

# Student Conference on Conservation Science – New York

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## Poster Abstracts





**Seheno Andriantsaralaza**

*Lemur Conservation Network*

## **Effect of red-fronted brown lemur gut passage on the germination of baobab species**

Malagasy baobab trees (genus *Adansonia*) are hypothesized to have lost their co-evolved seed disperser, the Malagasy megafauna, including giant tortoises, giant lemurs and elephant-birds. Therefore, baobab species are considered anachronistic plants. Currently, baobab fruit consumption and seed dispersal might be assured by native mammals. We tested this hypothesis by studying the effectiveness as seed dispersal agents of the red-fronted brown lemurs (*Eulemur rufifrons*). We tested, in experimental ways, the quality of seed dispersal which is the one of key measurements of the effectiveness seed dispersal. In fact, we studied effects of baobab seeds (*Adansonia rubrostipa* Jum & Perr) passage through guts in five captive individuals of red-fronted brown lemurs at Tsimbazaza Park in Antananarivo. We determined germination rates and average time to germination (latency) for seeds ingested and defecated by lemurs and compared these to those seeds extracted manually from fruit. Our results showed that defecated seeds had a significantly higher germination rate than those control seeds. Thus, lemur gut passage can improve seed germination of Malagasy baobab species. This study revealed extant animals such as lemurs could replace the Malagasy megafauna as potential seed dispersers of baobab species and have a crucial role in preserving the endemic plants species.

**Rupinder Kaur Bakhshi**

*Duke University, Durham, NC, USA*

## **Understanding the dynamics of human-carnivore conflict in a global tiger hotspot**

Human wildlife conflict is one of the major challenges facing conservation in developing countries like India. Government and NGOs working in Corbett Tiger reserve and the forest areas around, in the Himalayan state of Uttarakhand record annual livestock depredation of almost 900 animals by tigers and leopards. We have addressed three components of the issue – firstly we used more than 3000 livestock kill locations for a period of 2011-2018 to understand the spatial and temporal factors affecting frequency and intensity of these incidents using a dynamic occupancy framework. The second component involved assessing the efficacy of the government compensation scheme in the state of Uttarakhand using reports of HWC incident recorded with the government for the period of 2013-2015. Third, is understanding the attitudes of affected farmers of the region towards, PAs, tigers and compensation. Livestock kills by carnivores are expected to have a higher likelihood during rainy seasons, in areas closer to drainage features or near forest farm edges. In terms of compensation cases, we found that 47% of the 414 cases sampled were paid and 53% were pending with a mean delay of 409 days. The difference between time taken to settle the cases was statistically significant between PAs and non-PAs. Crop depredation cases had the highest mean time taken, followed by livestock and human deaths. We expect that given the number of incidents and delays in compensation people will have strong negative attitudes towards PAs and compensation schemes.

**Cecilia B. Barriga Bahamonde**

*George Mason University, Fairfax, VA, USA*

## **Conflicting ecosystem services and frugivorous mammals in the Peruvian Amazon**

In one of the most biodiverse regions in the world, the Southeastern Peruvian Amazon, frugivorous mammals play an essential role in dispersing seeds, contributing to the survival of many utilitarian plant species. Native human communities rely on them as food and on some plants they disperse for a variety of uses such as sustenance, construction, and crafts. However, the relationship between mammal diversity and the benefits they provide is not well known. Trade-offs between ecosystem services (ES) from direct consumption of these animals to wild fruits and raw material provision have not yet been studied in the field. My research aim is to highlight the importance of the diversity of frugivorous mammals in relation to the provision of ES relevant to local communities in the Peruvian Amazon forest, as well as to analyze the trade-offs between conflicting ES. To accomplish this, I identified plant species that are both used by native communities and mainly dispersed by terrestrial and arboreal frugivorous mammals, and I will focus my study in those. I will measure the species abundance, richness, diversity, and functional diversity of terrestrial and arboreal frugivorous mammals in the surroundings of three native communities and inside protected areas in the Peruvian Amazon. Then, I will assess the provision of wild meat, wild fruits, and raw materials and will identify the relationship between them and the mammal community structure. Finally, I will evaluate trade-offs between benefits from hunting to wild fruit and raw material collection and provide recommendations to balance these trade-offs.



