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A historical and modern approach to population assessments of the deep sea Nautilus

Nautilus are disappearing as a result of unregulated fisheries throughout the Indo-Pacific created to support a world-wide demand for Nautilus shells. Possessing a reproductive strategy similar to large mammals, nautilus are therefore unable to repopulate these depleted populations quickly. To support needed conservation initiatives, a comprehensive assessment of Nautilus populations was conducted. The study was performed in four locations to compare a fished population (Philippines) to non-fished populations (Australia, Fiji, and American Samoa). The process relied upon historically accepted methods, such as baited traps, to calculate catch per unit effort (CPUE), and modern techniques utilizing baited remote underwater video systems (BRUVS) to calculate population densities. Additionally, genetic samples were collected from each specimen and ecosystem descriptions were recorded from the BRUVS. The CPUE in the Philippines was significantly lower than the CPUE in non-fished populations. Likewise, the population density in the Philippines was significantly lower than the three non-fished areas. While the genetic analysis will be completed in July 2013, Nautilus ecosystems are distinctly different between locations. The results suggest that fisheries not only have a negative impact on Nautilus populations, but non-fished populations are small and vulnerable to exploitation. These data provide the first comprehensive analysis of the destructive impact of Nautilus fisheries, while also providing baseline data for future climate change studies. Nautilus are sensitive to temperature change and may be an important indicator species of climate change. Protective measures not only benefit Nautilus and its ecosystem, but may also assist humans in developing effective climate change models.

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Genetic consequences of forest fragmentation in Ecuador for a widespread canopy palm

Animal-mediated seed dispersal shapes patterns of genetic diversity for many tropical plant species, and this essential interaction can be disrupted by forest fragmentation. Our objective was to compare the genetic consequences of fragmentation for the canopy palm *Oenocarpus bataua* in recently fragmented and continuous forest in northwest Ecuador. We hypothesized that gene flow would be limited in fragmented forest compared to continuous forest, which would decrease genetic diversity and increase spatial genetic structure. Using 10 microsatellite loci, we genotyped adult trees, undispersed seedlings (individuals beneath adults), and dispersed seedlings (individuals away from adults) in 6 forest fragments of varying sizes (2.7 – 47.9 ha) and distances (2.4 – 23.8 km) from a large continuous forest reserve (130,000 ha), where we genotyped individuals in the same categories. Allelic richness was similar between fragmented and continuous forest, but declined in adults and undispersed seedlings as fragment size decreased. Genetic diversity for dispersed seedlings did not decline with fragment size, indicating that seed dispersal processes increase genetic diversity in small fragments. Spatial genetic structure of undispersed and dispersed seedlings increased with distance from the forest reserve, which suggests that isolation from continuous forest promotes local population structuring. These findings suggest the size and location of a fragment are critical characteristics that influence patterns of plant genetic diversity, but in our study, the genetic characteristics of forest fragments are similar to continuous forest. The conservation and maintenance of genetic diversity of plants in fragmented communities may rely on the persistence of seed dispersal processes.

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Community perception: baseline to protect two endemic and endangered Colombian birds

Niceforo's Wren and Chestnut-bellied Hummingbird are endemic and endangered bird species to the Chicamocha canyon in Colombia. Agriculture, fires and logging have been identified the most common causes of habitat loss affecting the distribution and population sizes of both species. In order to develop a conservation plan in the region, local perceptions of natural resources and territorial planning were investigated in 36 communities. 48 workshops were organised to identify territorial perception features based on social cartography methods. Water was identified as the most important



natural resource for communities. Pollution, drought and misuse were perceived as main causes of shortage of water supply. Although participants showed knowledge about plants and animal species of the region, few people identified the endangered bird species and ignored their ecological importance. Participants perceived also those social aspects such as envy and the lack of solidarity influence on the way in which the community faces environmental challenges. Thus, locals identified weak capacities in sustainable production, soil recovery, reforestation, recycling, territorial planning and leadership strategies. Our results show that social and educational changes are urgent for the protection of the two endangered bird species. Therefore, conservation plans should build up key capacities for conservation and sustainable use of biodiversity in the Chicamocha.

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Monitoring Monitors: Genetic Structure of the Highly Exploited Nile monitor

Overexploitation by humans is a leading cause of biodiversity loss and species extinction. Identifying genetic subdivisions in highly exploited species is necessary to minimize the loss of distinct populations and overall genetic variation. Management units, MUs, represent functionally independent populations recognized by significant divergence in allele frequencies. Conservation approaches increasingly manage discrete MUs separately to preserve the geographic variants present throughout a species' range. The Nile monitor, *Varanus niloticus*, is highly exploited for the skin trade throughout the Sudano-topical region of Africa, yet little is understood about the genetic structure of this species. In this investigation, polymorphic microsatellite loci and mitochondrial sequence data were used to assess the patterns of genetic differentiation in *V. niloticus* across the Sudano-topical region. Significant genetic structure was observed throughout the area, as assessed with F-statistics and the program STRUCTURE. The phylogenetic tree created with 12S rRNA mitochondrial sequence data also corresponded to the genetic patterns observed with microsatellites. Specifically, populations in western Mali show a distinct genetic separation from populations in eastern Mali and the neighboring region, possibly delineating discrete MUs. Large-scale fluctuations of Lake Chad and the surrounding hydrology within the last thousand years could account for the observed genetic structure of *V. niloticus* in this area. The genetically unique populations present in Mali could call for more stringent trade regulations to preserve the genetic diversity of this species. Managing *V. niloticus* based on population genetics can serve as a model for additional conservation efforts for other exploited species.

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Effects of agricultural land-use on the functioning of Ugandan rainforest streams

Many authors have studied the effects of riparian deforestation on streams but much of this research has been conducted in temperate systems where current deforestation rates are low. To see how land conversion influences lotic ecosystems in a deforestation hotspot, we compared rainforest streams inside Kibale National Park, Uganda, with streams flowing through agricultural land around the park. Sampling benthic macroinvertebrates and basal resources, we first demonstrated that agricultural streams have a lower biomass of both allochthonous detritus and macroinvertebrate detritivores. Contrary to what we hypothesized, agricultural streams did not have a higher biomass of periphyton or macroinvertebrate scrapers. We then compared ecosystem functioning in forested and deforested streams using a leaf bag experiment to measure decomposition rate, diel monitoring of dissolved oxygen to measure primary production, and estimates of density, biomass, and maximum body size to model secondary production of different macroinvertebrate and fish taxa. We found that: (1) deforested streams have a much slower detritus decomposition rate than forested streams, (2) primary production was low in both stream types, and (3) standing stocks and estimated secondary production of consumers were much lower at farm streams. Taken together, these results suggest that deforested streams have an overall lower productivity than forested streams. We have previously demonstrated that agricultural land-use in this region reduces stream biodiversity and water quality: we now show that deforestation also impacts stream ecosystem functioning. We argue that maintaining riparian buffer zones along stream banks would benefit both the biodiversity and the functioning of Ugandan streams.

