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Poster Abstracts

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Primates of Pacaya Samiria: population dynamics in a changing climate

Habitat preferences and population dynamics of Neotropical primates have been studied from several different angles including: population synchrony, resource availability, forest structural variation, and rainfall variation. Seasonal variation between rainy and dry seasons is further complicated by larger scale El Niño and La Niña events. The research I conducted this summer seeks to address the following question: What is the relationship between extreme rainfall variation in the Peruvian Amazon and population dynamics of frugivorous, insectivorous, folivorous, and seed-eating primates? Studies have shown a strong correlation between fruit availability and frugivorous primate abundance, but it is still unclear what drives changes in population structures of non-frugivores. The end goal of this thesis is to create a comprehensive map of primate habitat preferences in the Pacaya Samiria National Reserve in Peru, with attention to seasonal or annual changes in habitat preferences. As part of a long-term study in the Pacaya Samiria, I recorded habitat preferences using a line-transect census survey method including species type, number of individuals, primate activity, height in trees, and habitat type. I used NOAA's standard Oceanic Niño Index to identify El Niño and La Niña years. Using these years as a proxy for extreme rainfall variation, I am making projections for future conditions which are expected to be increasingly variable for Peru. As I analyze the data I have collected along with 15 years of past data collected by Operation Wallacea in the Pacaya Samiria, I will be focusing on the years directly following El Niño and La Niña years to determine if there is a trend in population growth, decline, or stability. This research is timely and pertinent, especially following the intense early 2017 flooding events in Peru. These floods were deemed "a coastal Peruvian El Niño" and were likely caused by localized warmer waters off the coast.

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Quality of leaf-litter and ant assemblages in shade-grown coffee in Chiapas, Mexico

In Latin America, shade-grown coffee represents the livelihood of countless traditional and indigenous farmers in the region. Therefore, it is vital to understand the ecological interactions underway in coffee agroecosystems as these may ultimately impact the farmer's lives and future conservation efforts. Little is known about the benefits that planned shade trees offer to diverse above- and belowground communities in coffee agroecosystems. A useful lens to evaluate the ecological benefits of shade trees is to assess how ground-dwelling ant and detritivore communities respond to the quality of leaf-litter from established nitrogen-fixing tree species, such as *Inga micheliana*, and non-nitrogen fixing species, such as *Alchornea latifolia*. We set out to answer the following questions: 1) how do C:N ratio and lignin content differ between *I. micheliana* and *A. latifolia*; and 2) how do ground-dwelling ant communities and detritivore communities differ from high C:N ratio leaf litter and low C:N ratio leaf litter. Results show: 1) *I. micheliana* has a lower C:N ratio than *A. latifolia*; and 2) a higher abundance and richness of ants from the *Pheidole* and *Solenopsis* genera and detritivores in *I. micheliana* sites than *A. latifolia*. This suggests that there may be significant feedbacks from nitrogen fixing vegetation to brown food webs by the creation of higher quality leaf litter, thus increasing detritivores and ground-dwelling ant communities. Brown foods webs can provide an array of ecosystem services such as increased soil organic matter and fertilization, hence reducing the use of synthetic fertilizer, ultimately, creating resilient agroecosystems.

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Land-use and a network of pest control providers in sun coffee farms

Almost half of Earth's natural habitats have been transformed for agriculture. Land conversion not only alters landscape structure, ecological processes, and species diversity, but also the ecosystem services these organisms provide. To better understand the impact of land-use on a network of pest control providers, we manipulated access to pests by ants and birds through exclusion experiments in sun coffee farms adjacent to endangered Atlantic Forest fragments remains. We tested for synergies and trade-offs in the provision of pest control of coffee's most economically influential pest, the coffee borer beetle (CBB). We measured the efficiency of CBB control in four different settings: i) the exclusion of ants, ii) of birds, ii) of both, and iv) in the presence of both across three landscapes that differed gradually in intensities of land use. We tested whether CBB control is influenced by the organisms interactions with proximity to forest fragments, forest cover (%), and coffee cover (%) at multiple scales. Our preliminary results show that ants are more efficient providers of CBB control in the absence of birds



in interaction with increasing forest cover at the landscape scale and coffee cover at the local scale. This first result suggests pest control providers respond differently to land use change and coffee farms benefit from the inclusion of forest fragments in their management. We propose the interface of agriculture and conservation as an opportunity to explore and connect socio-environmental challenges to the network of organisms that inhabit crops and provide ecosystem services.

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Ready to be released? Health assessment of the endangered Burmese star tortoise in Myanmar

The Burmese star tortoise (*Geochelone platynota*), known for its star-shaped pattern on its carapace, is native to the forest edges in dry central Myanmar. Although rarely studied, researchers know that *G. platynota* face multiple threats, including loss of habitat due to deforestation and overharvesting for the international pet trade. Consequently, by the early 2000s, there were fewer than 20 remaining in the wild. In 2007 the Turtle Survival Alliance (TSA) and Wildlife Conservation Society (WCS) along with the support from the Myanmar government, created assurance colonies within the natural range of the species. Remaining tortoises were captively bred and there are now over 8,000 tortoises in these assurance colonies. Due to the overall success of the program, reintroduction of the tortoises into protected areas began in 2013. WCS Zoological Health Program personnel performed health screening on tortoises to ensure the health of 350 individual captive reared juveniles slated for release from those facilities to the wild. However, for future releases of captive tortoises, the protocols and testing used could also be a model for developing biologically appropriate “wellness” parameters. For this study we created the wellness parameters from the healthy tortoises sampled in two sites by reporting the hematology values (e.g., total solids, packed cell volume, red blood cells count, white blood cells counts) while accounting for possible differences between the sex and site. Our results can be used to as a comparative baseline for veterinarians making health and release recommendations for *G. platynota* at these and other facilities as well as for *G. platynota* confiscated from the illegal pet trade.

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Domestic cats: response to urbanization and impact on bird survival

Free-ranging domestic cats kill an estimated 1.3 to 4.0 billion birds in the USA annually, but controversy exists on how this predation impacts bird species as well as how to effectively manage cat populations. This study attempts to address those questions by modeling what variables influence cat abundance and bird survival at >50 homes in the Washington, DC area involved in a Smithsonian-run citizen science program. We deployed motion-sensor cameras and conducted distance transects to determine cat abundance at each home, then compared sets of models of cat response to urbanization and human demographics. The same sites participate in Neighborhood Nestwatch, a citizen science project that allows for an estimation of bird apparent survival from mark-recapture data. We compared a priori models of bird survival with models including cat variables. Cat abundance is highest at intermediate levels of urbanization and in less educated areas, contrary to some previous findings. Variables influencing bird survival differ by species, with some responding negatively to cats. This study represents a new approach for investigating the impact of cats on birds. Limitations and future directions are discussed.

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Legend Lake bathymetric mapping

Legend Lake, located in Menominee County, WI, is a system of lake basins with regulated influent and effluent dams. Active aquatic invasive plants have been actively managed through chemical treatments that require accurate water volume estimates to be effective. Bathymetric maps constructed for Legend Lake in 1991 were believed to contain errors resulting in inaccurate volume calculations. Results show the 2016 bathymetric map yielded seven percent more volume than was reported in 1991. Periodic bathymetry surveys are vital to understanding the current morphology of a lake system. Underestimating lake volumes can lead to ineffective herbicide treatments. Conversely, overestimating total lake volume leads to the over-application of herbicides, which has been shown to impact both invasive and native plant populations. If the lake in 1991 was correctly mapped, then any change in elevation could be due to sedimentation. The addition of sediment has a wide range of impacts on this lake. The updated 3D model can be used to make future management decisions for Legend Lake.



Catherine Bravo

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Sensitivity to water limitation of tropical montane plants in the Peruvian Andes

The Tropical Andes are a biodiversity hotspot for conservation and will be exposed to shifting temperatures and precipitation as climate changes. However, most studies on plants in this region have only focused on their ecological relation with temperature. Along a 2.5 km elevational gradient in the eastern slopes of Manu National Park, Peru, precipitation changes with elevation, exposing plants to different water regimes. To better understand their distribution, we studied the community-scale physiology of tropical montane plants. Eighteen 5x5 m plots were sampled at 4 elevations: above cloud limit, upper cloud forest, lower cloud limit, and below cloud limit (3500, 3200, 1500, 1000m asl, respectively). Five mature leaves from all woody understory plants with basal diameter > 1cm, and height < 3m were collected from the plots. Leaf discs were exposed to a hypertonic solution to recreate the low water potentials that plant cells experience when water is limited. The solute leakage after the treatment was used to calculate a relative index for cell damage (%). Our results indicate that plants located at the lower cloud limit had the highest levels of cell damage (mean = 72.6 ± 13.56), followed by below cloud limit (mean = 57.2 ± 2.39). This study provides evidence that understory plants in pre-montane areas are more sensitive to low water potentials in their leaf cells, and these plants are located where rainfall is more abundant (~5000mm yr⁻¹). Changes in precipitation can likely affect the current and future distribution of tropical montane plants in the Andes.

