DROSERA INTERMEDIA*: COMPARING A RECENTLY RECRUITED POPULATION TO AN OLDER POPULATION WITH A DIFFERENT HABITAT**

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*Drosera intermedia*, a state listed species in northern Ohio, has undergone population reductions due to the loss of habitat. Of the eight known populations only one is a continuously existing population. The remaining populations have been recruited from the seed bank through the planned (1 population) or unplanned (6 populations) removal of topsoil. If further restoration work is to occur, then its habitat preferences will have to be determined. This study compares the demographics of a recently recruited population to an older population. The younger population occurs in very sandy soil with sparse ground cover while the older population occurs in soil containing more organic matter, greater volumetric water content, and greater ground cover. Three counts of both populations were completed in the summer of 2005. Analysis of the preliminary data indicates that the older population has greater spring recruitment (59% vs. 45% of the plants counted were seedlings), and survivorship of young plants (92% vs. 85%) than the younger population. Of the juveniles that survived until the August count 29% in the younger population and 7% in the older population flowered, although very few of the juveniles succeeded in setting seed.

### **ISLAND CONSERVATION PLANNING: MANAGING CHALLENGING PRIORITIES THROUGH INTEGRATIVE GIS-BASED ANALYSES**

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Catalina Island, part of the California Channel Islands in the Pacific coast of the United States, faces multiple conservation and management challenges related to endangered and endemic species, rare habitats, feral animals, invasive plant species, a growing tourism demand and a complex infrastructure and road system. Deciding what areas of the Island require immediate intervention is of critical importance in order to effectively apply scarce resources and address emerging issues and problems. An integrative Critical Watersheds Database was created from an extensive amount of research-based information on rare and endemic plants and wildlife, invasive plant species, vegetation communities, and non-native animal species, which included distribution and densities for most species. Watersheds were assessed according to several criteria in order to obtain a Ranked Watersheds Map. Data sets, such as roads, management units, fire history, fuel loads and risk, recreational pressure, cultural sites, and other factors were overlaid on this map to assess threats to the ecological communities in these watersheds. This poster highlights the resulting maps and explores how they are being used as a major decision-making tool for developing intervention strategies, defining priorities, and informing management decisions.

### **USING GIS TO IDENTIFY POTENTIAL CORRIDORS UTILIZED BY NORTH AMERICAN BADGERS IN THE SAN FRANCISCO BAY AREA AND MONTEREY COUNTY**

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A small population of North American badgers (*Taxidea taxus*) lives in fragmented habitats within the San Francisco Bay area and Monterey County in northern California. Due to increasing fragmentation of badger habitats it is important to identify potential corridors that badgers may utilize to facilitate movement between the habitat patches. Using GIS, I created a habitat suitability model for badgers consisting of soil, vegetation, and slope layers. I then added road layers and urbanized areas to create cost surface layers. A Least-Cost Corridor analysis was performed on the cost surface layers to identify potential corridors within the region. Road kill data was then compared with the delineated corridors to test the model and identify the primary areas currently utilized by badgers for implementing future corridor plans. As an example of how this study model could be used, five badgers have been killed by vehicles along Reservation Road in Monterey County, which runs through existing badger habitat. Comparison with the corridor model shows this is one of the primary areas to implement a future corridor to allow for badger movement among the fragmented habitats.

### **CONSERVATION BEYOND BOUNDARIES: HIGH NOON FOR NEW ZEALAND'S RANGELANDS?**

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New Zealand's rangelands occupy 2.6 million ha of government-owned leasehold land (10% of the land area), extensively farmed by some 300 "runholders." The native biodiversity existed without land mammals until two were introduced by Polynesians about 1200 AD, and a wide range by Europeans from the 1840s. Mammalian grazing then began and, in combination with frequent burning, competing herbivory from feral animals, and weeds, the rangelands were transformed. Today, low-mid elevation areas, though often botanically highly modified, retain considerable native invertebrate diversity. A current process of government-sponsored tenure review, initiated by individual leasees and facilitated by legislation, allows productive, mostly lower elevation lands to be privatized. Land use then changes rapidly from extensive pastoralism to more intensive activities. Higher elevation areas usually revert to conservation management but issues such as elevational connectivity are only being addressed through some whole property government purchases. This paper analyses the current situation where the process lacks a national overview and where the land tenure changes, while providing some stakeholder benefits, are leading to fragmentation of conservation lands, a dearth of low-mid elevation protection, and increasing concern from both farming and conservation sectors for associated social changes, biodiversity loss, landscape transformation, access alienation, and off-property ownership.

**ECONOMIC GROWTH, BIODIVERSITY CONSERVATION, AND SCB**

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Growing numbers of biologists and economists are recognizing a fundamental conflict between economic growth and biodiversity conservation. We provide cursory coverage of the theoretical and empirical basis for this conflict. We also summarize some of the policy considerations available to address economic growth and develop an economy that operates sustainably within the limits of nature. As a key first step toward gaining a foothold in the policy arena, we emphasize the need for professional organizations, like SCB, to adopt a strong position in favor of transitioning from a growth economy to a steady-state economy.

**EVALUATING EFFECTS OF HABITAT LOSS, HUNTING, AND EL NIÑO EVENTS ON A THREATENED SPECIES**

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Much effort has been made to understand effects of direct human disturbance on declining wildlife populations, yet confounding effects of global climate cycles such as El Niño Southern Oscillations are rarely considered. We performed a demographic study of *Propithecus edwardsi*, a lemur inhabiting the eastern rainforest of Madagascar, to evaluate the impact of habitat loss, hunting, and changing global cycles on its population and to re-evaluate present endangerment categorization under the IUCN. Over 18 years of demographic data were used to parameterize a stochastic stage-structured population model. Results suggest that hunting, habitat loss, and climate change are all significant threats to the population, but that habitat loss is the most urgent problem. El Niño events resulted in temporarily reduced fecundity which may contribute to their present decline, but overall were much less important for determining population growth than hunting or habitat loss. The chance of 50 percent population decline within three generations was high for several scenarios, suggesting that current IUCN classification is justified. Our study suggests that to slow the decline of this species, it is critical to both create more protected areas and to control hunting pressures. Management strategies should focus on protecting and maintaining adult breeders.

**DISPERSAL OF KARNER BLUE BUTTERFLIES AMONG LUPINE PATCHES WITHIN A COMPLEX FORESTED ECOSYSTEM**

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Karner blue butterfly (KBB) is an endangered species that occurs as subpopulations within patches of blue lupine that are dispersed throughout a matrix of unsuitable forest habitat. It is assumed that the butterfly behaves as a metapopulation with local extinctions occurring within lupine patches (subpopulations) with subsequent recolonization from adjacent patches by dispersal flights. It is also assumed that dispersal is restricted to flights of less than 200 m and that mature forest acts as a barrier to flight dispersal (USFWS KBB Recovery Plan). However, there is a paucity of data on KBB dispersal. We measured dispersal during both first and second flights within a complex 2 km square landscape. We documented 233 cases of dispersal among patches through a matrix of closed canopy oak with 92% of the flights greater than 200 m. Mean and median dispersal for males was 440 m and 370 m and for females was 518 m and 370 m. Maximum dispersal distance measured was 1.6 km for an individual male, with 17 butterflies dispersing more than 1 km. The assumption that the butterflies cannot disperse farther than 200 m and that forested landscapes act as a barrier to flight is false.

**FLORISTIC SURVEYS AND PLANT BIOGEOGRAPHY ON SMALL ISLANDS IN THE SAN JUAN ARCHIPELAGO, WASHINGTON**

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To develop appropriate priorities and effective strategies for conserving island ecosystems, actions must be founded on a thorough understanding of the status and distribution of biota. Despite over a century of surveys, there still remain large gaps in our knowledge of the plants across the 172 islands that comprise the San Juans. The flora of many islands has never been surveyed despite their proximity to known occurrences of state and federally-listed rare species. In 2005, we initiated botanical forays that focused on collecting specimens of all vascular plants, mosses, and lichens on many of the smaller islands. To date, we have surveyed 27 islands from 0.02–14 ha in area, and have completed identifications of all vascular plants and many of the nonvascular and lichen taxa. We have identified 19 new occurrences for several state-listed taxa, and a new occurrence of an undescribed *Castilleja* subspecies. Overall, 72% of the collected vascular plants were native, ranging from 44–100% on the different islands. Future work will expand surveys to include additional islands. We also will examine the distributional patterns of rare and common native species, introduced species, mosses, and lichens, and interpret these patterns in terms of their biogeographical and conservation implications.

**THE ROLE OF LOCAL COMMUNITIES IN CONSERVATION OF THREATENED BIRD SPECIES IN THE CASPIAN REGION**

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The analysis of probable causes of the decline of rare bird species in Caspian region indicated that they are related to the impact of global natural or anthropogenic factors (climate changes, habitat transformation). Removal of such factors is either impossible or requires much resources. But for those small populations of threatened species that survived under such changes or adapted to global adverse agents, local factors become more influential. These factors are related to direct or indirect impacts of the activities of local communities (e.g. hunting or disturbance). Therefore, optimization of the relations of local land

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users (of any age or social group) with rare species is the key in conservation. The fate of threatened bird species in studied region depends on the attitude of local people to birds and on willingness to regulate or modify steady land use practice. Specific tools for stimulating such activities in local communities are mass education actions including training in conservation techniques. The most appropriate grounds for such undertakings are Important Bird Areas (IBAs) at which small populations of threatened species survived. Just for IBAs we have shown the experience of the relevant succession of conservation activities from monitoring to introducing renewed management practice.

### **RISK ASSESSMENT OF ZOO POPULATIONS: A NEW PARADIGM**

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Small, captive populations experience threats to population viability similar to wild populations: demographic, genetic, and environmental factors interact with current size and structure to impact future population sizes. Through collaborative and coordinated programs, managers strive to develop self-sustaining, genetically diverse populations, to adapt management decisions enhancing population viability, and to identify those populations with high risk of extinction. We developed a new paradigm for assessing future risks: ZooRisk, a computer program, assists managers in making scientifically-based decisions for captive populations. The model projects population changes and provides quantitative assessments based on a population's past history, the biology of small populations, and management strategies for captive populations. In the past, the common measure of viability for programs was the population's gene diversity relative to 90% at 100 years. ZooRisk categorizes viability using five quantified demographic, genetic, and management criteria and assigns a risk score for each population, giving managers a more comprehensive assessment of extinction risk. Because these tests are standardized, the metric can be used for comparisons between populations. Sample risk assessments are presented for sunbitterns (*Eurypyga helias*) and pygmy hippopotamus (*Hexaprotodon liberiensis*), which have different structures and dynamics resulting in different risk categories.

### **NESTLING PROVISIONING RATES AND POTENTIAL AFFECTS ON THE ENDANGERED CALIFORNIA LEAST TERN AT ALAMEDA POINT, SAN FRANCISCO BAY, CALIFORNIA**

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The California Least Tern (*Sterna antillarum browni*) colony at Alameda Point, San Francisco Bay, California, has grown in this highly urbanized estuarine environment since the mid-1970s. There has been a concurrent decline in reproductive success since the mid-1990s. We investigated the possibility that changes in nestling provisioning rates were contributing to the decline in breeding success. We examined interannual and diurnal differences in nestling feeding frequencies from 2003–2005. Daily feeding frequencies to chicks differed significantly among years, with 2003 having a significantly higher average feeding frequency than 2004 or 2005. However, we did not find significant differences after controlling for differences in chick developmental stages among years. We found diurnal patterns in feeding rates, with higher feeding frequencies in the morning and evening hours compared to the afternoon hours. While feeding frequencies remained similar among years, there may have been changes in prey quality or distribution that have negatively impacted breeding success. The diurnal patterns in feeding frequency likely reflect the vertical migration patterns of prey species. Changes in composition and distribution of fish in the Bay may have impacts on the recovery of this endangered, piscivorous bird.

### **CLOSING THE LOOP: MEASURING THE STATUS OF EFFECTIVE CONSERVATION OF BIODIVERSITY WITHIN ECOREGIONS AS AN ADAPTIVE MANAGEMENT STRATEGY**

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Conservation planning processes, particularly at a large scale, such as an ecoregion, often neglect to close the adaptive management loop by incorporating measures and monitoring into subsequent planning iterations. As a result, ecoregional plans are often static blueprints that quickly become outdated in a dynamically changing landscape. This presentation will discuss the ecoregional indicators of biodiversity, threat, and conservation management status that The Nature Conservancy uses to measure the status of effective conservation. Examples from the eastern United States, the Rocky Mountains, and South America will highlight how ecoregional status measures and indicators can be used to quickly update ecoregional plans, identify urgent conservation priorities, catalyze conservation action, reallocate resources, and measure progress toward organizational milestones. The financial investment of periodically tracking data to populate these measures can be high, but the benefits of closing the loop in adaptive ecoregional planning—more responsive decision making with higher levels of confidence and organizational accountability—are worth it.

### **THE ALLURE AND THE REALITY OF BOTTOM-UP ECOSYSTEM APPROACHES TO COASTAL RESOURCE MANAGEMENT**

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The idea of a bottom-up ecosystem approach to coastal resource management is appealing due to the consideration of ecosystem structure, function, and processes, the consideration of multiple resources and human uses, and the involvement of stakeholders through collaborative decision-making. A novel experiment in combining these ideals is currently underway in Washington's San Juan Islands, where a multi-stakeholder citizen group that is advisory to county government has partnered with The Nature Conservancy to develop a science-based management plan for the marine waters of the county using an ecosystem approach. Although the prospects appear promising, the San Juan example illustrates some of the inherent difficulties in such an approach, including (1) The costs of acquiring adequate scientific information on the condition of various ecosystem components and processes (should it exist) and appropriately interpreting it for management planning may be greater than most community groups can bear. (2) For marine resource management, the community of stakeholders that should be involved extends beyond local residents to include both visitors to this popular recreational area and the broader

public who are the true owners of these public trust resources. Developing a scientifically-sound management plan requires strategies to meet the greater transaction costs of adopting an ecosystem approach, which may ultimately be more than a bottom-up effort can bear.

**CONSERVATION ON THE ENDEMIC OWLS AT LIANHUASHAN IN GANSU, CHINA**

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The conifer forest along the Qinghai-Tibet Plateau is an important endemic bird area in China with rich biodiversity. However, due to a long period of forest logging, especially selective logging of large trees, endemic owls (the Sichuan Wood Owl, *Strix davidi*, and the Boreal Owl, *Aegolius funereus beickianus*) might not find enough large nesting trees for breeding. During 2002–2004, 120 nest boxes were hung up in the conifer trees at the height around 4–6 meters in the Lianhuashan Mountains to help the endemic owls. The Boreal Owl started to breed in the nest boxes in 2003, 17 owls bred in our nest boxes during 2003 to 2005, with the breeding success rate averaged 68.2% ( $n = 7$  nests, 22 eggs). The Sichuan Wood Owl is a vulnerable species, our playback line transect census showed that it was in a very low density of about 2–3 pairs in an area of 10 km<sup>2</sup>. The first pair of Sichuan Wood Owl bred in our nest boxes in 2005, with 2 eggs laid. Both young owls were fledged and radiomarked. One young owl died within one month of fledging, the other survived to the winter, and moved 2.0 km from its nest. We believe the nest boxes gave great help to the endemic owls, and as nest boxes become familiar, more owls will breed in our nest boxes.

**INDIVIDUAL-BASED MODELING OF THE TARANGIRE NATIONAL PARK ELEPHANTS: FUTURE PROJECTIONS FOR A RAPIDLY INCREASING POPULATION**

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Recovering elephant populations in many African reserves and increasing human populations in fragmented habitats outside reserves have created new challenges for maintaining viable elephant populations. Tarangire National Park in Tanzania provides a dry-season refuge for an elephant population (as well as populations of other large ungulates), which migrates into the surrounding areas outside of the park during the wet season. The population has been individually monitored for the past 13 years and is expanding rapidly at 6 per year. Rapid growth has occurred through very high survival rates and reproductive parameters that are at the biological minima for the species: mean interbirth interval was 3.26 years (including a 22 month gestation period) and mean age at first birth was 10.2 years. We present an individual-based model of elephant population dynamics that incorporates the impact of environmental variability and density dependence on birth and death rates and is parameterized with data from this individually-monitored population. Based on our model projections the Tarangire population will continue its rapid increase in the near future. We explore the impact of various carrying capacities on the population's dynamics and discuss the challenges of predicting when density-dependent effects may begin for the population.

**COMMUNITY FORESTRY AND COMMUNITY BASED ECOTOURISM: COMBINING TWO CHALLENGING POLICY INSTRUMENTS TO CONSERVE SPINY FORESTS IN SOUTHERN MADAGASCAR**

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Policy instruments to enable community management of forests have come to the forefront in Madagascar in recent years. Having been driven to some degree by the conservation lobby, the emphasis of their implementation has often been on biodiversity conservation to the detriment of the livelihood needs and the economic factors that will determine the success of community management agreements. In Madagascar, ecotourism has often been cited as the means by which revenue can be generated to offset the loss of access to natural resources by local communities who agree to conserve forests, or who live next to formally protected areas. However ecotourism has seldom made a significant enough contribution to the livelihoods of the communities living in and near biodiverse forests. A policy process analysis has been used to determine the drivers of community forestry policy and case studies used to identify the conditions under which ecotourism and community forestry are likely to be effective. A detailed study of the Ifotaka Community Forest demonstrates where the potential exists for certain types of sites to use ecotourism revenue to offset livelihood changes from the management agreement and to implement a community reforestation initiative.

**THE IMPACT OF WHITE-TAILED DEER ON TREE REGENERATION AND PLANT INVASIONS IN AN EASTERN NORTH AMERICAN FOREST FRAGMENT**

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Overabundant white-tailed deer populations (*Odocoileus virginianus*) threaten the integrity of eastern deciduous forests through reducing tree seedling recruitment, changing understory community composition, increasing erosion, and increasing dispersal of invasive species. Because little is known about the extent to which deer enhance exotic species invasions we asked (1) does deer herbivory enhance exotic species' abilities to dominate forest communities, and, if so (2) what is the nature and effect of this interaction between deer and invasive plants on native plant communities? To examine these questions, we employed a split-plot design and manipulated the presence and absence of deer (with deer-proof exclosures) and invasive plants [with manual weeding of invasive plants, primarily garlic mustard (*Alliaria petiolata*) and Japanese honeysuckle (*Lonicera japonica*)] in the Crum Woods of Swarthmore College in southeastern Pennsylvania. We present the initial results on plant growth, tree regeneration, and shifts in community composition this ten-year study. We discuss our success in meeting our goals of raising local awareness of ecological threats in this suburban forest fragment, stimulating management efforts, and giving undergraduates hands-on research experience in conservation biology.

**BIRD POPULATION RESPONSES TO REMOVAL OF FUEL LOADS COMPRISED OF EXOTIC WOODY PLANTS**

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Over the past decade, wild fire events in riparian bosque (forested) areas along the Middle Rio Grande between Elephant Butte and Albuquerque have increased dramatically owing to flood suppression and accumulation of dead wood and exotic tamarisk and Russian olive. This problem culminated in a large wild fire in July 2003 that resulted in the evacuation of hundreds of City of Albuquerque residents and captured the national media's attention. Prior to this event, the Rocky Mountain Research Station, in collaboration with the Middle Rio Grande Conservancy District, City of Albuquerque Open Space, and Bosque del Apache National Wildlife Refuge, designed a study in 1999 to compare effectiveness of three methods of fuel removal for reducing fire risk, preventing reoccurrence of exotics, and restoring native habitats, plants, and animals. A goal of managers is to preserve cottonwoods while reducing or eliminating tamarisk and Russian olive stems, so study sites were selected that had cottonwood overstories and tamarisk and olive understories. Population and nesting responses of breeding bird species were evaluated prior to and following fuel removal treatments. My talk reports on (1) bird population responses of selected species three years prior to, and immediately exotic plant removal at 9 study sites and 3 control sites, and (2) nesting guild response to mechanical removal of exotics.

**MARINE PROTECTED AREAS ALONG THE PACIFIC COAST OF THE UNITED STATES: TOWARDS A REGIONAL CONSERVATION APPROACH**

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As the Pacific coast of the United States continues to be at the forefront of innovative, science-based, and stakeholder-informed MPA planning and implementation at the federal and state levels, it is becoming increasingly important to fully understand the scope of existing marine protected areas across the region. An initial analysis of the MPA Center's inventory of U.S. Marine Managed Areas is able to show the first comprehensive picture of Pacific Coast MMAs, including summaries of types of allowable use, level of governance, conservation purpose, and scale of protection. This first-time illustration of that suite of areas will enable managers across the region to take the bigger picture into consideration as they adaptively manage sites. The NOAA National MPA Center is initiating a West Coast Pilot of the National System of MPAs that will involve developing, testing, and applying the scientific information and analytical tools to more effectively use MPAs as a tool for maintaining healthy, sustainable marine ecosystems as well as promote regional coordination among managing entities. An overview of the protected areas along the Pacific Coast will be presented and the Center's efforts to facilitate a regional approach to marine conservation for the Pacific Coast will be discussed.

**SCIENCE IN THE EVERGLADES: THE INTERFACE OF SCIENTISTS AND MANAGERS**

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Large-scale ecosystems play a critical role in sustaining ecological integrity and stability, and in retaining important ecosystem services. The Florida Everglades is a valuable biological and ecological national treasure that has been severely degraded from flow alteration and development. The Comprehensive Everglades Restoration Plan (CERP), passed in 2000, is a joint federal, state, tribal, and local project that aims to improve water quality and quantity and ecological functions while continuing to provide water supply and flood control. Implementation of CERP's restoration has been slower than planned; many factors have been suggested as contributing to implementation problems. This research uses qualitative and quantitative analyses to address barriers that have prevented effective science communication and CERP implementation. Data were gathered through semi-structured interviews with upper-level scientists and managers involved with CERP. Barriers identified include the involvement of multiple stakeholders with conflicting agendas, historical mistrust among participants, and poor interpersonal relations among organizations and individuals. Recommendations for CERP and other large-scale ecosystem restoration projects include the designation of a specific and well-defined pathway for scientific communication, co-location of participants working on related activities, and the creation of a diverse restoration task force that is independent of agency affiliation.

**INBREEDING AND GENETIC RESTORATION IN MEXICAN WOLVES**

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Inbreeding in small populations can reduce individual and population fitnesses, making recovery more difficult. To better manage extant genetic diversity among Mexican wolves, three unrelated captive wolf lineages were merged beginning in 1996. Although each lineage had accumulated substantial inbreeding, offspring from crosses between lineages should be free of inbreeding and its adverse phenotypic effects. To evaluate the effects of inbreeding and outbreeding among Mexican wolves, we examined the probability of giving live birth, litter size, and survival of pups to six months of age among captive wolves and recruitment by wild pairs in the reintroduced population. For captive wolves, the effects of inbreeding in the dam and / or pups were apparently weak among wolves from the founding lineages, but paradoxically, were 2 to 6 times stronger among cross-lineage wolves. The three fitness measures, however, were 11 to 81% greater among cross-lineage wolves than among the founding lineages. Among wild wolves, inbreeding in the pups had strong negative effects on pup recruitment, and may largely account for the low reproductive rates observed in this population. We conclude that merging Mexican wolf lineages is resulting in genetic restoration, and that inbreeding depression may be difficult to detect in some populations.

**COMMUNICATING FOR CONSERVATION: PERSPECTIVES ON THE SCIENCE-RELIGION DIALOGUE**

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Recent editorials in *Conservation Biology*, largely initiated by David Orr, have addressed the need to more fully engage religions in the cause of conservation. Much debate has ensued about the degree to which conservation science and religion are conflicting or complimentary, as well as how conservation scientists may best approach religious groups. In light of these discussions, it is time to re-examine the diversity of existing views about the relationship between science, religion, and human knowledge in general. Science and religion began to diverge in the Middle Ages until, in our time, Stephen J. Gould has suggested that science and religion should be considered "nonoverlapping magisteria." However, many people hold alternate views about the relationship between the two, and this is important for scientists to understand as they seek to rally support for conservation. I will use original Venn diagrams and texts from various religions to illustrate these differences as well as to highlight areas of agreement that may benefit conservation. Broadening our understanding of the diversity of views as we re-examine Gould's paradigm can increase the effectiveness of our communication, put old conflicts into context, strengthen areas of convergence, and increase cooperation for the benefit of biodiversity.

**CONSERVATION AND MANAGEMENT NEEDS OF POPULATIONS OF A LONG-LIVED TEMPERATE CORAL UNDER THE EFFECTS OF HARVESTING AND CLIMATE CHANGE**

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The emblematic Mediterranean red coral (*Corallium rubrum*) is a long-lived colonial aposymbiotic coral growing in dimly lit habitats, from 10 to 200 meters in depth. The red coral is protected by different legislative rules mainly due to intensive harvesting suffered since antiquity. Recently large scale mortality events linked to climatic change have strongly affected shallow populations, posing new questions for the conservation of this species. The goal of our research is to develop conservation plans for this species derived from an interdisciplinary approach including the analysis of population structure and dynamics, population genetics, reproduction, and thermotolerance experiments. We examined populations from areas with contrasted environmental conditions and disturbance regime in the northwest Mediterranean Sea. The main results showed that marine reserves can be good tools for population recovery in front of harvesting pressure, although they cannot avoid the effects linked to elevated temperature contexts, which caused significant increase in mortality rates and reduction of reproductive output. In these mortality events, different degrees of impact were observed in populations at local as well as large spatial scales. Hence the research on the differential adaptive capacity should be envisioned. This study provided some basis to anticipate populations' trajectories over mid- and long-term scales in view of the present shift in disturbance regime.

**EFFECTS OF LIVESTOCK GRAZING ON PLANTS AND SONGBIRDS IN CALIFORNIAN VALLEY GRASSLANDS**

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We studied the effects of livestock grazing on plant and songbird communities in Californian valley grasslands. Though little-studied in California, grassland-dependent passerine species are believed to be declining and are recognized as having high conservation value. Grazing is a dominant land use in their breeding habitat, directly influencing vegetation structure and composition. Using non-metric multidimensional scaling, recursive partitioning, logistic regression, and linear mixed-effects models, we analyzed the temporal and spatial scales at which livestock grazing affects the plant community in 9 parks east of San Francisco Bay. We linked the relationships between plant community characteristics and breeding bird abundance and distribution in 2003–2005 for key species: Grasshopper Sparrow (*Ammodramus savannarum*), Horned Lark (*Eremophila alpestris*), Western Meadowlark (*Sturnella neglecta*), and Savannah Sparrow (*Passerculus sandwichensis*). Grazing was positively correlated with native plants in some parks, but plant community composition varied at the park level and was also strongly influenced by annual weather conditions. Abundance of the grassland specialists Horned Lark and Savannah Sparrow was strongly correlated with increased vegetation structural complexity. Generalist Western Meadowlark were negatively correlated. Grassland-obligate Grasshopper Sparrows were only found in grazed areas. Managed grazing can enhance native species in valley grasslands.