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Social Interactions in the Ivory Trade: Comparing Chinese and Western Perspectives

The last two years have seen the highest African elephant poaching and largest seizures of ivory ever. In both Western and Chinese societies, many news articles have been published and myriad online comments written on these issues. Through out this, all countries have declared their shared interest in conserving elephants. Yet elephant death rates are

now exceeding birth rates. I compare the two perspectives on this issue. I used a problem-oriented analytical framework, and drew data from a content analysis of news reports. I am specifically interested in mapping the context (social process) at play in this case, especially who the participants (organizational) are, their perspectives, and interactions. Currently, data shows that the English-language world's view is that the problem is the Chinese middle class eager to buy ivory products. In contrast, in the Chinese-language world, people see that international conservation groups are exaggerating the problem. And the Chinese public tends to associate the problem with corruption, claiming that officials are the major problem. The Chinese government argues that people are ignorant and it is the wealthy that are to blame. I concluded that these contrasting problem definitions reflect different cultural outlooks. I suggested that the African elephant conservation could benefit from greater consensus among all participants in which they seek to clarify and secure their common interest. This will require adjustments in the current social process. Additional data is being gathered from interviews with participants in the trade chain from Kenya, to Hong Kong and mainland China.

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Protected Area Downgrading, Downsizing, and Degazettement (PADDD) in North America

Although conservation practitioners and policy makers typically assume that protected area boundaries are permanent, evidence suggests otherwise. Efforts to document 'protected area downgrading, downsizing, and degazettement' (PADDD) suggest that legal changes have been enacted since 1900 to change the size and status of protected areas worldwide. We reviewed peer-reviewed and grey literature to document and analyze causes, trends, and patterns of PADDD. In the United States, 260 PADDD events were enacted between 1900 and 2012; 1791 events are currently part of proposed legislation. Events have occurred in every decade across all federal agencies which manage public lands. In addition, we conducted a focused analysis of the landscape-level impacts of PADDD events on Yosemite National Park and the surrounding Sierra Nevada WWF ecoregion. Despite its high profile, Yosemite experienced two downsize events and one downgrade during its early history, the impacts of which can be measured today. In particular, these downsizes opened up 23% of the park's original area to infrastructure, forestry, and other industrial activities. Overall, the magnitude and pervasiveness of PADDD across space and time implies that even the most iconic protected areas should not be regarded as permanent fixtures on the landscape, but instead recognized as dynamic systems.

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Can bamboo forest work as conservation tools in a fragmented landscape in Colombia?

Only 15% of premontane forests in the Colombian Andes remain (900-1700 m altitude), and most remnants are native private bamboo forests (*Guadua angustifolia*). These fragments preserve a large proportion of the original vegetation, and provide refuge for local fauna, including the last populations of red howler monkeys, *Alouatta seniculus* found in this range. Fast-growing bamboo has great economic significance in the region, and consequently, its harvest is regulated by local environmental authorities. Can bamboo forestry practices be adapted to help conserve threatened fauna? Red howler is a highly appreciated primate in the region, thus it is a good target and flagship species for this study. We compared diet, activity and ranging patterns of six howler troops in fragments with high vs. low levels of bamboo stem extraction over one year. Howler behavioral ecology was not different between the two extraction levels, nor did it differ from patterns found in protected forests. However, there is a temporary change in ranging patterns during logging periods. Howler diets in bamboo fragments are species-poor, across all study areas. We measured density and recruitment of key food trees and found that recruitment is low, perhaps due to mechanical damage during stem logging. Our results suggest howlers can tolerate high levels of bamboo logging, given silvicultural improvements and that bamboo forestry would aid howlers' conservation without compromising economic gains. We recommend bamboo agroecosystems as a conservation tool to connect and increase habitat, while providing economic benefits to their owners.

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Implications of aquatic resource dependency for conservation in rural Amazonia

A continuing challenge to effective resource management and conservation in the Amazon is a lack of information on the varying forms and extent to which rural peoples rely on natural resources for their livelihoods. Aquatic resources – including fish, as well as some reptiles and mammals – often constitute the majority of rural peasants' subsistence and income across the Amazon, but receive relatively little attention in academic and policy discussions. Increasing human exploitation of Amazonian wetlands, as well as continued interest in community-based management programs as a way to curb this pressure, emphasize that clearer understandings of differences in how and why local peoples depend on aquatic resources is critical. I present a case study from the Pacaya Samiria National Reserve, a large, seasonally flooded forest park in the Peruvian Amazon with long-established community-based resource management projects. Household survey data collected over six months in 2012 from three ribereño communities located inside Reserve boundaries demonstrate significant community dependence on several fish and turtle species for daily subsistence and income from sale. Results indicate high variation within and among communities in the nature of this aquatic resource reliance, but also show that the structure of existing community-based management projects is generally increasing, rather than decreasing, local levels of aquatic resource dependency. Such findings emphasize that the unilateral introduction of community-based management projects without understanding local resource reliance can result in the entrenching of rural peoples in poverty and increasing exploitation of critically endangered animals that are endemic to Amazonian wetlands.