**Mai Bernheim**<sup>1</sup>, Beny Trabelcy<sup>1</sup>, Natalie Avital Cohen<sup>2</sup>, Rachel Heiblum<sup>2</sup>, Israel Rozenboim<sup>2</sup> and Uri Shanas<sup>1</sup>

<sup>1</sup>University of Haifa, Haifa, Israel; <sup>2</sup>The Hebrew University of Jerusalem, Jerusalem, Israel

## **Male or female? Can we determined hatchlings' sex of reptiles absent sex chromosomes?**

Rising temperatures under the current global warming trend pose a challenge to species' physiological and behavioral systems. For TSD (temperature dependent sex determination) species it may have detrimental effects, potentially changing their populations' sex ratio and survivability. Discriminating TSD hatchlings' sex became crucial for monitoring and developing population management programs for endangered species under climate change scenarios. Often, TSD hatchlings' sex could not be interpreted by karyotype examination or by morphological differences. The common methods for sexing TSD species are mostly invasive (e.g. blood sex hormones analysis; gonads laparoscopy or histology). We therefore developed a non-invasive technique to identify the sex of the spur-thighed tortoise, *Testudo graeca*, a vulnerable TSD species. The method includes extraction of sex hormones, estradiol and testosterone, from stool samples of adult and young tortoises both males and females. We collected the stool samples, and then developed an extraction method followed by ELISA (enzyme-linked immunosorbent assay) to quantify both hormone levels in each sample. Our method allows the identification of sex hormone levels from tortoises at different ages. Moreover, for the first time, we reveal that it is possible to identify the sex of young individuals according to their estradiol levels. Unpredictably, young females show lower levels of estradiol than males. We postulate that this surprising finding may indicate sexual differences in sexual maturity age in this species. This study further offers a new non-invasive method for sexing hatchlings in TSD species.

**Devon Block-Funkhouser**, Miarisoa L. Ramilison, Onjaniana Razafindramasy, Richmond Aririguzoh, Benjamin Morrison, Malcolm S. Ramsay  
*Princeton University, Princeton, NJ, USA*

## **Tree usage of Coquerel's sifaka in Mariarano village, Northwest Madagascar**

Habitat destruction and other anthropogenic influences have generally negative effects on species distribution and abundance. Habitat destruction in Madagascar has caused a decline in population size of Coquerel's sifaka (*Propithecus coquereli*), a critically endangered species of lemur endemic to the island. Because of this habitat destruction, many Coquerel's sifaka now live directly alongside humans in anthropogenically altered habitats, such as villages, where various non-native tree species have been introduced. The response of Coquerel's sifaka to these introduced tree species is unknown. In this study, we found that Coquerel's sifaka in anthropogenic habitats spend a significant amount of time in both native and introduced tree species. We surveyed 3 different social groups of Coquerel's sifaka living within 100 meters of Mariarano village within the Mahamavo forest in NW Madagascar. For each group, the tree species used was noted from 7 am to 5 pm every 30 minutes for 7 days. Over the span of 21 days with a total of 429 observations, we found that the groups used 6 introduced tree species, 28 native tree species, and 9 unknown tree species. Only group 1 was found in introduced trees more frequently than native trees. The introduced tree species most often noted was mango (*Mangifera indica*)– 56% of the time for group 1, 29% of the time for group 2, and 15% of the time for group 3. Our preliminary results suggest that Coquerel's sifaka are able to persist in human modified areas by using introduced trees for various behaviors. While we observed extensive use of introduced trees, further research should investigate population persistence in these landscapes.

**Christian R. Bojorquez**, Colette J. Feehan  
*Montclair State University, Montclair, NJ, USA*

## **Effects of Multiple Stressors on Sea Urchin Larvae**

Anthropogenic activities are causing widespread changes to the marine environment. In particular, marine fauna and flora are threatened by ocean warming and ocean acidification. These phenomena each can contribute to changes in the distribution of marine species; however, combined effects of multiple stressors on species can be difficult to predict. Laboratory mesocosm experiments with model organisms can be useful in elucidating the effects of multiple stressors on marine species. Our research is focused on examining combined effects of ocean warming and ocean acidification on the sensitive early life-history stage of the sea urchin *Arbacia punctulata* at the northern extent of its geographic range in Narragansett Bay, Rhode Island. Classical models of thermal physiology would predict that *A. punctulata* should experience a northward range expansion due to ocean warming. However, we hypothesize that although *A. punctulata* will experience improved growth and survival when exposed to warming thermal conditions at the northern

extent, this response may depend on ocean pH. Here, we will present the results of laboratory experiments on *A. punctulata* larvae exposed to either a historical spring temperature in Rhode Island or near-future projected spring temperature in combination with a historic pH or near-future projected pH. The results of this research will provide insight on the potential responses of marine organisms to changes in the ocean environment.