**MEASURING MAMMAL ACTIVITY ON DECOMMISSIONED FOREST ROADS**

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Forest managers implement various forms of road decommissioning to rehabilitate the ecological integrity of terrestrial and aquatic ecosystems in national forests. However, little research has measured the effects of road decommissioning on wildlife populations and habitat. I conducted a pilot study in the Flathead National Forest (Montana) to test sampling methods and determine an adequate sample size needed to measure the effects of road decommissioning on terrestrial wildlife. I used soot-coated track plates with anise oil / wood chip lure, remotely-triggered cameras, and scat and pellet transects to detect mammal activity on paired open and decommissioned roads. Camera data was the most effective in allowing me to determine that approximately 6–8 road pairs are needed to adequately measure mammal activity differences between open and decommissioned roads on the Flathead National Forest. In future studies, I will improve sampling methods by increasing the number of cameras and track plates used on each road, separately testing roads with cameras or track plates to eliminate lure bias, testing during various seasons including the hunting season, and improving scat and pellet transects. I will also gather existing wildlife population data in order to measure mammal activity on roads in proportion to the size of local populations.

**SUSTAINABLE BAT CONSERVATION IN CAUCASUS MOUNTAIN REGIONS**

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Karstic areas of Lesser Caucasus in Armenia and Georgia are the most biologically rich region situated between the Black and Caspian Sea, which are among the Earth's 25 most endangered hotspots. The proposed regions are situated at the biological crossroads for species from central and northern Europe, central Asia, and the Middle East. According to the literature 31 bat species occur in that region. *Myotis schaubi* is endangered, *Myotis hajastanicus* is data deficient, and 6 other species (*Rhinolophus mehelyi*, *Rhinolophus hipposideros*, *Rhinolophus euryale*, *Myotis bechsteini*, *Myotis emarginatus*, *Barbastella barbastellus*) are vulnerable according to IUCN. Based on our earlier experience in Romania and Ukraine, methods for bat monitoring, survey techniques, community work, and design of management plans for special protected areas for bats will be implemented in the proposed areas. Our aims are to identify key areas with national / international importance for bat conservation in the target regions, to make an audit of existing data, to collect all available literature and unpublished research results for providing an up-to-date status report of cave dwelling bat species, and to promote conservation of local endangered species and habitats through public awareness.

### **PROFESSIONALIZING THE CONSERVATION SECTOR: PROJECT MANAGEMENT TRAINING CONSERVATION GRADUATE PROGRAMS**

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Our objectives were to (1) examine which conservation graduate programs have courses in project cycle management and (2) develop a curriculum based on the Conservation Measures Partnership's Open Standards for the Practice of Conservation. We contacted faculty members of 49 graduate programs in conservation. We received responses from 26 of the 49 programs, of which six offer such a course. We found that among the respondents (1) Few offer a course in project cycle management. (2) Existing courses either offer the theory or practical experience, not both. (3) There is no use of standardized terminology. (4) No course offers an overview of the entire process. To address the needs highlighted in the gap analysis, we developed a graduate curriculum in project cycle management based on the Open Standards. This curriculum is divided into 12 topic modules that include the seven steps in the Open Standards, TNC's Excel tool, budgets and fundraising, leadership and ethics, and group project presentations. Instructors will present each topic through lecture and discussion and ask students to apply these concepts to semester-long projects by using a collection of instructional "application tools." This curriculum was developed to be adaptable to a variety of educational settings and is an open resource available to all interested parties.

### **AN APPROACH TO INTEGRATE BEHAVIORAL INFORMATION INTO POPULATION MODELS**

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Recently there has been a call to enhance population models by explicitly including information about behavioral strategies, particularly those affecting population dynamics (e.g. habitat selection). However, the few proposed approaches require detailed individual-based data that are rarely available for imperiled species. Here, we present a simple approach to incorporate spatial and demographic consequences of behavioral strategies in population models. We develop a spatially explicit deterministic model, a Leslie-Lefkovich matrix, that includes expected costs and changes in spatial dynamics (movement rates) of several habitat selection strategies. Model predictions were explored under multiple scenarios that vary on the expected costs and movement rates. Results suggest that including behavioral information greatly changed predicted population sizes. Increasing movement rates reduced total population size but increased homogeneity in the distribution of individuals among sites. Incorporating expected costs in survival rates also reduced population size, but reductions were greater than those expected from lowering survival rates, suggesting costs must be included explicitly. We conclude that both changes in spatial dynamics and expected costs should be considered when estimating population viability. The proposed approach provides a simple method to achieve this goal, and may be applied to more realistic population models and generalized to include other costs or behaviors.

### **MIXED OUTCOMES FOR ECOLOGICAL INTERACTIONS IN FRAGMENTED MAULINO FORESTS**

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The composition, structure, and functioning of biodiversity change with forest fragmentation. Usually, the intensity of ecological interactions is depressed in fragments due to the impoverishment of the consumer fauna. In the fragmented Maulino forest of central Chile, we have studied pollination, herbivory, granivory, insectivory, egg predation, and fecal decomposition. We also assessed the abundance of the interacting species. Compared to the continuous forest, pollination and herbivory are depressed but granivory, insectivory, and egg predation are intensified in fragments. Changes are coupled to similar variations in consumer abundance. Fecal decomposition did not change with forest fragmentation despite a reduction in the abundance of decomposers. Results demonstrate that even within a single forest type, ecological interactions might change in more complex ways with fragmentation than hitherto recognized. Management and conservation of Maulino forest remnants ought to consider these complexities.

### **INTERNATIONAL LEGAL ISSUES RELATED TO THE IMPLEMENTATION OF A TRANSBOUNDARY NETWORK OF MPAS IN EASTERN AFRICA**

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TRANSMPA is an EU funded project aiming at designing networks of Marine Protected Areas (MPAs) in the transboundary areas between Mozambique and Tanzania and the former and South Africa. Three types of research threads are being developed: biophysical, socioeconomic, and governance. For the latter, several types of information were collected including on pertinent bounding international instruments and on the ratification status for each of the three countries. The data for 73 bounding international instruments were analyzed in search of patterns of ratification for these African countries in order to determine the current commitments and predict the harmonization level required for the implementation and management of the MPAs.

Most of the instruments deal with biodiversity and marine pollution issues and only one third is within the regional level. The three countries have ratified the most emblematic instruments, both the global (Biodiversity, Climate Change, CITES, Ramsar, etc.) and regional levels (Nairobi Convention, SADC, African Union, etc.), though not always to full extent, i.e., including their subsidiary legislation. Nevertheless, some instruments that have not been ratified by any of the three countries are considered to be key elements in the development of the transboundary network of MPAs in the region.

**BENTHIC PELAGIC LINKAGES IN MARINE ECOSYSTEMS AND THEIR RELEVANCE TO VERTICAL ZONING IN MARINE PROTECTED AREAS**

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MPA design requires a science-based determination of which extractive activities (e.g., fishing) must be restricted or prohibited to achieve a site's conservation goals. Recent designations have raised the issue of whether every MPA must be "no take" to be effective, or whether some recreational fishing for pelagic species could be compatible with those MPAs focused primarily on conserving benthic communities. This management approach, termed "vertical zoning" within an MPA, requires an understanding of the nature, direction, strength, and predictability of ecological coupling between pelagic and benthic assemblages, and thus of the potential indirect effects of pelagic fishing on the protected benthic communities. To explore this issue, NOAA's MPA Science Institute convened an expert workshop of fisheries biologists, ecologists and recreational fishermen in November 2005. This diverse team summarized broad patterns of benthic-pelagic linkages in United States ecosystems (e.g. by depth, habitat, mobility guild), and identified general ecological conditions under which considering vertical zoning in benthic-focused MPAs might be (i) inappropriate due to strong benthic-pelagic coupling (e.g. nearshore habitats, coastal pelagic species, sea mounts, spawning areas), (ii) potentially appropriate due to weak coupling (e.g. offshore, oceanic pelagic species), or (iii) worthy of further study due to complex, indirect, or variable benthic-pelagic coupling.

**FERAL CATS AND WILDLIFE ON SANTA CATALINA ISLAND, CALIFORNIA: DISTRIBUTION, DISEASE AND THEIR EFFECTS ON MANAGEMENT**

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Exotic species introduced to Santa Catalina Island have had severe impacts on the ecology of the island's native plant and animal species. Feral cats (*Felis catus*), the most abundant and widely distributed invasive animal species, pose a threat to several species of conservation importance, particularly the endangered Santa Catalina Island fox (*Urocyon littoralis catalinae*) and the Santa Catalina Island shrew (*Sorex ornatus willetti*). The extent of the feral cat distribution and the associated difficulties of implementing control actions on a species closely associated with humans require carefully designed plans strongly supported by scientific data. This study analyzed the spatial distribution of endangered and threatened island endemics with feral cat distribution, habitat use, diet, and disease concentrations. Extensive distribution overlap between feral cats and island foxes was found in riparian corridors and island chaparral. Human settlements increase opportunities for cat and fox interactions that cause injuries and potentially spread of diseases such as toxoplasmosis. This data is being used to by the Catalina Island Conservancy to define priority areas of intervention for the management of feral cats.

**GOVERNING FOR CONSERVATION: A DIVERSITY OF GOVERNANCE MODELS FROM SOUTHERN MEXICO**

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What kind of governing features best foster biodiversity conservation? How can those features grow out of or be mapped onto existing governing frameworks? This paper answers these questions by describing the governance context in Calakmul, Mexico, home to Mexico's largest protected area for tropical ecosystems. In addition to county and village (or ejido) governing structures that most directly shape local conservation, the paper focuses on efforts to create a new layer of local governance responsive to a series of sustainability goals. This public-private coalition is, at present, a work in progress. Still, the coalition's aims and, importantly, its own model for governance and its ability to adhere to that model are revealing for what they say about conservation governance more generally. Is a green democracy possible in countries with weak democratic traditions? What other governing models are available that might provide the public participation and accountability that act as hallmarks of democratic models? By exploring the genesis of this new Calakmul initiative, its frustration with past governing models, and how the initiative attempts to fit with some aspects of existing governing structures and over-ride others, the paper includes an assessment of conservation governing models both in theory and in practice. The initiative's long-term prospects rest on the extent to which its processes and outcomes are viewed as legitimate to local citizens and office-holders.

**SPATIAL ECOLOGY OF TRANSLOCATED RIPARIAN BRUSH RABBITS**

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The endangered riparian brush rabbit (*Sylvilagus bachmani riparius*) occupies areas of dense, brushy cover along streamside communities in the northern San Joaquin Valley of central California. The 1998 recovery plan for this subspecies called for the establishment of three self-sustaining, wild populations within the historical range, and not including the population in Caswell Memorial State Park—the only confirmed population in 1998. Towards achieving this recovery goal, more than 250 captive-born rabbits (most fitted with radio-collars) have been released on the San Joaquin River National Wildlife Refuge since July 2002. A subset of translocated rabbits has been monitored via radio-telemetry at least twice weekly for more than 3 years. Preliminary analysis of the movements of 77 individuals indicated that males had larger home ranges and core areas than females, regardless of season. However, female home ranges were larger during the breeding season than at any other time of the year. The maximum dispersal distance was 1.1 km for females and 2.5 km for males, and mean dispersal distances were 578 m (se

109 m) for females and 897 (se 181 m) for males ( $p = 0.079$ ). No individuals were observed returning to the release enclosures.

**AMPHIBIAN CHYTRIDIOMYCOSIS AND CONSERVATION IN OREGON AND VENEZUELA**

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One important limitation in conservation research is the difficulty in sharing advances in methodology among scientists across borders. In particular, interdisciplinary research topics involving scientists from multiple fields often leads to disparate and non-comparable results from studies examining the same questions in different regions. It is difficult to ascertain whether study methods or underlying environmental processes are responsible for reported results. Such is the case for amphibian chytridiomycosis, a globally emerging infectious disease that has been implicated in amphibian population declines in Australia and the Americas. Conservation science and ecological research alike are interested in detecting patterns of disease in both native and geographically separate ecosystems. Here we discuss field and laboratory research efforts on amphibian chytridiomycosis in the U.S. Pacific Northwest and Venezuela to highlight similarities, differences, and opportunities for standardization of methodology and conservation efforts.

**HIGH PREVALENCE OF SYLVATIC PLAGUE IN FLEAS COLLECTED FROM BLACK-TAILED PRAIRIE DOG BURROWS IN NORTH-CENTRAL MONTANA**

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Sylvatic plague was introduced into North America over 100 years ago. The disease causes high mortality and extirpations in black-tailed prairie dogs, which is of conservation concern because it provides habitat for the critically endangered black-footed ferret. Our goal was to elucidate the mechanism *Y. pestis* uses to persist in prairie ecosystems during enzootic and epizootic phases. We used a nested PCR protocol to assay for plague genomes in fleas collected from prairie dog burrows potentially exposed to plague in 1999 and 2000. No active plague epizootic was apparent in the 55 prairie dog colonies sampled in 2002 and 2003. However, 63% of the colonies contained plague-positive burrows in 2002, and 57% contained plague-positive burrows in 2003. Within plague-positive colonies, 23% of sampled burrows contained plague-positive fleas in 2002, and 26% contained plague-positive fleas in 2003. Of 15 intensively sampled colonies, there was no relationship between change in colony area and percentage of plague-positive burrows over the two years of the study. The highest percentages of plague-positive colonies were recorded in May and June. The surprisingly high prevalence of plague on study area colonies without any obvious epizootic suggested that the pathogen existed in an enzootic state in black-tailed prairie dogs. These findings have important implications for the management of prairie dogs and other species that are purported to be enzootic reservoir species.

**EXTRA-PAIR PATERNITY IN SANDHILL CRANES (*GRUS CANADENSIS*) REVEALED USING MICROSATELLITE DNA MARKERS**

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The presence of extra-pair paternity (EPP) in a dense breeding population of sandhill cranes (*Grus canadensis*) was tested using six microsatellite DNA markers. The frequency of EPP for this long-lived species with long-term pair bonds ranged between 4.4% (2 of 45 chicks) and 11.1% (5 of 45 chicks). The two confirmed extra-pair chicks were from different broods of one pair that has been socially bonded for a minimum 12-year period. The social male was rejected as the genetic father in both cases. The three other cases of EPP (twice the social male was rejected as the genetic parent, once the social female was rejected) may be authentic infidelity, or mate replacement prior to sampling. The range of EPP for this population of sandhill cranes is close to other species with similar mating systems. For the confirmed cases of EPP, the female was able to increase her individual reproductive success without losing her territory. For territorial female sandhill cranes, EPP may serve to both increase individual reproductive success and provide access to a territory (via the genetic father) in case of divorce or mate loss. EPP may be an effective way for sandhill cranes to increase genetically effective population sizes as these populations rebound from the near extirpation that took place in the early 20th century.

**SEX DIFFERENCES IN THE PHYSIOLOGIC RESPONSE TO ACUTE OFF-HIGHWAY VEHICLE EXPOSURE IN THE NORTHERN SPOTTED OWL**

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Non-invasive measures of glucocorticoids in feces can provide valuable indices of anthropogenic disturbance impacts on wildlife. We are partnering with the USDA Forest Service, US Fish and Wildlife Service, and Blue Ribbon Coalition in a large-scale study of the effects of off-highway vehicle (OHV) use on the Northern Spotted Owl (NSO) (*Strix occidentalis caurina*) in the Mendocino and Shasta-Trinity National Forests of northern California. OHV use has nearly tripled in the last ten years and is a growing concern for managers. Extensive validations have demonstrated that metabolites in owl scat accurately reflect circulating levels of glucocorticoids. We used these techniques to determine that acute exposure to experimentally applied OHV use significantly increased corticosterone in male, but not female, NSO. This sex difference is consistent with previous work demonstrating that proximity to logging roads and intensely harvested forest correlates with higher glucocorticoids in male, but not female, NSO. Sex differences in demands associated with reproduction may underlie the variation in vulnerability to disturbance in this species.

**CORRELATING AREAS DELIVERING IMPORTANT HYDROLOGICAL SERVICES WITH KEY BIODIVERSITY AREAS IN MADAGASCAR**

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The remaining forests in Madagascar harbor the most unique and threatened flora and fauna on the planet yet they are being deforested as a result of human activities like upland rice cultivation, charcoal production, and mining. Loss of upland forests directly threatens habitats critical for biodiversity and may result in increased erosion and sedimentation of streams. This in turn can harm downstream irrigation works on which large populations depend for rice cultivation. It is possible that forest loss may contribute to flooding in small watersheds. In this study we devised several spatial indices that integrate population, land cover, and land use maps and hydrological information to identify the most important areas for hydrological services provided to human populations living downstream. Then we correlated these areas with Key Biodiversity Areas identified from species occurrence data. The results show significant overlap between the two.

**THE EFFECT OF NATIVE FORB ABUNDANCE DECLINES ON INVASION RESISTANCE IN CALIFORNIA GRASSLANDS**

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Yellow starthistle (*Centaurea solstitialis*) negatively impacts California grasslands through losses of forage quality, native species, and landscape aesthetics. We investigated whether shifts in native species' abundances affect the susceptibility of grasslands to starthistle invasion. This is important because changes in species abundance are more common than species extinctions, and ecosystem functions such as invasion resistance may be mediated by such changes. We created simplified grassland microcosms consisting of varying abundance levels of the native tarweed (*Hemizonia congesta*) and a functionally contrasting, dominant grass, *Bromus diandrus*. We invaded half the microcosms with starthistle and measured plant biomass, soil moisture, nutrient availability, and starthistle flower and *Hemizonia* seed numbers. Declining *Hemizonia* abundance increased microcosm susceptibility to starthistle invasion, with a non-linear relationship between *Hemizonia* abundance and invasion resistance: small declines in *Hemizonia* abundance produced little loss of function, but larger declines produced an accelerating loss of invasion resistance. Starthistle invaded *Hemizonia* even at high abundances, indicating that restoration using solely supplemental *Hemizonia* seeding may not control invasion. Interestingly, *Hemizonia* continued to contribute to invasion resistance at low abundances, indicating that even rare forbs may be important in protecting California grasslands from invasion.

**USING BIOGEOGRAPHY TO TARGET CONSERVATION RESEARCH EFFORTS IN VIETNAM**

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Lying within the Indo-Burma biodiversity hotspot and encompassing 12 ecoregions, Vietnam has attracted the interest of biogeographers for over 150 years. Despite this work, and recent attention for several large mammal discoveries, the richness and distribution of Vietnam's biodiversity remain poorly known, especially among less-frequently studied taxa, e.g. known amphibian diversity has more than doubled since 1998. Vietnam's government is in the process of expanding the forested protected area network from 1.3 to 2 million ha. To aid in site selection and to better map biodiversity distributions, we undertook comparative multi-taxa (small mammals, birds, herpetofauna, fishes, and invertebrates) inventories across elevation gradients at three forested locations, which were unprotected, poorly studied, and biogeographically varied. This effort was the first of its kind for the region. Results from vertebrate surveys include 11 newly described species, 16 new country records, and at minimum 30 endemic species. Results were analyzed using complementarity indices and biotic affinity scores to address underlying biodiversity distribution patterns and conservation significance. We conclude that two sites represent important conservation areas: the most northerly for a rich, subtropical fauna both highly threatened and currently under-represented in Vietnam; and the central site for elevated and globally significant endemism.

**TRANSBOUNDARY POACHING: A CASE STUDY OF POLICIES AND PRACTICES**

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Hungary is an important migrating fowl zone. In November 2001 Hungarian customs caught Italian poachers smuggling nearly 12,000 protected birds. Birds are standard items on many Italian menus. The Hungarian hunting associations' need for revenues and greed resulted in the mass poaching of millions of protected birds. The well-organized Hungarian-Italian group broke customs seals on trucks and attached new seals on the truck after adding the bounty. The Environmental Committee of the Hungarian Parliament investigated policies and practices which led to a few policy recommendations. (1) Lists of protected birds should be harmonized regionally, including all countries which are nesting or migratory zones for protected species. (2) Hungary takes the lead and prepares EU policies forbidding protected animals from being used for consumption. (3) Banning not only the sale of this shot, but also its use within Hungary, as well as making poaching a criminal offense. (4) Police and customs authorities coordinate their activities and all shipments of wild game should be inspected again at the border. Since 2004, this problem has become more difficult due to the elimination of trade borders between Hungary and EU, and will become even more difficult when further countries join the EU in years to come.

**NATURAL RESERVES OF KAZAKHSTAN**

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The first Central Asian natural reserve, Aksu-Dzhabagly, was established in Kazakhstan in western Tien Shan. At present time there are 10 natural reserves in Kazakhstan among 113 natural protected areas. The total areas of PAs is 21,036,283 hectares

(7.72), the total area of natural reserves is 1,075,498 hectares (0.39): Aksu-Dzhabagly (1926, 128 118 ha), Naurzum (1931, 191 381 ha), Barsakelmes (1939, 16 795 ha), Almatinskiy (1964, 71 700 ha), Korgalzhin (1968, 258 963 ha), Markakol (1976, 75 048 ha), Ustyurt (1984, 223 342 ha), West Altai (1992, 56 078 ha), Alakol (1998, 19 773 ha) and Karatau (2004, 34 300 ha). The main legislative base is the Law of Republic of Kazakhstan "About special protected natural areas," adopted on 15 July 1997, which includes 11 kinds of natural protected areas. The position Natural Reserve (zapovednik) is corresponding to Category I (A and B) of IUCN nomenclature of protected areas. The system of natural reserves of Kazakhstan is developing and integrating into regional and global net of protected areas.

### **KAZAKHSTAN RED DATA BOOK OF ANIMALS**

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The Red Data Book of Kazakhstan was established by government in January 1978. It was the first RDB in USSR. That red list included 87 animal species (4 fishes, 1 amphibian, 8 reptiles, 43 birds, 31 mammals) divided on 2 categories: rare and threatened. The second animal RDB edition was published in 1991 as a technical government document (500 copies, no pictures) and included vertebrates (129 species and subspecies) and invertebrates (105 species) divided on 5 categories; the red list included 16 fishes, 3 amphibians, 10 reptiles, 58 birds, 42 mammals, as well as 2 worms, 6 mollusks, 1 crustacean, and 96 insects. The third edition was published in 2 parts: vertebrates (1996) and invertebrates (2004). The current list of animals was adopted by government in 1995 (vertebrates) and in 1998 (invertebrates). Two species of birds and 2 mammals were excluded from the list. The invertebrate RDB part was created by specialists of Institute of Zoology and Tethys Scientific Society in 2003. The red list was reduced to 96 invertebrate species (2 worms, 6 mollusks, 1 crustacean, 2 arachnids and 85 insects). The IUCN criteria (2001) were used (4 EX-r; 5 CR, 12 EN, 73 VU, 2 NT).

### **IMPACT OF INVASIVE BLACK RATS ON BONIN ISLANDS, JAPAN**

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Bonin Islands are a Japanese oceanic archipelago, characterized by a high degree of endemism (41%). The presence of black rats (*Rattus rattus*) has raised concern for the negative impact that this invasive species can produce over native biota. Since very little information was available, we studied the rat population in Chichijima and Minamijima, two islands of the archipelago as a case study. All the main habitat types in both islets were sampled using live and snap traps. Rats were present in all plots except in those areas dominated by the invasive *Casuarina equisetifolia*. Rats were found breeding throughout the year. Habitat preferences were different in both islands: in Chichijima rats preferred secondary habitats whereas in Minamijima they preferred natural habitats. In Chichijima, rats were dependent on vegetal foods, producing severe damage on native species. On the other hand in Minamijima they consumed important amounts of fleshy foods (28.2% of their diet). This is of special concern since their diet included endangered species such as newborn marine turtles. These results suggest that black rats are likely to produce high impacts on the native flora and fauna of Bonin Islands. Management actions are urgently needed in both islands.

### **SEEKING BIOLOGICALLY REPRESENTATIVE REGIONS: A NEW METHOD FOR QUANTIFYING AND COMPARING SPECIES COMPOSITION**

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Patterns of species richness may be one of the most studied phenomena in ecology. Indeed, ". . . there has arisen a veritable midge-swarm of [richness] measures now suspended in the literature" (Whittaker 1977). In conservation planning, species richness and species endemism are most often used as surrogates for overall biodiversity. But they are inadequate metrics for discriminating among areas for conservation planning because they do not reveal how similar or different the actual composition of species may be from one area to another. A more useful metric for identifying priority conservation areas would be one that indicates the degree to which one area also represents the species composition of other areas. Here we describe a new method for quantifying the compositional similarity of species among geographic regions. We demonstrate its application to comparing aquatic communities among small drainages of the Mississippi River basin as well as to vertebrate species assemblages among ecoregions across the world's terrestrial biomes and realms. At regional and global scales our compositional metric reveals biodiversity patterns that differ significantly from patterns of species richness or endemism. It suggests which subset of regions best represent overall biodiversity based on species identities rather than species counts or endemic species.

### **RURAL LANDS STEWARDSHIP AND SPECIES CONSERVATION IN COLLIER COUNTY, FLORIDA**

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Collier County, Florida contains diverse ecosystems that support listed species such as the Florida panther, wood stork, and northern crested caracara, but it is also confronted with rapid growth and urban development. To balance development with environmental protection and agricultural sustainability, consultants developed an innovative county-level Rural Lands Stewardship Program (RSLP). This program, approved by stakeholders, scores environmental attributes (land cover, species occurrences, soils, restoration potential, etc.) on land parcels. Landowners voluntarily enter the RSLP, receiving development credits in proportion to environmental values of their land and their willingness to remove various land use rights on specific parcels. The RSLP creates powerful economic incentives to protect the most environmentally sensitive lands first, which is now occurring. Development credits may be used only in areas with low natural resource value. As an example, we document the programs impact on conservation efforts for the northern crested caracara. Although a major development project impacted a

caracara breeding area, landowners, consultants, scientists, and wildlife agencies collaborated successfully in developing a plan to restore equivalent caracara habitat that will be managed in perpetuity, and regularly monitored for use by caracaras. The RLSP has greatly enhanced landowner cooperation, including increased reporting of nesting caracara pairs.

**A DATABASE TO TRACK POPULATIONS OF ENDANGERED, THREATENED, PROPOSED AND CANDIDATE SPECIES IN NATIONAL PARKS**

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There are currently 453 species that are federally listed or proposed for listing in 193 units of the National Park Service (NPS). To meet the challenge of sharing data between parks, administrative offices and other federal agencies, NPS in conjunction with the Colorado Natural Heritage Program has developed the NPS Endangered Species Act Database. The database tracks the status, expenditures, and recovery information for each federally listed or proposed species that occurs on NPS lands. It also cross-references species nomenclatures between the NPS and the U.S. Fish and Wildlife Service, to aid in the required annual reporting of this information. Since its inception in 2000, the challenge has been to create and augment the data flow process to allow everyone from park biologists and NPS upper management to data managers to annually review and update this information. The information is also made available to the public on an internet web page; visitors can ask which listed and candidate species occur in a national park, which parks have particular species, and how much the Park Service spends on a species each fiscal year. The database also includes management summaries for recovery plans of listed species that occur in national parks.

**EFFECTS OF GRAZING ON POPULATION SIZE AND PREDATION RISK FOR RODENTS IN A COASTAL CALIFORNIA GRASSLAND**

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High-intensity, short-duration (HISD) grazing has been hypothesized to simultaneously increase forage quality for livestock while maintaining habitat for grassland wildlife. We examined effects of HISD grazing on population size and perceived predation risk for rodents in an experimental coastal grassland in northwestern California. Mark-recapture data indicate that, relative to ungrazed areas, rodent populations have plummeted on HISD-grazed fields. Depletable feeding trays were used to assess the giving up density (GUD) of food as a measure of predation risk. GUDs were consistently higher in grazed than in ungrazed fields, and they were positively correlated over time with the abundance of local raptors, suggesting that more abundant predators and less cover elevated perceived predation risk. However, raptors rarely hunted over grazed fields, and the removal of rodents by raptors appears much less frequent in grazed than in ungrazed fields. Thus, our results suggest that the decline in rodent density in grazed areas may stem more from abandonment prompted by the rodents' diminished sense of safety than from harvest by raptors.