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Thermal effluent alters benthic invertebrate communities in the St. Lawrence River

Temperature is a primary physical constraint on the distribution and abundance of aquatic organisms. Increasingly, human activities modify natural thermal regimes of aquatic systems, thereby altering the composition and structure of the organismal community. For decades, the Gentilly-2 Nuclear Power Plant (CNG-2) in Bécancour, QC has discharged coolant water into the St. Lawrence River at temperatures as much as 10°C above ambient. This study aims to quantify how the diversity, composition, and abundance of the St. Lawrence benthic macroinvertebrate community has been altered by CNG-2 thermal effluent. Benthic samples were collected at sites along the thermal gradient downstream of CNG-2 in May and September 2012. Environmental predictors varying with distance downstream of CNG-2 (e. g. depth, temperature, flow rate) were recorded at each station. Macroinvertebrate diversity and abundance were measured for each site and analyzed in relation to local environmental variables. Preliminary results suggest that taxonomic richness and abundance are elevated with increasing temperatures, but such patterns are driven by a few highly tolerant taxa, including thermophilic invasive species. With the closing of CNG-2 in December 2012, these results provide a baseline for monitoring both the succession of the benthic community and the potential persistence of thermophilic invaders in the absence of the thermal discharge. On a broader scale, this system serves as a living laboratory for studying the ecological implications of climate change on the St. Lawrence River.

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Re-thinking connectivity in conservation: chasing the tales of woodland mammals

Reacting to developments in conservation biology, landscape ecology and bio-geography, conservation policies increasingly advocate improving 'connectivity'. However, the notion of 'connectivity' has been interpreted in a variety of ways in both policy and practice. Through an ethnographic study of three woodland mammals in the UK, my research explores how these different connectivities intersect, interact and interlink. Specifically, I examine conservation practices relating to three native (or at least, once native) species: red squirrels *Sciurus vulgaris*, pine martens *Martes martes*, and wild boar *Sus scrofa*. Through lengthy periods of participant observation, supporting interviews, and textual analysis, my research demonstrates how four main types of connectivity are at work (to varying degrees) in these situations: (i) spatial; (ii) ecological; (iii) social; and (iv) political. Spatial and ecological notions of connectivity are tightly defined within conservation theory, but their application to actual situations becomes complicated by familiar issues of land tenure, competing objectives and jurisdiction; and by less familiar concerns relating to conflicting visions, invasive species, and animal agency. Social connectivity (referring to the relationship between people and 'nature'), and political connectivity (which relates to the linkages between organisations, agencies, and concerned communities) are both shown to be highly influential in the organisation, practice, and justification



of conservation practices. Crucially, through chasing the tales of these three mammals, what becomes evident is the need for a more integrated notion of connectivity, one which combines these four dimensions to generate enabling frictions within conservation policy and practice.

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Resolving weak genetic population structure using relatedness and social networks

The ability to detect genetically structured populations is essential to the assignment of appropriate management units for conservation and management. While much progress has been made to identify population units using genetic distances and assignment-based methods, these measures hold limited power for elucidating patterns of weak population sub-structure common in species with complex ecologies. Measures of relatedness between individuals have recently been lauded as a high-resolution tool for detecting weak genetic structure at the population level. Here, I use relatedness measures to resolve weak genetic structure in a breeding population of humpback whales off West Africa. Previous studies have demonstrated fine-scale spatial and temporal heterogeneity in the genetic structure of this population, leading to the formulation of two hypotheses: i) there exists a single population with a large geographic breeding distribution, or ii) there are two populations that utilize different breeding areas at different times of year. To test these hypotheses, I employ genotypic data from 10 microsatellite loci with adequate power to discriminate individual-level relationships. I then calculate multiple measures of relatedness and use analytical techniques innovated in the social networking field to identify and map clusters of genetically related individuals through time. I partition the data set to explore the effect of sex, month, and year on the composition of genetic clusters observed. The findings of this study are informative for understanding the ecological processes underlying fine-scale evolutionary patterns, and are essential for appropriate management of this population of whales by coastal States and the International Whaling Commission.

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Fences limited the population recovery of the endangered Przewalski's gazelle

The endangered Przewalski's gazelle (*Procapra przewalskii*) is endemic to China with about 1,000 individuals distributing in fragmented habitat around the Qinghai Lake. Although fencing has been criticized as a major threat, its impacts on population dynamics are not yet understood. We estimated densities of the largest sub-population of the species using distance sampling in springs of 2009 and 2012, and detected a possible population decline (mean±SE, 14.4±4.5 vs. 11.9±2.7 individuals/km²). We conducted population simulations using static life-table and matrix model, and found a negative population growth (-0.086/year). Survival had much higher elasticity than fertility (0.816 vs. 0.184) which suggested survival was the key parameter limiting population growth. We examined observed death events' causes (2010-2012), and evaluated fences' impacts on gazelles' mortality using systematically collected spatial and habitat data through parallel transect surveys. Fences provoked 50% female mortality with determined death causes. At least 25% calf mortalities were due to ensnaring at 25-70cm above ground, while adults hurt at 105±5cm (n=6) when jumping over. Death events occurred in areas with higher fences' densities (Mann-Whitney U=266.00, p=0.026) and the locations were nearer to fences (Mann-Whitney U=1601.00, p<0.01). Mortality frequencies and distance to fences were negatively correlated (n=6, rs=-0.986, p<0.01). The matrix models all resulted in positive population growth when removing death events occurred within 10m, 20m or 50m away from fences. We therefore suggested that, to reduce the gazelles' mortality, fences should be lower than 100cm with a gap at least 25cm above ground especially in gazelles' calving areas.

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How the historic landscape drives the evolution of movement characteristics

Movement among habitat patches has costs and benefits, and the effects of these costs and benefits on individual fitness are expected to drive the evolution of 'optimal' movement characteristics that minimize the cost:benefit ratio. Prior research suggests this cost:benefit ratio varies with the landscape attributes. Therefore we expect populations in landscapes with different attributes to evolve different movement characteristics. To test this we used an individual-based, spatially explicit

model to simulate the evolution of movement characteristics in artificial landscapes, varying the habitat structure (low or high habitat cover), habitat stability (stable, ephemeral, or disturbed), and non-habitat 'matrix' quality (high or low quality). As expected, the evolved movement characteristics varied with the landscape attributes. We found that fewer individuals emigrated in landscapes with less habitat; however, emigrants were likely to display characteristics that increased their mobility in these landscapes (i. e. decreased boundary avoidance, increased movement speeds, more linear movement paths in the matrix). Temporal variability in habitat also tended to result in populations with characteristics conferring greater mobility. Decreasing matrix quality increased the probability of emigration; however, individuals more strongly avoided crossing from habitat to matrix during emigration in these landscapes. These results have implications for how we identify, and manage landscapes for, at-risk species; effects of human land use on species may depend on both the current pattern of land use and the historic landscape attributes, as the strength of land use effects on species may depend on the movement characteristics that evolved in response to the historic landscape.