**Alberto Borges**<sup>1,2</sup>, Mike Clifton<sup>2,3</sup>, Celestine Makobe<sup>2,4</sup>, Riccardo Zennaro<sup>2,5</sup>

<sup>1</sup>Catawba College, Salisbury, NC, USA; <sup>2</sup>National Museums of Kenya, Nairobi, Kenya; <sup>3</sup>The Explorer's Club of Kenya, Nairobi, Kenya; <sup>4</sup>Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya; <sup>5</sup>UN Environment, Nairobi, Kenya

### **Athi River Expedition**

This research assesses and communicates the impacts of waste water pollution on communities and ecosystems living along Athi River. Athi River is Kenya's second longest river (390km). It flows South - East with its source in Ngong Hills and its delta along the Indian Ocean coastline. It drains an area of 70,000 km<sup>2</sup> and is a vital water source to millions of people and several ecosystems including Tsavo National Park. However, over the past 15 years, it has been on the receiving end of Nairobi's waste. All sorts of garbage is thrown into it, especially plastic bags and bottles. Furthermore, a combination of grey and black water from raw sewage and industrial waste is dumped into the river untreated and unchecked. This expedition, which is on its second stage, aims to go a step further to: 1. Identify chemicals and heavy metals present at different points along the river. 2. Identify invertebrate bio-indicators. 3. Document through photography, the impacts of waste water pollution and solid wastes on the flora, fauna, local communities and geographical features along the river. 4. Identify solutions to solve the problem that shall be presented to UN Environment and relevant Kenyan authorities for positive action. 5. Host a photographic exhibition to raise awareness on the plight of communities and ecosystems along Athi River.

**Ren Cao**, Huijing Huang, Zi'an Wang  
Duke University, Durham, NC, USA

### **Impacts of high-speed railways on forest cover change in China**

Railway and high-speed railway constructions can cause various environmental harms including mortality, environmental disturbances, barrier effects and invasive species. Deforestation is another serious concern. With ambitious Belt and Road initiative, China is exporting its much-applauded high-speed railway projects while the international community is concerned about the consequent environmental impacts. This study examines effects of bridge ratios and tunnel ratios, two closely-related technical standards, on forest cover change. In this article, we develop a methodological framework to pool data from various resources such as government information disclosure and examine the patterns between forest cover and other related factors such as population density, GDP growth rate and density of station. The results indicate that bridges have a positive effect on conserving forest while tunnels have a negative effect. Negative tunnel effects can be explained by the long-lasting negative impacts resulted from the construction of the HSR projects rather than the operation of such projects. Taking a retrospective approach, this study provides a few important policy recommendations on future Environmental Impact Assessment regarding data transparency and ex-post validation of HSR projects.

**Emily Casper**, J. Alan Clark  
Fordham University, New York, NY, USA

### **Feast or famine: assessing urban stopover resources for shorebirds in Jamaica Bay, NY**

Stopover sites provide critical opportunities for migrating shorebirds to rapidly regain body mass and replenish fat reserves so that they can complete their migrations successfully. Stopover site quality is often linked to prey abundance and availability, with many shorebird stopover periods coinciding with seasonal peaks in prey abundance at reliable locations. While past research suggests that the identification and management of high quality stopover sites is critical to shorebird conservation, little is known about the quality of urban stopover areas. This study investigates prey availability and shorebird diet during spring migration at Jamaica Bay, an 18,000-acre urban estuary located in New York City. We utilized benthic core sampling methods to determine what macro-invertebrate prey items are readily accessible to foraging shorebirds in Jamaica Bay during the spring of 2018. We used molecular scatology, combined with next generation sequencing (NGS) techniques, as a noninvasive method to reconstruct the diet of migrating Semipalmated Sandpipers (*Calidris pusilla*). We targeted short DNA fragments of two mitochondrial genes (16S and

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COI) to detect a wide variety of prey taxa, but also emphasized the value of horseshoe crab eggs as a possible primary food resource to migrating shorebirds in Jamaica Bay. The results of this study provide useful insight into management decisions and strategies concerning migratory shorebirds staging in Jamaica Bay during spring migration. Furthermore, the study can inform shorebird conservation efforts by starting to build an understanding of how migrating shorebirds utilize urban, highly developed landscapes as stopover sites.

**Rachel Chaffee**, Mark Weckel, Preeti Gupta, Karen Hammerness, Timothy Podkul, Kea Anderson  
*American Museum of Natural History, New York, NY, USA*

### **Staying in science: examining youth pathways in conservation/environmental science**

This longitudinal study aims to deepen our understanding of why youth from underrepresented backgrounds with deep interest, aptitude, and achievement in conservation science do or do not pursue conservation and/or environmental science college degrees. Drawing on data from approximately 60 urban youth participating in, or alumni of, a mentored conservation science research internship program, we examine the potential role of youths' mentored research experiences and their social networks in youths' decisions to pursue conservation degrees and careers. Findings from this study may contribute new insights into the features of informal and formal education settings that may best support the conservation pathways of youth from diverse socioeconomic and racial backgrounds, particularly first-generation college students and youth from immigrant families.