**CAN SHADE TREES AND BIRDS HELP JAMAICAN COFFEE FARMERS WITH INSECT PESTS?**

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Shade-grown coffee has been heralded as an agricultural crop that benefits tropical economies and provides habitat for forest wildlife, especially birds. Current economic forces, however, encourage the elimination of shade trees from coffee farms, diminishing their ecological value. We examined avian insectivory in shaded and unshaded portions of a Jamaican coffee farm. Economically harmless lepidopteran larvae were placed in coffee plants to simulate an insect irruption, and larval disappearance rates were measured inside and outside bird-proof enclosures in shaded and unshaded areas. Larvae disappeared faster outside than inside enclosures, suggesting birds can play a role in suppressing irruptions. Moreover, this effect was significantly stronger in shaded than in unshaded portions of the farm. Surveys confirmed that birds were significantly more common in shaded areas, and the species most likely to contribute to insectivory in the coffee layer included primarily migratory songbirds. Lastly, damage caused by the coffee berry borer (*Hypothenemus hampei*), the most important insect pest of coffee in the New World, was inversely correlated with the amount of shade cover, suggesting birds may help control pest abundances more generally.

**POPULATION CHANGES AND GENETICS OF CHUM SALMON IN THE SOUTHERN PORTION OF THEIR RANGE (CALIFORNIA, OREGON, AND COLUMBIA RIVER) AND POSSIBLE IMPACTS OF CLIMATE AND OTHER CHANGES**

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Spawning populations of chum salmon historically extended as far south as the San Lorenzo River in California and 322 km upstream in the Sacramento River. In 1905–1906 chum salmon was the most abundant salmon species in streams surveyed between the Sacramento and Columbia rivers. Today, these populations have greatly declined, and in the Columbia River are now listed under the ESA as a threatened species. In 2006 recovery plans for Columbia River chum salmon are being proposed. Little life history, genetic, or other biological information has been developed on these fish. This information is important as southern populations may represent remnants of historical populations with characteristics essential to the successful restoration of depleted present day populations. Information developed in conjunction with ODFW, WDFW, and USFWS includes demographic, genetic, and life history data, such as presence or absence of spawning populations, age structure from scale collections, and timing of migrations. Preliminary microsatellite genetic data indicate Oregon coastal chum differ from interior populations and may contain unique genotypes and adaptations. These unique characteristics may be especially important as increasingly rapid changes in climate, pollution impacts, and development expose salmonids to pressures beyond their ability to adapt, forcing further declines and even extinction.

**EFFECTS OF DISTURBANCE ON THE FITNESS OF CAVITY NESTING BIRDS IN OAK SAVANNAS**

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The Oak Openings Region has the greatest concentration of rare species in Ohio. Cavity nesting birds are decreasing in number and disturbance in the form of standing dead trees (snags) impacts the fitness of these birds. Snags provide habitat for roosting and nesting, a foraging substrate, and amplify drumming / tapping calls for these birds. This study combines theoretical behavioral ecology with conservation biology to investigate the fitness of cavity nesting birds in relation to snag density and characteristics in oak savannas of northwest Ohio. Field surveys and a spatial database are being used to analyze the relationship between disturbance and behavior. Cavity nesters have more choices of habitat in the high snag density plots, which reduces competition for nesting locations, food, and territory. Less time is spent foraging which occurs on the snags rather than other vegetation or the ground, with an increase in weight and body fat composition. Eggs are laid earlier and fledgling success increases. This study provides guidance for current management techniques such as burning of oak savannas and girdling of trees that cause anthropogenic disturbance in lieu of natural disturbance. The final results also create a further understanding of how disturbance specifically impacts the fitness of organisms.

**WHAT MAKES SEABIRDS DEFENSELESS TO INVASIVE RATS? AN ANALYSIS OF SEABIRD CHARACTERISTICS AFFECTING VULNERABILITY**

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On rat-invaded islands, seabird populations have been extirpated or severely reduced from rat predation pressures. Although invasive species eradication is widely accepted as a conservation tool, it has been highly contested by some stakeholders, who often cite inadequately documented rat effects as reasons to forego eradication. We reviewed the literature to examine which seabird characteristics make them vulnerable to invasive rats. 66 studies cited rat impacts, totaling 85 rat-seabird interactions on 49 islands. Seabirds with low mean adult weights were impacted most severely ( $p < 0.001$ ) and were preyed on significantly more than heavier birds ( $p < 0.001$ ). Rats preyed on eggs and chicks more than adults ( $p < 0.001$ ). Ground, burrow, and crevice nesting seabirds were most vulnerable ( $p < 0.001$ ), with ground nesters enduring the most severe impacts ( $p < 0.001$ ). Nesting types preyed on varied according to different rat species ( $p < 0.001$ ), with *R. rattus* and *R. exulans* preying on mostly crevice and burrow nesters, and *R. norvegicus* preying on mostly ground nesters. 91% of studies cite rat impacts anecdotally without experimental analysis. Scientists should pursue studies that experimentally document impacts of rats on seabirds to fill in our data gaps and advance our current knowledge.

**A HABITAT-SPECIFIC EDUCATION PROGRAM TO INCREASE AWARENESS OF THE ROLE OF INTRODUCED PREDATORS IN NATIVE SPECIES DECLINE**

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In the Santa Monica Mountains of southern California, USA, amphibian species breeding in permanent streams have declined primarily due to the introduced red swamp crayfish (*Procambarus clarkia*). Most affected have been the California treefrog (*Hyla cadaverina*) and California newt (*Taricha torosa*). Of particular interest to area conservation agencies is the prospect of community-based adaptive management of predators in target streams. Key to effective community-based management is an educated populace that appreciates the native amphibian diversity of the area and problems posed by introduced predators. We have produced two education programs which combine age-appropriate PowerPoint presentations with supplemental information sheets, school activities, and evaluation instruments. The program emphasizes the dependence of native species on mountain stream habitats and the disruption caused by introduced predators. The program has been presented at six schools and seven civic events by students from Pepperdine University. Before and after evaluations ( $N = 150$  for schools and  $N = 70$  for adults at civic events) indicate a 40% increase in the ability of students to recognize species and to discriminate natives and non-natives as a result of participating in the program. Adults show an improvement of 20% in similar evaluations. Such educational programs can be instrumental in laying the ground work for community-based conservation efforts.

**GENETIC STRUCTURE OF GRAUER'S RUSH WARBLER (*BRADYPTERUS GRAUERI*), AN ENDANGERED ALBERTINE FIFT ENDEMIC**

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The Endangered Grauer's Rush Warbler (*Bradypterus graueri*) is a poorly studied species confined to highland swamps of the Albertine Rift Region. Genetic structure was studied in 36 individuals collected across the species range in Rwanda, Uganda and the Democratic Republic of Congo. A total of about 2117 bp of the mitochondrial genes ND3, ND2 and ATP6 were sequenced. The study demonstrates clearly the distinctiveness of each population and a break between central and southern populations. Although population densities are declining and suitable habitats shrinking the Grauer's Rush Warbler (GRW) is not genetically depauperate at any of the study sites. Each population constitutes a distinct evolutionary significant unit suggesting that management at each site should ensure that habitat quality is effectively monitored and maintained.

**CONSERVATION AND MANAGEMENT OF SWAMP DEER (*CERVUS DUVACELI BRANDERI*) IN KANHA NATIONAL PARK**

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Kanha National Park is well known for its scientific management and its tiger (*Panthera tigris*), which can be easily spotted and photographed. In 1973 Project Tiger was launched in Kanha for the conservation of rare and endangered endemic species of

swamp deer (*Cervus duvaceli branderi*). Its population multiplied dramatically five fold just within 15 years from 111 in 1973 to 547 in 1988. The species was virtually brought back from the brink of extinction. There after its population continued to decline and it is now stable about 350. Various management issues are reviewed and conservation strategies are discussed. Inbreeding of small fragmented population, change in climate, requirement of its specific food habit and habitat preference, loss of habitat by weed infestation of invasive alien species, encroachment of woodland over grasslands, soil erosion, degradation of habitat, over grazing and competition with spotted deer (*Axix axix*), predation by tiger, and animal diseases are the main causes of decline in its population. Park may be managed to achieve at least 600 swamp deer in next five years. To accommodate the growing population of herbivores at least 15% of geographical area of the Park must be brought back under grassland against the present area of 11.9% and 10% grasslands with sparse trees. Restoration of grassland habitat and semi-captive breeding of swamp deer of different genetic characters in a large predator proof fence are essential for its survival.

#### **MEASURING CONSERVATION SUCCESS**

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A major challenge facing conservationists, policy-makers, and donors alike is how to evaluate the success of conservation efforts in order to identify those approaches that are most effective. We report the results of a collaborative project among the diverse members of the Cambridge Conservation Forum to develop harmonised approaches for assessing conservation success. The participating organizations include international, national, and local NGOs and partnership organizations, IGOs, national statutory bodies, and academic research groups. The resulting scorecard style questionnaire is designed to help project implementers identify the impacts of their actions. It addresses seven major categories of conservation activity and focuses on the linkages between the different types of conservation action and their outcomes and ultimate conservation impact. We report the results of trial application of this tool to conservation projects from 10 different organizations, and discuss its potential for synthesizing conservation experience using common measures, and thereby opening up opportunities for quantitative identification of determinants of project success.

#### **VOLUNTARY VILLAGE RELOCATION IN INDIA'S BHADRA WILDLIFE SANCTUARY: ADDRESSING PEOPLE'S LIVELIHOOD NEEDS WHILE PROTECTING A PARK'S FUTURE**

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The future of many parks and reserves depends on protected area management efforts that reconcile socio-economic needs of people living in protected areas with biodiversity conservation. We documented a voluntary resettlement project underway in India's Bhadra Wildlife sanctuary where 11 villages were willing to relocate provided their socio-economic needs were met. We interviewed 258 of the 419 households that lived in the reserve and involved in the relocation project. Our study examined human activities and their ecological impacts, and then measured post-relocation responses for 11 of the 13 villages that were relocated. Overall, 58%–91% of people from the different villages considered the relocation project a success in the short term. In specific contexts, relocation may be a potential viable conservation tool if sought by villagers, conducted with active consultation and financial support of their socio-economic aspirations.

#### **LIMNOLOGY OF HIGH-ALTITUDE RAINFOREST STREAMS ALONG DISTURBANCE GRADIENTS IN THE BWINDI IMPENETRABLE FOREST OF UGANDA**

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Given the small extent of rainforests in East Africa and the high intensity of conversion, studies of deforestation effects on aquatic communities are critical for describing impacts and documenting pre-conversion conditions. In this study we explored the relationship between deforestation and water quality in high-altitude montane streams in and around Bwindi Impenetrable National Park, Uganda. Between February 2003 to May 2004, we quantified effects of season and level of disturbance on a suite of physicochemical characters measured across sites that ranged from undisturbed rainforest to agricultural land. Correlation analyses showed that environmental variables indicative of human impacts in the catchment were highly correlated with each other. Repeated measures ANOVA indicated significant seasonal effects for stream depth, discharge, conductivity, and total dissolved solids. Water conductivity, turbidity, and total dissolved solids also differed with level of disturbance with higher levels at anthropogenically-impacted sites than in intact forest. The findings show that riparian vegetation removal correlates with changes in water quality, and supports the role of riparian buffer strips along stream banks in agricultural areas.

#### **TRACKING ALBATROSS AND TRASH ACROSS BORDERS: A TOOL FOR INTEGRATED OCEAN, COASTAL, AND WATERSHED CONSERVATION**

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The far-ranging, long-lived Black-footed Albatross can provide useful information about human-related impacts to marine ecosystems. Albatross are surface feeders that feed on fish and squid on the ocean surface. They also ingest floating plastic debris which adults then feed to their chicks with potentially detrimental effects on their growth, contaminant loads, and survival. A satellite telemetry study to investigate movements of albatross, habitat use, and overlap with marine debris during

2004 and 2005 is being used to increase public awareness of the critical need for plastic pollution prevention. The "Eastern Garbage Patch" is a persistent oceanographic feature that accumulates plastic debris from both sides of the North Pacific in alarming densities. Results of our GIS mapping analysis indicated 13 of the 18 tagged birds ventured into this region where they spent on average 26% of their time during their post-breeding movements (July–October). Through diverse local and national outreach collaborations, including teacher workshops, development of classroom activities, production of posters and stickers, and the direct engagement of the public through lectures and beach clean-ups, we have used this charismatic marine predator as a tool to link the daily actions of people with conservation problems across borders and oceans.

### **THE IMPACT OF GLOBAL CHANGE ON BUTTERFLY SPECIES RICHNESS IN CANADIAN PROTECTED AREAS IN THE PAST CENTURY**

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Climate and land use changes are likely to force many species to shift beyond the boundaries of existing protected areas. Although many models have been constructed to test whether species will remain within such areas given future climates, very few tests of protected area effectiveness in the face of 20th century global change have been possible. In this study, we tested whether long-established protected areas in Canada have proven effective at retaining their original complement of butterfly species given the environmental changes that have occurred in the past century. We measured the change in species richness of 187 butterfly species over two epochs (1880–1949 and 1950–2000) in all protected areas established before 1940. Overall, species richness has increased in protected areas. However, richness change within park boundaries was often similar to the richness change outside the protected area boundaries, suggesting that this effect does not arise because protected areas are particularly effective at buffering species against global change. Moreover, in regions where richness has significantly decreased, there are few long-established protected areas. Our results suggest that a randomly placed protected areas network would be just as effective in conserving butterfly species richness in Canada as the present-day protected areas network.

### **IMPACT OF HUMAN PHYSICAL DISTURBANCE ON NUTRIENT DYNAMICS DURING DECAY IN A KENYAN MANGROVE FOREST**

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Human physical disturbance by coastal communities is prevalent in tropical mangrove forests, especially to provide fuelwood and construction material. However few studies have directly studied the impact of these local extraction on processing of mangrove productivity. This study aimed to determine the impact of mangrove degradation on rate of decomposition and nutrient dynamics. Litterbags of three mangrove species with known amount of leaves were exposed within sites under different levels of human disturbance. Leaves were retrieved fortnightly and dry weight, C, N, and P content determined. Rates of decomposition and nutrient content were then compared between the species and levels of human disturbance. Results of the study indicate that disturbed sites have lower rates of litter decomposition than corresponding undisturbed sites, this corresponds to lower N and P fixation during the process of decay at these sites. It was therefore concluded that human physical disturbance alters the capacity of a mangrove habitats to process and recycle nutrients.

### **IMPLEMENTATION OF AN INTEGRATED INVASIVE SPECIES-LED AND SITE-LED MANAGEMENT PLAN ON CATALINA ISLAND, CALIFORNIA**

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Invasive species are considered one of the greatest threats to biodiversity and are the leading cause of species extinctions in island ecosystems. Santa Catalina Island, California, is no exception. Faced with 76 invasive plant species threatening 98 natural heritage species and unique habitats, it becomes difficult to prioritize the allocation of limited resources. The Catalina Island Conservancy, which owns and manages 88% of the 48,000-acre island, has developed and implemented an integrated management program to protect the Island's biodiversity from priority invasive plant species. The program incorporates both a species-led and a site-led approach to prioritizing management actions. Seventy-six invasive plant species were mapped along 600 transect miles and ranked for priority of control based on their impacts, invasiveness, abundance, and distribution. Seventy-five watersheds were treated as habitat management units and ranked for priority of protection based on the presence of rare, listed, and endemic flora and fauna, and rare and sensitive habitats within them. This combination of management approaches, based on extensive research data, is guiding extensive eradication (35 species) and control (4 species) efforts of priority invasive plants in watersheds with the greatest native biodiversity.

### **GENETIC IDENTIFICATION OF FISH HOSTS OF FRESHWATER MUSSELS IN MAINE**

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The yellow lampmussel (*Lampsilis cariosa*) and tidewater mucket (*Leptodea ochracea*) are listed as threatened in Maine and are proposed for federal listing. Like most freshwater mussels, they have an unusual life cycle during which their larvae (glochidia) are obligate parasites of fish. Knowledge of host fish species is, therefore, critical to freshwater mussel conservation. Previous laboratory studies have indicated that white perch (*Morone americana*) and yellow perch (*Perca flavescens*) are potential hosts for the yellow lampmussel, and white perch for the tidewater mucket. The goal of this research is to determine if these species act as host fish in natural conditions and also to assess additional species as possible hosts by sampling naturally parasitized fish in the wild. A species-specific DNA key utilizing restriction fragment length polymorphism (RFLP) patterns of the mitochondrial ND1 gene was developed to identify glochidia attached to wild-caught fish. Hosts identified under laboratory conditions were confirmed from naturally parasitized fish. Additional fish species were also found to be potential hosts for the yellow lampmussel and tidewater mucket in Maine, with some differences among localities. These results are crucial for

understanding the complex ecological interactions between mussels and their hosts and for conservation planning.

**CAUSES OF MORTALITY TO THE ENDANGERED SOUTHERN CASSOWARY IN QUEENSLAND, AUSTRALIA**

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The Southern Cassowary (*Casuarius casuarius johnsonii*) is endemic to northeast Queensland, Australia, where it inhabits tropical rainforest. The species stands up to 2 meters tall and is Australia's heaviest bird. Of its total previous habitat, only 20 to 25 remains with much of this under pressure for development. The Southern Cassowary is listed as endangered by both the Australian Commonwealth Government and Queensland State Government. The Queensland Parks and Wildlife Service (2002) estimated 1500 to 2500 adults remain. The primary cause of the species decline is habitat loss and fragmentation, with motor vehicle strikes and dog attacks considered major threats for local populations. The purpose of our research was to quantify the causes of mortality to Southern Cassowaries. We obtained data for 140 cassowary deaths from 1848 to 2004. The leading cause of death for 110 cassowaries from 1986 to 2004 was motor vehicle strikes (55), and the second leading cause of death was dog attacks (18). Together, motor vehicles and dogs caused 74 of the cassowary mortalities for which the causes of death could be determined. Seventy-nine of the recorded cassowary deaths (63) were in the Mission Beach area, suggesting this local population is under tremendous pressure.

**SPECIES COEXTINCTIONS AND THE BIODIVERSITY CRISIS**

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To assess the co-extinction of species (the loss of a species upon the loss of another), we present a probabilistic model, scaled with empirical data. The model examines the relationship between co-extinction levels (proportion of species extinct) of affiliates and their hosts across a wide range of coevolved interspecific systems: pollinating Ficus-wasps and Ficus, parasites and their hosts, butterflies and their larval hostplants, and ant-butterflies and their host ants. Applying a nomographic method based on mean host specificity (number of host species per affiliate species), we estimate that 6300 affiliate species are "co-endangered" with host species currently listed as endangered. Current extinction estimates need to be re-calibrated by taking species co-extinctions into account.

**POSSIBLE EFFECTS OF EL NIÑO ON AN ENDEMIC SULAWESI MACAQUE: POPULATION TRENDS IN *MACACA NIGRESCENS***

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Several El Niño Southern Oscillation (ENSO) events have occurred in the last two decades. Severe ENSO events can cause decreased amounts of rainfall in parts of southeast Asia and dramatically dry out areas of rainforest. Consequently, this can create a stressful time for the flora and fauna. The present study is concerned with the possible effects of ENSO on *Macaca nigrescens*. This macaque species is endemic to the central portion of the northern peninsula of Sulawesi, Indonesia. It only occurs within Bogani-Nani Wartabone National Park and any remnant adjacent habitat. The primary data set is from population data collected during six field seasons from 1987 to 1998, including three seasons at the end of a severe ENSO. The average size of the encountered groups was lower in all three of the ENSO years as compared to the non-ENSO years. This would likely be due to more fissioning or subgrouping to cope with food availability. Still, it must be noted that this species commonly subgrouping during the day and small groups were most commonly encountered every year. While many of the data also indicated a reduction in immature monkeys during ENSO years, this was not consistent throughout the data set.

**CONSERVATION OF THE ENDANGERED FLORIDA GRASSHOPPER SPARROW (*AMMODRAMUS SAVANNARUM FLORIDANUS*) USING HOME RANGE DELINEATION BASED ON RADIODIOMETRY**

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Conservation areas for endangered grassland birds must be designed to encompass sufficient area to maintain a viable population. The endangered Florida Grasshopper Sparrow (FGSP) is an endemic subspecies restricted to Florida dry prairie, a globally imperiled community. Much of the remaining dry prairie is owned and managed by state and federal government agencies to promote recovery of FGSP by minimizing habitat fragmentation and through use of prescribed fire. To examine relationships between time-since-fire and non-breeding season home range size, we tracked adult Florida Grasshopper Sparrows for up to seven months using radiotelemetry with multiple recaptures for transmitter replacement. Home range estimates show that adult FGSP are relatively sedentary throughout the non-breeding period in areas burned within the previous growing season. Home range areas reflect habitat characteristics maintained by prescribed fire and minimal habitat fragmentation, important management implications for this endangered species and potentially for other grassland bird species.

**COMMUNITY BASED CONSERVATION AS A TOOL FOR BIRDS AND BIODIVERSITY CONSERVATION: THE ROLE OF SITE SUPPORT GROUPS IN IMPORTANT BIRD AREAS (IBA)**

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The community-based conservation paradigm has been lately embraced in Africa as a key component of conservation and management of biodiversity. In this study, I look at the impacts of Site Support Groups (SSGs, a new community based conservation approach) in which local people are involved in conservation of Important Bird Areas in central Kenya. A questionnaire survey was used to examine community knowledge of birds and their habitats as well as the values local people

place on birds. The study also assessed the impacts that the site support groups are having on the local communities, and their role in helping the IBA program to meet its objectives of working with local communities in birds and biodiversity conservation. Levels of knowledge of birds were similar across sites with and without SSGS and tended to be gained from elders and peers. Members of SSGs and the community ranked acquiring environmental skills, training, and publicity as the main benefits from the IBA program. Overall the IBA partnership has improved relations with communities and other interested stakeholders. For the SSGs to be more successful, the study recommends for more provision of information, openness about the work of the SSGs, and increased interaction with the wider community.

### **LOVE THY FROGS: INCREASING AWARENESS THROUGH FROG CONSERVATION EDUCATION IN INDONESIA**

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Study of amphibians has lacked attention in south East Asian regions, especially in Indonesia. An effort to increase frog conservation awareness of school children and teachers in selected schools has been done from 2002 in the province of West Java, Indonesia. So far, there is a poor awareness on the diversity of frogs in this area. We developed a 2 hour outreach program to school children and conducted a teacher-training program. For older children (grades 10–11), we developed a 2 day Frog Camp where students joined our research group to study frogs in the field. In total 563 schoolchildren from 13 schools from grades 3–11 have been involved in this project. Nineteen teachers had attended our workshop and more schools have expressed their interest in joining the program. Although we could not measure direct impact of this program, we believe that this program has been successful in showing the children the diversity of frogs in the region and opening their eyes on the conservation issues related to frog survival.

### **THE STATUS OF FROGS IN THE MOUNT GEDE PANGRANGO NATIONAL PARK, WEST JAVA, INDONESIA**

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Mount Gede Pangrango National Park is one of the last remaining pristine areas in the highly populated province of West Java, Indonesia. The latest frog inventory was performed during the 1960s by Liem and there has been no further research since then. During 2003/2004 we revisited all but one of Liem's study sites and found 18 species of frogs. Four species recorded by Liem in the 1960s have not been found in this survey: *Fejervarya cancrivora*, *Bufo bipocartus*, *Microhyla palmipes*, and *Rana nicobariensis*. However, we recorded three additional species, *Rana hosii*, *Leptophryne borbonica*, and *Limnonectes macrodon*. Species composition differs due to several reasons: (1) change of habitat, (2) differences in survey locations, and (3) differences in sampling methods and effort. In the 1960s the endemic frog *Leptophryne cruentata* was the second most abundant frog after the common frog *Rana chalconota*. Nearly 40 years later, *Rana chalconota* is still the most abundant frog encountered, but the number of *L. leptophryne* observed has declined sharply. There is a possibility that *L. cruentata* is declining, therefore there is a need to establish long-term monitoring sites and survey programs to ensure conservation of this species.

### **SEA-LEVEL RISE AND THE LOWER KEYS MARSH RABBIT: IMPACT OF GLOBAL CLIMATE CHANGE ON AN ENDANGERED SPECIES**

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The Intergovernmental Panel on Climate Change projects a global surface temperature increase of 1.4 to 5.80 C between 1900 and 2100. One consequence of this increase is raising sea levels mainly due to oceanic thermal expansion. Estimates of sea-level rise range from 0.09 to 1.5 m by the year 2100. Sea-level rise will have many impacts on small islands including increased likelihood of coastal flooding, salinization of freshwater wetlands and water tables, and coastal land loss. Using a Geographic Information System and the best available elevation data, we modeled 3 scenarios of sea-level rise: 0 cm (baseline), 50 cm, and 100 cm. The amount and distribution of salt marsh habitat that remained under these scenarios was estimated and linked with a RAMAS-Metapop population viability model to estimate the impact of sea-level rise on the Lower Keys marsh rabbit, a federally endangered species. Sea-level rise, in general, negatively impacted persistence of the Lower Keys marsh rabbit. Our model will aid conservation planning for endangered species in the lower Florida Keys, USA.

### **SPATIAL USE OF TERRITORIES BY WHOOPING CRANES WINTERING ON THE TEXAS GULF COAST**

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Endangered whooping crane (*Grus americana*) pairs maintain territories on the wintering grounds in and around Aransas National Wildlife Refuge, on the Texas Gulf coast. Available habitat for territories has been suggested as potentially the first limiting factor the population may reach. Increased knowledge of territory characteristics and overwinter use patterns by cranes is important for ongoing conservation efforts. This study took place during winter 2003–2004 and 2004–2005 on Blackjack Peninsula, where the smallest territories occur. Territories were described using habitat type proportions (land, water, and edge) and various landscape metrics, calculated using FRAGSTATS. Crane movement paths were analyzed using Kruskal–Wallis tests to compare movement velocity (meters traveled per minute) by month and family. Territories ranged in size from 43.82 ha to 96.57 ha. Results of FRAGSTATS analysis indicate that substantial differences in the spatial distribution of ponds and edge density exist between territories. Movement velocity varied significantly by family and month, ranging from approximately 3 m / min to over 6 m / min. Whooping cranes appear to increase their exploration rate upon arrival to the wintering grounds and again prior to beginning the migration to the breeding grounds. Changes in food availability within the territory may affect this pattern.