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Implications of hypoxia tolerance for wetland refugia use in Lake Nabugabo, Uganda

Aquatic hypoxia can affect predator-prey interactions by altering the success rate of the predator and/or the vulnerability of prey. For example, in the Lake Victoria basin of East Africa, native prey exploit hypoxic wetlands as refugia from predation by introduced Nile perch (*Lates niloticus*). Here, it is predicted that species exploitation of wetlands depends on their hypoxia tolerance relative to the heterogeneity of wetland hypoxia. In this study, we compared the hypoxia tolerance of four fish taxa that differ in their use of hypoxic wetlands in Lake Nabugabo, Uganda: the cichlid *Pseudocrenilabrus multicolor victoriae* that inhabits the dense swamp interior; and three taxa that inhabit wetland ecotones including Nile tilapia (*Oreochromis niloticus*), *L. niloticus* and juvenile endemic haplochromine cichlids. We characterised hypoxia tolerance by exposing fish to progressive hypoxia and quantifying variation in aquatic surface respiration (ASR). The effect of body size on tolerance was explored in *L. niloticus* by quantifying ASR behaviour across a range of size classes. The most tolerant taxon was the swamp specialist *P. multicolor*, indicated by its low ASR thresholds, while the other three taxa did not differ in ASR behaviour. Body size effects were present for *L. niloticus* suggesting a lower tolerance to hypoxia in larger-bodied individuals, thus limiting their ability to penetrate wetlands.

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Are corridors important for tigers?

We investigated the efficacy of corridors in maintaining genetic connectivity of the tiger meta-population in the Satpura-Maikal landscape of central India using population- and individual-based genetic clustering methods on multilocus genotypic data from 273 individuals. We found that the tiger meta-population in the Satpura-Maikal landscape has high genetic variation and very low genetic subdivision. Individual-based Bayesian clustering algorithms reveal two highly admixed genetic populations. We attribute this to connectivity and high gene flow in this landscape. We used Bayesian and coalescent-based analyses to estimate gene flow and found that the tiger meta-population in central India has high rates of historical and contemporary gene flow. We also found the highest rates of contemporary gene flow in populations that are connected by forest corridors. However, deforestation, road widening, and mining may sever this connectivity, impede gene exchange, and further exacerbate the genetic division of tigers in central India.

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Looking outside the box – the importance of landscape dynamics to local conservation

Ecological communities and ecosystems occur within a broader landscape that in many cases affect local-scale population, community and ecosystem level processes. At this era of human domination almost all ecosystems are spatially fragmented and embedded in heterogeneous human-altered landscapes. Landscape interactions among patch types, including man-made (e. g. agriculture, urban and plantations), may strongly impact native ecosystems and thus increase the urge for conservation of these impacted ecosystems. However, I argue that a landscape-scale approach also implies that conservation

should adopt a new perspective, one that acknowledges that interactions with man-made ecosystems may alter native ecosystems, sometimes in ways that are inevitable, and thus call for a change in conservation goals. I will show two examples of studies of native ecosystems in a larger context of a human-altered landscape. One example is of a highly heterogeneous Mediterranean landscape in which native oak communities interact with planted pine forests. Cross-colonization by oak and pine trees in their reciprocal systems has been changing both native oak shrublands and restored pine forests, with implications for the functioning of these ecosystems and for their conservation and management. The second example is from a tropical landscape, in which the interaction between forests, agriculture and restored abandoned agriculture, depends on the landscape-scale colonization potential of different species, and the ability of colonizing species to cope with local conditions. The study cases will provide examples of how understanding landscape-scale interactions affect the goals for conservation or restoration of native ecosystems.

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Threatened Seabird Breeding Biogeography and Priority Islands for Conservation

While seabirds play important functional roles in marine and terrestrial ecosystems, 28% of species are at risk of extinction. The most significant threats occur on breeding islands where proven conservation actions can benefit seabirds. We identified, for the first time, all past and current breeding islands for the world's 98 threatened seabird species (Critically Endangered, Endangered and Vulnerable, as categorized on the IUCN Red List) and scored islands based on the sum of each breeding population's endemism and extinction risk category. We then identified physical and political attributes of each island. We found 967 islands with 1,361 breeding seabird populations. Islands were variable in size, owned by 47 countries and concentrated in the southern oceans. Twenty-four islands containing 63 populations were identified as priorities for conserving the highest concentrations of the world's most threatened seabird species. Of these, the median island size was 261.9 km², nationally designated protections were established on 17 (71%) islands (11 were fully protected), and 16 (66.7%) islands were owned by relatively wealthy countries. Conservation actions on seabird breeding islands, such as the removal of invasive species, are logistically and economically feasible particularly when islands are relatively small, land is already protected and funding for action is available. Therefore, colony-based protection of threatened seabirds is a unique conservation opportunity, and can be prioritized on islands with the highest concentrations of species at the highest risk of extinction.

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Conservation implications of oceanic manta ray spatial ecology

Oceanic manta rays, a poorly understood, charismatic marine megafauna, are under intense fishing pressure worldwide. One of several species of Mobulid rays whose gill rakers are used as a pseudo-remedy in Traditional Chinese Medicine, thousands of mantas are killed each year in developing countries such as Sri Lanka and Indonesia. Given this intense harvest and the species' low reproductive rates, manta populations are in decline, threatening economically important ecotourism programs in many developing countries. Despite their popularity with the public, mantas are one of the few remaining marine megafauna whose spatial ecology has not been closely examined. By investigating the movements and spatial dynamics of oceanic mantas, we intend to highlight subpopulations with increased susceptibility to overfishing, develop regional conservation recommendations, and identify critical habitats that can be protected from an ecosystem management perspective. Based on stable isotope analysis from widely disparate geographic regions, oceanic manta isotope signatures suggest distinct populations between regions. Similarly, preliminary evidence from satellite-tracked individuals indicates a high degree of regional fidelity on the order of months to years. However, tracking data also suggest individual animals exhibit different patterns of habitat use within regions. Our findings suggest that management actions should account for clear separation of populations among regions (and thus region-specific susceptibility to harvest), while spatially explicit conservation methods will be improved by understanding within-region behaviors and habitat use.