Luke Carabbia

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Parental food allocation in the greater ani: nestling gapes may act as supernormal stimulus

The greater ani, a cooperatively breeding neotropical cuckoo, forms groups of 2 – 4 unrelated, socially monogamous pairs that lay their eggs in a single nest with all group members contributing to caring for the clutch and raising the chicks. Chicks have a very rapid development – being able to leave the nest after only 5 days – and thus require a substantial amount of food to maintain this growth rate, but the manner in which adults determine individual food allocation remains unknown. In this study, I begin to analyze how the conspicuous black and white flanges and yellow gape pattern of the nestlings influence adult feeding decisions. For the first 4 – 5 days after hatching for 10 nests, we took daily measurements of the chicks – including bill length and width to determine gape size – and marked them with a unique paint combination before returning them to the nest where we set up a camera to monitor feeding events. I also took high resolution photos of individual nestling's gapes in order to determine the degree of variation between individual chicks. Preliminary analysis of the video footage of feeding events has shown no simple pattern to how adults select nestlings for food allocation suggesting that further research into more complex signals such as the gapes is necessary, and simple analysis of the photographs does indicate variation between individuals though more work needs to be done in taking standardized daily photos of each individual nestling's gape in order to determine how the gape changes over the monitoring period and how this affects the adult's decision.

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The demographic history of black-and-white ruffed lemurs in Ranomafana National Park

Madagascar is renowned for its high levels of species diversity and endemism; however, it is also considered a conservation priority due to extreme habitat loss and fragmentation. These processes can have severe negative implications for Malagasy biota, and preserving the integrity and continuity of the remaining habitat is paramount for maintaining species diversity and viability. Previous studies of the Critically Endangered black-and-white ruffed lemur (*Varecia variegata*) have suggested this species experienced a recent genetic bottleneck even within large, continuous tracts of rainforest, such as Ranomafana National Park (RNP). To understand when and to what degree a bottleneck within RNP occurred, we will perform a skyline-plot analysis to reconstruct the demographic history of this population. To achieve this, we have collected fecal samples from four locations within RNP and, using a suite of ten microsatellite markers, we have genotyped and identified at least 29 unique individuals. These microsatellite data will enable us to reconstruct population size through time and construct a skyline-plot to assess the viability of our study population.



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Spatial relationships for vegetation and soils in coastal salt marshes

This study investigated spatial patterns of species diversity in salt marsh vegetation and how vegetation and soils of remnant and restored marshes differ after 40 years of restoration on the Oregon coast. Vegetation surveys of 1m x 1m plots were conducted along previously-established transects of salt marsh vegetation surveys for four sites; three restored salt marshes and one remnant site. In addition, vegetation data were collected from three 20m x 50m modified Whittaker plots at each site. Plot data were used to calculate species-area and species-accumulation curves. Soil samples were collected at transect plots and processed per National Soil Survey Center protocol for analysis of pH, bulk density, salinity, conductivity, and carbon/nitrogen content. Results suggest that remnant marshes are more heterogenous in species composition compared to restored marshes. In restored marshes, species such as *Carex lyngbyei* tend to dominate the sites with high frequency of occurrence and percent cover. Salt-tolerant species, such as *Triglochin maritima* and *Sarcocornia perennis* are associated with higher salinity/conductivity and low elevation conditions, while high marsh species, including *Argentina egedii* and *Agrostis stolonifera* are associated with higher elevations and lower salinities. Marsh surface elevation does not differ significantly among sites that were restored at different times in this estuary. Vegetation of restored salt marshes is significantly less diverse and more spatially homogenous than that of reference sites, even 38 years post-restoration. Site hydrology, time since restoration, and prior land-use history influence the vegetation community composition at Salmon River Estuary.

Nafilah Chowdhury, Desiree Pante, Jessica McKay

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Role of Rivers in the speciation of the Blue-crowned Manakin (*Lepidothrix coronata*)

Aim: To analyze the role of rivers in the genetic, geographic, and morphological distribution of the Blue-crowned Manakin, whilst revisiting the taxonomy to establish the number of subspecies. **Location:** Amazon Basin, South America. **Methods:** Morphological analysis using the *Lepidothrix coronata* skin collection at the American Museum of Natural History (AMNH) to map out species ranges. Genetic analysis was performed using tissue samples from Instituto Nacional Pesquisas de Amazonia (INPA) mtDNA ND2 and cytb genes were sequenced and concatenated for a maximum parsimony phylogenetic tree using Genious. **Results:** We recovered 8 morphological subspecies corresponding to 8 genetic subspecies. Rivers are conducive to speciation of *Lepidothrix coronata*, and other species, such as plants. Rivers do play in genetic speciation since the ranges of the subspecies are distributed within the Amazon River and its tributaries. Rivers do not separate the morphological groups since the morphological groups are sympatric within the Amazon Basin. **Main Conclusion:** The Amazon Basin and its tributaries separate genetic groups of *Lepidothrix coronata* in contrast to the morphological groups. The former were isolated in between at least two rivers, such as the Rio Negro and Rio Branco. The phylogenetic tree with high bootstrap support revealed that one group is concentrated within the northern side of the Amazon River, but the southern part of the Amazon River contains several other groups of L.c. This type of distribution concludes that the Northern groups are sister to the Southern group, both genetically and morphologically.

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Aquatic urbanites: examining the presence of *Tursiops truncatus* in the New York Bight

Wildlife tourism can facilitate opportunistic observations on the presence and group size of diverse marine mammal species. At present, there has been no systematic study of bottlenose dolphins (*Tursiops truncatus*) in the Western New York Bight although historical and anecdotal data indicate their presence in the area. The aim of this study was to describe the seasonal occurrence and group size of bottlenose dolphins in a coastal survey area of approximately 82 kilometers (41 nautical miles) proximate to the New York and New Jersey metropolitan area. Vessel-based opportunistic observations were conducted annually on board a seasonal whale watching vessel from May-November 2011-2016. Encounters ranged from 10-36 events per season. The estimated mean group size was 50 animals with an overall mode of 100 individuals per group over the course of the study period. A comparison with historical data suggests an increase in the observed estimated group size of this species in this region. We also conducted spatial and statistical analyses of species seasonal occurrence in relation to human activity (i.e., shipping lanes, recreational boating). This study provides baseline data for future research on the presence and group size of bottlenose dolphins in an area that faces increasing human-wildlife interaction.



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Selva App: a mobile data collector for conservation in Bogota Eastern Hills Forest

The participation of people in the construction of the knowledge of our environment is currently a powerful tool for the conservation of species and their habitats. When citizens are in contact with nature, they take ownership of the biodiversity that lives in each ecosystem. If people identify what they see in their environment, they are more likely to become aware of the importance of preserving species inhabiting their hometowns. To help citizens and the Environment Secretary of Major Bogota Government to increase environmental awareness, we developed Selva iOS / Android. This is a mobile application that allows people to photograph and record species when visiting every single ecosystem in the city. Selva offers an intuitive interface (Instagram-like) to share photographs of species via geo - positioning (GPS) technology, between peers. Selva could be a real time biodiversity map of species build by apprentices and experts to locate and record flora and fauna everywhere. The data generated is curated under Darwin Core standards (DwC) in order to corroborate species identification from the photo records. Through Selva App every citizen can play an active role in the creation of, for example, illustrated guides, such as the Flora of the Paramo of Matarredonda (<http://fieldguides.fieldmuseum.org/guides/guide/829>), or other publications about the state of our natural ecosystems, guided by expert scientists. The Selva app brings conservation closer to people, and it will ultimately create community awareness about caring for nature.