**CLINAL AND BIOGEOGRAPHICAL GENETIC VARIATION OF THE DUNGENESS CRAB (*CANCER MAGISTER*): IMPLICATIONS FOR MARINE RESERVE DESIGN**

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Accurate knowledge of a species dispersal capability is imperative in designing a reserve that will effectively conserve that species. The Dungeness crab (*Cancer magister*) has high conservation value due to its importance in both the commercial and sport fishing industries. Recently, concerns have been raised about the sustainability of the Dungeness crabbing industry due to a decreasing catch yield and a number of fishery crashes in several areas along their range. The goal of this study is to ascertain the mitochondrial genetic variability among Dungeness crabs in order to more closely examine the dispersal capabilities of the species, which will ultimately aid in its effective conservation. A ~315 base pair region of the Cytochrome c Oxidase subunit I (COI) mitochondrial gene was isolated and sequenced from 216 adult crabs from Crescent City to Port San Luis, California January-June 2005. Nucleotide and amino acid sequences were compared within and between populations in California, and to sequences collected in the past (1997-2004) for 701 Dungeness crabs from parts of Alaska, Oregon, and Washington. Three universal nucleotide haplotypes and one amino acid haplotype were found among all locations, with slight clinal variation from Alaska through California. Genetic diversity indicates a high dispersal capability among Dungeness crabs, allowing the species to retain high amounts of gene flow between populations.

**EXPLORING THE BIOGEOGRAPHICAL IMPLICATIONS OF SEASONAL-MOSAIC FIRE REGIMES IN THE HUMANIZED SAVANNA LANDSCAPE OF SOUTHERN MALI**

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Savanna fires are a major determinant of vegetation cover. Each year fires burn vast areas of the West African savanna-woodland. Experimental studies on the long-term effects of repeated burning have shown that the tree / grass ratio is a function of the seasonality or timing of fires. Recent synchronic studies for the study region in southern Mali find that the indigenous burning regime produces a highly fragmented landscape mosaic that may influence the frequency and timing of fires for different vegetation types. This research aimed to provide a diachronic study to determine the regularity of the spatiotemporal pattern of burning for southern Mali. The study examined a series of 18 burn-scar maps generated from Landsat imagery drawn from a 30 year period (1972-2003). The burn-scar maps were combined in a GIS to determine the spatiotemporal pattern of the fire regime. Despite gaps in the data set the results indicate that the fire regime has a distinct spatiotemporal pattern that is reproduced annually creating a seasonal-mosaic landscape in which some areas regularly burn early, others regularly burn late, and some rarely if ever burn. The implications of this pattern for savanna fire management, biodiversity conservation, and savanna fire ecology are discussed.

**DNA BARCODING: A VALUABLE TECHNIQUE FOR 21ST CENTURY CONSERVATION?**

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Conservation biologists may soon be able to rapidly identify organisms with a new technology, "DNA barcoding," which relies upon a short, standardized DNA sequence (such as the conserved mitochondrial gene, *cox1*). Its advocates envision a time when anyone can simply put a small piece of an organism into a hand-held "tricolor" to identify it. Numerous biologists advocate barcoding because of its early successes and potential benefits, which have motivated extensive funding, international conferences, and diverse popular and scientific coverage. While current research focuses on whether barcoding will work, however, its broader socio-ethical dimensions have been largely ignored. In this presentation, I introduce DNA barcoding and critically assess two prevalent assumptions about its significance for conservation: (1) development of a library of barcodes and an electronic handheld field guide, the Life Barcoder, will democratize and enhance public access by empowering many more people to call by name the species around them, (2) identification of species using standardized barcodes and the Life Barcoder will engender appreciation of biodiversity locally and globally. It is important to evaluate these claims, as they are being used by proponents seeking billions of dollars to catalogue DNA barcodes.

**CHARACTERIZATION OF RARE PLANT TAXA IN VERNAL POOL ECOSYSTEMS**

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It is important to understand the distribution and characteristics of rare plant taxa present in vernal pools in order to create effective conservation and management practices. However, currently little is known about the linkage between rare taxa and particular vernal pool community types. Vernal pools were sampled throughout California from 2001 through 2005 by our University of California, Davis vernal pool team, and a subset of these data was used to characterize the distribution of rare taxa. The dataset contains 17 rare plant species in 244 plots distributed in vernal pools throughout California. The data includes information on soil, geologic substrate, location within a pool, land-use history, species lists, and cover of each species in the plot. Using these data we have been able to determine what environmental factors each plant species prefers, as well as the most common associates and community types for each rare plant species. As a consequence of this work, it should be possible to better predict the distribution of rare plant taxa and to improve policy decisions about vernal pool conservation.

**SOLITARY BEE COMMUNITIES IN A VINEYARD LANDSCAPE**

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Because bees do not pollinate grapes, the conversion of oak woodland to vineyard may present an especially difficult problem for solitary bees. These bees may lose both nesting habitat and food resources when oak woodlands are converted to vineyards. The remaining wild habitat fragments in heavily converted landscapes like the Napa Valley of California, are the equivalent of island refuges in an inhospitable sea. To study the effects of these landscape-level changes on the solitary bee

communities of the remaining oak woodlands, we developed criteria for matching sampling areas in vineyard-dominated landscapes with similar areas of oak habitat not dominated by vineyards, intensive agriculture, or development to create a randomized block design of "treatments" (areas with high degree of "vineyardization") and "controls" (oak-dominated areas). We compare solitary bee species richness and abundance in these areas and floral host use. We find a significant difference in species richness, community composition, and floral host use between treatments.

### **CAN FOREST MANAGEMENT MODEL THE WAY FOR WILDLIFE CONSERVATION ON COMMUNAL LANDS IN SOUTHERN MEXICO?**

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Mexico offers opportunities for landholders to manage forest and wildlife resources for economic gain. Can similar goals of conservation and financial growth for two different resources yield the same result on communal lands? The present study compares the purpose, application, local value, and motivation to conserve forest versus wildlife resources on communally owned land in southern Mexico. From May to July 2000, a total of 282 men from three ejido communities and two sport hunting clubs were interviewed. The sport hunting information indicates whether the ejidos could gain revenue from this sector. Using the ejido information, we explore how communal landholders can take advantage of this unique economic opportunity using their forest management as a model to boost motivation to sustainably use, and thus conserve, wildlife. Our results show that despite the short amount of time the wildlife management program has been in place and the organizational challenges of local communities under this program, the potential is high for these communities to supplement their income and increase their motivation to conserve wildlife on their lands. We also find that Mexico's resource management approach can serve as a model for other countries to follow.

### **BOLSTERING CONSERVATION BENEFITS OF THE CLEAN DEVELOPMENT MECHANISM: CAN NON-STATE CERTIFICATION SYSTEMS FACILITATE STATE-CENTERED EFFORTS?**

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To contend with the perceived shortcomings of the standard global environmental governance regime, environmental advocates have backed certification, sidestepping traditional governance institutions and in their place employing the market to generate compliance. I evaluate two recently created certification systems, the Gold Standard and the Climate, Community, and Biodiversity Standards, which have emerged in the context of conservation of biodiversity and climate change. These two certification schemes were developed in an attempt to fold non-climate environmental benefits, such as the conservation of biodiversity, into the Kyoto Protocol's criteria for emissions reduction projects. This paper assesses certification scholars Bernstein and Cashore's argument (Working Paper; November 2005), which claims that certification schemes aim to cultivate sufficient private authority and legitimacy to govern on their own. Instead, I argue that certification schemes, as demonstrated through the abovementioned two standards, can have another objective: working in tandem with and reviving public policy. This paper explores how the two standards do not fit Bernstein and Cashore's process for institutionalization and acquisition of legitimacy. It concludes with an exploration of the merits of the resultant shared private / public authority handling of climate change and conservation of biological diversity, as well as other environmental problems.

### **REDUCING TRANSACTION COSTS OF THE CLEAN DEVELOPMENT MECHANISM**

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Much enthusiasm surrounds the Kyoto Protocol's Clean Development Mechanism (CDM) and its subsequent carbon market's ability to financially justify preservation efforts. However, the growing cost increase of emissions abatement and trading credits threaten these projects' financial success. Here, we identify and analyze the transaction costs of greenhouse gas emissions trading using current knowledge of projects and existing case studies from 24 countries. By initially defining transaction costs as those that are not directly attributed to greenhouse gas (GHG) reduction and which are specific to the CDM authorization process, we were able to categorize and quantify specific costs of past and existing projects. Total transaction costs for CDM projects can range between US\$20,000 to US\$1 million depending on the type, size, and timeframe of the project. Additionally, while the highest transaction costs per unit of carbon were found to arise from small-scale projects, costs vary with project type and host country. Recommendations for transaction cost reduction include project bundling, the creation of a methodology-licensing scheme (similar to that of pharmaceutical companies), increased use of information technology to facilitate project development, and increased capacity for CDM authorities.

### **MARKET DRIVEN CHANGE COULD IMPROVE THE CONSERVATION ROLE OF TROPHY HUNTING IN AFRICA: EXTERNAL ACCREDITATION OF HUNTING OPERATORS**

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Trophy hunting is of major significance to conservation in Africa by providing economic justification for wildlife-based land uses over vast areas. However, there are limitations to the conservation role of trophy hunting, some of which are common to multiple African countries. Some conservationists have suggested independent accreditation of hunting operators to address these problems. We investigated the potential efficacy of accreditation by administering a questionnaire to hunting convention attendees. We assessed hunting client preferences and operators' perceptions of client preferences. When purchasing hunts, clients are less concerned than operators realized with guarantees of obtaining trophies and more concerned with experiencing wilderness and biodiversity, and knowing that their hunt benefits local communities. Contrary to operators' beliefs, clients are less willing to hunt where conservation issues are compromised. These data suggest that clients would select operators who contribute to conservation and community development and discriminate against those who do not. However, partly due to the nature of advertising by hunting operators, clients are unable to select among operators on these bases. An independent

accreditation system would enable market-based change in the hunting industry by creating incentives for operators to conduct hunting activities in a manner conducive to conservation and community development goals.

**SURVIVORSHIP OF ENDANGERED *SYLVILAGUS BACHMANI RIPARIUS* (RIPARIAN BRUSH RABBITS) FOLLOWING WILDFIRE AND FLOODING**

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*Sylvilagus bachmani riparius* is an endangered subspecies of brush rabbit native to the Central Valley of California. In July 2002, we began releasing captive-born riparian brush rabbits at the San Joaquin River National Wildlife Refuge (SJRNR) as part of a controlled propagation and reintroduction program. In July 2004, a major wildfire burned a significant amount of the riparian community at SJRNR. In the spring and summer of 2005, persistent rain and an unusually heavy and rapid Sierra Nevada snowmelt led to substantial flooding at SJRNR. During and following these events, we conducted intensive monitoring of the reintroduced rabbit population via radio-telemetry. Of the 47 radio-collared rabbits that inhabited areas threatened by the fire, we believe only three died as an immediate result of the event. Within 180 days of the fire's ignition, 24 of the collared rabbits had died (49.0%). During the same 180-day period in 2003, we observed 15 mortalities in 30 collared rabbits (50.0%). Of the 35 collared rabbits that inhabited flooded areas, 13 died within 15-days of inundation (37.1%), and 22 died within 180 days (62.9%). We believe the lower survival of rabbits during flooding was due to the prolonged inundation and scouring of suitable and familiar habitat.

**NOCTURNAL EMERGENCE AND FORAGING OF THE WESTERN TOAD (*BUFO BOREAS BOREAS*)**

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Published research on nocturnal foraging of the sensitive-listed (USFS) western toad (*Bufo boreas boreas*) has been primarily limited to controlled laboratory settings. Conclusions about movement and habitat use have been based solely on daytime measures, which may miss important foraging habitat and underestimate movement rates. Our study was twofold: test environmental cues that may be involved in the initiation of toad foraging, and monitor the first two hours of feeding activity to examine differences in movement and habitat use between day and nighttime periods. We examined nighttime emergence of seven adult toads at the Lubrecht Forest, Montana. Potential environmental cues, ambient light, ground temperature, air temperature, and humidity, were recorded. Ambient light appears the most closely related to emergence, with all toads delaying onset until well below 5 lux. The foraging activity study was limited to the tracking of three toads from emergence through two hours of feeding. Distance traveled averaged 21.62 m, and foraging radius averaged 8.85 m, but no consistent pattern in directionality or macrohabitat use existed. This limited study suggests that daily habitat may not be reflective of nighttime foraging habitat use, and that land use planning exercises may be underestimating land usage requirements of the foraging western toad.

**PREDICTING CHANGES IN HABITAT AVAILABILITY DUE TO MANAGEMENT DECISIONS REGARDING ARTIFICIAL WATER SOURCES: A CASE STUDY OF BIGHORN SHEEP**

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The use of water developments for wildlife conservation is a contentious issue. In Joshua Tree National Park, California, decades of pumping water for gold mining before 1960 and increased water use for urbanized areas outside the park led to the disappearance of several naturally occurring springs within desert bighorn habitat. As a conservation measure, wildlife managers established a number of water developments in sheep habitat. However the present day emphasis to maintain a "natural" environment has led to management decisions to stop future maintenance of these artificial water sources. How the loss of this water will impact the population is unknown. Based on GPS locations of bighorn ewes from 2002-2004, we used logistic regression and GIS to model past and present availability of critical summer habitat within the park. We then used GIS-based models to predict how the loss of man-made water sources would affect habitat availability. The models predict a 77% loss of currently available critical summer habitat and a substantial increase in the distance between habitat patches. In light of the anthropogenic changes to water availability, active maintenance of current man-made water sources may be essential to the future sustainability of desert bighorn sheep in Joshua Tree National Park.

**COMPARATIVE ECOLOGY OF TWO JAGUAR POPULATIONS UNDER DIFFERENT LAND TENURE AND HUMAN DISTURBANCE REGIMES IN MEXICO**

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Jaguars (*Panthera onca*) remain one of the least known felid species of the world with a trend to persist in remote pristine places, and increasingly becoming in contact with humans. The objective of this study was to compare the basic ecology of two jaguar populations under contrasting management systems to understand their conservation needs while coexisting with humans. The study sites are located in Sonora and Querétaro, Mexico. On these study areas we utilized a suite of methods (spoor, camera-traps, and prey surveys) to determine distribution, habitat association and abundance. We found significantly different habitat use between populations, where both species are mainly associated to tropical forests; also jaguars in Sonora are using oak-woodlands, and pine-oak in Querétaro, avoiding human created habitats. We found jaguar abundance in Sonora as 1.4 individuals per 100 km<sup>2</sup> in Sonora, and 0.5 individuals per 100 km<sup>2</sup> in Querétaro. Ungulate prey abundance is significantly higher in Sonora than Querétaro. Another difference between areas is the lack of human presence in Sonora.

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Although both populations are vulnerable to extirpation, the causes are different; Sonora is more exposed to poaching, while Queretaro is affected by human encroachment and habitat fragmentation.

### **MAMMAL ABUNDANCE AND RICHNESS IN A TROPICAL FOREST OF THE SOUTHERN YUCATAN PENINSULA**

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Around the world tropical forests provide shelter for more than a half of the total animal species on earth, they are one of the most productive ecosystems. Despite of their total earth coverage (only 7%) they provide countless environmental services. Nowadays Mexican tropical forests patchiness has been increasing as outcome of deforestation process, which in turn has diminished mammalian diversity. In the present work we used camera traps to evaluate richness and relative mammal abundance in a tropical forest of the southern Yucatan Peninsula, Mexico. With 32 cameras (35 mm CamTrakker) 8 plots of 4 km<sup>2</sup> were established in the study site and remained there for 50 days. As upshot we obtained 206 pictures corresponding to 18 mammal species (jaguar, ocelot, margay, mountain lion, and Bairds tapir, among others), species with highest frequency appearance were white-nosed coati, paca, and agouti. The study site has enormous ecological relevance because it shelters many species with high extinction risk like Bairds tapir, ocelot and jaguar. Long term monitoring of this site will allow us to develop better management and conservation plans.

### **EFFECTS OF HABITAT FRAGMENTATION ON BIG AND MEDIUM-SIZED MAMMAL COMMUNITY IN SAO PAULO STATE (BRAZIL)**

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Sao Paulo State is the most densely populated in Brazil, and consequently, a few patches of the native vegetation remain. However, big and medium-sized mammals are still present, including endangered species like *Puma concolor*, *Chrysocyon brachyurus*, *Myrmecophaga tridactyla*, and others. The area of this study considered 7 fragments of savanna and semideciduous forest and their surroundings, composed essentially by sugar-cane and eucalyptus monocultures. To understand how the process of habitat fragmentation influenced the occurrence of big and medium-sized mammals, 23 camera traps were installed in the study area, remaining there for 17 months. From the 15 species registered, *Puma concolor*, *Chrysocyon brachyurus*, and *Tayassu tajacu* explored the landscape most intensely, with a relative frequency index (RFI) of 12; *Leopardus pardalis* and *Herpailurus yagouaroundi*, in contrast, registered RFI of. *Chrysocyon brachyurus* showed the highest relative abundance index (RAI = 0.00485), followed by *Puma concolor* and *Tayassu tajacu* (RAI = 0.00416). MANOVA tests suggested the distribution of these mammals in the landscape is more influenced by the habitat quality in the patches and matrix than by the vegetation type. Therefore, keeping the quality of the fragments is vital to save one of the last mammal refuges in the region.

### **CAN ECOSYSTEM-BASED MANAGEMENT BETTER CONSERVE THE PROTECTED SPECIES OF THE NORTHWESTERN HAWAIIAN ISLANDS?**

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Ecosystem-based management (EBM), a method of managing increasing demands on natural resources, is often used in terrestrial environments; however, its use in marine environments has proved difficult to define and even more so to implement. Due to the dominant role of fisheries in current management, EBM in marine environments usually occurs within the framework of Ecosystem-Based Fisheries Management (EBFM), which does not provide a platform for various regulatory agencies to oversee the diverse and complex aspects of marine ecosystems. The northwestern Hawaiian Islands, a proposed National Marine Sanctuary, presents a unique case study for how EBM could provide better overall protection and management of unique resources at stake. Managing human uses for ecosystem sustainability is a difficult task due to limited understanding of interconnection among species and the impact of outside activities on these connections. However, due to remoteness and limited human presence, the NWHI provides a relatively simplified system around which to develop a marine EBM plan. Significant to the ecosystem management of this region are the conservation needs of protected species such as endangered Hawaiian monk seals, green sea turtles, and albatrosses. Given the uniqueness of the NWHI and its evolving management status, this study addresses factors affecting the design and implementation of a more integrated, comprehensive marine EBM plan and its conservation potential in this region.

### **LINKING SCIENTIFIC RESEARCH, EDUCATION AND PROMOTION OF SUSTAINABLE ACTIVITIES TO CONSOLIDATE A BIOLOGICAL CORRIDOR IN THE ATLANTIC FOREST OF ARGENTINA**

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Atlantic forest is considered one of the 5 priority world hotspots of biodiversity, whereas less than 7% of this ecosystem remains in Brazil, Argentina and Paraguay. In this fragmented scenario, ecological corridors are necessary to maintain the connectivity of the forest remnants. Since 2002 we have conducted a project to preserve and increase the ecological connectivity between two important protected areas in the Atlantic forest of Argentina through scientific research, restoration, environmental education, promotion of non-timber activities, and agroecological practices. We used satellites images to detect a reduction (+ 40%) in forest cover of the corridor in the 1987–2002 period, and to identify corridors of continuous forest between protected areas. To assess the functionality of the corridor we implemented a bird-ringing program with 72 species captured in 4500 hours / net. With this information we created an education program in local schools and a media strategy to emphasize the importance of this area. In 2005 in cooperation with others, NGO, and the provincial government we acquired a portion of continuous forest in the corridor to create the first co-managed biological corridor provincial reserve. The long-term sustainability of this novel protected area and private lands in the corridor is our challenge.

**EVALUATION OF CONSERVATION STATUS OF BIODIVERSITY AND PRIORITIZATION OF AREAS IN CAUCA VALLEY, COLOMBIA**

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The Cauca Valley is a region of Colombia with great biological diversity, especially of birds but with a protected area system designed mainly ad hoc. Based in the conservation planning framework we evaluated if current protected areas are enough to protect this biodiversity. We used ecosystems, some species of birds and mammals, and ecological processes as surrogates. With maps of potential distribution of species, original ecosystem distribution, and localization of ecological processes we set the targets for biodiversity conservation and analyze if this the target achievement of the surrogates within the current protected area system. We found that this system have to be improve in order to preserve the biodiversity in a long term. Many ecosystem types especially dry forests and shrubs are not included at all. Also many species distribution areas are not within the areas as well as a considerable extension of the components that represent ecological processes as altitudinal gradients and riverine corridors. We propose new areas in order to enhance the protected area system based in the results of an irreplaceability analysis. The outcomes of this research are going to be used by decision makers to set new protected areas or corridors.

**PRIORITIZATION OF U.S. NATIONAL WILDLIFE REFUGE LAND ACQUISITIONS FOR BIODIVERSITY PROTECTION**

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The field of conservation biology is filled with research on optimizing land protection for biodiversity and protected area design. Few studies have looked at the practical application of land protection prioritization methods used by government agencies. The U.S. Fish and Wildlife Service among federal agencies in its wildlife conservation mission and its ability to establish new national wildlife refuges without an act of Congress. The USFWS uses its Land Acquisition Priority System (LAPS) to rank land acquisition projects based largely on biological criteria. In 2001 the USFWS made major changes to its LAPS. We analyzed the land acquisition priorities and funding trends of the USFWS before and after these changes in LAPS to determine if different habitats or species groups were emphasized between years. We found that USFWS priorities prior to changes in LAPS emphasized waterfowl and wetland protection, while after changes in LAPS increased emphasis on endangered species and grassland protection. The majority of Congressionally appropriated funds, however, were for projects that the USFWS did not request funding for. Other factors appeared more important in project selection than biological need. This paper reflects on the interaction between science and policy in habitat protection.

**DIET AND FORAGING ECOLOGY OF A PARROT COMMUNITY (FAMILY: PSITTACIDAE) IN COSTA RICA: IMPLICATIONS FOR PROTECTED AREA DESIGN**

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Conservation of the parrot community (Family: Psittacidae) in Curu National Wildlife Refuge, a private reserve in Costa Rica, depends on the identification and preservation of the most important food resources in the diet of each parrot throughout the year. The area contains 6 parrot species ranging from 65–900 g, each requiring a diverse mix of seeds, fruits, flowers, leaves and bark (food types) in order to sustain themselves. From August 2003–July 2005, we documented the parrots' diets and foraging ecologies by walking transects through the site's main habitats a minimum of 3 times per week. After recording the tree species, food types, and dates and times of each parrot foraging bout over the 2 year period, we documented 1159 foraging bouts on 61 food plant species in 25 families. Larger parrots like the Scarlet Macaw (*Ara macao*) foraged mainly on seeds, while smaller parakeets foraged mainly on fruits. As a community, the parrots foraged in all habitats and areas of the reserve, and were found to forage in adjacent areas to the reserve. Protected area design and conservation on adjacent private lands will be vital to the long-term conservation of this community of parrots.

**SERVER BASED TOOLS AND GEODATABASE TO SUPPORT DISPARATE USERS INVOLVED WITH MARINE PLANNING IN CALIFORNIA**

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Geographic information systems (GIS) are increasing in popularity as a means of supporting planning efforts but traditionally complex spatial analyses have been restricted to serving the technically proficient. Planning efforts that involve scientists, GIS specialists, and stakeholders pose a unique challenge to integrate tools that satisfy the needs of all user populations. We developed a marine geodatabase and server architecture to support marine planning in California, including MPA planning by the state's Marine Life Protection Act (MLPA) and planning efforts undertaken by the National Marine Sanctuaries. These efforts require extensive geospatial data layers and visualization tools to support the stakeholder and scientists developing alternative designs for MPA networks. An extensive decision support system (DSS) was developed that includes an ArcSDE / SQL geodatabase, ArcIMS web-maps, an ArcGIS server-based MPA decision support tool, and multiple terminal servers for running custom ArcGIS model builder tools. We describe the complete architecture associated with this decision support system, including information flow and the interactions among software and hardware elements. Our GIS based decision support system may serve as a model system for marine planning efforts in other state or federal processes.

**COMMUNITY FIELD SURVEY OF THE ENDANGERED AFRICAN WILD DOG (*LYCAON PICTUS*) IN SOUTHEASTERN KENYA**

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One of the world's most endangered predators, wild dogs have dramatically declined with perhaps only 5500 remaining. Wild dogs are particularly vulnerable to extinction because they are wide-ranging and most live in unprotected areas increasing the risk of conflict with people. Virtually nothing is known about the status, distribution, or ecology of a recently confirmed population in the Biodiversity Hotspots of southeastern Kenya. During Phase I of a long-term community-based project, locals trained in survey techniques carried out the first large scale biological survey. In contrast to reports in the 1997 IUCN / SSC African Wild Dog Action Plan, the survey team found that wild dogs are widely distributed in semi-arid bushland and woodland, and coastal forests sampled. Reported group sizes (mean: 7.7, range: 220 including pups; n = 44) are similar to other areas. Livestock owners reported almost twice as many losses due to lions or hyenas than wild dogs. Most people see 13 lions together suggesting numbers are low, which could benefit wild dogs because lion predation is a major cause of mortality. Our findings indicate there is a potentially viable wild dog population that may be an important link for the metapopulation in the Horn of Africa.

**CONSERVATION PLANNING FOR SALMONIDS IN A CHANGING CLIMATE**

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This paper presents the application of a conceptual framework for conservation planning in a changing climate. The framework employs a climate sensitivity response (CSR) curve representing a key relationship between climate change and a conservation target as a tool for focusing adaptation planning and site management. The nonlinear relationship between increases in air temperature resulting from future climatic change and stream temperature provides a useful CSR for addressing a key impact of climate change on salmonids. The CSR approach can incorporate the impact of synergistic threats to salmonids including the removal of riparian vegetation that can increase direct solar gain, the elimination of flood flows and the removal of large woody debris that reduces hydrological complexity and deep pools that provide cold water refuges, and logging, grazing, and construction of impervious surfaces that accelerate stormwater runoff. The CSR approach also provides a tool for assessing adaptive opportunities that increase the resilience of salmonids, including the restoration of riparian ecosystems and instream habitat to increase shading and cold water refuges, managed releases of cold stored water from dams to maintain stream temperatures, and prioritization of site selection, protection and restoration efforts across sites.

**ENHANCING EXPERT OPINION ON OREGON COAST COHO SALMON (*ONCORHYNCHUS KISUTCH*) CRITICAL HABITAT WITH A DECISION SUPPORT SYSTEM**

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The listing of Oregon Coast coho salmon (*Oncorhynchus kisutch*) as threatened in 2000 required NOAA Fisheries to designate critical habitat. An expert panel, convened for the purpose, found there were massive, unwieldy, data sets available. In order to create a transparent, repeatable decision process they adopted a fuzzy logic-based decision support system (DSS). The DSS design incorporated expert opinion by first describing the data to use, then reviewing the available data and defining the decision process. We then constructed a DSS that simulated the expert decision process. The team applied the resulting DSS to 82 watersheds on the Oregon Coast and used the results as the basis of their recommendations. They identified 42 watersheds with high value for conservation, 28 medium, and 10 low. Our experience suggests that the combination of a DSS and professional judgment works well for making recommendations regarding conservation policy. The DSS allowed for full transparency in the basis of the recommendations and allowed the final expert review to incorporate data and human experience the DSS could not analyze. Enhancing professional judgment with a DSS can result in clearer, more accurate, and more acceptable recommendations.