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Land use change and ecosystem services dynamics in Central Kalimantan Indonesia

There has been a rapid land use change in Central Kalimantan Indonesia, particularly due to conversion of forests into oil palm plantation. This study aims to analyze ecosystem services dynamics following land use change in Central Kalimantan during a period of 2000-2010. Spatial distribution of four ecosystem services (timber production, oil palm production, carbon storage, and orangutan (*Pongo pygmaeus*) habitat) was mapped in the two years. We applied three different mapping methods, i. e. interpolation with the use of geostatistics (for timber and oil palm production), lookup table (for carbon storage) and Maxent (for orangutan habitat). Analyzed from land cover map 2000 and 2010, about 414,500 ha area of peat swamp forest and 857,000 ha area of dryland forest have been deforested, followed by establishment of new oil palm plantation in 933,000 ha area. The land use change leads to the increase of oil palm production (14.8 million ton fresh fruit bunch) during the period, but this has to be compensated by the loss of timber production (1 million m³), vegetation carbon storage (11.9 million ton) and suitable area for orangutan habitat (72,900 ha). These results inform us the ecosystem services trade-off following conversion of forests into oil palm plantation, including where the trade-off takes place.

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Wildlife Law Awareness and Hunting in Belize

Wildlife laws are the foundation of conservation policies governing the public's actions at a national level, and are instrumental for the development and management of conservation projects. This study presents the results of the first nation-wide survey in Belize assessing the level of wildlife law awareness and people's level of involvement in hunting. We quantified the influence of demographic (age, sex, ethnic group) and socioeconomic (education, experience of conflict with wildlife, hunting and farming involvement, and ownership of wildlife as a pet) factors on wildlife law awareness levels. Most respondents had moderate understanding of national wildlife laws, but were rarely able to identify the enforcing agency. Education and District were the only factor which explained the levels of wildlife law awareness. Hunting levels were higher in the rural areas of the Toledo, Cayo and Orange Walk districts. The findings of this study can guide government agencies in disseminating relevant wildlife law information in those communities most in need of it, hence serving as the base of a national campaign.



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Understanding nesting ecology and behavior of green sea turtles

Monitoring and ground survey on the nesting beach provide sightings on the population status and conservation of green sea turtles, *Chelonia mydas* in Setiu, Terengganu, Malaysia. This method is carried out especially to overcome anthropogenic threats in the area such illegal poaching, excessive noise and light pollution, unplanned development near the coastal and so on. We collected the distribution data from 2007 until 2012, and recorded that the highest number of nesting occurred in 2012 (mean = 28.714). We also mapped 98 nesting areas in reserved Telaga Papan Beach, Setiu within six months period (March until August) in 2012 by using Global Positioning System (GPS). We recorded that the plot with the most frequent nesting activities has least human disturbance and land-use. We recorded that most attempts occurred at dunes and emergence hour were most frequently at 12 am – 1.59 am (23%). During this extensive survey, we measured the curved carapace length (mean = 98.369 cm) curved carapace width (mean = 85.595 cm) and clutch size (mean = 81.602 eggs) of the nesting marine turtles. Out of 151 nesting attempts, 35.1 % false crawls are recorded and both variables are strongly correlated ($r_s = 0.8827$, $p = 0.0198$). We suggest that strict monitoring by adequate number of rangers is to be done to reduce illegal poaching and other disturbances from human activities. As training is continuously provided to these rangers, these threats can be reduced and conservation status of green sea turtles can be improved.

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Acoustic Monitoring as a Scalable Seabird Monitoring Solution

Seabirds are the most threatened marine group with 28% of actual seabird species at risk of extinction and 49 species critically endangered or endangered. Because most seabirds breed in fragile, inaccessible and isolated locations, often returning to concealed nest sites only at night, managers and researchers face considerable financial and logistical challenges when measuring seabird populations and the success of conservation actions. We tested the efficacy of acoustic monitoring as a cost effective tool to document the presence, distribution and relative abundance of seabirds in these remote areas. In two species (*Sterna fosterii* and *Puffinus pacificus*), rates of acoustic activity are highly correlated with relative breeding abundance across years and across sites. For the endangered *Brachyramphus marmoratus*, we found acoustic sensors provided a higher power to detect elusive species, conferring higher power at lower cost to detect changes in activity. To make such an approach scalable, we developed low-cost acoustic sensors based on a smartphone platform that can telemeter data and operate autonomously for field deployments. We tested these sensors at a globally important seabird colony (SE Farallon Island, CA) and detected all three focal species over 3 months with 99% uptime. We find automated acoustic sampling and detection is a powerful cost effective tool to improve the power and scope of seabird monitoring activities, particularly for the world's threatened and elusive seabirds.

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Do Songbirds Preferentially Forage on Native Plants During Migratory Stopovers?

Over the past century, the prevalence of non-native plants has increased dramatically. Non-native plants support different invertebrate communities than native plants, and non-native fruit have different nutritional value than native fruit. As a result, non-native plants might attract or deter vertebrate foragers differently than native plants. Migratory songbirds are foragers that depend on the on the plant and invertebrate communities at stopover sites where they stop to rest and refuel. During stopovers, songbirds must often rely on the ecological resources provided by non-native plants, especially in areas of high human density that are particularly prone to disturbance and plant invasion. While current land management strategies often involve considerable investment of resources devoted to non-native plant control, little is known about whether foraging migrants show a preference for native plants or if non-native plants can act as ecological equivalents. In this study, we are quantifying the plant associations of foraging birds to test the hypothesis that birds preferentially associate with native plant species during migratory stopovers. During spring and fall migration in 2011 and 2012, we documented plant associations of foraging birds at stopover sites throughout southern New York and Connecticut.



Preliminary results from two sites showed that foraging birds preferentially associated with native plants over non-native plants during spring migration. We are continuing to analyze data from additional sites and will use our results to help inform land restoration and management efforts.