**Fu Hsiang Chih**, Christina Colon  
*Kingsborough Community College, Brooklyn, NY, USA*

### **The effect of eastern coyotes on raccoons on activity budgets in New York City**

The eastern coyote (*Canis latrans x lyacon*), is a predominantly nocturnal predator which has recently invaded New York City. This omnivore preys on small rodent, birds, insects and small mammals, a diet similar to that of the raccoon (*Procyon lotor*), a resident mesopredator and a nocturnal omnivore (Gehrt and Prange 2006). Since they share the same diet and hunting time, in New York City Parks when their habitat overlaps, coyotes could take over raccoon hunting locations and limit their food resources, which could lower the population of raccoons as coyote numbers increase. This would support the Mesopredator Release Hypothesis (MRH), stating apex predators limit the population of mesopredator by limiting their food resource and preying on them (Crooks & Soulé 1999, Gehrt & Prange 2007, Newson 2017). This interaction could be beneficial by reducing diseases transmitting raccoon and their pathogens. However, a decline in the raccoon population could also lead to an increase in the population of rats and other rodents, which carry infectious diseases. The main purpose of this study is to better understand the possible impacts of coyotes on resident raccoons in New York City. The population of raccoons in parks without coyotes will serve as a control, while the raccoon population in parks with coyotes will be considered the experimental group. It is hypothesized that both the number and activity budget of raccoons will decline with the arrival of resident coyotes. Preliminary observations from camera trap data collected through Gotham Coyote ([www.gothamcoyote.com](http://www.gothamcoyote.com)) indicate that the presence of coyotes leads to a seasonal decrease in the activity budget of resident raccoons.

**Anna Ducroiset**<sup>1</sup>, Briana Hauff-Salas<sup>2</sup>, Nicole Rowe<sup>1</sup>, Sequoia Cirillo<sup>1</sup>, Thomas Goreau<sup>3</sup>, Konrad Hugen<sup>1</sup>, James Cervino<sup>1</sup>  
<sup>1</sup>*Woods Hole Oceanographic Institution, Woods Hole, MA, USA*; <sup>2</sup>*Our Lady of the Lake University, San Antonio, TX, USA*; <sup>3</sup>*Global Coral Reef Alliance, Cambridge, MA, USA*

### **Roundup and increased ocean temperatures cause immunosuppression in dinoflagellates**

Glyphosate (N-(phosphonomethyl) glycine) is the active ingredient of the herbicide Roundup. Glyphosate inhibits the shikimate pathway in plants. Increased use of herbicides and rising sea surface temperatures suppress immunological and biochemical pathways in free-living planktonic *Gymnodinium* and *Symbiodinium*: *D trenchii*, B1, and C *goreauii*, that are part of a unique group of primary producers and symbionts within hermatypic reef corals. Microscopic examinations of healthy dinoflagellates reveal dark pigmented mitotic cells and distinct organelles. Dinoflagellates inoculated with a 0.1% Roundup solution in water baths at 24C, 30C, and 32C for 8hrs, 24hrs, 48hrs, 1 week, and 2 weeks, experienced impaired rates of cell division over time. Light microscopy was used to diagnose the cellular organelle conditions and surface morphological integrity of cells with herbicide at increased temperatures 24C and 32C at 48hrs, 1 week and 2 weeks. All high temperature treatments alone show swollen cell size and minor degenerative morphology. However, thermal stress plus Roundup, especially at 32C, showed increased cell lysis, including membrane blebbing, cell





shrinkage and thylakoid disorganization. Caspase-3/7 was used as an indicator of cell death (apoptosis). All cell types showed cancerous morphology, though apoptosis was lowest in cells exposed to higher temperature and Roundup, indicating that Roundup acts as an immune suppressant. Glyphosate cleaves to a large number of proteins within the cell, leading to orderly dismantling of apoptosis and thereby impairing the immune systems, causing direct necrosis of dinoflagellates and free floating primary producers.

**Demey Everett<sup>1</sup>**, Emily Schilling<sup>1</sup>, Danelle Larson<sup>2</sup>

<sup>1</sup>Augsburg University, Minneapolis, MN, USA; <sup>2</sup>Minnesota Department of Natural Resources, Bemidji, MN, USA

### **Investigating ecological requirements of amphipods to inform wetland restoration**

Freshwater amphipods are a key component of wetland food webs and provide an important food resource for higher trophic levels, including migratory waterfowl. These organisms are also likely bioindicators of wetland health. Amphipod densities, in particular *Gammarus lacustris* and *Hyalella azteca*, have been declining in the Prairie Pothole Region (PPR) of North America, with associated declines in waterfowl populations. We have limited knowledge of the ecological requirements and factors limiting amphipod abundance and distribution in the PPR. We are investigating relationships between aquatic plants and amphipod densities using a comparative approach examining plant community structure in amphipod-rich and amphipod-poor wetlands across the region. Our data collection season will take place during summer 2019 when we will quantify and identify amphipod species and emergent, submergent, and floating wetland plants in approximately 60 wetlands. Our data will be used in conjunction with a longer term study assessing other factors impacting amphipod densities in wetlands across the region. Our study will enhance ecological understand and future management of wetlands in order to support wildlife.