**HABITAT MANAGEMENT GUIDELINES FOR AMPHIBIANS AND REPTILES**

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Habitat alteration, fragmentation, and loss are considered to be major challenges for the conservation of amphibians and reptiles (or herpetofauna). Herpetofaunal populations in the United States are declining, and as long as human populations expand, habitats will be modified. Thus, Partners in Amphibian and Reptile Conservation (PARC) recognized an opportunity to provide proactive guidance for improving the compatibility of land management practices with these animals. PARC has developed a series of regionally-specific best management practices, or Habitat Management Guidelines (HMGs). These guidelines use the best science available to produce recommendations that are easily understood and practical for land managers and private landowners. The objectives of these guidelines are to keep common species common, stem the decline of imperiled species, provide guidance on the management and restoration of amphibian and reptile habitats while benefiting other many other wildlife species, and reduce the likelihood of species becoming listed as threatened or endangered. Landowners and land managers are presented with measures to help them maximize compatibility with their existing management objectives, or to optimize their management actions specifically for herpetofauna. We will present examples of the management recommendations from the HMGs, as well as information on PARC's development of accompanying training modules.

**BIODIVERSITY ISSUES IN U.S. PACIFIC NORTHWEST MANAGED FORESTS**

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Challenges to biodiversity conservation in managed forests of the US Pacific Northwest are a complex mix of biological, socio-economic, policy, and management concerns. Biodiversity in regional managed forests are a particular concern, with about 200,000 km<sup>2</sup> (48%) of the landscape in the states of Oregon and Washington having forest cover. Current disturbances across this expanse are predominantly related to timber harvest, but also include recreation, cattle grazing, mining, fire, invasive species, disease, and the concern of habitat alteration due to climate change. Over 300 vertebrates are associated with the humid western portion of this forested landscape alone, and biodiversity concerns regionally extend to a broader array of taxa including vascular plants, lichens, bryophytes, fungi, and invertebrates. We synthesize current directions regarding ten topics: (1) regional biodiversity priorities, (2) aiming for ecological function, (3) comparing active and passive management approaches, (4) habitat modeling, (5) invasive species, (6) monitoring, and (7) information systems. Successful conservation programs must clearly identify the definitions, processes or roles of each of these areas in an adaptive-management framework in which management is conducted as learning trials from which to evaluate and readjust decisions.

**COMPARISON OF METHODS FOR ESTIMATING DENSITY OF THE ENDANGERED GOLDEN LION TAMARIN AND THE INTRODUCED MARMOSET IN BRAZIL'S ATLANTIC COAST FOREST FRAGMENTS**

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Surveys of primate species in their natural habitat yield essential information for species conservation initiatives. However, these researches should use rigorous techniques capable of yielding accurate data. Censuses of the endangered golden lion tamarin (*Leontopithecus rosalia*-GLT) and the introduced marmosets (*Callithrix* spp.-CM) were carried out using three different methods in five forest fragments where the absolute GLTs density had been previously calculated during long-term studies. Accurate individuals densities of GLTs were obtained using line transect and play-back methods, but with large variances. There were significant differences in the variances between densities calculated using both line transect and play-back methods indicating play-back as a recommended method to survey GLTs. No significant difference was found in the densities of CM using three different methods, linear transect, play-back, and capture-recapture. Densities of CM with smaller variance were obtained using the capture-recapture method. This can be explained by the previous habituation of the marmosets with the capture sites and traps, making the capture easier during the study. Researchers usually standardize their methods to obtain comparable census data. However, this study showed for play-back methods that researchers should be aware of the behavioral differences between species and populations because it can result in biased data.

**A HOLISTIC APPROACH TO MASTER PLANNING FOR CONSERVATION AND INTERPRETATION: CATALINA ISLAND CONSERVANCY'S INTERPRETIVE PROGRAMMING**

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Land managers often find that the areas they manage have deep ties to the local community, their cultural history, and their local identity. When that community serves as a gateway to the protected land there is often a great challenge of keeping a balance between access and conservation management goals. The Catalina Island Conservancy has a dual role to protect and preserve its lands while also serving the recreational interests of the local and visiting communities. To meet this part of its mission the Conservancy has worked with local stakeholders in the interpretation of conservation management and natural history through a Master Interpretive Plan. This plan has effectively incorporated conservation goals with tourism, the mainstay of the local economy. The community-based Master Interpretive Plan integrates an in-depth survey of local and visiting community demographics and economy, several conservation forums with local stakeholders, a certification and professional development program for local guides and interpreters to ensure correct and consistent messages and facts, and evaluation tools to assess the long-term effectiveness of this approach. This poster highlights the major elements of the Plan and provides examples of specific products, concepts, and implementation strategies.

**SPATIAL ECOLOGY AND ABUNDANCE OF MEXICAN BOBCATS IN NORTHWESTERN MEXICO TO ASSESS ITS CONSERVATION STATUS**

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A lack of ecological studies on bobcats (*Lynx rufus*) in Mexico has precluded wildlife managers and decision makers to successfully determine its conservation status; the objective of the study was to gather baseline ecological data to help assess its conservation status in the sky islands of the Sierra Madre Occidental. Utilizing a suite of methods (spoor, camera-traps and observations) we determined habitat seasonal use for 2002, 2003, and 2005. Bobcats used 9 habitat types, most importantly juniper-oak woodland (34.8% records), pine forest (18%) and pine-oak (15.5%), significantly differing from availability; we also recorded significant differences between years and seasons. Habitat use was similar between 2003 and 2005, differing from 2002. We estimated a density of 1 individual per 20 km<sup>2</sup>, which is low compared to other bobcat studies. Low abundance and spatial habitat use patterns appear to be related to precipitation variation and consequently on prey distribution. Alternative restrictions on harvest and modification of conservation status should be applied to this population classifying it as vulnerable to extinction.

**A SURVEY OF CAVE DWELLING BATS OF NORTHERN MEXICO**

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## **Conservation Without Borders • Abstracts, Contributed Poster Presentations**

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The United States–Mexico border is home to the world’s largest remaining bat populations, and these bats play vital economic and ecological roles. Some borderland bats species form enormous colonies in caves, and they are exceptionally vulnerable to human disturbance and vandalism. Such species will never be secure until key roosts are identified, protected, and monitored. In 2003 we started a long term project to identify, monitor, and protect the most important bat roosts in northern Mexico. To date we have estimated a population of about 15.5 million bats in 31 undocumented roosts in the Mexican states of Baja California, Coahuila, Nuevo Leon, and Tamaulipas. Eight of them are major free-tailed bat (*Tadarida brasiliensis*) caves, three are for Ghost-faced bats (*Mormoops megalophylla*), two for lesser long-nosed bats (*Leptonycteris curasoae*), and one for Cave Myotis (*Myotis velifer*). Six free-tailed bat caves had been mined for guano, and the bat populations at three is extirpated.

### **RAPID INVENTORY, ASSESSMENT, AND STATUS OF ASPEN IN A SIERRA NEVADA WATERSHED**

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Aspen (*Populus tremuloides*) has been dramatically reduced in forests throughout the western United States, yet few land managers have systematically evaluated aspen stand condition and extent at a watershed scale. Here, we summarize results from a rapid inventory and assessment of aspen in the Clavey watershed, one of the longest remaining free-flowing rivers on the west slope of the Sierra Nevada mountains. At the watershed scale, we compared systematic drainage walks to aerial and remote-sensing inventory efforts in order to determine the most accurate and efficient methods of detecting aspen. In each stand we measured aspen canopy cover and stand composition at three different heights. Prevalence of conifer encroachment, grazing, and wildfire history were also examined. Results to date indicate that over 75% of the aspen stands are losing their overstory faster than it is being replaced and are likely to become extirpated without natural disturbance events or active management. These data will be used by a multi-stakeholder watershed group to prioritize local management actions and identify restoration opportunities.

### **LAS CALIFORNIAS BINATIONAL CONSERVATION INITIATIVE: A VISION FOR BIODIVERSITY CONSERVATION AT THE BORDER OF ALTA AND BAJA CALIFORNIA**

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Renowned as a global hotspot of biodiversity and threat, the California South Coast Ecoregion is bisected by the United States–Mexico border. Increasingly, border security measures and urban encroachment threaten to sever the ecological cohesion between the two sides. We conducted an analysis to identify a conservation reserve network within the border region that would represent the full complement of natural communities of this biogeographically rich, coast to mountains to desert landscape. We utilized a site selection algorithm (SPOT) to identify areas of exceptional biological richness (based largely on vegetation-type diversity) and high ecological integrity (based largely on degree of human land use impact). Asymmetries across the border in data quantity and quality, characteristics of land use, and public land ownership complicated the analysis. We depict our results by dividing the study area into four categories of conservation value; threats and strategies also divide into these categories. A priority of this analysis was to identify areas where binational corridors might best be protected to maximize ecological permeability across the border. Existing development impacts already constrain opportunities for such connectivity, highlighting the urgency for binational conservation action. We discuss the complementarity of this “vision” with other societal objectives, including border security efforts.

### **THE IMPACT OF FIRE ON THE FOREST TREE DYNAMICS IN BWINDI IMPENETRABLE NATIONAL PARK, SOUTHWESTERN UGANDA**

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Much as tropical evergreen forests are thought to be fire resistant ecosystems due to lack of sufficiently dry fuel loads, this assumption is rapidly collapsing with the proliferation of recent forest fires in the world including Bwindi Impenetrable Forest, a home to a diversity of flora and fauna including the critically endangered mountain gorilla. Knowledge about the effects of such fires is very limited. This study investigated fire effects in this Afromontane environment by use of plot sampling along line transects. The major goal of this study was to determine the effects of fire on seedlings, saplings, poles, and trees. Here, I present a comparison of fire impacts in 30 burnt and adjacent unburnt sites. The study was able to characterize both fire prone and fire resistant tree species and determine the regeneration patterns (recovery rate) of the burned sites. The study goes on to recommend a strategy of using fire resistant tree species as boundary markers and creation of buffer zones for conservation of this delicate Afromontane environment.

### **MANAGEMENT OPTIONS OF YALA PAPYRUS SWAMP FOR SUSTAINABLE DEVELOPMENT AND BIODIVERSITY CONSERVATION**

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Yala wetland is a rare resource in Kenya, always a center of controversy between the developers, local community, and conservationists since the 1950s. Although its ecological importance has been recognized, management options that ensures sustainable development for the locals, who live in abject poverty, and the conservation of the threatened biodiversity are lacking. A survey that involved interviewing locals living within a 20 km radius from the wetland on its utilization, resources inventory, and regeneration was undertaken. The wetland resource base was categorized into open water, wetland vegetation, and lacustrine based on ecological, economical and cultural significance. Valuation of the returns from the wetland utilized by locals as water source (53%), food (60%), grazing (58%), construction materials (68%), household equipment (98%), fish (61%), cultural significance (23%), medicinal (45%), and fuel (45%). Ecological importance of the wetland included habitat for fauna (birds, fish, and animals), and hydrological functions. Conservation and local community desires were compatible, and the management option that could ensure biodiversity conservation and artisanal utilization by locals had the best short and

long-term value of US\$12 billion per annum that was 590 and 230% higher if the resources was utilized either for agriculture or grazing respectively.

#### **IDENTIFICATION AND CONSERVATION OF NEW IMPORTANT BIRD AREAS (IBAS) IN LEBANON**

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Lebanon is on the migration "super-highway" between Africa and Europe / Siberia, hosting large numbers of migratory birds twice yearly, a resident Middle East endemic in Syrian Serin, and several breeding biome-restricted species. However, to date only four IBAs have been declared. We are working on a three-year program with the Society for Protection of Nature in Lebanon (SPNL), the Birdlife International local partner, to gain qualification for IBA status for new sites under the various Birdlife International criteria. Between 2005 and 2007 we shall survey all prospective sites in the country. In 2005 we visited twelve locations at least six times each and surveyed for avifauna and non-avian biodiversity. Additionally, we assessed threats, land use and site conservation requirements. Four locations surveyed by A Rocha Lebanon and two surveyed by SPNL have been recommended for IBA status under one or more of the following Birdlife criteria: bottleneck sites for migratory soaring birds (A4.iv), hosting significant number of biome-restricted species (A3) and breeding site for globally threatened species (A1). In 2006 we will survey more sites and will also be involving local communities in building "stakeholder" teams to protect and manage IBAs, thus achieving conservation of biodiversity in previously threatened locations.

#### **LANDSCAPE FACTORS AND COMMUNITY COMPOSITION IN A NATIVE PARASITOID GUILD: A CASE STUDY IN CONSERVATION BIOLOGICAL CONTROL**

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This study outlines the (1) temporal and spatial variation in the composition of the parasitoid guild of the native herbivore sunflower moth (*Homoeosomae electellum*), which is the most serious pest of agricultural sunflower in California and (2) the landscape factors that influence parasitoid guild parameters such as species richness and overall parasitism. At 32 agricultural and self seeding sites in California's Great Central Valley, sunflower moth larvae were collected and reared in order to survey parasitoid species richness, contribution to overall parasitism by each species, and relative life history strategies of the parasitoid guild during 2003, 2004, and 2005. In addition, sentinel larvae were exposed to parasitoids during three separate periods of the 2005 season to clarify temporal patterns. Survey and sentinel experiment results were analyzed using a principle components approach to look for landscape features that influence parasitoid guild composition factors. Presence of perennial plant habitat within one mile of the collection site and pesticide use within a one mile radius significantly affected parasitism parameters. The aim of this work is to continue to define the community, population, and landscape level factors affecting beneficial insect populations in landscapes fragmented by land use changes and pesticide applications.

#### **CONSERVATION STATUS OF THE NIGERIAN CHIMPANZEE (*PAN TROGLODYTES VELLEROSUS*) IN CAMEROON**

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Unregulated wildlife hunting, habitat loss and degradation threaten the Nigerian-Cameroon chimpanzee (*Pan troglodytes vellerosus*) with extinction. As expected, many remnant forests have lost most of their megafauna, including significant populations of chimpanzees. We undertook a review of the distribution patterns and numbers which reveals that there are only 5000-8000 Nigeria-Cameroon chimpanzees in the wild between rivers Sanaga in Cameroon and Niger in Nigeria. The rapidly declining population of chimpanzees in general merits attention because, more than any other species, they closely resemble humans genetically, behaviorally, and physically, and thus provide an important link to our evolutionary history. The current paper reviews the status of Nigerian-Cameroon chimpanzee in Cameroon and complements the action plan for the subspecies in Nigeria. Clearly, the survival scenario for chimpanzees would be improved by increasing the management effectiveness of priority sites. Significantly there is urgent need for systematic surveys of the subspecies throughout its distributional range, identify priority areas, and implement conservation interventions to ensure their long term survival.

#### **IMPACT OF INVASIVE SPARTINA ON AVIAN COMMUNITIES IN SAN FRANCISCO BAY TIDAL SALT MARSHES**

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Atlantic smooth cordgrass (*Spartina alterniflora*) was introduced into San Francisco Bay in the 1970s, and has since spread and hybridized with native cordgrass. The exotic cordgrass has become abundant in many marshes, with potentially serious impacts on native plants and animals. We assessed the impact of the *Spartina* invasion on avian saltmarsh communities by comparing the distribution and abundance of species in invaded marshes and uninvaded marshes. In spring 2005, we conducted variable circular plot surveys in seven invaded and five uninvaded marshes for a total of 65 points. We found over four times as many Alameda song sparrows (*Melospiza melodia pusillula*, a California Species of Special Concern) in uninvaded, native marshes than in invaded marshes, and, in contrast, nearly four times as many marsh wrens (*Cistothorus palustris*) in *Spartina*-invaded marshes than in native marshes. Results were more equivocal for California clapper rails (*Rallus longirostris obsoletus*, a federally endangered species) but we detected slightly more rails in invaded marshes than in native marshes. Our results indicate that while native birds may occupy *Spartina*-invaded marshes, alteration of tidal marsh habitat associated with the invasion may be favoring marsh wrens, who normally occupy fresh- or brackish-water marshes, over saltmarsh-obligate species.

### **NUTRIENT COMPOSITION OF DIETS CONSUMED BY THREATENED SOUTHERN SEA OTTERS**

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The slow growth of the threatened sea otter (*Enhydra lutris*) population in California is accompanied by several phenomena, such as low and declining mass to length ratios, high and increasing time spent foraging, high dietary diversity at the population level, high dietary specialization at the individual level, and high rates of infectious disease, that are consistent with nutritional inadequacies in otter diets. We are investigating nutritional constraints on this population by combining an examination of the nutrient composition of otter prey with information on the diet consumed by individual wild otters. The diets consumed by individual otters vary greatly, with each otter concentrating on only a few types of prey. We are analyzing samples of over 80 species of otter prey including crustaceans (Cancer crabs, kelp crabs), echinoderms (sea urchins, sea stars), bivalves (mussels, clams), gastropods (*Tegula* snails, abalone) and echinoderms (fat innkeepers). Most otter prey are low in fat (less than 10%, dry matter basis), fat-soluble vitamins, and energy but high and variable in protein and calcium content. Variation among prey species in the nutrient composition of the edible fraction suggests that diet choice has nutritional consequences for individual otters but impacts at the population level are uncertain.

### **PREPARING TO ASSESS CLIMATE CHANGE EFFECTS ON AUSTRALIA'S MARINE ECOSYSTEMS**

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Australia harbors a highly endemic marine biodiversity and many species of great conservation concern. Some observed shifts in ranges and phenologies appear related to predicted long-term climate / ocean changes. These observed shifts imply shifts in the composition, structure, and functions of marine communities, and thus their ecosystem services. Climate change projections are being used to inform range change predictions, but these predictions are limited by a paucity of monitoring and ecological studies that would provide baseline information for Australia's key marine biota and ecosystems (and by climate model resolution). We reviewed sensitivities of particular Australian species to variations in physical and chemical characteristics, enabling a ranking of the relative vulnerabilities of species-of-concern. However, direct studies of climate change impacts, notably on intertidal fish, invertebrates, and birds, are still generally few in Australia outside of Great Barrier Reef coral studies. Much of the knowledge of marine ecosystem responses to climate change around the world emerged serendipitously from existing monitoring programs, fisheries catch data, and paleo-oceanographic studies. Australia could vastly improve its ability to assess climate-driven changes to its marine ecosystems by implementing assessment and monitoring programs that track changes in indicator species / assemblages / ecosystems in relation to physical and chemical changes.

### **USE AND NON-USE VALUES OF THE YALA SWAMP, KENYA TO THE LOCAL COMMUNITY**

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The Yala is an extensive inland swamp in western Kenya. This is a report of a four-month survey of the use and non-use values of the Yala Swamp to neighboring communities, using mainly questionnaires to interview 38 local households. Water and fish formed the mainstay for subsistence among the local people while there is a vibrant basket economy based on the *Cyperus* papyrus and *Typha* spp. vegetation. It is also an educational resource. The swamp's two satellite lakes form a medium of transport and a recreational site, and the riparian habitat is a source of medicinal plants, game meat, and wood fuel. More than 90% of the Lake Victoria Basin Biome-restricted bird species and a further four *Papyrus* endemic and one globally threatened bird species are found in this wetland. The swamp vegetation breaks strong winds, helps conserve the riparian soil, and filters off pollutants from upstream, although local people and their livestock are threatened by diseases and pests from the swamp. It has aesthetic and cultural values and is a refuge for the only remnant viable population of Cichlid fish species now extinct from Lake Victoria but are also threatened here as the swamp is currently under official agricultural reclamation.

### **ASSESSMENT OF WOODY SPECIES DIVERSITY AND THE NATURAL POTENTIAL OF ITS CONSERVATION: CASE STUDY IN BURKINA FASO**

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In Burkina Faso and other low income countries in West Africa human pressure on plant resources is strong. That worsens threat on phytodiversity because of the fragile ecological balance due to climate instability. Facing this problem there is a need to state the actual plant diversity and assess their potential of regeneration for further plan of conservation. We carried out woody vegetation inventories in eastern Burkina Faso along a north-south transect. Researches included evaluation of species richness and analysis of juvenile floristic composition and population structure. Results showed a total of 204 woody species distributed into Sahel and Sudan climatic zones. Species richness decreases from global inventory to juvenile stratum. Few species are frequent in juvenile class and most of them have bad population structure due to bush fire, pasture, agriculture, and drought. Species richness and regeneration potentialities are strongly linked to climate types and local habitats. The actual diversity of woody species is important but threatened because of lack of regeneration. Many plant species and / or families could rapidly disappear from semiarid areas if urgent conservation program is not established. This program should, for example, include conservation of portions from high diversity lands and enriching of protected areas with threatened species.

### **POPULATION DIAGNOSTIC OF THE SEAHORSE *HIPPOCAMPUS ERECTUS* IN THE LAGOON OF LA RESTINGA, MARGARITA ISLAND, VENEZUELA**

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*Hippocampus erectus* is a seahorse species listed as Vulnerable on the IUCN Red List, based on the inferred decline of their populations around the world. In Venezuela the conservation status of this species is unknown. The purpose of this research was to determine the current situation of wild *H. erectus* populations in the Lagoon of La Restinga National Park and provide basic biological knowledge of the species. We evaluated for a period of one year 48 transects of 50 m<sup>2</sup> each, using the underwater visual census technique. Population densities were considerably low, mean density being 0.019 individuals / m<sup>2</sup> (range 0 to 0.1 individuals / m<sup>2</sup>). We also estimated the proportion of sexes, size distribution, and reproductive season. Spatio-temporal variations in seahorse abundance were correlated with the physico-chemical parameters (temperature, salinity, and dissolved oxygen) characteristic of the sectors in the study area. These results are the baseline for the development of a line of research on the conservation of wild seahorse populations in Venezuela.

**STRENGTHENING SCIENCE-BASED CONSERVATION FOR THAILAND'S WORLD HERITAGE SITE THROUGH TIGER CONSERVATION AND LIVING LANDSCAPE PROGRAM**

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For almost half a century, Thailand has vigorously invested in protecting natural resources by establishing national parks and wildlife sanctuaries, now covering 15% of the country area. Unfortunately the policy has caused an increasing tension between conservation and utilization pressures. Although forest areas appear virtually unchanged following satellite images, wildlife populations still suffer from poaching, competition with livestock, and forest product collections. The status quo law enforcement and social community campaign cannot prevent many species from declining. The focal spot for an innovative approach is at a 6000 km<sup>2</sup> world heritage site located next to the border with Myanmar. At the site, monitoring has become a crucial measure, guidance, and warning. Monitoring by camera trapping in 2004–2005 revealed that the area supported 4 tigers / 100 km<sup>2</sup>, the best tiger density in southeast Asia. Monitoring of tiger prey using a system of line transects allows prediction of the tiger population health. Other landscape species for the site that represents all ecosystem types and threats on the site include tigers (*Panthera tigris*), Asian elephants (*Elephas maximus*), rufous-necked hornbills (*Aceros nipalensis*), and otters (*Lutra* spp.). The living landscape approach placing wildlife as a core has given managers clearer link between interventions, threats, and conservation targets through monitoring outcomes.

**RESERVE NETWORKS IN FRAGMENTED LANDSCAPES OF SOUTH-CENTRAL CHILE: CHALLENGES AND ALTERNATIVES**

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The Nahuelbuta Coastal Range, located in the central Chile biodiversity hotspot, has dramatically reduced its cover of native forest due to historical agricultural use and intensive exotic tree plantations. Recently, forest companies are becoming increasingly conscious of the value of protecting remnant fragments. We have conducted a diagnosis of the potential to create a network of reserves in private lands of the Nahuelbuta Coastal Range. We have found that most forests suitable for conservation are located in less productive, high elevation areas. On the other hand, the more productive and more diverse native forests of lowland areas have been reduced to small fragments under significant edge effects. However, there is an extensive network of riparian habitats conserved around forestry plantations, which contains samples of most habitat types. We have developed, based on international standards, a set of criteria, and indicators to prioritize conservation efforts in the area. We concluded that conservation on these highly fragmented landscapes requires a specific approach due to the scarce flexibility of conservation scenarios. We recommend to complement natural (native forests) with semi-natural (exotic forest plantations) ecosystems to ensure a more efficient and sustainable alternative.

**THE EFFECTS OF PERSONAL EXPERIENCE ON PUBLIC ATTITUDES FOR OR AGAINST THE MANAGEMENT OF *URSUS AMERICANUS* IN NEW JERSEY, USA**

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Throughout the 1800s to the mid 1900s, black bear (*Ursus americanus*) ranges and population sizes declined in New Jersey. Since the 1970s bear populations have increased, and more recently, expanded into suburban areas of the most densely populated state in the USA. From 1995–2003 bear-human conflicts rose from 285 to over 3000. In December of 2003, the state's first bear hunt since 1970 took place among much controversy. Despite its success, the New Jersey Supreme Court cancelled a 2004 hunt days before the scheduled initiation. Although management decisions should be guided by scientific research, public opinion may not be ignored. Utilizing Dillman's Total Design Method, we initiated a mail survey in areas where there are high and low population densities of black bears. The study will provide an accurate representation of the factors involved in human-bear interactions that lead to attitudes for or against management techniques. Data generated will assist in the design of educational materials and arm the state's wildlife managers and policy makers with much needed information upon which scientifically sound policy decisions can be made. Results illustrate how personal experiences with black bears affects respondents' attitudes towards bears and their management.

**ORIGINAL OLD-GROWTH FOREST COMPOSITION FOR LYELL ISLAND, HAIDA GWAII (QUEEN CHARLOTTE ISLANDS), BRITISH COLUMBIA**

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A simple question—what was the original extent of old-growth forests?—is very difficult to answer. Forest inventories have been maintained for decades, but solely for timber and the original old-growth forest information is deleted upon logging. However

that information still exists in records that pre-date logging. We used 1966 forest cover paper maps and 1937 aerial photos to reconstruct the original forest composition for Lyell Island, Haida Gwaii. We digitized and georeferenced the paper maps and interpreted the 1937 photos following standard timber inventory methods for areas logged by 1966. We found that the reconstruction methods were successful in determining original old-growth forest composition and timber attributes can be used for conservation purposes. The original extent of culturally important western redcedar forests and the most productive forests were highly underestimated in the historical forest cover model used in planning. Large individual cedar trees are visible on the 1937 air photos, so inventorying their original extent is possible. Logging by 1937 was overestimated by 300% on the forest cover maps. Early forest cover maps and air photos are readily available for coastal British Columbia, so it is possible to create environmental baselines before logging was widespread, a database that has myriad uses for conservation and restoration.

### **URBAN-NESTING COOPER'S HAWKS MONITORED BY CITIZEN BIOLOGISTS IN BERKELEY, CALIFORNIA**

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In recent decades, urban nesting Cooper's Hawks (*Accipiter cooperii*) have been studied intensively in Wisconsin and Arizona, the results raising questions about urban zones as ecological traps. During 2002–2005, we trained an average of 24 people per season to search a 2782 ha area of Berkeley and Albany, California, for nesting Cooper's Hawks. Effort averaged 570 hrs / season. During 4 years, we found 48 active nests of which 45 were successful. Ash (*Fraxinus* spp.), American Elm (*Ulmus americana*), Coast Live Oak (*Quercus agrifolia*), and Monterey Pine (*Pinus radiata*) accounted for 69 of nest trees. Twenty-two nest trees were on streets or in yards, 15 in parks, and 11 on campuses. Average density ranged from 198–309 ha / nest, comparable to the highest known Cooper's Hawk nest densities. Productivity averaged from 3.3–4.2 branchers / successful nest. Nest building was from late February to late March, incubation from late March to mid May, hatching from early May to early June, and branching from early June to early July. Just over 1000 prey items were collected at nest sites in 2002–2003, including 24 bird and 3 mammal species. Mourning Dove (*Zenaidura macroura*), American Robin (*Turdus migratorius*), Rock Pigeon (*Columba livia*), Western Scrub Jay (*Aphelocoma californica*), and House Sparrow (*Passer domesticus*) accounted for 83 of identified items.