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Activity patterns of sympatric small forest carnivores in southwestern China

The conservation and management of small forest carnivores in southwestern China are difficult due to our limited knowledge about their behavior and basic ecology. To understand the activity patterns and temporal partition of sympatric carnivores, we examined a large camera-trapping dataset (14936 trap-days from 432 locations) collected from 2004-2012 in four nature reserves in MinShan Mountains, southwestern China. We defined consecutive camera-trapping photographs as single detection and calculated the number of detections for the five most common small carnivore species (i. e., masked civet *Paguma larvata*, leopard cat *Prionailurus bengalensis*, hog badger *Arctonyx collaris*, yellow-throated marten *Martes flavigula* and Siberian weasel *Mustela sibirica*). We then calculated the Activity Index, which was defined as the ratio of hourly detections by the total detections and depicted across 24h, for each of the five species. We also calculated temporal overlap and conducted a cluster analysis, which divided these five species into two groups. Masked civet, leopard cat and hog badger were nocturnal species with 93.5%, 74% and 66.7% detections occurred between 18:00 and 06:00, respectively. Yellow-throated marten and Siberian weasel were diurnal with 88.7% and 73.3% detections occurred between 06:00 and 18:00. The highest temporal overlap happened between masked civet and leopard cat (0.73), followed by leopard cat and hog badger (0.66), masked civet and hog badger (0.65), yellow-throated marten and Siberian weasel (0.60). The results indicated temporal segregation in this carnivore guild and provided basic information which could facilitate species-specific management. Meanwhile, we also obtained insight into niche differentiations for follow-up studies.

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Search strategies are a critical aspect of settlement decisions within a landscape

Dispersal plays a central role in population and community dynamics and is a deceptively complex process. Dispersal is the product of multiple interacting factors that are expressed across distinct behavioral stages (emigration, transience, and immigration). We examine the mechanisms underlying the decision to continue moving in lieu of breeding, and we do so within the framework of statistical decision theory. We examine the pre-breeding dispersal movements of bobolinks (*Dolichonyx oryzivorus*) and how search duration changes according to habitat configurations. Our results indicate that dispersal duration was short across a wide range of habitat configurations, but that the duration of dispersal increased with an increase in the amount of unsuitable habitat found within the landscape. Due to the fact that bobolinks are long-distance migrants and their breeding season is relatively short (6-8 weeks) finding and prospecting for suitable habitat creates an additional challenge. Bobolinks must be able to arrive and find a breeding territory relatively quickly, and as predicted by our model, long periods of searching results in costs that are too high to be sustainable. From a management standpoint it is thus clear that we must be able to maintain habitat that does not present costly search scenarios in terms of length of search. To our knowledge statistical decision theory has never been used to analyze changes in dispersal behavior. We suggest that it provides a coherent framework with which to evaluate how various factors interact to produce a complex ecological process, such as dispersal.

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Screening life history traits of tropical tree species for use in reforestation

Philippines has experience some of the worst deforestation rates since the 1980's. The country currently has 24% of the original forest cover and there is a focus on conservation and reforestation of the cleared areas with native species. However, many projects that aim at reforestation with native species have been unsuccessful because they relied on late successional trees with perceived high ecological and economic value, but which cannot survive open-field growing conditions. The objective of this study is to aid species selection for reforestation programs by inferring life history traits from easy to collect field data such as DBH, crown position, and location. We are aiming to identify early successional species that exhibit high juvenile growth rates and good survival under open field conditions. We are using data collected during three field seasons



over a period of 17 years from three natural forest plots in the Philippines. From this data we derived variables of tree vigor, tree social status, local density, and spatial competition. We aim to develop a multivariate index based on these derived variables. Preliminary results from a simple principal component analysis of ecological and life history traits reveal the ecological amplitudes that can be found in important families of forest trees and suggest a possibility of screening many native trees for better site-species matching. These findings will aid in time efficient screening of numerous species that can be used for reforestation with native species in the tropics.

Caitlin Doughty

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Examining Participation and Power between Local Actors in the Peruvian Andes

In an attempt to protect the endangered *Polylepis* forests in the Peruvian Andes, Asociación Ecosistemas Andinos (ECOAN), a local non-governmental organization based in Cusco that focuses on bird conservation, implemented a joint conservation and development project. Their efforts are aimed at twenty-one comunidades campesinas in the Andean highlands outside of Cusco and include the creation of Private Conservation Areas where communities reside and replanting *Polylepis* among other activities. The purpose of my project is to evaluate the implementation of the local ECOAN project and compare it to the literature that focuses on international and national planned projects to see if there are any meaningful differences. I will use a mixed-method qualitative approach including interviews and participant observation. I will visit three of the communities in which ECOAN works for my work as well as interview ECOAN staff and the staff of supporting agencies, Inter-American Foundation (IAF) and American Bird Conservancy (ABC). My hypothesis is that many of the problems emphasized in the literature (stemming from internationally and nationally produced projects) will be minimized when a project is implemented by a local agency because they understand local power relations and share local discourses. I also expect that the support ECOAN receives from international organizations will affect the methods they use to include communities and implementation. The results from this case study can be used to address the weaknesses that arise from the failure of large international and national organizations to seriously incorporate local complexities when they implement conservation projects.

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Recovery of Natural Systems: Does it happen?

The idea that nature is fragile is common both in popular culture and conservation literature. To test this assumption we attempt to answer two related questions: to what extent are ecosystems resilient in the face of perturbations, and what ecosystem properties confer this stability? Jones & Schmitz (2009), using a meta-analytic approach, have shown that ecosystems are often able to recover. However this work focused on author's stated opinions on whether the system had recovered and how long the author believed it to have taken. To get around these potentially biasing variables, we extend this meta-analytic approach by extracting data provided in peer-review studies and estimating rate of recovery in a uniform metric. We then examine if the variance in the rate of recovery is explained by characteristics of the particular system from which the metric was taken. Based on theory we expect characteristics like high trophic level, long generation time, habitat-type and type of disturbance to make a difference in terms of recovery time. We find that there are no strong patterns in resilience in the studies considered and discuss possible explanations for the unexpected result.