Kathryn Didion

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Education to combat land degradation in rural Kenya

Land degradation in Laikipia County, Kenya, is a severe problem affecting the health and livelihood of its inhabitants. Overgrazing, deforestation, and poor land management result in desertification. The Northern Kenya Conservation Clubs (NKCC) provide after-school classes at twelve local elementary schools to educate students about conservation in order to combat these issues. This summer, I worked as an intern for NKCC to teach and to plan and execute Community Conservation Day, an event that showcases what each school has learned during the year. At this year's event, more than 400 students participated in the games, poems, and dramas performed at the event. A new activity this year, a Habitats of Kenya tri-fold brochure, was created in response to students' confusion as to what a forest habitat is, as most have never seen a habitat other than the desertified one on which they live. The activity was done in nine of the twelve schools and was one of the school's displays for the event. This display characterized the four main habitats in Kenya and showed students how improper land use can lead to desertification and loss of habitat, blending art and science to create a memorable learning experience.

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Consumption and assimilation patterns of the eastern box turtle, a diet generalist

Eastern Box Turtles (*Terrapene carolina*, EBT) are generalist omnivores and important seed and fungal spore dispersers throughout the eastern United States. Studies have shown that EBT feed opportunistically on seasonally available fruit, plants, invertebrates, and occasionally carrion. We radio-located EBT in the Pine Barrens of Long Island, New York and collected fecal and blood samples. We identified prey items to the highest possible taxonomic level, and quantified seeds in the fecal samples. Plasma was analyzed for C and N isotopes ratios (δC and δN). We found highly seasonal patterns in fruit seed abundances in fecal samples correlating with availability. Vaccinium fruit were in 50% (June), 50% (July), and 20% (August) of samples, showing consumption of Vaccinium before they ripened and after they fell to the ground. Unidentifiable plant material was in 90-100% of samples in all periods. Coleopterans were in 70% (June), 85% (July), 80% (August), and 80% (October) of samples. Snails were in 10% of samples from June, August, and October, and 28% of July samples. Mushrooms were in 10% of June samples, 45% (July), 10% (August), and none in October. Surprisingly, stable isotope analysis indicated no significant differences in the δC and δN from EBT plasma sampled throughout their active season despite seasonal consumption patterns. Low plant digestibility reducing nutrient assimilation, diet items with similar δC and δN contributions, and a short study period may have affected EBT nutrient assimilation patterns.



Ashley Fortner

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Evaluating the effectiveness of behavior monitoring applications in the red panda

The red panda (*Ailurus fulgens*) is an endangered species that faces numerous threats to survival including habitat loss, poaching, and animal traps. Ex-situ conservation can help ensure long-term survival, but low reproductive success, poor milk production, and maternal cannibalism prevent a self-sustaining population. To better understand these challenges, the Smithsonian Conservation Biology Institute (SCBI) and Dr. Elizabeth Freeman have placed motion-activated video cameras within nest boxes of female red pandas at the SCBI to monitor maternal behavior. Although this technique is useful, the data is time consuming to analyze. Ruby for Good, a non-profit software company, has developed two programs to aid in red panda monitoring; one that will cut footage not containing red pandas and another that will facilitate behavior scoring. This project compares the new programs to traditional hand-scoring methods. To test the effectiveness of this program, videos were hand-scored for behaviors and dead space was removed from the 2014 and 2015 birthing season raw data to establish a baseline. Then the raw video footage was run through the Ruby for Good software to cut out dead space, and the behaviors on the remaining footage were scored using the current Behaviour Pro application. Based on preliminary data, this program is as effective at cutting out dead space as older methods. The success of this software program could allow more efficient data gathering and analysis. Timely feedback will contribute to the development of important management strategies that could enhance reproductive success for this endangered species.

Meaghan Gade, William Peterman

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Distribution patterns of salamanders across environmental and wildfire gradients

The Southern Appalachian Mountains harbor the greatest diversity and abundance of terrestrial Plethodontid salamanders. Yet, these recognizable and enigmatic salamanders are at risk of decline in the face of global climate change and accompanying extreme weather events like wildfire. Plethodontids' unique lungless anatomy requires them to inhabit cool and moist areas to facilitate cutaneous respiration, making this group particularly sensitive to environmental change. Therefore, understanding the fine-scale microhabitat associations related to elevation, temperature, precipitation, and moisture is of utmost importance. Furthermore, the increased frequency of extreme weather events such as wildfire, presents a significant challenge to plethodontids because such events can alter critical parts of salamander habitats, such as removing woody debris and leaf litter used by salamanders as refugias. Considering salamanders are incapable of long-distance dispersal, their persistence and abundance is linked with their immediate microhabitat, and any alteration could be catastrophic to survival, further emphasizing the importance to better understand their distribution and abundance across relevant environmental gradients. The present study assesses variations in the distribution and abundance of plethodontid salamanders across elevation, moisture (i.e., distance to streams), and wildfire gradients. Repeated point-count surveys will be conducted across the environmental gradients of interest and Bayesian Binomial mixture models will be used to assess the effects of wildfire interacting with existing environment gradients on salamander distribution and abundance. The information gained from this study will further our understanding of the responses of terrestrial salamanders to both short-term and long-term global change, and inform conservation and management decisions.

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Analysis of coyote activity around open-air compost site

Coyotes (*Canis latrans*) have expanded their range to encompass most of the United States including the east coast. As coyotes have moved across the United States, hybridization has occurred with domestic dogs and remaining wolf communities. Some predict that these coyote hybrids will move into niches once occupied by apex predators, like wolves, due to behavioral effects of the hybridization. Domestic pets, cattle ranchers, farms, and captive breeding centers like the Smithsonian Conservation Biological Institute (SCBI) would potentially be at risk should coyotes adopt more aggressive behaviors. In order to determine whether open-air compost sites lead to higher levels of coyote activity, a camera-trapping study was conducted to determine if coyotes were more active around an open-air compost site at the SCBI. The compost site contained not only animal waste, but also remaining pelleted feeds, the remains of animal carcasses, and whole prey feed remains. The cameras were set for five weeks at a control and a study site, and the resulting photos were analyzed to determine the detection frequency of coyotes. The results showed that there was a higher incidence of camera trapping events of coyotes at the compost pit when compared to the control site ($p = 2.054 \times 10^{-9}$). These results suggest the compost



site may be drawing coyotes to the area and may have implications for future management at the SCBI and other animal management areas.

Ann Marie Gawel, Haldre Rogers

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Rats as seed predators or dispersers in a novel ecosystem

Novel ecosystems are comprised of both native and non-native species in new abundances and engaged in new interactions. While non-native species are normally considered harmful for native ecosystems especially in remote oceanic islands, our study takes a closer look the roles that non-native species play in a system that has suffered a large amount of native species and functional loss. The invasive brown treesnake (*Boiga irregularis*) is responsible for the functional extinction or extirpation of the island of Guam's native forest birds. We performed feeding trials on rats (*Rattus rattus*) caught in the wild on the island of Guam to determine their role in either seed dispersal or seed predation. We fed rats fruits from one dozen species of native and non-native trees, removed intact seeds from their scats, and planted these seeds along with control seeds that were not gut-passed. Rats ate at least some amount from every species of fruit that we presented to them. They destroyed seeds from majority of the species that we tested, especially larger seeds. However, seeds from several species survived gut passage and germinated in a higher percentage than control seeds. We see that in a system that has lost most of its native seed dispersers, rats do not take on desirable functional roles. Plans to control invasive snakes without introducing other seed dispersers will result in an increase in rat abundance, and further exacerbate the declines in seedling recruitment.

Harrison Goldspiel

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Spatial and historical drivers of pool-breeding amphibians in central New York

Pool-breeding amphibians of the forested northeastern United States have complex life cycles, requiring connected terrestrial adult and aquatic larval habitats. Habitat augmentation (e.g., vernal pool construction) is an increasingly common conservation strategy in this region, especially in areas where there have been substantial wetland losses, yet there is no consensus regarding how these projects should best be designed. This research examined how different spatial arrangements of larval (wetland) and adult (upland) habitat regulate terrestrial amphibians populations in forests with distinct land-use histories. Amphibian abundances and upland microhabitat characteristics were sampled in an experimental array of 39 vernal pools constructed in 2010 at Heiberg Memorial Forest (Tully, NY). Time and area-constrained visual encounter surveys and forest habitat assessments were conducted in uplands varying in vernal pool densities (0 – 9 pools) and stand age (primary versus post-agricultural secondary forest) to test whether greater wetland or upland habitat availability is associated with larger populations of Wood Frogs (*Lithobates sylvaticus*) and Spotted Salamanders (*Ambystoma maculatum*). Previous work suggests that older forests with higher quality of adult habitat and/or sites with greater pool densities may support larger populations of pool-breeding anurans and salamanders. This research aims to estimate these relationships to obtain a more complete understanding of the ecological and historical drivers of amphibian communities and inform guidelines for conservation and land management.