**Kristie Falconer**

*Princeton University, Princeton, NJ, USA*

### **Butterfly diversity within the habitat types of Krka National Park, Croatia**

Butterflies are important bioindicators in assessing the impacts of climate change and habitat destruction in an ecosystem, therefore monitoring and studying their populations is essential for conservation efforts. Europe has many butterfly monitoring schemes, however, target countries, like Croatia that harbor many endemic species within its understudied Dinaric Alps region, are still unevaluated. To broaden understanding of butterflies in this region, I investigated butterfly composition, richness, and abundance between different habitats in Krka National Park, Croatia. Butterflies are known to be influenced by their environment, including climate, vegetation, and disturbance levels. I examined these factors through defined habitat structures within the park, for example the open, karst grasslands, burnt grasslands, and riverine hornbeam forests. Through conducting butterfly survey transects throughout the park, I collected information on butterfly community compositions and overall abundances. Results potentially outline interesting correlations between the effects of habitat structures on butterfly diversity and richness, especially through disturbance levels and vegetation types (forest versus grassland). This in turn can provide Krka National Park officials valuable information on key habitat types that harbor unique communities and/or protected butterfly species for conservation efforts, and also provide relative abundances and locations of each species within the park for tourism/educational purposes.

**Anthony Garcia<sup>1,3</sup>**, Candace Landau<sup>2,3</sup>, Anthony Carigulo<sup>3</sup>

<sup>1</sup>Hillcrest High School, New York, NY, USA; <sup>2</sup>The Summit School, New York, NY, USA; <sup>3</sup>American Museum of Natural History, New York, NY, USA

### **Detecting hybridization between coyotes (*Canis latrans*) and domestic dogs (*Canis lupus familiaris*) in New York City**

Coyotes, historically found in the Midwest of the United States, have been expanding their ranges over the past century to reach areas such as the East Coast. Consequently, coyotes are increasingly discovered in urban areas, particularly New York City, which has reignited the question of their potential hybridization with domesticated dogs. To detect the potential hybridization between the two species, our team utilized a Microscribe tool to collect the 3D geometric morphometric data from samples of coyote, domesticated dog, and wolf skulls and mandibles in order to discern any morphological differences. Our results show the cranium data showed the most morphological overlap between coyotes and domestic dogs found in NYC, while the mandibular data showed a stark contrast between coyotes/wolves



and domesticated dogs. These results show the early indicators of potential hybridization occurring on the migratory forefront of coyotes coming into New York City and urban centers alike.

**Tatiana Gladkikh**<sup>1</sup>, Rachelle Gould<sup>1</sup>, Marla Emery<sup>2</sup>, Patrick Hurley<sup>3</sup>

<sup>1</sup>University of Vermont, Burlington, VT, USA; <sup>2</sup>USDA-Forest Service, Northern Research Station, Burlington, VT, USA; <sup>3</sup>Ursinus College, Collegeville, PA, USA

### **Exploring the links between cultural values and stewardship through foraging**

Cultural values, or non-material benefits that people receive from nature, might be one of the main reasons people engage in environmental stewardship. Environmental stewardship, in turn, could have important benefits for conservation. However, research that explores the links between cultural values and stewardship is limited. This qualitative study explores cultural values associated with foraging in New York City, and whether foraging is somehow associated with engagement in environmental stewardship. The study will focus on the members of Russian-speaking communities and will consist of semi-structured, in-person interviews. Data collection will take place in the Fall 2019. Preliminary findings suggest that some foragers might regularly engage in informal stewardship practices and could potentially support conservation objectives of public green spaces. Results of this study will have practical application for the management of public green spaces in New York City. Further, the study will contribute to the existing body of literature on non-material benefits people receive from nature, and whether cultural values and contact with nature lead to development of stewardship behavior.