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The Early Birds are Getting Earlier: Long-term Shifts in Dawn Chorus Onset

Anthropogenic activities may alter the timing of events critical for reproduction and survival. Previous ecological research focused on the impacts of such anthropogenic activities on changes in phenology or seasonal patterns. However, anthropogenic activities, such as those increasing temperature, and ambient noise and light, may also alter diurnal rhythms. Just prior to sunrise, individuals of many avian species begin vocalizing; this period of synchronized vocalizations is called a dawn chorus. Birds commonly use dawn chorus vocalizations during mate selection and territory defense. To determine whether the onset of dawn chorus has shifted over time, I conducted an analysis dawn chorus onset using data extracted from primary literature spanning 110 years. I used a least squares linear regression on a species-independent scatter plot of average dawn chorus onset and year of observation. I found that species dawn chorus onset currently begins, on average,



seven minutes earlier than in the 1900s. This average was not uniform across all species; while some species showed no shift in onset timing, onset in other species shifted by as much as 60 minutes. Previous studies have linked altered dawn chorus onset to delayed nesting, reduced clutch size, and increased energy expenditures for vocalizations. Given the link between reproductive fitness and dawn chorus onset, understanding shifts in dawn chorus onset is important as many populations of many avian species are in serious decline

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Comparison of primary and secondary forest site occupancy by birds in Central Amazon

Secondary forests (SF) are expanding worldwide and replacing large areas of old growth forest (OG) in the tropics. Four recent reviews suggest that SF older than 20 years has similar richness than OG, though better understandings on fauna composition in SF, as well as robust quantitative data are still essential to support the optimism of these studies' message. Aiming for a detailed understanding of SF use by birds in Amazon forest we tested predictions about relative differences in site occupancy by 72 bird species in 107 OG and 44 mature (15-30 years) SF sites. Our predictions organized species in three groups: SF-prone, SF-averse, and neutral, i. e. without any predicted occupancy difference between environments. We collected species detection data for the whole bird community using autonomous recording devices with temporally replicated visits to each site. Using a hierarchical community model implemented in a Bayesian framework we explicitly accounted for the possibility of environment-related detection errors and estimated probabilities of site occupancy and detection for each species as well as for each group. Surprisingly, hypothetical SF-averse species occupied both environments with the same probability, even though its detection was lower in SF than in OG. Neutral group species had the lowest mean SF occupancy suggesting that our predictions might be based on limited natural history information. Based on our posterior occupancy estimation for each species we propose a new species composition for SF-prone, SF-averse and neutral groups, and suggest that mature SF on the study area should be protected.

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Molecular and isotopic methods for dietary analysis in big cats using scats and hair

Obtaining accurate information on the dietary ecology of threatened or endangered species is a critical part of conservation planning. Previously, information on diets of large carnivores, such as big cats, was only obtained through hard parts analysis of digested prey in scats. While an appropriate method, species level identifications via small hair and bone fragments proves challenging, and the full range of prey diversity can be overlooked. Recently, next-generation sequencing has allowed "prey barcoding" from the fragments of prey DNA remaining in the scat to be a viable method of determining diets from scat samples. Our research focuses on using this prey barcoding method in concert with stable isotope ecology to obtain an unprecedented look into the detailed dietary ecology of tigers and other cats in a modern and historical context. Stable isotopes can trace changes in trophic levels of cats between different habitats, and by using museum hair and tissue specimens, can also trace changes in prey base over time. We have refined these new methods using captive zoo feeding experiments in order to better understand natural variation in scats obtained from wild populations. Our data show molecular and isotopic dietary data from captive tigers, and also from wild tigers from areas where detailed dietary analyses of tiger populations have never been done, such as Laos. It is vital for us to utilize new methods of dietary analysis in order to ensure the prey base of endangered big cats is not further depleted in areas with declining populations.

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Parasites as indicators of aquatic ecosystem complexity to inform restoration

Banded killifish (*Fundulus diaphanus*) parasite communities were examined in littoral habitats in the Hudson River estuary, which has a history of severe anthropogenic pollution and disturbance. Parasite community composition reveals the trophic linkages present in the ecosystem and the richness of the ecosystem biota through specific obligatory parasitic relationships with their hosts. Despite their large contribution to the species diversity and ecological dynamics, parasites have often been overlooked in conservation research on community composition and diversity, food webs, and overall ecology. Killifish (n=285) were examined from 3 different littoral habitat types at 6 sites in summer 2012 for a spatio-temporal comparison of



parasite component communities. Twenty-eight parasite species were found and the component communities from each site differed significantly. Abundance of *Posthodiplostomum minimum*, *proteocephalid metacestodes*, and *Contracaecum* sp. cysts explained most of these differences. All sites showed high prevalence of the myxozoan gill parasite *Myxobolus funduli* which, due to the severity of infection, may have detrimental health effects. Sites shared some species in common as indicated by high Sørensen's similarity coefficients (0.743-0.865). Parasite diversity, as expressed using the Shannon-Wiener Index, was high at all sites and highest in the two secondary channel sites. The secondary channel had the highest parasite species abundance and diversity, suggesting that host species abundance and diversity was also high in the secondary channel habitat. Insight into the ecology of littoral habitats in the Hudson River estuary gained from studying the parasite communities at ecological reference sites could inform restoration and management decisions.

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Natural areas buffer the impact of pesticides on wild apple pollinators

Recent declines in honey bee health and increasing demand for pollination services highlight a need for enhancing wild pollinators in agriculture. Apple is an economically important crop in New York State that is visited by a diverse and abundant wild bee fauna. To identify landscape- and farm-level drivers that support healthy wild bee communities in orchards, we surveyed a total of 22 orchards throughout Western New York during bloom in 2011 and 2012. Surrounding land use was quantified at both landscape (1km) and local scales (300m), and the Environmental Impact Quotient Field Use Rating Index was calculated to describe pesticide use through the growing season. We employed mixed linear models to test the effects of surrounding land and pesticide use, as well as their interaction, on bee community abundance and species richness. Wild bee abundance and species richness decreased significantly with agricultural intensification at the landscape scale and with increased pesticide use. However, wild pollinator communities visiting apple were buffered from the negative effects of pesticides when more than 30% of the landscape comprised natural areas. Our results support that protection from pesticides and proximity to natural habitat are central to insuring wild bee pollination in apple orchards.