Catherine Golubovsky, Joshua Boadu

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The Gotham coyote

For the past 200 years, coyotes (*Canis latrans*) have been expanding their range from the west of the Mississippi River to the east of North America. In recent years, coyotes have adapted to large metropolitan areas, such as New York City. The diet of coyotes living in NYC provides an insight into an important aspect of how coyotes are able to thrive in such an urban environment. We used scat analysis to understand their overall dietary niche. We also examined how habitat type could affect coyote diet by comparing coyote diets between two largely contrasting sites, Elmjack and Pelham Bay Park, which exemplify the contrast between coyote habitats in NYC. We collected 136 coyote scats across nine sites in NYC from 2009 to 2016. While mammalian food items dominated coyote diet citywide, overall, the diet was very diverse and demonstrated the expected generalist diet for coyotes. Coyotes living in Elmjack, a mixed use area, showed a diet that demonstrated a high dependency on human related items, while coyotes living in Pelham Bay Park, a protected open space, presented a diet concentrated in proteinaceous mammalian items. This may indicate that poor habitat quality leads to an increase in the opportunities for coyote consumption of anthropogenic item and the necessity for these in their diet.



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Jaguar feeding ecology: Advances from next-generation sequencing

Jaguars (*Panthera onca*) are the largest felids in the Americas. They are apex predators and critical to ecosystem function and structure. Jaguars have a complex feeding ecology and are threatened by the loss of prey species thus requiring a standardized methodology to assess their feeding ecology. This study used noninvasive genetic sampling (fecal DNA, n = 164) and DNA metabarcoding to comparatively examine dietary habits of near-threatened jaguars across four different study sites in Belize, Central America. Our study detected 18 different prey species and concluded that jaguars in Belize primarily prey on medium-sized mammals (78% O, relative occurrence; 67% B, consumed biomass), preferring nine-banded armadillos (*Dasypus novemcinctus*) (44% O; 38% B) and Central American agoutis (*Dasyprocta punctata*) (30% O; 25% B). Prey diversity (H', Shannon diversity index) for jaguars was highest at sites with diverse habitat types. Trophic niche breadth for jaguars was low in protected and undisturbed forest areas (e.g., Cockscomb Basin Wildlife Sanctuary), indicating that jaguars select for 1-2 prey species rather than expressing a generalist feeding behavior. In summary, this dietary study provides critical knowledge for ongoing jaguar conservation and management efforts in Belize and beyond. We also conclude that DNA metabarcoding is a promising analysis approach for dietary studies in Neotropical wildlife species due to its ability to efficiently process large amounts of scat samples that may contain a complex prey composition and/or difficult-to-identify prey species.

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Effect of anthropogenic injuries on the social associations of bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida

Social connectivity is an important factor for measuring the survivability of bottlenose dolphins (*Tursiops truncatus*). Dolphins rely upon other individuals for information transfer, protection from predators, and feeding success. Within the resident community in Sarasota Bay, Florida, groups form according to three main structures. These include large nurseries of females with their most recent offspring, juvenile groups, and strongly bonded long-term male pairs. While ecotourism in Sarasota Bay helps livelihoods, recreational boating and industrial fishing have led to increases in the number of boat strikes and net entanglements. These anthropogenic factors cause debilitating injuries to the animals and disrupt their group associations and social networks. Using long-term data sets available for the dolphin community in Sarasota Bay, we investigated how these injuries affect the social associations of the dolphins by (1) examining changes in group size and total number of associates before and after injury; (2) evaluating differences before and after injury in network metrics, such as the average degree, network diameter, graph density, and modularity. We found that dolphins tend to join larger groups and have more associates post injury. Our findings support the need to consider negative impacts of ecotourism on wild animal populations.

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Genetic variation in recently expanded eastern coyote (*Canis latrans*) populations

Human-mediated range expansions have increased in recent decades and represent unique opportunities to evaluate the genetic outcomes of establishing peripheral populations across broad expansion fronts. Over the past century, one of the most extreme examples of an extensive range expansion includes the coyote (*Canis latrans*), which now inhabit every state in the continental United States. Coyote expansion into eastern North America was facilitated by anthropogenic landscape changes and followed two broad expansion fronts. The northern expansion extended through the Great Lakes region and southern Canada, where hybridization with remnant wolf populations was common. The southern and more recent expansion front occurred approximately 40 years later and across territory where gray wolves have been historically absent and remnant red wolves were extirpated in the 1970s. Our initial microsatellite survey of eastern coyote populations suggested that population structure corresponded to a north-south divide, consistent with the two known expansion routes, and identified a mid-Atlantic contact zone between these two populations. Our follow-up study employed genome-wide markers to quantify which regions of the eastern coyote genome have introgressed from wolf populations as a result of interspecific hybridization. We further explored how introgression varies along a latitudinal gradient and conducted genomic cline analysis to identify wolf-derived loci that may be under directional selection in eastern coyote populations.



Leyla Hernandez, Ivan Prates, Ana Carnaval
The City College of New York, NY, USA

Combining environmental and trait data to predict biotic impacts of invasive anole

Invasive species are known to disrupt ecological communities due to the lack of natural competitors. Recently, an exotic species of lizard was collected from several trading ports in the state of Sao Paulo, southeastern Brazil. The species has been identified through phylogenetic analysis as *Anolis porcatius*, a lizard native to Cuba that has successfully established populations outside of its native range, in Florida, and the Dominican Republic. Based on the phylogenetic results, I found that the Brazilian specimens are closely related with samples from Florida and the Dominican Republic suggesting that the Brazilian population came from a previously invaded area, hence being a secondary introduction. Identifying locations in South America where this exotic species is likely to establish is important not only for foreseeing their ecological and economic impacts, but also to expand our knowledge about the natural history of this species in relation to their strong invasive status. To do this, I am modeling the suitability of the South American environment to this particular species using records from both native and introduced populations. I am also exploring collection records and the literature to ask whether and how the morphology of invasive anole species changes in the course of an invasion and if there are records about their impacts on native communities. By detecting connections between morphological traits and invasion of particular environmental spaces, my ultimate goal is to predict the niches that this species may successfully fill in Brazil and monitor their activity in those areas.

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Landscape structure and the potential control of “pasture sharpshooters”

Biological pest control is an important ecosystem service in agricultural areas. In tropical pastures, spittlebugs can bring losses of several millions/year. To understand the factors that regulate biological control of these spittlebugs, we evaluated through predation experiments the effects of forest cover amount, fragment size and distance from fragment on predation process. In addition, we tested the effect of different methodological procedures in the detection of relationships between pest control and landscape structure. We worked with landscapes in the Atlantic Forest, and for each landscape used three transects of 100 m length inside pastures. Predation rate showed a positive relationship with forest cover within 400 m and with fragment size, and a negative relationship with distance from fragment. Predation patterns varied with the type of prey used and the exposure time of the experiment. Sentinel prey's experiment (with real preys) showed weak patterns with forest cover in 3 km, while dummy caterpillars experiment (with artificial prey) showed clearer patterns associated with forest cover within 400 m, and with fragment size. Negative effect of distance from the forest became clear only with longer exposure times. Predation process in the matrix is thus influenced by the landscape structure, particularly in more local scale (400 m), and different types of prey and exposures times influence ecological patterns that emerge. Our work highlights the importance of landscape management structure in agricultural areas to optimize pest control service, as well as the need to use more than one type of experiment to access predation process.