### **BIOLOGICAL INTEGRITY AND DIVERSITY: WATERFOWL AND THE NATIONAL WILDLIFE REFUGE SYSTEM**

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The National Wildlife Refuge System Improvement Act of 1997 has a mandate of maintaining biological integrity and diversity. In the following study we asked the question of whether or not this mandate has been fulfilled for waterfowl species (ducks, geese, and swans, family Anatidae) common to the United States. We used representation, redundancy, and resiliency as indicators of biological integrity and diversity. We did so at three geographic scales: continental United States, flyway, and climatic. Within each of those geographical contexts we examined the extent to which the three above mentioned principles were achieved during each of the three stages in the life cycle of waterfowl (breeding, migration, and wintering) on each of the 545 National Wildlife Refuges. Preliminary results indicate 46 of 47 waterfowl species satisfy the principles of representation and redundancy at the national scale. In addition, 42 of the 45 waterfowl species nesting in the United States satisfy the principles of representation and redundancy during the breeding stage. If further results continue to support our preliminary findings, then the present National Wildlife Refuge System may be comprehensive enough to maintain biological integrity and diversity of waterfowl at the scale at which we conducted our research.

### **CONSERVATION OR IDEALIZATION? THE ESSENCE OF NATURE DILEMMA AND THE EFFORTS TO INTEGRATE ENVIRONMENTAL POLITICS AND LOCAL KNOWLEDGE IN PROTECTED AREAS**

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During the past five decades Italian mountains have been highly depopulated. The environmental abandonment and the erosion of traditional landscapes resulted in so severe hydrogeological risks that national and European regulations about nature protection, accordingly to concepts as community-based conservation and sustainable development, tend to enhance the ecological role of local communities and their traditional environmental knowledge. Nevertheless, cultural and social struggles remain between protected areas managers and local populations. Exploring the conflict in Parco Nazionale dei Monti Sibillini, a protected area in the Central Apennines, my anthropological research has revealed how professional ecology and biology, as political practices, seems to conceive a public, universalistic form of possession and management of nature excluding local traditional uses. The attitude of park managers consists in forms of nature protection which appears bureaucratized and insensitive to local communities needs and expectations; as a result depopulation still increase as well as populations' feelings of disillusion and hostility towards the park as a tool for sustainable development. Thus the emerging question is whether to conserve a nature—as always managed by local populations—or produce a new, idealized model of nature to satisfy the expectations of tourists and ecologists.

### **FLORISTIC COMPARISON BETWEEN A PRESERVED AND A DISTURBED CERRADO PHYSIOGNOMY IN BRASÍLIA, BRAZIL: A STUDY OF HUMAN IMPACTS IN THE VEGETATION COMPOSITION**

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The Brazilian socio-economic scenario culminated in a great human occupation process, that threatened hardly the Brazilian savanna ("Cerrado"), by conversion of vast areas of natural vegetation into agricultural or urban areas or into urban areas. Among the Cerrado physiognomies that was more jeopardized by those impacts are the "veredas" (gallery vegetation), important shelters of wildlife and essential areas in the maintenance of hydrologic dynamics. The main goal of this research was to evaluate the impacts of urbanization at a species level in a "vereda" environment. As part of this research, it was

executed a floristic survey and comparison between two "vereda" areas, in a disturbed one and in a preserved one, both in Brasilia. The vegetal species found in these two areas were collected using the plot sampling method, and identified. After the compilation of the species list, the Sorensen coefficient (a similarity index) was applied in order to verify the similarity degree between the two areas. The results obtained indicate that the "veredas" are divided into zones that order greatly the floristic composition. The impacts affect in an unequal way these zones. Many characteristic species of other Cerrado physiognomies and disturbed areas were found in the disturbed vereda.

**SYNCHRONY BETWEEN THE NIDIFICATION OF ARARIPE MANAKIN (*ANTILOPHIA BOKERMANNI*) AND THE RAINS REGIME**

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The third consecutive year of monitoring the reproductive period of the Araripe Manakin, a Critically Endangered bird endemic to northeastern Brazil, has shown a three-month delay relative to the same period in 2004–2005 and 2002–2003. In 2005, the average rainfall between July and November was the lowest observed value in the 1974–2004 interval in the study area. Although monitoring was performed only for three years, the synchrony with the dry season was evident, and was also observed for other bird species. Climatic catastrophes were observed around the world in 2005, with unprecedented series of hurricanes in the Atlantic, and the worst drought in the eastern Amazonian region in the past 100 years. There is a possibility that the temperature increase in the planet, mainly related to the emissions of greenhouse gases, may be leading to extreme climatic events, with consequences to the conservation of biodiversity.

**THE EFFECTS OF WARNINGS ABOUT DEPLETING RESOURCES ON RESOURCE CONSUMPTION: A LABORATORY STUDY**

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Depletion of natural resources continues to be a significant environmental problem. Media messages warning of depleting resources are common, yet little research has studied the impact of such warnings on resource consumption. To investigate this, we conducted two studies using a paradigm known as a resource dilemma (RD), in which maximum personal gain is in direct conflict with group welfare, to examine the impact of warnings about depleting resources on consumption of the resource. In Study 1, 90 participants played 16 trials of a 5-person RD game in which they harvested points from a common resource pool. After trial 12, participants were informed they were dangerously close to depleting the resource, and thereafter received no additional warnings. Harvesting dropped immediately after the warning, but within 3 trials returned to the pre-warning level. In Study 2, 85 participants played 22 trials of a RD game, with warnings after trials 12 and 17. Replicating Study 1, harvesting dropped after the first warning, and returned to the pre-warning level within 3 trials. Supporting a "boy who cried wolf hypothesis," consumption rates were unaffected by the second warning. Results suggest that the effectiveness of warnings about depleting resources may diminish over time if no crisis is immediately apparent.

**EFFECTS OF WILD GRAPE VINES ON UNDERSTORY AND MID-STORY VEGETATION IN A NORTHERN HARDWOOD FOREST**

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Vines use other plants for structural support allowing them to be narrow, flexible, and capable of rapid growth. Although extensive forested areas in the northeastern United States are over-populated with wild grape vines, little is known about the effects of these dense vine populations on other forest plants. The purpose of this study was to address these effects in a 13-hectare old-growth northern hardwood forest located in northwestern Pennsylvania by comparing 576 1 m<sup>2</sup> understory control quadrats (no vines) and 128 7 m<sup>2</sup> mid-story control subplots with 432 1 m<sup>2</sup> understory treatment quadrats (with vines) and 96 7 m<sup>2</sup> mid-story treatment subplots. Results show that understory biomass is 37.5% lower in plots with vines compared to plots without vines ( $t = -2.1$ ,  $p = 0.05$ ), whereas mid-story biomass was only 3.9% less (not significant) in plots with vines. Nine understory and 13 mid-story rare plant species were absent from the samples with vines, and three understory species had lower abundances in samples with vines compared to samples without vines including *Viola* spp. (-99%), *Onoclea sensibilis* (-75%), and *Dryopteris carthusiana* (-53%). Vine abundance along the forest-field edge is roughly double the vine abundance in the forest interior except in interior gaps. Management options are discussed.

**BADGER BEHAVIOR IN A FRAGMENTED LANDSCAPE: IMPLICATIONS FOR CONSERVATION PLANNING IN CALIFORNIA**

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The American badger (*Taxidea taxus*) is listed as a California Species of Special Concern. The badger's grassland habitat is currently one of the least protected habitats in the state, and is becoming increasingly fragmented by suburban and agricultural development. Recent studies elsewhere indicate that badgers range widely, and thus might be particularly sensitive to this fragmentation. However, almost nothing is known of badger habitat use, home range sizes, or dispersal distances in California. I investigated the movement behavior and habitat use of 9 radio-implanted badgers in a fragmented landscape in Monterey County, California. Badger home ranges ranged between 1 and 10 km<sup>2</sup>, and I did not observe long-distance dispersal of the 2 juveniles. Male and related female ranges overlapped, while non-related females occupied exclusive home ranges. Badgers used grassland and coastal sage scrub habitat more often than expected and avoided oak woodlands; and were often located in close proximity to residential areas. Although no radio-implanted badgers crossed the highways bordering the study area, 9 unmarked road-killed badgers were reported during the study period. These results not only identify threats to badgers, but they can also be used to guide conservation planning in California grassland habitats.

**MULTI-SCALE FEATURES FOR IDENTIFYING INDIVIDUALS IN LARGE BIOLOGICAL DATABASES**

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Identifying individual animals is necessary for answering many questions in wildlife ecology. Limitations of conventional techniques prompt for alternatives that minimize impacts on animals and improve search efficiency. Semi-automated photo-identification techniques have been developed in marine mammal research, but show moderate retrieval rates and often require extensive manual follow-up. We demonstrate a novel method that identifies individual marbled salamanders using their dorsal patterns with high retrieval performance. For example, in a database of 1008 images, 95% of 101 known matches were identified in the top 10 ranks by our method. To test it, we indexed all adult marbled salamander captures from a one year span and used our recognition method to facilitate analysis. We determined that 366 individuals were captured between 2 and 5 times. Of these, less than 2% were captured at more than one of the fourteen pond basins, suggesting that breeding migrations were strongly directional and pond-shopping among first time breeders was infrequent. There was significant variability in the duration of individual stays. The majority of males stayed between 15 and 35 days and the majority of females staying between 30 and 50 days and stay was uncorrelated with weight changes. The recognition algorithm facilitated these conclusions, rapidly. We believe that this method is generalizable to other patterned animals, and of significant value for answering biological questions.

**IMPACTS OF HUMAN RECREATION ON MAMMALIAN CARNIVORES IN PROTECTED CALIFORNIA OAK WOODLANDS**

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Surveys show that people in California value easy access to protected areas—including state and regional parks, wildlife refuges and open space preserves—but recreational use of these areas may have negative impacts on wildlife populations. We used the distributions and relative densities of four mammalian carnivores as indicators of the impacts of non-motorized recreation in protected areas in northern California. We surveyed 30 similar oak woodland sites and paired neighboring sites that do and do not permit recreation. We collected scats along on- and off-trail transects throughout each site and found significantly lower densities of native carnivores in protected areas that permit recreation than in sites that do not. Within protected areas that permit recreation, native carnivore detections were lower in areas with a high frequency of domestic dog visits. This research reveals the need for reconsideration of the way we view non-motorized recreation in reserves intended to protect wildlife. Results are being extended to land managers and conservation planners in order to balance the increasing demand for recreation and wildlife conservation in urbanizing landscapes.

**OCCURRENCE AND CONSERVATION OF ALLUVIAL GROUNDWATER ECOSYSTEMS IN THE WESTERN UNITED STATES**

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In mountain and piedmont valleys, rivers may recharge their aquifers at large spatial scales (1–2 km lateral to the channel). Distributed across this extensive recharge area is a unique suite of groundwater organisms, including hyporheic stoneflies, amphipods, and copepods. Biological diversity of fluvial groundwaters is perhaps the Atlantis of freshwater conservation: they are not addressed in any of the major freshwater assessments or conservation plans in North America. *Stygobromus* amphipods show high rates of endemism, and many organisms are new to science, belong to cryptic taxonomic groups, or are not well described for North America. Poor taxonomic treatment, lack of comprehensive collections and general view of these systems as transitional areas are major impediments to evaluating and conserving this ecotype. At the same time, with the overlap of urban and agricultural land use and the demand for fresh water, there is a high risk to surficial groundwaters. We describe a conceptual model of groundwater invertebrate biogeography based on the Hyporheic Corridor Concept, with river networks as the potential link between populations of karstic or marine origin. We predict that alluvial groundwater ecosystems are widely represented throughout the western United States, and are critical to the conservation of groundwater biodiversity.

**CHILEAN DOLPHIN—AQUACULTURE INTERACTIONS IN SOUTHERN CHILE: IS AQUACULTURE A THREAT FOR THE CONSERVATION OF THIS ENDEMIC SPECIES?**

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The expansion of the aquaculture industry in southern Chile has been fast and extensive, but with important environmental costs. Since this activity is developed in coastal waters, there is an important overlap with unique marine species, such as the endemic Chilean dolphin (*Cephalorhynchus eutropia*). The main goal of this study was to evaluate the effects of aquaculture activities, including boat traffic generated by it, on habitat use and behavioral patterns of Chilean dolphins in Chiloe Island. During summer 2002, dolphins' movement and behavior were assessed by digital theodolite tracking and GIS analysis. Dolphins concentrated their use in shallow areas with low or no mussel cover and avoided areas with more than 60 mussel cover, indicating that high mussel coverage restricted dolphins from using areas. Boat traffic generated by aquaculture activities caused significant dolphin behavioral shifts. During boat presence, dolphins increased their swimming speed up to 41 and altered in 88 their swimming reorientation rate. Since dolphins use the study area mainly for feeding, the negative effects caused by aquaculture activities represent a potential threat to this dolphin local population. We propose that better regulation should be applied for marine concessions criteria, which should include for example marine mammal habitat use.

**ENVIRONMENTALISM WITHOUT RESISTANCE**

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To overcome opposition to environmentalism, we could learn from psychotherapists' concept of resistance—people's unconscious struggle against change. "Therapy without resistance" addresses three questions: Is the problem solvable? Are

there competing intentions? Am I the kind of person you think can help you solve this? Resistance to environmental messages might likewise be overcome. Is the problem solvable? The task of healing the planet can seem overwhelming, causing some people to avoid and deny. One answer is to share success stories and to frame the environmental movement in the tides of history (citing successful past movements for change). Are there competing intentions? Greed, addiction to material goods, and a perceived need to feel like top species (or top nation) are obstacles to environmental awareness. These apparent "gains" and such traits as narcissism, uncritical nationalism, and consumerism impede the change of paradigm. We need to reveal the costs of these "gains" and to persuasively articulate other gains to replace them. Am I the kind of person? If people dismiss the messenger, the message never has a chance to be heard. By reducing the dissonance between the messenger and the intended audience, we might improve the likelihood that the message will be heard.

**MOUNTAIN LION CONSERVATION IN A FRAGMENTED URBAN LANDSCAPE IN SOUTHERN CALIFORNIA**

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Urbanization eliminates natural habitat and fragments what remains, presenting particular challenges for wide-ranging species, such as mammalian carnivores. Mountain lions are the largest remaining carnivore in many areas of western North America and represent perhaps the ultimate challenge for carnivore conservation in urban landscapes. Since 2002, we have been studying the behavior, ecology, and conservation of mountain lions in and around Santa Monica Mountains National Recreation Area, west of the city of Los Angeles, through the use of GPS radio collars. Although habitat quality and prey populations appear to be sufficient, based on home range sizes the Santa Monica Mountains and other remaining blocks of open space in the region are too small, on their own, to preserve viable mountain lion populations. Thus, it is critical that mountain lion movement occur between these habitat blocks and across freeway barriers, particularly for young dispersing animals. We have documented movement by lions across one freeway to the north, but as of yet no movement across the largest and busiest freeway (Highway 101). We have documented successful lion reproduction in the Santa Monica Mountains, but the fate and dispersal of these kittens will have critical implications for the long-term viability of the species.

**THE CONSERVATION STATUS OF POPULATIONS OF THE TROPIDURID LIOLAEMUS LUTZAE ALONG ITS GEOGRAPHICAL RANGE: AN ENDEMIC LIZARD THREATENED WITH EXTINCTION**

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The endemic and threatened with extinction lizard *Liolaemus lutzae* has a relative small range restricted to beaches of sand dune habitats (called restingas) of Rio de Janeiro State in Brazil (only 200 km extent of range) which are under intensive anthropic disturbance. Some populations have dramatically declined. There was no information on the actual status to any population. We estimate an index of population size in all areas where the species still live, the actual geographic distribution, evaluate habitat condition, and present suggestions of habitat conservation and restoration to minimize risk of local extinctions. The density of *L. lutzae* at each area was strictly related to the present types and extent of habitat disturbances. We detected that the lizard disappeared from at least four areas it used to occur. The most common negative sources of habitat degradation were the removal of beach vegetation to construction of houses, coastal roads and / or sidewalks, trampling on vegetation, vehicle traffic on vegetation, and littering, which presently constitute important sources of threat for the species existence. If conservation actions are not carried out urgently, the simultaneous population loss in most areas along its range will lead to a risk of the species disappearance in the near future.

**NATIONAL ECOSYSTEM GAP ANALYSIS FOR PARAGUAY**

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Recent ecosystem mapping efforts in Paraguay have identified all terrestrial ecosystems, and interest in representative conservation of these ecosystems is a priority of the government and NGO conservation community. To prioritize those ecosystems most deserving of conservation attention, a national gap analysis was conducted to determine the representation of these ecosystems in the national system of protected areas. Ecosystems and protected areas were spatially combined, and statistics were generated on the representation of each ecosystem in the protected area estate. Ecosystems were assigned into the following representation categories: Poor (0–5% of the total area of the ecosystem represented in the protected area system), Moderate (6–10%), and good (> 10%). The results of this analysis will be described with a focus on those ecosystems which were found to have no representation whatsoever in protected areas.

**MORPHOLOGICAL AND BEHAVIORAL DIVERSITY SUGGEST THAT BREEDING POPULATIONS OF LARK SPARROWS SHOULD BE CONSIDERED IMPORTANT UNITS OF CONSERVATION**

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It is commonly believed that the sharing of common overwintering grounds and increased dispersal capabilities of long-distance migratory bird species promote genetic cohesion and prevents local adaptation of their breeding populations. We compared genetic, morphological and behavioral diversity of four breeding populations of Lark Sparrows (*Chondestes grammacus*) distributed throughout most of its range. Genetic analyses of the mtDNA control region (47 samples) revealed no significant differences in levels of genetic diversity and no obvious pattern of regional groupings, suggesting either relatively high degree of population interchange or recent isolation. In contrast, discriminant analysis of 5 morphological traits from 93 individuals measured revealed three regional groups corresponding to the California, Texas, and Ohio / Illinois breeding populations. Sonogram analyses from at least ten males from each population revealed higher levels of syllable sharing within rather than among populations, suggesting the presence of regional song dialects. In spite of their apparent lack of genetic differentiation, morphological and behavioral characteristics suggest that breeding populations of Lark Sparrows should be considered

important units of conservation concern.

### **IS SURVIVAL DEPENDENT ON PATCH SIZE? SURVIVAL OF FOREST BIRDS IN SOUTHWESTERN COSTA RICA**

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Habitat loss and fragmentation is currently signaled as the primary cause for worldwide population declines and species extinctions. Current research on the effects of habitat fragmentation on populations has mainly focused on quantifying differential reproductive success between fragmented and continuous habitat. Not until recently has research begun to focus on the effects of habitat fragmentation on survival. We analyzed the effects of patch size on survival for five forest birds in the region of Coto Brus, Costa Rica. All individuals were marked and recaptured in six forest fragments, ranging in size from 0.09–30.0 ha, from 1994 until 2005. The effects of patch size on survival varied between species, with *Platyrinchus mystaceus* and *Atlapetes bruceinucha* showing the strongest effect ( $R^2 = 0.95$  and  $R^2 = 0.43$ , respectively). We then grouped all species by degree of forest dependency. As expected, the effect of patch size was strongest for the group with a high degree of forest dependency ( $R^2 = 0.47$ ) compared to the group with a medium degree ( $R^2 = 0.13$ ). These findings suggest that highly forest dependent species might have an estimable threshold patch size at which the probability of survival will be too low to sustain the population.

### **A NEW SOFTWARE PROGRAM FOR DESIGNING, MANAGING, MONITORING, AND LEARNING FROM CONSERVATION PROJECTS**

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The Conservation Measures Partnership has recently released the Open Standards for the Practice of Conservation to help conservation practitioners design, manage, monitor, and learn from their projects. The Partnership is now working with Benetech, a Silicon Valley based non-profit software developer, to create a user-friendly software program to help practitioners implement these standards. This program is based around a friendly step-by-step interview that guides practitioners through the steps involved in defining their project scope and targets, developing schematic conceptual models and spatial maps of their project site, ranking threats, developing objectives and actions, and choosing appropriate monitoring indicators and methods. The program also enables projects to easily export their project data to donor reports and (if they so desire) to a central database where other practitioners can learn about their work. This software has the potential to truly transform the practice of conservation. In particular, it will help field practitioners to plan and implement their projects more efficiently and effectively, managers to get standard information to improve the execution and coordination of programs, donors to benefit from better information and common forms and reports to minimize transaction costs, and members of the entire conservation community to learn from one another.

### **RIPARIAN AREAS IN THE FRAGMENTED LANDSCAPE OF SOUTHERN PORTUGAL: APPLICATIONS FOR CONSERVATION PLANNING**

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Riparian areas encompass a low percentage of land and are extremely vulnerable to disturbance, consequently a valuable resource for conservation. Current drought, desertification, and fragmentation patterns of arid Mediterranean areas of southern Portugal may irreversibly affect riparian habitats. We assessed the status of riparian areas using combined methodologies to understand riparian plant composition and structure and its use by mammalian carnivores as focal species (POCTI/MGS/47435/2002). We found (1) rich and diverse riparian plant community with patchy distribution, (2) strictly riparian plants mostly bordering rivers, whereas streams and creeks were invaded by Mediterranean sclerophytes, (3) carnivores were positively correlated with plant diversity and negatively correlated with the area devoid of vegetation, and (4) carnivores used mostly riparian galleries, especially when surrounded by agricultural fields. Our results indicate that in southern Portuguese arid Mediterranean areas, the distribution and diversity of riparian plants are decreasing due to a plant community shift towards a sclerophyte Mediterranean assemblage. However, riparian habitats are important for wildlife, especially in highly altered areas. Conservation of riparian landscapes in southern Portugal may require designing restoration and conservation guidelines for listed riparian habitats that avoid diversity loss and acknowledge their potential effects in the nationally protected cork oak woodlands.

### **HIGH PREVALENCE OF CHYTRIDIOMYCOSIS IN WILD POPULATIONS OF ANURANS**

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Chytridiomycosis has been implicated in some of the catastrophic declines in amphibian populations in various regions of the world. Despite strong associations between the disease and dying frogs, little is known about the ecology of the pathogen. In the spring and fall of 2004, we sampled nine seemingly healthy populations of the Lowland Leopard Frog (*Rana yavapaiensis*) and four populations of the American Bullfrog (*R. catesbeiana*) from Arizona for the presence of chytrid using PCR amplification. We found that individuals in ten populations carried the disease pathogen, and in some populations the infection frequency was greater than 50%. We were unable to detect the pathogen in three populations that were either hydrologically isolated or associated with thermal hot springs. Our results indicate that the chytrid pathogen is widely distributed and abundant in this region even when host populations are not experiencing catastrophic declines. Our results also suggest that thermal springs

likely serve as refugia from the pathogen.

**CONSERVATION IN AGRICULTURAL LANDSCAPES: A DEMOGRAPHIC STUDY OF A FOREST HERB, *TRILLIUM GRANDIFLORUM*, WITHIN HEDGEROWS AND FOREST PATCHES**

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Biodiversity conservation in agricultural landscapes depends on the maintenance of suitable habitats at the margin of production land. Efficient conservation strategies in these landscapes require sound knowledge of the processes driving population dynamics in fragmented habitats subject to recurrent anthropogenic disturbances. In this study, we compare the demographic response of a self-incompatible forest herb, *Trillium grandiflorum*, in three habitat types frequently found in agricultural landscapes: forest interiors, forest edges, and hedgerows connected to forest patches. Analysis of the stage-structure of 19 populations reveals that habitat type has a significant effect on recruitment, with substantially lower proportions of juvenile individuals in hedgerows, followed by forest edges and forest interiors. These differences may be partially explained by the lower rates of flowering and pollination observed in hedgerows as compared to forest patches. Moreover, seed set in natural and experimental populations was significantly affected by flower density and spatial isolation. Our results raise important questions about the capacity of linear structures, such as hedgerows, to support viable populations of forest herbs and therefore to act as corridors linking isolated populations. Understanding the processes affecting population persistence in these habitats will contribute to optimizing conservation efforts in agricultural landscapes.

**DEVELOPING BIOLOGICAL GOALS AND OBJECTIVES FOR PROTECTED AREA MANAGEMENT: LESSONS LEARNED FROM CANADA, MEXICO, AND THE UNITED STATES**

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Managers of publicly protected areas in Canada, Mexico, and the United States are mandated by law and regulation to develop science-based goals and objectives to guide conservation and management. We examined lessons learned from land management plans for National Protected Areas in Canada, Natural Protected Areas in Mexico, and National Wildlife Refuges in the United States, identifying several areas of common concern. We conclude that management direction is strongly influenced by local managers and tradition. Biological goals and objectives frequently lack a connection to broader ecosystem concerns. Often there is inadequate use of available and relevant scientific information in developing objectives, and objectives contain insufficient detail. Monitoring of progress toward achieving objectives is generally limited, with insufficient staff and funding being major contributing factors. Public involvement is critical to the success of land management plans. Specific recommendations for improvements in developing biological goals and objectives are presented. Use of available science can be increased through improved access and training. Ecosystem level goals should be created to provide guidance to local areas. Monitoring can be improved through training and prioritization of efforts. In addition, we encourage the use of standard metadata to allow accurate transfer of data and information holdings.

**CARNIVORE COMMUNITY RESPONSE TO A LARGE WILDFIRE IN SAN DIEGO COUNTY, CALIFORNIA**

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Understanding wildlife response to fire is crucial for assessing fire management practices in fire-prone habitats such as chaparral in southern California. From 25 October to 5 November 2003, the largest wildfire in recent California history burned 113,425 hectares of this diverse semi-arid shrubland in San Diego County. Beginning August 2005, we examined the impact of this wildfire on the carnivore community through motion-sensored digital cameras, track plots, and hair snares three times per year within 3 km of the fire perimeter, within the burn interior, and in unburned chaparral. Cameras detected coyotes (*Canis latrans*) most frequently (22.7 overall capture rate). Gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*), and striped skunk (*Mephitis mephitis*) were detected at lower frequencies (capture rate). Initial data suggest similar levels of coyote activity across perimeter, interior, and control sites. Track plots indicated presence of coyotes and a higher frequency of bobcats compared to camera surveys. Hair samples were collected at 30 of camera stations and 70 of track plots, suggesting differences in detection methods. Hair analyses can increase sample size for presence / absence surveys and provide genetic structure to carnivore communities. Through these methods, we will continue surveys to determine differences in the carnivore community across burn perimeter, interior, and unburned sites.

**BRINGING RESEARCH INTO K-12 CLASSROOMS**

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Education in the sciences is a vital component to the continued success conservation efforts. A National Science Foundation sponsored program at the University of Maine (NSF GK-12) helps meet this need. The program provides fellowships for outstanding graduate students to recurrently demonstrate science in local K-12 classrooms. A major goal of the NSF GK-12 program is to enhance K-12 science education by providing expertise, equipment, activities, and role models that would not otherwise be available to K-12 teachers and students. This poster will focus specifically on facilitating the understanding of the scientific method through hands-on fish research. Under the guidance of their Fellow, sixth grade students designed and executed an experiment testing the effects of different fish species and densities on water quality. The students researched the topic, formed hypotheses, compiled and analyzed the data, and presented the results. The Fellow formulated lesson plans for each step to emphasize the role and application of the scientific method. This experience ties directly to their annual school science fair where they will put their new knowledge into practice. These hands-on activities in research are great tools for enhancing science education in K-12 classrooms and instilling a lifelong appreciation for science and conservation.