**Darcey B. Glasser**<sup>1</sup>, Tony L. Goldberg<sup>2</sup>, Jessica M. Rothman<sup>1</sup>

<sup>1</sup>Hunter College of City University of New York, NY, USA; <sup>2</sup>University of Wisconsin-Madison, WI, USA

### **Observation at ecotourism site reveals opportunity for modes of pathogen transmission**

Chimpanzee (*Pan troglodytes*) tracking is a popular ecotourism activity across Sub-Saharan Africa, offering visitors a personal wildlife experience and providing governments a source of foreign income. However, chimpanzee ecotourism may increase the risk of disease transmission to and from apes. Previous risk assessments have primarily focused on aerosol transmission, while other modes, such as environmental features and fomites, may also be important. This study assessed how tourist behaviors might facilitate cross-species disease transmission at a popular tourist site in Kibale National Park, Uganda. We collected observational data during 101 chimpanzee tracking excursions (n=235 hours). We recorded behaviors of over 500 tourists, guides, and student interns. Common behaviors included spitting, sneezing, and coughing. Per excursion, instances of face to hand contact averaged 125.84 (SD=34.45), and instances of touching large tree trunks or branches while near chimpanzees averaged 230.14 (SD=108.66). Uncommon behaviors included urinating, defecating, discarding waste, and applying aerosol bug sprays. Initial tourist group sizes and durations of group merging were also calculated. Multiple tourist groups merged over 30% of the time, increasing group size to a mean of 17 tourists instead of the recommended 6. Overall, high rates of merging, coupled with frequent unsanitary behaviors, may increase the risk of cross-species disease transmission. Regulations to minimize the impact of ecotourism on chimpanzee and human infection risk should consider the realities of tourist behavior and the full range of modes by which pathogen transmission between species might occur.

**Alexander Gottdiener**

Princeton University, Princeton, NJ, USA

### **Valuing open space areas for bird species richness: what data matters and why**

Land trusts and municipalities invest in open space to increase recreation and to protect biodiversity. Whereas land trusts may favor parcels that are large and vegetatively diverse, municipalities may favor those that are easily accessible for human activity. In this project, we will take these two goals, translate them into variables that capture the values of land trusts and municipalities, and assess their relative importance to help guide open space conservation decisions using bird species richness as a case study. Because of financial limitations for land trusts and municipalities, our study reviews what types and how much data is necessary to optimize the selection of land to conserve bird species richness. From the perspective of a land trust, of all the attributes characterizing parcels, area and percent mature forest are the best predictors of bird species richness. From the perspective of a municipality, medium density housing and diversity of land use types in the surrounding matrix are the best predictors of bird species richness. When these variables are combined, the resulting model's only significant variable is the diversity of land use types, which has a positive effect on open space area bird species richness.



**Yusif Habib**<sup>1,2</sup>, Francis Adarkwah<sup>1</sup>

<sup>1</sup>Vision World Network NGO. Accra, Ghana; <sup>2</sup>University of Padova, Italy

## **Mono-cropping Rubber Plantations in Ghana: The Incessant threat to Biodiversity**

Ghana was known for its rich biodiversity and dense forest cover in the Sub-Saharan Africa. However, due to developmental projects and other commercial interests, these have influenced land use pattern with dramatic changes. It is estimated, about 90% of the original forest cover is lost. This was because, partly, rubber plantations were established in the regions of Ghana where the evergreen forest belt laid. Consequently, the mono-cropping of natural rubber effaced massive native forest species as well as habitats serving as the abode to pertinent fauna endemic to the region including flora species. This tactically are precarious to the native flora and fauna originally existing in their natural habitat converted to a different land cover-type (mono-cropped rubber plantation), decadently increasing the decline of biodiversity. By this, the Vision World Network, an NGO in Ghana was awarded a short-term funding in 2017 from the BUSAC Fund agency supported by USAID and other international donor partners to conduct research on how mono-cropping natural rubber plantation was contributing to biodiversity loss, and other peripheral subjects such as livelihoods and water quality. Scoping studies on land cover change, stakeholder engagement (advocacy) and ecosystem assessment were conducted. This paper therefore presents key recommendations on how biodiversity loss could be halted amidst the growing keenness by the rubber industry to boost productivity and expand land-area in Ghana.

**Jason Hagani**<sup>1</sup>, Suzanne Macey<sup>1,2</sup>

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

## **Home ranges of wood turtles and using rarefaction to improve tracking study design**

The wood turtle (*Glyptemys insculpta*) is considered threatened throughout its geographic range. An understanding of wood turtle movement patterns and habitat use can aid in the creation of conservation plans for the species. In addition, large variation between sampling size and duration of home range studies suggests that a standard methodology for determining the minimum amount of tracking data needed to conduct home range analyses is necessary to improve accuracy and increase comparability among populations. This study analyzed the home ranges of 27 wood turtles at a site in Fairfield County, Connecticut using 1475 radio telemetry points gathered between 2011 and 2016. Core home range for each turtle was defined as the area enclosed within 50% of points closest to the centroid, while total home range was defined as 95%. Average total home range size per individual wood turtle was ranged between 3.14 ha and 7.82 ha, while average core home range size per individual ranged between 0.99 ha and 1.69 ha, depending on the type of analysis used. Males used significantly larger core home ranges than females across methods, but there was no significant difference in total home range size between sexes. A methodology delineating the minimum number of points and the shortest amount of time needed to collect enough tracking data to conduct similar studies was created via the use of rarefaction curves. Initial results of this methodology suggest that a minimum of 55 tracking points over 2.5 years are needed to sufficiently determine a wood turtle's home range. This research will help conservation practitioners to best protect wood turtle populations from declining further.