Sonia Howlett
Princeton University, NJ, USA

Competition between native and introduced species in the food web of the Galapagos Island of Santa Cruz

The Galapagos, a cluster of small volcanic islands located on the equator 960km from the coast of Ecuador, are well known for their high levels of endemism and their conservation challenges from introduced species. Several studies have been performed to determine the specific diets and feeding ecologies of individual species on the islands. However, few studies have investigated the ecological impacts of introduced species in the Galapagos at the ecosystem scale. This project aims to perform a broad comparison of consumption interactions between introduced and native species in the Galapagos through a food-web analysis of the island of Santa Cruz. Food webs in Santa Cruz Island before and after humans arrived on the islands will be compared to determine the effect of introduced species on the structure of the island food web. This food web analysis will be supplemented with a comparison of 158 ten-minute grazing observations of endangered Galapagos giant tortoises (*Chelonoidis nigra*) and 152 five-minute grazing observations of introduced domestic cattle (*Bos taurus*) performed in summer 2017 on a small private ranch in the highlands of Santa Cruz. These data, complemented by DNA analysis of the plant species in ten tortoise fecal samples, will enable a comparison of the extent of direct competition between cattle and



Galapagos tortoises. Based on my preliminary results, I expect to see a lower level of direct competition between native and introduced species than commonly assumed in current literature.

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Relating traits and disturbance responses among tropical birds and dung beetles

Understanding the mechanistic basis of biotic homogenization—the increasing genetic, taxonomic or functional similarity of distinct geographic locations as a consequence of similarity species extinctions and invasions—is a priority in tropical landscapes undergoing ongoing anthropogenic disturbances. In highly modified regions such as the Brazilian Atlantic Forest, understanding the trait-based correlates of species that “win” or “lose” following forest decline will be critical to the design and implementation of effective land management and conservation strategies. While previous work has characterized variation in community level responses to native habitat loss in this region, less research has investigated particular traits that render certain species more disturbance-sensitive or resilient than others. We examined the relationships between species’ traits and species abundance response to declining forest cover, using both dung beetles and birds as model systems. Abundances of 42 dung beetle and 221 bird species were measured across twelve independent 3km landscapes, spanning a 10–60% forest cover gradient in the Brazilian Atlantic Forest. Analyzing beetles and birds separately, we used generalized linear mixed (GLMM) models to quantify species-level abundance responses to natural habitat loss at the most appropriate spatial scale for estimating these relationships. Using phylogenetic contrasts, we subsequently examined which traits (e.g., body mass, diet, diel, fecundity, and nesting strategy) correlated with species’ abundance responses in among beetles and birds respectively.

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Toxicokinetics of methylmercury in North Atlantic pilot whales (*Globicephala melas*)

Methylmercury (MeHg) is a neurotoxin that biomagnifies in food chains. High levels of MeHg have been observed in both marine mammals and humans. Although the adverse health effects of MeHg are well-documented, the toxicokinetics of MeHg in mammals are not as well understood. This study sought to better describe MeHg metabolism in long-finned pilot whales (*Globicephala melas*), which are important to the diet and culture of the Faroe Islands. We present a toxicokinetic model parameterized by analytical measurements of total Hg, MeHg and stable Hg isotopes in various organs (brain, heart, kidney, liver, muscle, placenta, and spleen) from seven pilot whales of different ages, sexes, and lengths. Both total Hg and MeHg measurements increased with estimated age. However, the fraction of MeHg decreased with increasing age in all organs except the heart and muscle, as pilot whales are able to demethylate 27% of ingested MeHg according to isotopic mixing calculations. The findings and model outputs of this study will illuminate the role of metabolism in altering the internal MeHg burden and help explain sources of MeHg variability observed in marine mammals and human populations. This understanding can help identify susceptible whale populations as well as contribute to more accurate consumption guidelines for locals.

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Using molecular techniques to determine provenance of illegal ring-tailed lemur pets

The ring-tailed lemur (*Lemur catta*) was once widespread across southern Madagascar. However, anthropogenic activities, such as habitat loss, hunting for bushmeat, and live capture for the illegal pet trade have caused ring-tailed lemur



populations to plummet in the past decade. Here, we compare genotypes of illegal wild-caught pet and confiscated ex-pet ring-tailed lemurs to those from wild populations to determine their source localities. To date, fecal samples have been collected from 26 wild-caught pet *L. catta* individuals. DNA was extracted and amplified at eight polymorphic loci following Parga et al. (2012, 2015). To determine the geographic origin of captive and confiscated lemurs, their genotypes were matched to a geographically-referenced allele frequency database generated from a reference library of 68 adults sampled from five wild *L. catta* populations (Anja, Bezà Mahafaly, Sakaviro, Tsinjoriake, Tsimanampesotse). Ultimately, results of this study can be used to help determine geographic “hot spots” of wildlife trafficking for which targeted conservation initiatives—including heightened security and increased conservation outreach—can be developed. This is a pilot study and additional sampling of both captive and wild populations of *L. catta* will be needed to accurately pinpoint these trafficking hot spots.

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Population genetic analysis of *Varecia variegata* in Ranomafana National Park

Madagascar is characterized by its high levels of species diversity and endemism, but it is also considered a conservation priority due to extreme habitat loss and fragmentation. These processes can have severe negative implications for Malagasy biota, and preserving the integrity and continuity of the remaining habitat is paramount for maintaining species diversity and viability. We sought to determine the efficacy with which a national park—a large, contiguous tract of forest habitat—maintained gene flow and genetic diversity within the Critically Endangered black-and-white ruffed lemur (*Varecia variegata*). To achieve this, we used microsatellite data from 38 adult *V. variegata* individuals at four locations within Ranomafana National Park (RNP) to evaluate genetic diversity and population genetic structure, as well as to test for evidence of a population bottleneck signal. We found evidence for one genetic population within RNP using both a Bayesian cluster analysis and a multivariate clustering method. Genetic variability was moderate (MNA = 4.00; HO = 0.628; HE = 0.624) and similar to a previous study performed within the park, albeit lower than in several other lemur taxa. Additionally, evidence for a recent population bottleneck was found under all three mutation models assessed. Together, these results suggest that RNP has been successful in maintaining gene flow in *V. variegata*, although this population may have suffered a recent decline in population size and genetic diversity.

Ashley Massey

Wynn Wynn Moving Pictures, NY, USA

Lights! Camera! Conservation action! Conservation science in the media

Scientists are repeatedly urged to communicate their research to policy makers and the general public. Conservation scientists can be eager to engage with media beyond academic journals, but it requires time and training to communicate effectively for maximum impact. This talk introduces “how we make a film” from the perspective of a production company collaborating with conservation scientists. The variety of possible formats for conservation media engagement are presented, from films, games/apps, social media, educational curricula, to virtual reality experiences.

M. Alejandra Munoz, Charles van Rees, Annie Miller, J. Michael Reed

Tufts University, MA, USA

Quantifying habitat suitability of an endangered Hawaiian waterbird for management

Habitat is a crucial behavioural process in animal life histories that affects their lifetime fitness and reproductive success. The endangered Hawaiian Gallinule (*Gallinula galeata sandvicensis*) is a wetland specialist endemic to two islands in Hawaii where it has suffered extensive habitat loss by urbanization. The loss is severe on the island of Oahu, where 75% of its wetlands have been lost since human arrival to the island. The species' persistence depends on the restoration and improvement of relict wetland habitats, but habitat correlates of gallinule abundance are unknown. Our overarching goal is to determine the wetland features that increase gallinule abundance in order to infer their habitat selection. We collected a variety of habitat measurements at 34 habitats in 6 wetland complexes and examined relationships between these habitat features and the abundance of Hawaiian gallinules using a linear mixed modelling approach. We tested the hypothesis that gallinules are more abundant in wetlands with greater habitat interspersion, the degree to which patches of emergent vegetation are intermixed with water and bare ground. We used visual interpretation and analysis using ArcGIS and Fragstats to quantify habitat interspersion. Preliminary results found a positive relationship between gallinule abundance



and habitat interspersed. We suspect that interspersed increases habitat suitability by providing access to foraging, nesting, and hiding substrates while obstructing vision to prevent territorial aggression.

Quinn Parker

Princeton University, NJ, USA

Assessing *Microcebus ravelobensis* (golden-brown mouse lemur) populations across anthropogenic landscapes in the Mahamavo forest region, Madagascar

This project aims to examine the abilities of the golden-brown mouse lemur, *Microcebus ravelobensis*, to react to habitat loss and anthropogenic change in Northwestern Madagascar. *M. ravelobensis* is an endangered species as described by IUCN, so particular attention should be paid to its habitat needs if it is to survive into the future. As Madagascar loses primary forest to development and agriculture, it becomes more pressing to understand how wildlife is faring. Increased deforestation leads to increased habitat fragmentation and the isolation of populations. My research studies the possible implications of this fragmentation, as well as how anthropogenic development such as agriculture in the form of pastureland, rice paddies, and slash-and-burn areas affect the habitat dynamics of *M. ravelobensis*. I looked at the populations of *M. ravelobensis* in four habitat types: continuous forest, gallery forest, forest fragment surrounded by agriculture, and forest fragment surrounded by open savanna. The first significant find was that *M. ravelobensis* was present in all habitat types, indicating that for the present, human-impacted landscapes are still able to support populations. There were no significant body morphometric or weight differences between the mouse lemurs at the different sites. However, there was a significant difference in the proportions of adult and juvenile lemurs present. While the continuous forest appeared to support both adult and juvenile lemurs, the fragments and gallery forest contained mostly or all adults. This could have implications for the survival and procreation of these populations into the future, and whether or not the populations in the isolated fragments are producing offspring that are surviving. While the presence of *M. ravelobensis* in all forest types was encouraging, the difference in adult and juvenile ratios could be cause for concern if these fragments are unable to support progeny, and the isolated populations dwindle.