### **ELEVATIONAL LIMITS, CLIMATE CHANGE, AND AVIAN EXTINCTIONS**

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Climatic, ecological, and physiological effects of elevation impose limitations on species' range sizes that are key determinants of extinction risk. For nearly 8500 extant land bird species, an index of elevational limitation of range size explains 94% of the variation in of the probability of being in an extinction risk category. A modeling approach that combines elevational limitations and an intermediate IPCC surface warming estimate of 3.5 C by 2100, projects approximately 600 bird extinctions and close to 2000 species that risk extinction. Utilizing a tested and standardized index based on elevational distributions can improve conservation assessments of terrestrial species and will help identify those most vulnerable to global climate change.

### **TOURISTS FEEDING WILDLIFE COULD PHYSIOLOGICALLY CONDITION ANIMALS TO THE WRONG ENVIRONMENT**

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The study of physiological responses of animals to tourist disturbance is receiving increased attention. Of little direct examination, however, is the physiological effect of tourists feeding wildlife. In the present study the physiological impact of tourists providing a non-natural diet (squid from temperate-zone waters) to a wild, free-ranging Southern stingray population (*Dasyatis americana*) in the Cayman Islands is investigated. We show using a classification and regression tree analysis (CART) of serum non-esterified fatty acids that the fed population of rays is completely dependent on the provisioned food source. CART differentiated fed rays from two Cayman sub-populations of unfed rays based on a single fatty acid (FA), regardless of the root node FA, and misclassified published fatty acid profiles of squid (*Illex* spp.), the prey item, as a fed ray. Additionally, fed rays had significantly higher proportions of omega-3 polyunsaturated FA (PUFA) and lower omega-6 PUFA, exhibiting an essential FA signature - critical for disease resistance, membrane structure and function, and immune response - similar to that of marine animals found in cooler waters. Our results suggest that tropical stingrays fed a non-natural diet are becoming physiologically conditioned to inefficiently respond to the metabolic demands posed by their tropical environment. Management measures for this wildlife-tourism site are recommended.

### **HUMAN-LEOPARD PANTHERA PARDUS ENCOUNTERS IN NEPAL**

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Human-leopard encounters are not only one of the biggest threats to the leopards, but also a serious problem for communities sharing landscapes with leopards. This study aimed to assess distribution and abundance of forest leopards (*Panthera pardus*) and to examine causes of human-leopard encounters in Nepal. A total of 441 people were attacked and 121 killed by leopard, whereas 84 leopards were killed in retaliatory actions during 1994 to 2004. By integrating encounter data with GIS, we evaluated the distribution patterns and correlated with forest cover. The human-leopard encounter as a proxy indicates the leopards are distributed throughout the country and are increasing after mid nineties due the improvement of habitat by successful adaptive management of community forest (CF) in late eighties. However, encounter patterns varied geographically and seasonally but increased leopard population, inadequate habitat and prey base in the CFs, lack of connectivity, hiding covers in the crop fields are main causes of increased human-leopard encounters. The CFs significantly improve habitat for the wildlife but because of small sizes and lack of connectivity, the CFs are inadequate to support wide ranging species like leopard thus increasing encounters.

### **MEETING THE CHALLENGES OF CANADA'S SPECIES AT RISK ACT: PARKS CANADA'S WEST COAST SPECIES AT RISK PROGRAM**

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Canada's first national endangered species law, the federal Species at Risk Act, came into full force in June 2004. The Canada National Parks Act (2000) sets the maintenance and restoration of ecological integrity (through the protection of natural resources and natural processes) as the top priority for all aspects of national park management. To respond to these challenges, Parks Canada has been building its science capacity, internally and through partnerships with Universities and other agencies. Parks Canada staff have also been developing extensive partnerships with First Nations, private landowners, and industries in "greater park ecosystems," recognizing that park boundaries mean little to species and ecosystems, and that landscape approaches to conservation are key to maintaining and restoring ecological integrity inside park boundaries. To meet the challenges related to the recovery and conservation of rare and endangered species, Parks Canada initiated a national Species at Risk (SAR) Program in 2001. Key elements of the program include inventories and conservation assessments, research, recovery planning and implementation activities, and public education. On the west coast, a number of initiatives have shown clear positive results, including the restoration of Garry Oak ecosystems in the new Gulf Islands National Park Reserve along the Canada / United States border.

### **TESTING AN ABIOTIC FRESHWATER CLASSIFICATION SYSTEM IN THE HUDSON RIVER WATERSHED—DO FISH SEE WHAT CONSERVATIONISTS SEE?**

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Priority-setting in conservation is a topic of considerable debate. Biodiversity conservation planning often includes the identification of a set of priority areas intended to capture the full range of biological diversity. To accomplish this task, The Nature Conservancy relies on measures of environmental condition to estimate patterns of diversity in large-scale assessments. A GIS-based freshwater ecoregional assessment was developed which assigns watersheds to aquatic ecosystem types based on drainage size, geology, elevation, and landform. The highest-quality examples of each ecosystem type were identified,

assuming that they were representative of freshwater biological diversity. To test the efficacy of this assumption, we used an existing statewide data set to compile presence / absence data for native resident fish species in the Hudson River watershed and, using Multi-response Permutation Procedures (MRPP), tested for differences in fish communities among ecosystem types for 81 tributary watersheds. Overall, the classification performed fairly well, distinguishing between fish communities better than expected by chance. It was most reliable for large tributary watersheds and in the upper portion of the drainage. A further cluster analysis revealed many community groupings which spanned several ecosystem types, likely reflecting additional local-scale factors influencing fish community distribution.

**MULTI-SCALE SPATIO-TEMPORAL ANALYSIS OF ROAD NETWORK IN THE LAND BETWEEN ECOTONE**

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Most conservation initiatives are geared towards conservation of representative areas, while failing to address conservation issues in complex ecological transition zones (ecotones). These highly heterogeneous and patchy areas, which have been recognized as zones of control for ecosystem functioning, are increasingly threatened by the development pressures. This is particularly true for those near the urban centers that can induce exurban growth. The Land Between ecotone in the southern edge of the Canadian Shield in Ontario is an example of such a case where the existing land use management has left the ecotone vulnerable to increasing development threats from exurban growth. This study analyzed the threats associated with exurban growth in the Land Between ecotone using the road network as a surrogate for development pressure, since the road network alters the structure of existing land cover while also enabling further land use changes. The spatio-temporal pattern analysis of the road network in relation to various parameters and mapping of road density at multiple scales and functional distance to urban centers highlighted potential hotspots of future development. Initial conservation recommendations are identified in light of these results.

**THE IMPORTANCE OF CARNIVORES IN THE PRINTED MEDIA IN CHILE AND ITS RELEVANCE TO CONSERVATION PRACTICE**

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The knowledge of people on the species involved in human-wildlife conflicts can influence human attitudes toward carnivores and news in newspapers can influence the perceptions and what the general public knows about carnivores. We investigated the articles published by 15 Chilean newspapers between 2001–2005 and examined the news in terms of the species involved, the contents reported, and the sources of information cited. Seven species were reported in 57 articles. The cougar was the most cited species (66%), followed by Darwin's fox (11%). The main issues covered were depredation on livestock and rescue of injured animals in the case of cougar, and conservation initiatives for the other carnivores. Most articles published favourable information on the carnivores' public image (except for depredation events), giving information that contribute to increase the knowledge of people about carnivores conservation status. Articles concerning cougar show highly utilitarian and humanistic attitudes, articles concerning other carnivore species show mainly conservationist attitudes toward them. Newspapers could be used as a cost effective strategy to reach many people in conservation initiatives, but still remains to understand how these could influence human attitudes.

**WHO IS YOUR MAMA? MATERNITY TESTING IN ASIAN ELEPHANT**

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Southeast Asia is the home of the Asian elephant, an endangered species that requires large home ranges that cross political borders. Tourism represents a major source of income in the developing countries of this region, and baby elephants are highly prized as charismatic tourist attractions. A single baby elephant may be worth as much as US\$3000, leading wildlife authorities to require proof that young elephants were born in captivity rather than having been illegally captured from the wild. Genetic testing using polymorphic microsatellite DNA markers can provide the data needed for verification of maternity. We screened six polymorphic microsatellite loci developed for African elephants to assess polymorphism in 29 Asian elephants and to test the efficiency of assigning maternity in 6 putative baby elephant / mother pairs. As expected, we found that the number of alleles and the level of heterozygosity was lower in Asian elephants than in the African species. Although the level of polymorphism was sufficient for individual identification, it was not adequate for maternity assignment when candidate mothers from the same population were included. To provide scientific evidence for law enforcement, parentage assignment will require additional polymorphic loci, preferably ones that were developed specifically for the Asian elephant.

**DEVELOPMENT AND IMPLEMENTATION OF A RANGEWIDE CONSERVATION PROGRAM FOR THE RELICT LEOPARD FROG (*RANA ONCA*)**

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The relict leopard frog (*Rana onca*) was considered extinct until its rediscovery at several locations within the Lake Mead National Recreation Area, Nevada, USA, beginning in 1991. A total of seven populations were identified, six within Lake Mead NRA and one in Mohave County, Arizona, but two are now extirpated, and the global population of this species was thought to number fewer than 1100 individuals in 2000. Conservation efforts for this species are complicated by its historic distribution encompassing trans-boundary areas of three US states, multiple jurisdictional regions of federal management agencies, and a

unit of the National Park Service. Coordinated conservation actions were initiated in 2001 with formation of the Relict Leopard Frog Conservation Team and a comprehensive Conservation Agreement and Strategy was completed in fall 2005. Concurrent with conservation strategy development, RLFT partners have successfully implemented captive breeding and head-start programs, established four additional populations in the wild, completed critical life history research activities, and developed a cooperative field monitoring program. Future efforts will focus on adaptive management to enhance and expand existing wild and experimental populations, and on developing additional viable populations of the frog within historic range outside of Lake Mead NRA.

### **USING MARXAN AND CLUZ TO PRODUCE A PRELIMINARY CONSERVATION ASSESSMENT FOR MAPUTALAND, SOUTH AFRICA**

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Most protected area (PA) networks have developed in an ad hoc manner and fail to represent important elements of biodiversity, so a variety of planning techniques have been proposed to improve this situation. One such approach is systematic conservation planning, which is a target-driven process for designing PA systems and other ecological networks, but their use by practitioners has been limited. There are several reasons for this, including a perception that the required software is difficult to use and requires a large amount of biodiversity data. Thus, even when these planning exercises are undertaken, they often occur at the beginning of the planning process and rely on outside expertise. These perceptions are problematic because systematic conservation planning should be at the heart of all land-use zoning and protected area design. Moreover, it is important that all stakeholder organisations have the capacity to update these plans to reflect changes in land-use, land ownership and patterns of biodiversity. This poster illustrates how a user-friendly software package (CLUZ) was used together with basic landcover data to produce a preliminary conservation assessment that has already been used to inform important land-use decisions in Maputaland, South Africa.

### **LOSING THE SANCTUARY: DRY FOREST LOSS IN THE LAST ELD'S DEER STRONGHOLD**

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To assess long-term decline in dry deciduous forests at Chatthin Wildlife Sanctuary (CWS) in Myanmar (Burma), we analyzed five satellite images covering 32 years (Landsat MSS: 1973; Landsat TM: 1989, 1992; Landsat ETM+: 2001; ASTER: 2005). CWS is one of the last strongholds for dry deciduous forests and the associated endangered Eld's deer. Both are becoming increasingly rare throughout Asia. We compared deforestation inside and outside CWS to evaluate the sanctuary's effectiveness in preserving habitat. Our results demonstrate major habitat declines between 1973 and 1989 due to encroachment. 1989-2001 saw little habitat loss, presumably resulting from increased sanctuary protection associated with an Eld's deer conservation project. Construction of Thapansaik Dam and subsequent flooding in 2001 caused a new increase in habitat loss at CWS. Overall, habitat loss was significantly higher outside the sanctuary, resulting in almost complete deforestation and clearly demonstrating the enormous pressures on the reserve. We conclude that despite habitat loss, CWS provided significant protection for Eld's deer in the past. However, without changes to government land use policies in surrounding areas, CWS and its associated Eld's deer population will continue to decline.

### **UNGULATE INTRODUCTIONS IN SOUTH AFRICA: THE POOR GET RICHER THAN THE RICH**

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Humans rely on exotic species for their survival, especially for food. Exotic species are also transported worldwide for recreational and aesthetic reasons. Yet the humanaided movement of organisms is a great threat to biodiversity. Humans could be expected to introduce the highest number of exotic species to species poor areas. However, studies have shown that, for plants, species rich areas have more invasive species than other areas. Ungulates have been moved globally since prehistoric times for food, tourism, sport hunting, aesthetic, and other reasons. In South Africa many ungulates are being introduced throughout the country to satisfy hunting and tourism interests, on private land. These practices raise concern due to the high likelihood vertebrates have of becoming invasive. This study aimed to quantify the introduction of exotic ungulates in South Africa and to determine the relationship between the introduction of exotic ungulates and the species richness of indigenous ungulates. Game sale data between 1963 and 2005 was obtained. It was found that in the last five years about 40% of ungulate species sold were exotic to the location of sale. The highest number of exotic species sold was in areas with the lowest species richness of indigenous ungulates.

### **CATTLE FACILITATION OF ALEUTIAN CACKLING GOOSE FORAGING PATTERNS IN HUMBOLDT BAY PASTURES**

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A conflict between the dairy and cattle ranchers around the Humboldt Bay near Arcata, California, and the once endangered Aleutian cackling goose (*Branta hutchinsii leucopareia*) has arisen. Through successful conservation initiatives, the Aleutian goose has made a remarkable recovery from the endangered species list with a current population estimated at more than 60,000 individuals. In recent years, the Aleutian geese have incorporated surrounding pastures of Humboldt Bay as a major spring staging site prior to their long-distance migration to their Aleutian Island breeding grounds. The geese are dependant on nutrient-rich pasture grasses to build endogenous reserves that are critical to breeding success. However, local ranchers are dependant on these same pasture grasses for cattle milk and weight production. We describe livestock management regimes of coastal grasslands that may influence Aleutian goose pasture use in the Arcata Bottoms spring staging site with an emphasis on cattle grazing facilitating Aleutian goose foraging patterns.

**DISTRIBUTION AND ABUNDANCE OF ENDANGERED MARINE TURTLES AT PALMYRA ATOLL, CENTRAL PACIFIC**

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Sea turtles at Palmyra Atoll live in a unique environment removed from pervasive anthropogenic influence, offering singular opportunities for research and conservation. Marine chelonians are endangered worldwide, and human activities play a major role in population declines. Research at Palmyra will enhance understanding of sea turtles where they are relatively unaffected by people, providing an essential baseline for understanding natural processes and human impacts on these animals. Our research objectives at Palmyra are to study the distribution and abundance of sea turtles with regard to ecological interactions, behavior, conservation, and health issues. Future work will additionally focus on connectivity and movements within a regional context. In field surveys, green turtles (*Chelonia mydas*) were the species most commonly recorded, although hawksbills (*Eretmochelys imbricata*) were also present. Sea turtles were often flanked by juvenile sharks. Marine chelonians were observed along the north and south fringing reefs, in the hole east of East Pass, in the Central Lagoon, and off deeper reef slopes. There was evidence of infrequent nesting efforts, indicating this is not a major rookery. The information on distribution and abundance, in concert with foraging behavior observations, was instructive in identifying factors to be considered in restoration efforts at Palmyra.

**EFFECTIVENESS OF PROTECTION STRATEGIES IN TANZANIA: ASSESSING A DECADE OF SURVEY DATA FOR LARGE HERBIVORES**

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Considerable controversy surrounds strictly protected areas that prohibit consumptive resource use. We compared the effectiveness of heavily protected National Parks and Game Reserves, partially protected Game Controlled Areas, and areas with little or no protection in conserving populations of large herbivores in Tanzania. Comparisons based on surveys conducted in the late 1980s / early 1990s and again in the late 1990s / early 2000s show three consistent patterns across the country. First, significant declines in the densities of surveyed grid cells between two snapshots in time overwhelmingly outnumbered significant increases in all protection categories. Second, higher percentages of species fared well (increased significantly or showed no significant change) in strictly protected National Parks than in areas with partial or no protection and in heavily protected Game Reserves relative to areas with no protection. Third, significantly more species fared poorly (densities in surveyed grid cells declined or were too low to detect a decline) than fared well in areas with partial or no protection. While our analyses show that heavy protection is generally more effective than partial or no protection, continued long term monitoring is needed in Tanzania to inform managers if many large herbivores are experiencing declining population trends even within heavily protected areas.

**POPULATION DYNAMICS, HABITAT USE, AND TROPHIC RELATIONS OF THE SOUTHEASTERN BEACH MOUSE IN A COMPLEX COASTAL SETTING**

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Among beach mice, the southeastern beach mouse (SEBM, *Peromyscus polionotus niveiventris*) occupies the greatest diversity of habitats. This derives from the fact Cape Canaveral, on the east-central coast of Florida, is unique in that dune and coastal scrub vegetation offers landward widths of up to 3 km. Elsewhere, suitable habitat is found less than 200 m landward of the coastline. Cape Canaveral is under federal management because of aerospace enterprises. These habitats have been subjected to lightning derived fires, various salinity stresses, and periodic hurricanes since the sea level stabilized about 5000 years ago. We studied the SEBM on six trapping grids distributed from coastal dunes to as much as 3 km inland at biweekly intervals for three years. Our data show the inland populations were less variable than coastal ones. Coastal dunes experienced a total loss of SEBM following hurricanes in 2004. Recovery of plant cover on the dunes took five months; recovery of SEBM lagged about 12 months. Stable isotope ratios demonstrated important differences between coastal and inland diets. Genetic structure as revealed by microsatellite markers indicated minor genetic isolation by distance. Fire management of the coastal scrub will be essential for this species.

**RELICT PLANT POPULATIONS: MAINTAINING SPECIES DIVERSITY IN SMALL, ISOLATED PATCHES**

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Southern Missouri supports eight known paleoendemic populations of *Anticlea elegans* ssp. *glaucus*. The contemporary range for *A. e. glaucus* is approximately 650 km north. The purpose of this study was to estimate genetic similarity among eleven widely distributed relict and core-range populations of *A. e. glaucus*, including five Missouri populations, using intersimple sequence repeat (ISSR) molecular markers. I also monitored demographic structure and stage class transitions in three Missouri relict populations across four years. Missouri populations were among the most highly differentiated, although they occur in close geographic proximity, and Missouri relict populations as a group represented a broad spectrum of surveyed total species diversity. For species with paleoendemic populations, even small, isolated populations may contain significant amounts of species total genetic diversity, possibly including portions of genetic variation left behind in Pleistocene refugia. The monitored Missouri relict populations showed similar demographic structure and no evidence of recruitment via sexual reproduction. Persistence of these populations is primarily via long term survival of and vegetative reproduction by individual genets. These paleoendemic populations exhibit characteristics of little-studied alternative long-term population persistence strategies involving low recruitment, long term survival of established plants and asexual reproduction.

**PARTNERS IN RESTORATION AND AGRICULTURE: AGREEMENTS TO REDUCE REGULATORY BURDENS ON FARMERS AND LANDOWNERS WHILE ACHIEVING RESTORATION GOALS**

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Neighboring landowner concerns about endangered species regulations often generate opposition to habitat restoration. EDAW is partnering with The Nature Conservancy and the Sacramento River Conservation Area Forum's Advisory Workgroup of farmers, landowners, and land managers to reduce adverse effects of regulations on neighboring stakeholders while attaining restoration goals. Our work along the Sacramento River, where riparian woodland is proposed for restoration amid an agricultural matrix, is applicable to any partnership between habitat restoration and neighboring land uses. This poster compares 7 types of agreements that enable both restoration and neighboring landowner goals to be met. These agreements include Good Neighbor Policies, Neighboring Landowner Agreements, Memoranda of Understanding, Safe Harbor Agreements, Habitat Conservation Plans, streamlined permitting, and self-mitigating restoration design principles which reduce the risk of transboundary wildlife conflicts. We compare these agreements with 9 criteria: formality of assurances for neighboring landowners, level of protection for wildlife, flexibility, simplicity, level of responsibility held by restoration proponents, level of responsibility held by neighboring landowners, timeline to completion, length of time the agreement is binding, and financial cost. We offer an approach that restoration entities and neighboring landowners may use to identify the best tools to meet their specific concerns.

**AVIAN USE OF A MANAGED POND: A CASE STUDY IN SOUTH SAN FRANCISCO BAY AND THE IMPLICATIONS FOR SALT POND RESTORATION**

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The San Francisco Bay area contains the most important salt pond complexes for waterbirds in the United States, supporting significant numbers of migratory waterfowl and shorebirds and large numbers of nesting shorebirds, terns, and gulls. The current plan to restore tidal action to most of the existing salt ponds in the Bay places an important emphasis on understanding how to manage the remaining ponds for waterbirds. We analyzed a decade of waterbird numbers at a managed pond to look at use by avian species. Shorebirds, gulls, and waterfowl used the managed pond for wintering and migratory stopover habitat with year, season, taxonomic grouping, and water level important factors in determining use. The pond had numerous management challenges that are directly relevant to the proposed managed wildlife ponds within the salt pond restoration plan. These included sediment deposition, an unreliable water intake system, and the inability to maintain high salinity levels. This pond did not provide habitat for special status species or high-salinity specialists, nor provide for ground nesting birds. Maintenance of this pond will require active management in perpetuity. These results stress the importance of adaptive management and long-term planning in the Bay restoration project.

**CHELONIAN RESEARCH, EDUCATION, AND CONSERVATION IN SOUTHWEST CAMBODIA**

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The distributions of many species are uncertain owing to a lack of records and because almost no records exist for wild tortoises or turtles. According to previous records, there are 11 native and two introduced species of freshwater turtles and tortoises in Cambodia. The 2004-surveyed project funded by the BP Conservation Programme resulted that there are seven species of turtles and tortoises and there should be all 11 species in this area according to shell discovery, and that chelonian species are extremely threatened (local consumption and trading for market demand). The goals of the 2005-2006 follow-up project funded by BPCP are to further find out the distribution, abundance, threats, and habitat occurrence and to raise awareness of local people and the public. The project has three phases: (1) education of university and local students, village committee, authorities, and government rangers, (2) research on the endangered *Indotestudo elongata*, *Pelochelys cantorii*, *Hieremys annandalii*, *Platysternon megacephalum*, and *Manouria impressa*, and (3) creating a national working group to collect all turtle and tortoise information through meetings between government, NGOs, and rangers and at the end we will make a chelonian distribution map for Cambodia. Until now we found 137 shells and 47 live individuals of eight species, of which seven are globally threatened, and one that has never been recorded in Cambodia. The species include *Hieremys annandalii*, *Indotestudo elongata*, *Manouria impressa*, *Heosemys grandis*, *Siebenrockiella crassicollis*, *Cuora amboinensis*, *Amyda cartilaginea*, and *Cyclemys atripons*. Also, we successfully did two ranger training courses on turtle identification to rangers and a training course to university students.

**MICROSATELLITE VARIATION IN TWO SICHUAN JAY (*PERISOREUS INTERNIGRANS*) POPULATIONS IN WEST CHINA**

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The Sichuan Jay is one of the least known endemic bird species inhabiting the high mountain conifer forest in western China; it is listed as a Vulnerable species in IUCN's red list and has a small, declining, severely fragmented population as a result of extensive deforestation throughout its range. In this study, genetic variation in two Sichuan Jay (*Perisoreus internigrans*) populations at Zhuoni, Gansu, and Jiuzhaigou, Sichuan, were assessed using six microsatellite markers. The Zhuoni population showed a low heterozygosity, and was deviated from Hardy-Weinberg equilibrium corresponding a higher observed heterozygosity than expected, while the Jiuzhaigou population was in a Hardy-Weinberg equilibrium, although it also had a slight excess of observed heterozygotes. The bottleneck test found significant heterozygosity excesses ( $HE > Heq$ ) in both populations, which indicated both populations have suffered recent declines in population size. Considering its low heterozygosity and negative FIS, we suggest that Zhuoni population might have become fragmented and endangered, probably due to high habitat loss. The Jiuzhaigou population did not show any obvious signs of alleles lost.

**THE IMPACT OF LONGLEAF PINE STRAW RAKING ON NATIVE REPTILE AND AMPHIBIAN POPULATIONS IN THE SANDHILLS OF NORTH CAROLINA, USA**

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Efforts to promote restoration of critically endangered longleaf pine ecosystems on private lands in the southeastern USA continue to be financially hampered by the slow growth rate of longleaf compared to other pine species. Recently, however, the commercial harvest of longleaf pine needles ("pine straw") for use as landscaping mulch has rapidly increased in the region, yielding high profits for landowners but potentially severe impacts on native organisms. I conducted a two-year study of the response of reptile and amphibian populations to ongoing pine straw raking at 16 trapping sites (4 raked and 12 unraked) within a contiguous landscape of public lands in the Sandhills area of south-central North Carolina. A total of 1346 individuals of 27 species were caught during the study. Significantly more hognose snakes, spadefoot toads, and green anoles were captured on the unraked sites as compared with the raked sites, and on average more than twice as many total animals of all species were caught per site in the unraked areas (98.2 vs. 42.0). It appears that while some common species can tolerate the disturbance caused by pine straw raking, the practice as generally performed results in a pronounced decline in native reptile and amphibian populations.

**TEMPORAL ACTIVITY PATTERNS OF THE SANTA CRUZ ISLAND FOX: A NEWFOUND ANTI-PREDATOR DEFENSE FOR AN ENDANGERED SPECIES?**

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Research was conducted to inform conservation management of the critically endangered Santa Cruz Island (SCI) fox (*Urocyon littoralis*) by examining the possibility that strong predation pressure has altered fox circadian activity patterns. The SCI fox is a unique, endemic subspecies, whose population dramatically declined from over 1300 individuals to under 100 individuals over the past 14 years, due to novel, diurnal predation by recently invasive golden eagles *Aquila chrysaetos*. A mixed model ANOVA was used to compare levels of diurnal and nocturnal activity between 2004–2005 and 1992 fox activity data. Results showed that foxes exhibited significantly ( $p.0001$ ) lower levels of diurnal behavior in 2004–2005 (38.5) than in 1992 (61.7) and significantly higher levels of nocturnal behavior in 2004–2005 (87.7) than in 1992 (76.7), although the degree of significance was less pronounced for nocturnal behavior ( $p.0447$ ). These results indicated a definite, population-wide shift in the activity behavior of the SCI fox since 1992. Further study will examine whether this is more likely a long-term effect of natural behavioral selection by the novel, diurnal golden eagle or a temporary effect of reduced fox density. This distinction is crucial for accurate assessment of both the current predation threat to SCI foxes and the ongoing predation threat to SCI foxes as population density increases.