**Nourhan Ibrahim**

Princeton University, Princeton, NJ, USA

## **Secondary school conservation biology education in Laikipia County, Kenya**

This senior thesis project is an assessment of secondary school conservation education in Laikipia County, Kenya, and the development of a curriculum to address gaps in the existing conservation topics taught to secondary school students. This summer, I worked with four secondary schools near Laikipia County and interviewed teachers and policymakers about my curriculum, and then field tested two lesson plans. I am currently working on expanding the curriculum to a full ten lessons with original readings, and teachers at the four secondary schools will teach the curriculum. The goal of this project is to develop a curriculum that addresses key topics in the field of conservation biology and provides culturally relevant hands-on learning for students in this pastoral region of Kenya.





**Emily Jager**

*Columbia University, New York, NY, USA*

## **The impact of wildfires on soil nutrients over time in temperate rainforests of Chile**

The frequency and intensity of wildfires are a growing concern across the world as climate change increases their frequency by promoting drier and hotter weather. We investigated the effects of wildfires in the Araucanía Region of southern Chile. This region is composed of temperate rainforest, and has no history of wildfires due to its wet and seasonal climate, but in the past 20 years fires have been spreading. Forests are a vital resource in this region for agriculture and the forestry industry, and the endangered *Araucaria araucana* trees provide a staple resource for indigenous populations. In this project, we researched how wildfires in Araucanía's Protected Area forests affect soil nutrient cycling of carbon and nitrogen over time in order to understand the resilience of the forests. We collected soil cores and leaf litter across a chronosequence of sites: one that had a wildfire in 2002, one that had a wildfire in 2015, one that had a wildfire in both in 2002 and 2015, and a control plot that was never burned. We found that while much of the top organic layer of soil was lost in the fires, soils from the site that was burned once in 2002 returned to the control levels of carbon and nitrogen. Soil from the site burned once in 2015 had lower levels of total nitrogen and total carbon. However, the twice burned site had similar levels to the control and once burned in 2002 sites. This suggests that a second wildfire event does not have a significant impact on soil nutrients, and that the first wildfire is the most damaging. These results give important insight into the resiliency and time scale of soil nutrient regeneration.

**Aljuwan Jeffers**

*Pace University, New York, NY, USA*

## **The challenge of building a livelihood in a Caribbean coastal community**

Caribbean coastal communities depend on marine resources for their livelihood as coral reefs provide food, income and are intricately woven into their cultural traditions. A key part of understanding livelihoods is to understand the dependency communities have on coral reefs, what forms that can take, and how that is constantly changing. To accomplish these goals this research integrates three main fields of study: coral reefs, coastal communities and livelihoods. The vulnerability of coastal communities is often overlooked and, for this reason, the objective of this research was to fill this gap by examining the way in which coastal communities have responded to changes in access to coral reef resources. While, also examining the factors that influenced these responses to provide insight on their capacity to adapt. To conduct this research my fieldwork focused on the Dieppe Bay community which has the greatest focus on fishing activities on the island of St. Kitts. I used qualitative methods (30 questionnaire surveys and 10 interviews with native community members and fishers) in order to gain insight on how the vulnerabilities has affected their ability to build a sustainable livelihood. The main findings included seasonal variability of fisheries which was linked to weather conditions and a depleted reef, and resulted in community household incomes varying considerably. My findings also introduced ways of coping with seasonality, which included: alternating fishing practices and adopting post-harvest strategies. In turn I hope this research is used to assist with the development of more efficient approaches to the sustainable management of coral reef ecosystems.

**Sarika Khanwilkar**<sup>1</sup>, Carlos Gould<sup>1</sup>, Ruth DeFries<sup>1</sup>, Johannes Urpelainen<sup>2</sup>

*<sup>1</sup>Columbia University, New York, NY, USA; <sup>2</sup>Johns Hopkin School of Advanced International Studies, Baltimore, MD, USA*

## **Cooking fuel in the Central Indian Highlands landscape**

Exposure to household air pollution from the incomplete combustion of biomass accounts for millions of premature deaths each year and the extraction of biomass can hinder forests' ability to provide a healthy ecosystem for people by contributing to forest degradation, deforestation, and climate change. Liquefied Petroleum Gas (LPG) can be an important clean cooking fuel alternative in households who rely on biomass-based fuels. We surveyed 4,958 households within 500 villages across the Central Indian Highlands Landscape to assess the associations between LPG ownership and fuelwood collection. Using a remotely sensed measure of forest degradation from PlanetLabs high resolution imagery (3 meter), we assessed the associations between cooking fuel use and forest degradation around survey villages. We found that LPG ownership is not associated with perceptions of changes in the difficulty of collecting fuelwood but is associated with decreased number of hours spent collecting fuelwood. At the village-level, LPG ownership is not associated with forest degradation. LPG ownership in rural India is expanding enormously from policy such as Pradhan Mantri Ujjwala Yojana, which will likely have consequences for forest use but unlikely reduce forest degradation around villages.