Brielle Randall, Omari Romaine, Rae Wynn-Grant

American Museum of Natural History Science Research Mentoring Program, NY, USA

Humans and conflict with bears (oh my!)

Human-bear conflict in the Western Great Basin (WGB) in Nevada has increased with the population growth of the American black bear (*Ursus americanus*) in the region. Understanding the patterns of such conflict can aid wildlife managers in mitigating the problems and tailoring specific policies to reduce conflicts and keep humans and bears as safe as possible. In studying conflict reports from 2009 to 2014, conflicts were categorized by type, and the frequencies for time of day as well as for season were recorded. In comparing the trends over all six years, constancy was found in the most frequent time of day, season, and conflict type. However, there were upward trends in the number of occurrences per year as well as an increased frequency of occurrences during the night-time.

Lyndsay Rankin, Holly Jones

Northern Illinois University, IL, USA

Measuring the nearshore recovery of seabird islands following rodent eradication

As ecosystem engineers, seabirds drive the bottom-up control of many island food webs by depositing nutrient-rich guano into the islands on which they nest. This important ecosystem function is threatened by invasive species, with rodents as the primary source of seabird mortality. This has led to widespread rodent eradications on islands, resulting in the slow return of breeding seabirds and recovery of terrestrial communities. However, little is known about this ecosystem response in nearshore systems. This project examines the nearshore recovery of four seabird island chains in northern New Zealand. Study islands vary in invasion and eradication history from those never invaded to those eradicated of rodents as early as 1986. We wanted to determine if such islands differ in algal community structure and stable isotope enrichment. We expect nitrogen stable isotope ratios ($\delta^{15}\text{N}$) of nearshore algae to increase with time since rodent eradication, signaling the return of breeding seabirds. Preliminary analysis from the Mercury Islands indicates significantly higher macroalgae diversity on never invaded islands, followed by islands in order of eradication year. There was significant nitrogen isotope enrichment during the rainy season when frequent and heavy rains transport nitrogen-rich guano from the terrestrial system into the nearshore environment. When comparing isotope values between islands, macroalgae was significantly enriched in $\delta^{15}\text{N}$ on



never invaded islands compared to eradicated islands. With the addition of more study islands, this research could validate a new cost- and time-effective method of monitoring seabird islands undergoing restoration, minimizing disturbance to the already fragile terrestrial ecosystem.

Lily Reisinger

Princeton University, NJ, USA

The role of vector-transmitted disease in declining Grevy's zebra (*Equus grevyi*) populations

Although poaching of the Grevy's zebra (*Equus grevyi*) has ceased and CITES banned the trade of its skins, its population in Kenya has yet to bounce back nearly 40 years later while sympatric plains zebra (*Equus quagga*) populations continue to thrive. The current literature provides three possible explanations for this phenomenon: competition with livestock, higher predation rates, and disease. Previously only internal parasites were considered when assessing disease burdens with Grevy's zebras showing significantly fewer fecal nematode eggs. This study aims to extend the analysis of disease burdens by examining vector-spread diseases transmitted to zebras by *Stomoxys* biting flies. Data from the field demonstrate that zebras experience significantly fewer biting fly landings compared to bovids, and that there is no significant difference in fly counts between plains and Grevy's zebras. *Stomoxys* flies were trapped and used for choice landing experiments on bovid versus zebra hides. The significant preference for bovid skin over zebra skin in combination with no fly preference for either zebra species corroborates the results from the field data. Findings from this study in conjunction with others provide strong evidence that disease, whether from internal gut worm parasite or from vector-transmitted biting flies, is unlikely to be the reason that Grevy's zebra populations have not rebounded after hunting and hide trade has ceased.

Christian Rivera

Columbia University, NY, USA

Assessing ecological and social success in chelonian conservation programs

What is success in the conservation arena and how is it measured? A recent study found that for 90 conservation success stories analyzed, the definition of success in most of them (64%) was defined by the opinions and perceptions of the respondents and not on comprehensive evaluations. I conducted a comprehensive review of community-based conservation programs (CBCPs) of extant chelonians worldwide in order to identify how success and failure is defined in such programs. I present factors that may facilitate or undermine the success of chelonian CBCPs, and identify ecological, managerial, and social metrics that may serve as indicators of success if measured over time. Using the case of a complex CBCP in the Peruvian Amazon that allows for the sustainable harvest, consumption, and commercialization of a vulnerable freshwater turtle species (*Podocnemis unifilis*), I present the preliminary results of a study that illustrates how success is defined by a variety of stakeholders and the relevant metrics used. I employ a mixed-methods approach that integrates media content analysis, field interview data, and population modeling to compare how perceptions of success by stakeholders compare to ecological analyses of the turtle population, and identify and evaluate the ecological, managerial, and social metrics used to measure the progress of the CBCP. The results of this study can help conservation practitioners appraise, strengthen, and develop chelonian conservation programs that aim to incorporate comprehensive and context-specific indicators of success and failure into their management plans.

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Native species reforestation progresses toward natural forest structure in Madagascar

Tropical forests are vital ecosystems that are severely threatened by deforestation. Madagascar is a biodiversity hotspot that has lost 90% of its primary forest therefore reforestation with endemic tree species is a top conservation priority. We compared tree species diversity, canopy cover, and tree size across six reforestation sites to nearby forest fragments and secondary forest in the periphery of Ranomafana National Park, Madagascar to evaluate their progress toward matching natural forest structure. These sites were planted between 2006 and 2015, representing a progression from former agricultural fields toward forest. At this stage, tree species diversity and canopy cover is lower in reforestation sites than both fragmented (diversity: $p = 0.0014$, cover: $p < 0.0001$) and secondary forest sites (diversity: $p = 0.0041$, cover: $p < 0.0001$). Three native tree taxa (*Weinmannia bojeriana*, *Abrahamia* spp., and *Cryptocarya* spp.) are present across all sites and show the expected progression in size based on planting date. Those planted more recently (2013-2015) show less variation in size while those planted in 2006 are within the range of those in fragmented sites and are approaching secondary forest sites.



The structure of reforestation sites is progressing toward larger trees which will likely increase canopy cover, allowing more sun-sensitive seedlings to survive. After initial establishment of reforestation plots, species diversity could substantially increase through subsequent plantings and natural establishment via dispersal. Our findings highlight the need to track the short and long-term development of reforestation to evaluate its ultimate contribution to the conservation of biodiversity.

Neha Savant, Matthew Palmer
Columbia University, NY, USA

Comparing genomic structure and connectivity of a threatened species at multiple scales

For wild species to sustain healthy populations, movement between critical habitats and some degree of dispersal among populations is essential. Maintaining connectivity across a wide variety of landscapes is especially important for amphibians, most of which are moisture dependent and possess limited dispersal ability. The range of the long-tailed salamander (*Eurycea longicauda longicauda*) spans many different hydrogeomorphic features throughout eastern North America and populations are threatened with extinction in some states. As studying dispersal directly often requires intensive, large-scale and long-term demographic studies, genetic methods serve as an indirect, more efficient method. We are studying the genetic structure and connectivity of long-tailed salamanders in two different hydrogeomorphic landscapes, pond and stream networks, to understand how the species' genetic structure and patterns of movements are influenced by local hydrology and geology. We used drift fences and directional pitfall traps to study movement patterns in several populations to identify seasonal patterns of habitat use. Tissues samples and morphometric measurements were collected from salamanders between the months of May and August from five sites with networks of isolated ponds and five sites with small stream networks across northern New Jersey. Using microsatellites, genetic variation of pond-associated salamanders will be compared to genetic variation of stream-associated salamanders with the expectation that salamanders in stream networks will be more genetically similar due to the continuous habitat offered by streams. Understanding how hydrology and geology affects salamander movement and genetic structure will help delineate populations and can inform effective management for this threatened species.