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History of coastal fisheries in Marismas Nacionales wetland in the Gulf of California

Since Pre-Columbian times, humans exploited Marismas Nacionales(MN) the largest northern mangrove area on the Pacific coast of North America, in the Gulf of California. This study focuses on the history of exploitation of fishery resources from Pre-Columbian times to the present, to determine how past fishing activities have contributed to subsequent declines in fishery resources. The pattern of declining fish and shellfish populations was nonlinear. Oysters declined in prehistoric times but then potentially recovered, following genocide of the Indian population by Spaniards. Reduced fishing pressure lasted until the mid-19th century. Exploitation of oysters occurred with a precipitous decline by 1850s, and were depleted by 1960s. In early 20th century fishing cooperatives bloomed, and heavily exploited shrimp, also profitable sea turtle and shark fisheries existed. The final shift from relatively abundant to overfished marine fauna corresponded to the proliferation of outboard motors and nets in the estuaries, which extirpated big fish. Government subsidies in mid 20th century exacerbated the declines. By late 20th century neoliberal policies disrupted fishing cooperatives and illegal fishing increased together with unsustainable fishing practices i. e. the use of pork meal to catch shrimp, and illegal nets and cyanide to catch fish. We show that local artisanal fisheries effort should not be underestimated as well as the seemingly subtle shifts in fishing technologies, which have significantly impacted the lagoon-estuarine and coastal ecosystems in MN. This work demonstrates historical analysis is a powerful tool to understand fisheries shifted baselines and establish realistic targets for recovery of coastal ecosystems.

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Elephants, Small-Holder Farmers, and the Beehive Fence: Conflict Mitigation in Kenya

King's (2010) innovative work "beehive fences" in small-holder farms in Kenya proposed one means of alleviating elephant crop raiding amongst some of the poorest farmers. The idea for a beehive fence as a deterrent to elephants came from Vollrath and Douglas-Hamilton's (2002) observation that elephants demonstrated aversion to the sound of bees. Integral



to the fence design was the notion that the hives could provide an alternate source of income to farmers through the sale of honey, that the fences could be locally maintained, and that the fences would not have high costs. In King's (ibid.) approach, the design, implementation, and part of the data collection for the fence project was done in conjunction with the farmers themselves as part of a participatory process. King found that the beehive fence significantly deterred elephants at farms across the three study sites. However, the study did not focus on the layered socio-political context of perceptions of elephants, and how those perceptions might have changed such that, following involvement in the project, those perceptions might be more supportive conservation outcomes. Still to be understood is how participation in the beehive fence project might have shifted perceptions of elephants among farmers, strengthening the potential for conservation outcomes. Research to be conducted in summer 2013 will test the hypotheses that participation in the beehive fence project improved perceptions of elephants amongst farmers, and that farmers who participated in the beehive fence project exhibit perceptions that are more supportive of elephant conservation outcomes.

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How do wild grazers respond to cattle grazing on shared rangelands in East Africa?

Forty percent of earth's land surface is used for grazing domestic animals. Unsurprisingly, this has led to competition for land use between food production and protected areas. Therefore, conservation efforts are increasingly aimed at managing land for wildlife-livestock coexistence. However, much is still unknown about how wildlife responds to grazing by domesticated species. This study examines the behavioral response of a set of wild grazers in East Africa to changes in vegetation created by cattle. Understanding the effect of cattle on different wild species could allow ranchers and conservationists to adjust management plans to promote coexistence. Cattle could even be used as a tool to manage rangelands for wildlife. In Laikipia, Kenya, many conservancies and ranches have adopted policies of wildlife-livestock integration, combining cattle production and wildlife tourism. My research investigates how body size and mode of digestion (ruminant/non-ruminant) affect wild grazer responses to cattle grazing? Six focal species are studied: three ruminants (Thomson's gazelle, hartebeest, buffalo) and three non-ruminants (warthog, plains zebra, white rhino) spanning a range of body sizes. Cattle intensity is quantified across the study area using GPS collars on cattle herds. Vegetation is measured at 3-week intervals. Wildlife use is quantified using camera traps in areas of varying cattle intensity. The effect of cattle on vegetation and in turn on behavior of wildlife sharing this land can then be explored. Early results show interesting correlations between cattle, grass biomass and quality, and wild grazer distributions that differ by species based on size, and hence nutritional needs.

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Analyzing biological soundscapes for conservation ends

Analysis of acoustic data for conservation purposes has largely been limited to single-taxon efforts or projects concerning impacts of human noise (anthrophony) on calling communities (biophony). Little work has focused on the full range of acoustic frequencies (i. e. whole soundscapes) or high diversity calling communities such as are found in most tropical forests. These settings, however, are both highly threatened and show significant competition for some frequency bandwidths (acoustic niches). Analysis of whole soundscape recordings offers a means of observing biological changes in an environment due to physical human disturbances in an multi-taxa, fast, non-invasive, and ecologically meaningful way. This presentation focuses on (1) how comparisons of dawn calling sequences reveal significant differences in sonospecies composition and richness in disturbed and pristine habitats in Santa Rosa sector of el Area de Conservacion Guanacaste (ACG) in Costa Rica, (2) how some taxa show higher resilience than others to disturbance in the ACG, and (3) how comparisons of power spectral density distributions of multi-hour recordings are not significantly different between sampling nights or between sampling sites for a given habitat quality, but are significantly different between primary forest, young secondary forest and pasture in the ACG. The presentation closes with a discussion of the broader applications of soundscape and acoustic analysis for conservation efforts and future directions of research, and draws from pilot data collected in Indonesia, Brunei, Kenya, Panama and New Jersey.

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Linking lasers, land, and life: a multi-scale approach to avian habitat modeling

Forest breeding birds are a highly threatened group in the Northeast US, with many species suffering from habitat loss. Conservation and restoration efforts have been hindered by our poor understanding of the forest structure required by these



species. Here we combine vegetation structure metrics extracted from lidar data, collected across northern New Jersey and eastern Pennsylvania, with abundance data for twelve species of bird from the Breeding Bird Survey. Of these, six species were early successional breeding birds, and six were mature forest breeding birds. Forest structural metrics consisted of a range of height categories and differing measures of vegetation heterogeneity and texture. We used a bayesian hierarchical model to define relationships between habitat characteristics and abundance at each of five scales ranging from .2 to 50 ha. These Lidar derived habitat descriptions resulted in empirically-based habit models relating the influence of vegetation structure at different scales simultaneously. These results address two major questions in avian conservation research; what is the specific structure of forest vegetation influencing bird abundance for each species, and at what scales does vegetation structure influence these same bird abundances. Using these models enables land-managers to make specific decisions regarding how to augment or preserve forest characteristics to benefit threatened forest breeding bird species.