**INCIDENTAL CAPTURE OF SEABIRDS IN COASTAL TRAWL FISHERIES**

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The incidental capture of seabirds is well documented for longline and offshore bottom trawl fisheries but the information about interaction of seabirds with coastal fisheries is scarce or remains unknown. The mortality of seabirds in bottom trawl nets generally fits into two categories: impact with cables and nets entanglements. Trawl fleets are widely distributed along the coastal waters off Argentina, but 80 of the coastal vessels ( $> 275$ ) fish on the north grounds (Buenos Aires Province, BAP). An onboard observers program was established for studying the incidental capture of seabirds in Puerto Quequen, BAP. We recorded 166 hauls in 55 fishing days from July 2003 to November 2005. We recorded the incidental capture of two species, Great Shearwater (*Puffinus gravis*,  $n = 18$ ) and Magellanic Penguin (*Spheniscus magellanicus*,  $n = 2$ ) in seven hauls. Additionally, preliminary observations show at least that two species were impacted with cables: Great Shearwater and Black Browed Albatross (*Thalassarche melanophris*). Considering 14,400 hauls per year, an estimated 1562 Great Shearwater and 174 Magellanic Penguin may be trapped annually by this fishery only for nets entanglements.

**STUDY OF STATUS, DISTRIBUTION, AND ECOLOGY OF BENGAL FLORICAN (*HOUBAROPSIS BENGALENSIS*) IN THE GRASSLANDS OF ROYAL CHITWAN NATIONAL PARK, NEPAL**

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Survey of an endangered bird, the Bengal Florican, were done in the grasslands of Royal Chitwan National Park (RCNP) to know the status, distribution, and ecology. The research period was of six months and different field visits were organized in the months of March, April, and May. Mapping was done with the help of GPS and Arc View. Seven grasslands were surveyed in the RCNP and only two Phantas (Sukivar and Buddhanagar) holds the Bengal Florican and the encounter rate was found to be 0.06 / hr and 0.07 / hr respectively. A total of 103 man hrs was spent in the grasslands of RCNP, which results five separate sightings BF. Thus, the density of the Florican in the surveyed grasslands (2.35 km<sup>2</sup>) is found to be 0.85 male / km<sup>2</sup>. The total population is estimated to be 3–8. If we assume the equal sex ratio, the estimated population in the RCNP should not be more than 16 Florican. Quadrat method was used in which the plot size of (1x1) m was laid. Area species curve was used to determine the minimum plot required for survey. 2099 individuals of 41 different species were recorded in the entire patch of Phanta of Sukivar, which corresponds to 17 different families. Grass Family were dominant and the IVI value was maximum for *Imperata cylindrica*, which is 43.5. There is decreasing in the trends of the population since 1982 was noted. The main cause in its decline is the natural succession and the disturbance by the human activities in the park. The result acquired during this research is consider to facilitate the ongoing management activities inside the park and recommendation provided will ensure the survival of this endangered species in RCNP.

**MORTALITY OF FIRST BORN MAMMALS: IMPLICATIONS FOR DEMOGRAPHIC ANALYSES OF WILD POPULATIONS**

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Conservation actions often depend on generalizations from theory and / or hypotheses with ambiguous empirical support (e.g., sex allocation theory, small population paradigm). Tests of biological generalities—for example within and / or among taxa—are important for improved confidence in the analyses and management of wild populations. We tested an oft cited family of hypotheses about mortality of first born mammalian offspring: that mortality is greatest for “first born” mammals, that increased mortality is due to lack of behavioral maturity and / or physiological immaturity, and that first born males have higher mortalities than females. Our results have implications for the design and evaluation of population viability models, captive breeding programs, demographic projection models, and reintroduction success. We analyzed data for 51 populations (species) of zoo primates (8200 total births) and found few significant differences in mortalities for birth order, gender, or whether an individual was hand- or mother raised. Heterogeneity tests revealed differences for one or more variables in few species, which suggests that birth order or sex related differences in infant mortality are the exception, rather than a rule, for primate demography. These results demonstrate the need for caution when using species surrogates in the development of species management plans.

**THE HEART OF BORNEO: THREE COUNTRIES, ONE TRANSBOUNDARY CONSERVATION VISION**

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The transboundary forests of the island of Borneo are possibly the last opportunity for large-scale conservation in Southeast Asia. The world’s third largest island possesses staggeringly high levels of endemism across all groups of plants and animals. This is one of only two places on earth where orangutans, elephants and rhinos still co-exist and where forests are currently large enough to maintain viable populations. Ensuring the connectivity of the upland forests is crucial to the very survival of its many rare and endemic species, the cultural survival of its indigenous people and the locally and regionally important ecosystem services provided by the forests. WWF has developed the Heart of Borneo program to conserve 22 million hectares in the Heart of Borneo through a network of protected areas and sustainably-managed resource areas. This depends on international cooperation led by the Bornean governments and supported by a global effort to eliminate large-scale threats from forest, agriculture, and mining sectors. We discuss the adaptation of multi-party transboundary conservation models from other regions and highlight the potential benefits for large-scale conservation of the Heart of Borneo.

**ASSESSMENT OF GENETIC DIVERSITY IN POPULATIONS OF *SANGUINARIA CANADENSIS* USING AFLP ANALYSIS**

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*Sanguinaria canadensis* (bloodroot) is a perennial, medicinal, woodland species native to the Appalachian Mountain region in eastern North America. Due to the asexual propagation and concentration of the alkaloids of interest in underground rhizomes, populations are sensitive to environmental stresses and destructive collection practices. To determine the practicality of ex situ conservation methods, the genetic diversity must be characterized. We examined the genetic structure of 72 populations of bloodroot representing geographic regions of western and central North Carolina. Amplified Fragment Length Polymorphism (AFLP) fingerprints were used to assess genetic diversity, develop phylogenetic representations of the population genetic structure, and develop a conservation requirement strategy.

**PARTICIPATORY ACTION RESEARCH: A STRATEGY FOR GENETIC CONSERVATION IN MT. KITANGLAD NATURAL PARK**

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One of the challenges that biodiversity conservation is facing today is to come up with a field-based approach / strategy that would maximize people participation. There are initiatives but only a few venture into participatory action research as a strategy for biodiversity conservation. This research presents the process and results from using PAR as a strategy to promote social learning and collective action for the conservation of genetic resources in MKNRP. This approach constitute the community’s cyclical and iterative reflection / planning, implementation, and monitoring of outcomes. The community adapts strategies according to the needs, learning from the past and failure of actions until issues and problems of conservation are successfully addressed. The research observed that using this facilitative process, the community gained knowledge with the importance of particular species and their uses as well as the processing techniques. This shared learning encourages the community to increase diversity of these species in their backyards and gardens thus reducing impact inside the park. Although it’s too early to say, we expect that this effort will have a positive impact on the community in terms of giving the community access to the resources in the park without sacrificing the government’s effort in the protection of its resources.

**IMPLICATIONS OF VARIABILITY IN THE LOGGERHEAD SEA TURTLE NEST ENVIRONMENT TO HATCHLING QUALITY, MORTALITY, AND PRODUCTION ESTIMATES**

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We studied patterns of mortalities in posthatchling loggerhead sea turtles from 103 natural nests deposited on beaches in Florida. Turtles were collected during the first major emergence and were brought to the lab alive and in robust condition for rearing in a separate study. Sporadic mortalities were recorded and investigated. Although turtles were housed in different tanks and at two different facilities we found that the mortalities tended to be concentrated in some clutches and not others. Mortality was higher from nests that were excessively wet from either tidal inundation or prolonged rainfall. We found that the hatchlings incubated in wet conditions were more likely to die within a few weeks than their counterparts who incubated in drier conditions. This is important because not every hatchling that makes it to the water has an equal survival probability.

Hatchlings from the affected nests experienced mortality 4 times greater than the turtles collected from drier nests (40% vs 9%). Therefore, emergence success may not be a true indicator of hatchling survivability. Hatchling production estimates must be modified to take into consideration incubation conditions. At sites that are managed to maximize production, nest conditions should be monitored to minimize inundation risk. These results suggest that it may be desirable to relocate nests in danger of inundation to maximize both hatchling production and quality at rookery sites suffering from a decline in nesting.

**EDGE EFFECTS AND FRAGMENTATION: CONSERVING BAT BIODIVERSITY**

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Habitat fragmentation constitutes one of the main ecological problems worldwide, follow-on the quick loss and extinction of biodiversity. Bats, as other groups, are sensitive to habitat perturbations; little is known about consequences of edge effects on bats and its applicability to conservation. Our objective was to investigate edge effect on bat abundance and diversity in tropical subdeciduous forest, Veracruz, Mexico. During one year we captured 144 bats (12 species): inside forest fragments 25 bats (9 spp.), in the edge 102 (7 spp.), and in the matrix 17 (5 spp.), at three different fragments. Shannon–Wiener ( $H'$ ) indexes were significant between interior ( $H' = 0.7877$ ) and edges ( $H' = 0.2868$ ), also between exterior ( $H' = 0.6898$ ) and edges. Two bat species, *Sturnira lillium* and *Carollia perspicillata*, benefited with abundant food supply provided by *Piper auritum* and *Cecropia obtusifolia*; other bats used edges as corridors. Edges' importance for bats and their habitat are provide a wide quantity of food for some frugivorous bats, function as a source of pioneer plants-bat dispersed, contributing to tropical forest regeneration, are used by bats like connection among fragments, diminishing isolation among populations. Although edges are perturbed areas, they conserve most bat richness, so, edges should be considered as an essential element in developing actions directed toward diversity conservation, not only for bats, but also for all biodiversity.

**THE NSF GK-12 TEACHING FELLOWSHIP: SIXTH GRADERS EXAMINING THE EFFECTS OF CONTROLLED BURNS IN SUNKHAZE NATIONAL WILDLIFE REFUGE**

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The NSF GK-12 teaching fellowship is designed to bring exemplary undergraduate and graduate students majoring in science and engineering into local elementary, middle, and high school classrooms. The intention of the program is to provide a spark of interest in science by doing hands-on activities designed to engage the students and conduct real scientific research. Working with the 6th grade at Lewis Libby School and Sunkhaze National Wildlife Refuge the students developed a project examining the effects of prescribed burns on the abundance and species richness of small mammals in the refuge. Posing the students with this question, I guided them through the steps of the scientific method in which they formed hypotheses and designed the methods needed to answer that question. With the help of several volunteers the students were able to go out in the field and live trap small mammals. Thus far with a low sampling effort we have been unable to detect a difference between the burned and unburned areas. The project will continue with more trapping sessions and lessons on data analysis, and will culminate with a student presentation to the refuge manager on our findings.

**REDISCOVERING THE GUANACOS OF THE PARAGUAYAN CHACO**

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The guanaco (*Lama guanicoe*) is one of the least known species of the Chaco ecosystem in Paraguay. The isolated Paraguayan population marks the northeastern limit of guanaco distribution, and is classified as critically endangered. Largely unknown in Paraguay, the guanaco could be a flagship species for the Chaco, as it forms an important prey for large carnivores (*Panthera onca* and *Felis concolor*). Work carried out since 2002 in the northern Medanos del Chaco National Park (485,888 ha) and surrounding area has focused on evaluating the impact of hunting by indigenous communities. Two communities, together comprising over 150 families, were recently translocated to an area close to the park boundary. Hunters from the communities are known to take guanacos. The impact on guanaco population biology was evaluated, using camera traps to estimate population and range. The value of hunting for local livelihoods was also assessed, and a framework developed for collaboration between conservation interests and the community to promote sustainable use practices.

**IDENTIFYING THE CONTRIBUTION OF DIRECTIONAL HYBRIDIZATION BETWEEN TWO TOAD SPECIES (GENUS: BUFO) TO THE DECLINE OF A PARENTAL SPECIES**

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Habitat disturbance leading to the breakdown of ecological barriers has resulted in hybridization between numerous sympatric species and the decline or extinction of the parental species. Despite strong postzygotic selection against it, hybridization occurs between two normally ecologically isolated toad species, *Bufo nebulifer* and *B. fowleri*, as a result of human disturbance. This hybridization is potentially resulting in a decline of the rarer species, *B. fowleri*. Hybrids are morphologically cryptic; therefore, molecular methods were used to identify them. Single nucleotide polymorphisms (SNPs) are a recent technique utilized to identify hybrids that cannot be conclusively identified by morphological characteristics alone. Twelve species-specific SNPs from a 660 base pair fragment in a nuclear intron of the Rhodopsin gene were used to identify each species, and hybrids were identified based on heterozygosity at these sites. Ninety-two individuals from eight mixed breeding populations were directly sequenced and three male hybrids were identified. Although hybrids represent a low segment of the sample population, directional hybridization of male *B. nebulifer* with female *B. fowleri* may be a historical factor in the decline of *B. fowleri*. Furthermore, infertile male hybrids are thought to preferentially mate with *B. fowleri* females, potentially causing a devastating loss of reproductive effort in females of that species.

**RAPID BIOLOGICAL AND SOCIAL INVENTORIES: PROTECTING PRIORITY AREAS IN ANDEAN AND AMAZONIAN PERU**

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A critical first step in conserving biodiversity is broad-scale conservation planning. We use rapid biological and social inventories for the next step: translating conservation planning into conservation action. In 1996 the Peruvian government approved a countrywide conservation plan, identifying 38 priority areas for conserving the full spectrum of biodiversity in Peru. Eleven areas were already covered within the Peruvian park system (SINANPE); the remaining 27 were not sufficiently protected or totally unprotected. In close collaboration with our Peruvian partners, during 2000–2005 The Field Museum conducted rapid inventories of six of these priority areas and preliminary overflights in an additional one (total 5.7 million ha). We evaluated the biological singularity of each area, and surveyed the organizational strengths and conservation vision of nearby local communities to identify ways to engage local residents in long-term conservation. Based on our integrated recommendations, three areas are now strictly protected (Cordillera Azul, Megantoni, Gueppi), and four are on the road to becoming protected (Ampiyacu, Yavari, Matses, Sierra del Divisor). Together these seven areas represent 4.4% of the land area and an almost complete complement of terra firme and foothill habitats in Peru.

**IDENTIFICATION OF PRIORITY AREAS IN VIETNAM FOR BAT CONSERVATION**

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Bats play an essential role in most ecosystems and currently represent approximately half of mammalian diversity of Vietnam. However, bat studies in the country are especially limited. Among a total of 126 protected areas in Vietnam, comprising 4 biosphere reserves, 28 national parks, 44 nature reserves, 11 species / habitat reserves, and 39 landscape reserves, only 10% have been surveyed on bats. Yet over 100 species have been recorded and numbers of new taxa to the country, and, in some cases, new to science have rapidly increased with the latest surveys. Unfortunately, the bat fauna of Vietnam is currently threatened critically by a variety of such factors as hunting, over-exploiting of natural resources, or eco-tourism development. These factors may also disturb not-yet-surveyed habitats of bats. It is noteworthy that several species or subspecies endemic to Vietnam have not been re-documented for several decades. Based on the results from previous bat studies, together with on habitat status of each indicated area, the protected areas are systematically ranked according to the priorities for bat conservation.

**PHYSIOLOGICAL MEASURE VALIDATIONS FOR THE SOUTHERN RESIDENT KILLER WHALE**

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The southern resident killer whale (*Orcinus orca*) population in the Pacific Northwest was recently listed as endangered under the federal ESA. Possible threats facing this population include poor nutrition, disturbance, contaminant burdens, and immunosuppression. A critical component of successful mitigation will be the ability to differentiate the relative contribution of these stressors to population decline. We are developing a panel of non-invasive physiological measures in feces to determine which one(s) are having negative effects on the orcas. This panel measures thyroid hormone as an index of nutritional stress, cortisol and reproductive hormone metabolites as indices of disturbance stress and associated reproductive functioning, and several immunoglobulins as measures of immune functioning. Each measure must undergo a series of validations to test for the presence of the hormone or immunoglobulin in feces and the accuracy of the measurement. Thus far, we have successfully validated cortisol and thyroid hormone (T3) in killer whale scat using parallelism tests. These results show that these hormones are present in killer whale feces and can be measured. When applied to wild orcas, these measurements will allow us to physiologically monitor nutritional and disturbance stress as guiding tools for the southern resident management plan.

**RESOURCE USE RELATIONSHIP OF SYMPATRIC LARGE HERBIVORES IN THE WASGOMUWA NATIONAL PARK, SRI LANKA**

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Food habits and habitat use of the sympatric herbivores, axis deer, Asian buffalo, and Asian elephant in Wasgomuwa National Park, Sri Lanka were studied in the rainy and the dry seasons. Due to their invasion into the park, food habits of domestic cattle were also studied. Though each species had different habitat preferences, all of them preferred grasslands and forest-grassland ecotones to forest habitats. These animals showed particular food preferences. In spite of these preferences, their staple foods were commonly grasses. Cattle food included more than 92% of grasses in both seasons. Therefore, they reduce the grass resource for wild herbivorous mammals in the park significantly. Grazing pressure in the study area seemed to be high enough to suppress plant growth. Estimated biomass of the grassland in the dry season decreased to less than one-fourth of that in the rainy season. The high overlap in both habitats and foods for these herbivores in the dry season and, further, the overgrazing of commonly shared grass species suggest the possibility of competition among the animals in the dry season. In spite of differences between these herbivores, resource partition seems to be difficult in the confined area or limited size park.

**WHAT'S A CENTURY TO A SNAIL? AN OLD INVADER FINALLY ARRIVES IN SAN FRANCISCO BAY**

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In July 2005 we discovered the first known population of *Batillaria attramentaria*, an invasive mud snail native to Japan, in San Francisco Bay (SFB). Surveys suggest that this invasion is relatively new (i.e., less than 5 years old), offering a unique

opportunity to investigate invasion impacts over time. The invasion lends support to the theory that diversity does not limit invasion success, as SFB is one of the most heavily-invaded, and in that regard species-rich, estuaries in the world. While it is known that *B. attramentaria* affects invertebrate community composition, it is not clear what impact the invasion will have on ecosystem function and on other species in SFB. Specifically, this study involves a basic description of the invasion (genetics, parasites, population demographics) as well as an analysis of short term removal impacts on chlorophyll levels (as a proxy for primary production), and community composition. If *B. attramentaria* expands its range in SFB, it could have Bay-wide impacts on the mudflat communities, including invasion facilitation and changes in benthic diatom abundance. The results from the removal experiments can inform eradication decisions, contribute to our knowledge of estuarine health, and influence oyster aquaculture siting decisions, as non-native oysters (genus *Crassostrea*) are the mostly likely vector for this species on the west Coast of North America.

**DO NEST PREDATORS INFLUENCE HABITAT SELECTION AND NEST PRODUCTIVITY OF FOREST SONGBIRDS IN AN URBANIZING ENVIRONMENT?**

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Populations of many nest predators have increased in association with urbanization, which triggers conservation concern for songbirds breeding in remnant forest patches. From 2002 to 2004, we explored the relationship between diurnal nest predators (corvids and sciurids) and native songbirds in an urbanizing environment of the Puget Sound. Five of the ten songbird species we studied were negatively associated with combined predator abundance at the "landscape" scale (a 1-km<sup>2</sup> area surrounding forest patches), while two species were positively associated with predators. At a smaller scale (within the forest patches), six of the ten species appeared to avoid areas of more frequent predator activity, either by Stellar's Jays, American Crows, or all predators combined. All species bred in habitat used by nest predators, with relatively high success: 49.4% of all nests found (N = 411), and 49.0% of all territories monitored (N = 2125) fledged at least one young. However, estimates of "predator load" (the probability of detecting predators at a particular location) for American Crows were higher at failed nests than at successful nests. Similarly, Stellar's Jays were more likely to be detected around failed territories than around successful territories. Such consequences to reproductive success may reinforce the avoidance behavior that we documented at patch and landscape scales.

**THE HABITAT DELINEATION AND RESTORATION OF SACRAMENTO PERCH USING CONSERVATION PHYSIOLOGY**

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The translocation success rates for fish are less than 40% with habitat quality at the translocated site and number of individuals released cited as the main factors influencing the success rates. Even though the success rates are relatively low, this technique is employed in greater than 80% of fish recovery plans. Subtle changes in water quality, particularly those characteristics overlooked, can disrupt the physiological homeostasis in fishes producing a coordinated set of physiological and behavioral responses that can have long-term effects on individuals and their offspring. The determination of the physiological optima and sub-optima is useful for the habitat delineation and conservation of Sacramento perch (*Archoplites interruptus*), a threatened California sunfish. We investigated the physiological tolerances at three life stages (larval, juvenile and adult) to critical maxima and minima temperatures, dissolved oxygen minima, pH maxima, and salinity maxima at acclimated four temperatures; as well as measured the oxygen consumption rates of these fish exposed to varying temperature regimes. The determination of the physiological optima and sub-optima is useful for the habitat delineation and restoration of Sacramento perch to its critical habitat; in addition this information can focus restoration efforts on sites that are not exploited by non-native species.

**ANALYSIS OF THE NATIONAL INVENTORY OF MMAS: REGIONAL PERSPECTIVES**

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As part of an ongoing effort to design a national system of marine protected areas (MPAs), NOAA's MPA Center is conducting an assessment of an inventory of marine managed areas (MMAs). This unique and comprehensive database of United States place-based management represents a major collaborative effort by federal, state and territory managers. Analysis of the database produces national and regional pictures of the collection of MMAs (n = 1989), including summaries of existing protections and regulations, purpose, scale and duration of protection, types of allowable use, and level of governance. The descriptive results reveal important similarities and differences in the way MMAs are used among regions and in the ways they affect specific fishing activities. For example, preliminary analysis reveals the eight United States regions sharing similar percentages of MMAs managed by the federal government (approximately 20-30%), except for 6% in the Great Lakes. Florida state contributes the most MMAs to the Gulf of Mexico and South Atlantic (62% and 47% respectively), while California contributes the most MMAs to the Pacific Coast (55%). Finally, the Caribbean has 20 times more MMAs that restrict all fishing compared to the Mid-Atlantic with one MMA prohibiting fishing.

**NEGATIVE IMPACT OF INVASIVE MONGOOSE ON AMAMI RABBIT AND ITS CONSERVATION**

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For monitoring of impacts of invasive mongoose, we investigated the animal fauna by censor camera and the change of distribution by fecal pellet counts census of Amami rabbit (*Pentalagus furnessi*), which is one of the most flagship species on Amami Island in Japan. The island (712 km<sup>2</sup>) is originally lacked predatory mammals and located in the subtropical zone in southern Japan. The frequency of photographs of mongoose in the northern area was high (10%), but low (1-2%) in the southern area where rabbit density is high. In addition, our investigation also found that a mongoose entered into the breeding nest of a rabbit in daytime in the low mongoose density in the south. Furthermore, the rabbit population was found to be

rapidly decreasing and disappeared in less than eight years in relatively high-density mongoose area, especially in the north. These results indicate that if a small population of mongooses remains in rabbit habitat, the rabbit will become extinct due to predation by mongooses not only on adult rabbits but also on juveniles inside the breeding nest. Therefore, it is necessary to eradicate mongooses in the habitat of the rabbit and to prevent of their invasion into other rabbit habitat.

### **SCALLING UP FOR THE CONSERVATION OF THE GIANT PANDA: FROM PINGWU ICDP TO MINSHAN LANDSCAPE**

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For the conservation of the Giant Panda threatened by logging and poaching, Pingwu Integrated Conservation and Development Project was officially launched supported by WWF in 1997. The project focused on the effective management of Wanglang reserve and community-based conservation in Baima community. After five years implementation, the evaluation results stated that poaching in the reserve coming from other communities was still a big challenge, and tourism and habitat fragmentation became the main threats to the survival of the Giant Panda. The traditional individual protected area focused conservation strategy could not ensure the long-term survival of the Giant Panda and the effective management of the protected area itself. The conservation focus should move to the whole landscape conservation and ecological management. The priority action for the panda reserve management should be the networking among different protected areas including the Natural Forest Protection Areas both in function and structure.

### **GEOGRAPHIC INFORMATION SYSTEM ASSESSMENT OF FISHERY, TOURISM, AND MARINE PROTECTED AREA DYNAMICS ON THE BORDER OF BELIZE AND MEXICO**

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The Mesoamerican Barrier Reef System (MBRS) Program has established a network of marine protected areas (MPAs) in the western Caribbean to conserve marine habitats and to promote transboundary conservation. Fieldwork for comparative case-studies occurred at two transboundary MBRS MPAs, the Bacalar Chico Marine Reserve in Belize and the Xcalak Reef National Marine Park in Quintana Roo, Mexico. Interviews with stakeholders in the region identified their use of marine habitats by drawing maps of their coastal use patterns. Interview data for each case-study was recorded for two time periods: "before" and "after" MPA designation. These "map biographies" of the stakeholders' coastal use patterns were subsequently integrated into a geographic information system. Fieldwork in Belize suggested that the spatial extent of the range of commercial fishers has decreased while the range of touristic activities and MPA management activities has increased. Fieldwork in Quintana Roo suggested that the spatial range of commercial fishers has remained the same while the range of touristic activities and MPA management activities has increased. The difference in coastal use patterns between Belize and Mexico suggests that different intervention strategies are necessary in order to involve stakeholders in the conservation programs of each MPA.

### **COMPARING A SPATIALLY AND A NON-SPATIALLY EXPLICIT POPULATION VIABILITY ANALYSIS MODEL IN THE CONTEXT OF A GOLDEN-HEADED LION TAMARIN METAPOPULATION**

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Population viability analysis (PVA) has become a powerful tool in the management of populations of endangered species. To date few generic PVA platforms directly incorporate landscape features in simulations of demographic processes that affect small populations. Because threats facing endangered species are often mediated through habitat availability and configuration, the predictive power of PVA models may be limited without the inclusion of landscape features. One of the few generic spatially explicit PVA tools available is PATCH (Program to Assist in Tracking Critical Habitat). The objective of this study is to compare simulations run in PATCH to those generated in the widely used non-spatially explicit PVA program VORTEX. We modeled a metapopulation of golden-headed lion tamarins (*Leontopithecus chrysomelas*) ranging on 30 forest fragments in southwest Bahia, Brazil using both programs. Based on the results of our scenarios, we outline the strengths of each PVA tool in modeling a meta-population system. We determined that many demographic and landscape parameters can be incorporated into the programs, although often indirectly, depending on the program. We recommend that modelers use VORTEX when simulating populations affected by threats predominantly mediated through demographic processes, whereas PATCH is extremely useful for modeling territorial animals moving on dynamic and complex landscapes.

### **CHRONOLOGICAL AND SPATIAL ANALYSIS OF WESTERN JUNIPER (*JUNIPERUS OCCIDENTALIS* VAR. *OCCIDENTALIS*) IN CENTRAL OREGON**

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Western juniper (*Juniperus occidentalis* var. *occidentalis*) occupied 3 million ha in the western United States. Close to 95% of this juniper is post European settlement and is blamed for ecosystem degradation. Western juniper eradication by mechanical means and controlled burning has become widespread throughout portions of the northern Great Basin in efforts to restore sagebrushdominated systems. The goal of this study was to identify areas in central Oregon where western juniper seedling reestablishment following the removal of mature trees may be rapid and concentrated. We examined 35 areas treated by fire and mechanical removal that varied widely in slope, aspect, elevation, plant community, and understory diversity. Seedling densities within 900 m<sup>2</sup> plots in each site were determined and samples were from all junipers within plots for tree-ring dating. Field collected data in conjunction with remotely sensed data were used to build a model predicting regenerated seedling densities in treated, unsampled areas. Dendrochronological analysis indicates that the interval between removal of mature trees and seedling regeneration ranges from 1 to 18 years and that nearly 60 of the trees sampled established following treatment. The results from this study will be used to inform land managers, and to indicate areas for continued restoration efforts.