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Mangroves as potential reef refuges for Caribbean branching reef *Porites divaricata*

Worldwide coral reef decline has precipitated the search for natural coral reef refuges- areas where populations may persist through stressful events. Once considered unsuitable for corals, mangroves have recently been proposed as refuges after diverse corals survived a bleaching event on nearby reefs. Alternatively, these habitats may act as resilience reservoirs, which harbor robust coral genotypes that are already living at their range margins. To be a refuge or a resilience reservoir, mangroves must support viable, self-sustaining coral populations with the potential to serve as a source to the reefs. Our systematic survey of the mangroves in Calabash Caye, Belize revealed a population of over 190 individuals of a mangrove dwelling reef coral, *Porites divaricata*. In our ongoing study, we are investigating the hypothesis that this mangrove coral population is viable and self-sustaining by 1) determining the survival, growth, and self-recruitment capacity after 2 years and 2) determining the approximate growth rate and stable age structure of the mangrove *Porites divaricata* population. Preliminary data reveals that the population grew after 1 year with a large number of newly added recruits, and colonies experienced high levels of individual growth and survival. This will be the first study to monitor the survival, growth, and reproductive success of a coral population in the mangroves thus testing the validity of the mangrove-refuge hypothesis and will provide evidence for the first alternative non-reef natural refuge for coral reefs in a state of environmental decline.

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Metabarcoding approach for biodiversity assessment of Hawaiian coral reef ecosystems

The global decline of diversity-rich coral reefs underscores the widely-recognized need for effective research, monitoring, and conservation. However, many coral reef inhabitants may be difficult to detect with current methods. Traditional surveys involving morphological classification – though providing essential information on abundance and ecological interaction – require improved biodiversity information in order to guide more detailed investments in a rapid and standardized manner. Metabarcoding or metagenomic analysis of environmental DNA (eDNA) represents a novel and transformative method to systematically assess biodiversity. Extending from the technological innovation surrounding DNA barcoding of individual

organisms, eDNA metabarcoding allows for identification of numerous biological community members from genetic material present in environmental samples such as soil, water, feces, or gut contents. Although this methodology has been utilized successfully in characterizing bacterial communities and monitoring invasive species, its application towards marine whole-community assessment has been limited to this point. Thus, this presentation aims to: (1) provide an overview of eDNA analysis as a valuable conservation tool; (2) present preliminary results of a current metabarcoding study investigating Hawaiian coral reefs; and (3) discuss future work of this project and how metabarcoding can be incorporated into more comprehensive ecosystem-level assessment. The eDNA study to be presented, which incorporates a suite of chemical and physical properties of Main and Northwestern Hawaiian coastal waters, will be used in an integrated approach to not only determine predictors and drivers of coral reef biodiversity, but also develop a conceptual framework of ecosystem health to advance conservation planning and management.

Amanda Sigouin¹, Eleanor Sterling¹, Erin Betley¹, Andres Gomez², Anne Toomey³, Georgina Cullman¹, Cynthia Malone¹, Adam Pekor⁴, Felicity Arengo¹, Mary Blair¹, Chris Filardi⁵, Nadav Gazit¹, Kimberley Landrigan¹, Ana Luz Porzecanski⁴

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How does engaging stakeholders affect conservation outcomes? An analysis of evidence

Engaging local stakeholders is an important feature of many biodiversity conservation and natural resource management projects globally. But how does engaging stakeholders impact conservation outcomes? Much of the current literature on engagement consists of individual case studies or is focused on specific geographical contexts, making it difficult to draw broader conclusions regarding the effect of these efforts on conservation outcomes. We undertook a comprehensive review of the peer-reviewed and grey literatures to identify evidence on the efficacy of stakeholder engagement (both externally-led and self-organized engagement) in biodiversity conservation. Relevant results were sorted between case studies (n = 82) and meta-analyses (n = 31) published from 2011 to 2015 and background literature (n = 283) published from 2000 to 2016. We critically appraised case studies and meta-analyses and used a mixed methods analysis approach, and we conducted inductive thematic analysis on background literature. Multiple case study variables were assessed in relation to project outcomes, which yielded no significant results, but suggested a possible relationship between success in producing attitudinal change towards conservation and four engagement factors. Our qualitative case study analysis identified six dimensions of engagement processes that are critical for successful outcomes when a project is externally-driven, and suggests that understanding of governance and social-cultural context plays an important role in all types of stakeholder engagement efforts. Our study also led us to consider issues related to reliance on evidence available from published literature to understand links between conservation and stakeholder engagement, in particular with regard to self-organized engagement.

Stefanie Siller

Columbia University, NY, USA

Cultivating conservation knowledge in rural Kenyan schools, clubs and communities

Knowledge is social in origin. Thoughts are accumulated by many minds over generations, and ideas are the product of common life. Educational institutions are where much of this knowledge is acquired, transmitted and produced, and are thus central to the cultural and social shaping of youth. The knowledge taught in schools is known as “legitimate knowledge”: it is portrayed as truth, yet it often represents the dominant interest of society. This process is particularly significant in formerly colonized regions, where remnants of colonial education systems remove students from the local content and meaning provided by indigenous knowledge. Using an ethnographic approach, I analyzed the type of knowledge about the environment and conservation that is constructed in rural Kenyan schools. Furthermore, I considered the potential role that conservation clubs, after-schools conservation programs that are now popular across East Africa, can play in knowledge creation and dissemination. In particular, I focused on the Northern Kenyan Conservation Clubs (NKCC) in Laikipia. In the Kenyan education system, I found that conservation is valued for its economic potential, and humans are considered a threat to wildlife. NKCC, on the other hand, focuses on spreading general knowledge and interest about wildlife and environment through experiential learning. Furthermore, NKCC emphasizes connecting and sharing information with the local community. Comparative analysis of students showed that students in the clubs incorporated club knowledge about the environment over time. Thus, conservation clubs may provide successful channels of dialogue and knowledge sharing between students and the local community.



Jaima Smith

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The people's voice: it's what matters

How people relate to and understand the environment is invaluable to conservation efforts. It must be acknowledged that conservation is as much about people as it is the environment and species we aim to preserve, and ultimately, the mechanisms that drive conservation initiatives are social in nature. The goal of my research was to explore how local communities living on the border of Gunung-Gede Pangrango National Park in West Java, Indonesia perceive the natural environment and the wildlife with which they share the forest with. More specifically, it was my hope to gain a better understanding of how people feel about local conservation programs, determine the depth of their knowledge about Javan gibbons (*Hylobates moloch*) and the threats they face in the wild, and of how they understand the concept of 'endangered species'. I conducted semi-structured interviews with over 100 people during the months of June through August, 2016. Interviews revealed an unexpected narrative. Responses varied between how important people thought protecting the forest and wildlife was, and how crucial the need to expand agriculture is for their personal livelihoods. The local people have limited knowledge about Javan gibbon conservation, and the concept of 'endangered species' in general, is one that is understood very differently from person to person. Support from local government and community engagement is crucial, and developing more inclusive conservation programs and increasing awareness, is one way to ensure the success of conservation efforts for Javan gibbons in West Java.

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Occurrence of smooth coated otter *Lutrogale perspicillata* in Gujarat at new location

Three species of otter are found in India, only smooth coated otter *Lutrogale perspicillata* is reported in Gujarat. *L. perspicillata* is known to be one of the least studied species and has been assessed as 'Vulnerable' by IUCN and listed in Appendix II of CITES. Past records indicate the occurrence of species in few pockets of Gujarat. This study investigated the occurrence and distribution of otters in Gujarat from March 2016 to February 2017. Field survey was carried out to know current distribution of species. Direct observation and indirect evidences were observed. Habitat types and threats were documented. All current and historical records were mapped on Google map to understand the distribution of otter in Gujarat. The study revealed that otter was previously distributed in 11 different sites of Gujarat, majorly found in Narmada and Mahi rivers. Occurrence of the species from new location at Purna River was sighted for the first time. Direct sighting as well as presence of three burrows along the Purna River is indicative of breeding population. Thus, River Purna is very important habitat for survival of this species in Gujarat located in southern part. Anthropogenic pressures such as overfishing, sand mining, livestock grazing, removal of bank vegetation, construction of small check dams were identified as major threats. If this threat persists, its survival will be questioned in Gujarat. Hence, it is mandatory to conserve this species through restoration of its habitats, promote greater public awareness and involve local communities in the conservation.

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Herbivory, climate change and the future landscape of Isle Royale National Park

Climate change is expected to play a major role in the global restructuring of forests in the coming century. In particular, northern temperate forests are predicted to experience warmer temperatures, longer growing seasons, and increased browsing pressure from ungulate mammals such as moose (*Alces alces*), factors which have been demonstrated to alter forest community structure and function. Studies of forest compositional change given climate change are needed for effective future management and conservation of protected areas. Isle Royale National Park (ISRO) serves as an interesting case study for forest functional diversity change because it is an isolated ecosystem—with a large population of browsing herbivores—suitable for studying whole-community interactions. Here, we present an analysis of ISRO forest composition change, and lay out our plan for future research to further explore how forest functional diversity change is driven by moose herbivory and climate change. We synthesized previous park data collected by the Great Lakes Monitoring Network (GLKN), which quantifies site and species specific moose herbivory. We will collect data on the degree of moose herbivory in the same plots using a novel monitoring technique. Coupled with observations of annual mean climate variables through time (temperature, precipitation), we will compare the change of the relative dominance (estimated from basal area) of each overstory and understory species across years and between sites. Given the potential results of this study, we highlight the need for a more complete understanding of how herbivory influences forest dynamics under proposed climate change scenarios.



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Impacts of an introduced predatory fish on the trophic ecology of a native predator

In the context of invasive species, fish are among the most widely introduced organisms in freshwater systems. Some of the most dramatic outcomes following an invasion have been linked to the introduction of predatory fishes. In terms of trophic ecology, introduced predators can greatly affect native prey through predation, but they can also strongly impact native predators through predation on juveniles and/or competition. This can result in important ecological changes to the native predators, such as dietary and trophic position shifts. The main objective of our study was to investigate such ecological shifts in a native piscivore, using the introduction of the predatory peacock bass (*Cichla monoculus*) into Lake Gatun, Panama and its potential effects on the native predator *Hoplias microlepis*, as our model system. To set up our comparative framework, we sampled a combination of lakes and reservoirs that differed in their invasion status by the peacock bass (presence or absence) during the 2016 dry season in Panama, and used stomach content and stable isotope analyses to test for dietary and/or trophic position changes. Our preliminary results suggest that in the presence of the introduced peacock bass, the native predator has a lower body condition and a more diversified diet, comprised of fish, invertebrates and plants. Our results coincide with those of other studies investigating the impacts of introduced predatory fish on native predators, highlighting the far-reaching effects introduced apex predators can have on native communities.

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Andean bear prompts biodiversity survey and conservation of culture and environment

The indigenous Queros Wachiperi of Southeast Peru strive “to protect our culture, our language and our environment”. Fifteen years ago, infrastructural advancement pulled members from the once uncontacted community into a nearby town. Forest was taken to build homes and they left their traditions to face extinction. The few that remained behind established the first conservation concession in Peru protected by a native community. Their hope was to develop ecotourism that would bring back their people and conserve their heritage. Inviting conservation research was part of that plan, however the 7,000-hectare site, situated between two of the biggest biodiversity hotspots of Peru, has barely been studied. My interests intersected with those of the Queros when they confirmed sightings of Andean bear (*Tremarctos ornatus*) at low elevations, although the bears are understood to inhabit predominantly higher elevations. To try to confirm Andean bear presence, I set up 13 camera traps in the concession loosely guided by a 3 km² grid with three cameras maximum per quadrant for a six-month period. Cameras registered a total of 33 species of fauna and a paw print confirmed Andean bear presence. The charismatic Andean bear, acting as a flagship species, catalyzed the first widespread, long-term biodiversity survey of the concession. Results support the Queros’ goal of environmental conservation by increasing interest among local and research communities, allowing development of photo panels to encourage ecotourism and further biodiversity research, and uniting the community to return and conserve their culture alongside their natural heritage.

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Assessing urban oyster restoration through classical and next-generation approaches

New York City is one of the world’s archetypal metropolises, but human activities have led to disrupted urban ecology, including coastal degradation and decimation of once widespread native bivalves. Restoring oysters, which are keystone species and ecosystem engineers, is important for defending against storms, keeping the water clean, and sustaining fisheries and habitats. Monitoring is an essential component of effective restoration efforts and environmental DNA (eDNA) technology represents a novel and transformative biodiversity assessment method that provides volumes of data, including previously undetected or poorly characterized organisms such as microbes, protists, and some invertebrates. Here, we monitored and assessed eastern oyster (*Crassostrea virginica*) restoration at Soundview Park on the Bronx River using eDNA technique in comparison to existing survey data. Water and sediment samples were collected (n=40) during the warmer months from 2015 - 2016 from the oyster reef and two mud-bottom control sites. In total, 616 orders were detected. The most commonly detected orders were the diatom order Thalassiosirales (115,482 sequences) and alga order Pyrenomonadales (63,213 sequences). Permanova analyzed possible differences in biodiversity due to season, soil vs. water and year. Permanova revealed statistical significance of 2015 vs. 2016 site community member attendance (Bray-Curtis: $F_{3,44}=1.8723$, $P=0.008$; Jaccard: $F_{3,44}=1.6567$, $P=0.007$). Our research showed these techniques can complement the each other; eDNA uncovers



the presence of microorganisms, while morphology provides existence of crab species not detected by eDNA. This research provided an overview of the potential strength eDNA has as a monitoring tool for restoration sites throughout the estuary.

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Viral Sharing in the Bat Metacommunity

Bats are important reservoirs for pathogens, including epidemic human viruses like Ebola, Nipah, and SARS. Understanding the viral pool within bat communities, and the mechanism behind viral maintenance and viral diversification is critical for both bat conservation and prevention of bat-human spillover. We used data on bat-virus associations compiled from the literature ($n = 571$) corresponding to 206 species of bats and 109 viruses. We performed network analyses to understand patterns of viral sharing within bats. We found that the bat-virus network is modular ($Q = 0.57$), indicating that bat-virus interactions aggregate into distinct specialist or generalist community groups. This pattern is even more evident when limiting the dataset to viral nucleic acid detection rather than serology ($Q = 0.68$). The most central bat species (i.e., the most connected) is *Carollia perspicillata* (Seba's short-tailed bat) while the most viral rich bat is *Artibeus lituratus* (great fruit-eating bat, $n = 18$ viruses). St. Louis encephalitis virus is the most central virus and Rabies virus is the most host rich ($n = 83$ hosts). We then tested the role of geographic, life-history, and phylogenetic traits in our bat-virus network, while controlling for reporting effort. We tested for the effect that these traits' had on an individual host's position within the network (centrality) as well as the overall structure (modularity) of the network. This work sheds light on the potential host range of a virus, transmission of viral pathogens within bat communities, and highlights important new reservoir species for future viral surveillance.

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Bacterial communities in artificial v. natural ponds using environmental DNA

Fresh Kills Park, formerly Fresh Kills Landfill, once the largest municipal landfill in the western hemisphere is now undergoing a transition to public parkland. Very little ecological restoration has taken place since the closure of landfill operations in 2001, especially in rain water basins constructed in 1997. In this project, I use environmental DNA (eDNA) techniques to test the hypothesis of no difference in bacterial community composition and structure between artificial pond (three basins at Freshkills) to natural ponds (four on Staten). All ponds were sampled during early-June and late-August of 2016. This project represents the first use of eDNA techniques to explore bacteria in freshwater ponds. Water quality and habitat measurements (nitrate, phosphate, pH, temperature, pond age and surface area) were taken to examine possible differences of community structure. Recovered sequences were analyzed using the Quantitative Insights Into Microbial Ecology pipeline on the CUNY High-Performance Computing Cluster. 1,312,968 sequences were present across all samples prior to quality filtering steps. A total 1,116,397 sequences (85%) passed quality control steps. In total, 27,725 unique operational taxonomic units were identified from 26 phyla. PERMANOVA tests were used to compare community composition and structure relative to abiotic factors. Statistical tests revealed that all ponds in this study have similar bacterial diversity and community structure which leads to acceptance of the hypothesis of no difference between artificial and natural ponds. These are significant results because they suggest bacteria will colonize artificial ponds when water quality is similar to nearby freshwater bodies.



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