**Karissa Lowe**

*Princeton University, Princeton, NJ, USA*

## ***Osmia lignaria* as Strawberry Pollinators in Vertical Farms**

With current agricultural practices and human diets, the world faces a real possibility of global food shortages and environmental destruction coupled intricately together. Vertical farming offers a solution to this problem by increasing food production without increasing land use. However, vertical farming on a large scale is still in its nascent stages. This project explores the use of bees as pollinators in indoor vertical farming. More specifically, the project investigates the best conditions for a solitary bee, *Osmia lignaria*, to pollinate strawberries, a high grossing crop, indoors. Micro vertical farms hydroponically growing strawberries were set up in three humidity and temperature-controlled rooms. One room had no *O. lignaria*, the control. The second room included bees, and the third included both bees and a UV spectrum light. Two 30-day trials were completed: one with Spring-like and one with Summer-like conditions. Many aspects of strawberry production and bee vitality were compared between conditions. Results indicate that strawberries in the presence of *Osmia lignaria* have significantly higher volume than the control. Plants grown in the Spring-like conditions had a much higher number of berries produced. In addition, it was found that bee death rate was significantly lower in the presence of UV spectrum light in both Spring and Summer conditions.

**Dhawal Mehta**

*Saurashtra University, Rajkot, Gujarat, India*

## **Abundance and distribution of the four-horned antelope in Gir Protected Area**

The four-horned antelope (*Tetracerus quadricornis*) is endemic to India. Though widely distributed, it is nowhere found in high abundance and has always been known as a shy and elusive creature. From its reported distribution at the turn of the 20th century, the species has experienced dramatic range reductions with present populations surviving in isolated forested patches. The IUCN Red List has designated the species as Vulnerable and recommends the need for detailed scientific investigation to fill current gaps in understanding species distribution, ecology and biology. Very few studies have addressed the biology and ecology of this antelope and that too in selected pockets in India and Nepal. Gir forms the western most part of the distribution range of the species with a disjunct population from the peninsular Indian population. The current study was carried out in the Gir Protected Area to assess the abundance and understand the factors governing the distribution of the species. The abundance estimation was carried out using Distance sampling through data collected on vehicle transects. Presence only models were analyzed in a GIS platform to understand the factors that governed the distribution of the species in the study area. The density estimate of the species in the Gir Protected Area was found to be  $0.17 \pm 0.06$  (SE). The distribution of the four horned antelope was assessed using Maxent. Vegetation, Elevation and proximity to water chiefly contributed to the distribution of the species in the landscape.

**Sarah Milligan<sup>1</sup>, Morena Mills<sup>1</sup>, Selma Lendelvo<sup>2</sup>, Andrew Knight<sup>1</sup>**

*<sup>1</sup>Imperial College London, Silwood, United Kingdom; <sup>2</sup>University of Namibia, Windhoek, Namibia*

## **Determining the conditions for the spread of conservancies in Namibia**

Many conservation initiatives fail to capture the momentum needed to address some of the more pressing conservation issues of our time. The spread of conservancies in Namibia presents a unique case for analyzing the conditions for adoption and spread of conservation initiatives at a large scale. Since the registration of the first four conservancies in 1998, 82 conservancies have been formally recognized. Insights gained from understanding the spread of conservancies can support conservation initiatives across scales and contexts. This work uses the general elimination methodology (GEM) in order to understand the priority factors influencing the spread of conservancies in Namibia. This methodology is a qualitative evaluation technique that has been previously used to explore the causal contributions and pathways that contextual factors (at multiple scales) have on observable outcomes. The GEM is an alternative qualitative approach and, while popular in other fields such as development, has only been applied twice before in conservation research. Data collection will take place April-June 2019. The factors and pathways of spread that arise from this research will offer insights into how conservation initiatives (in this case, conservancy adoption) diffuses in complex contexts. This research will inform future conservancy evaluation and research within Namibia, with wider theoretical applications for the diffusion of innovation in the conservation sector. Because this research is grounded in interdisciplinary methods/theories, the results will inform conservation action and contribute to the growing body of innovation diffusion literature within the conservation sector.



**Cole Morokhovich**

*Princeton University, Princeton, NJ, USA*

## **The effects of climate change on broad-tailed hummingbird pollination behavior**

Climate change is altering the behaviors, ecological processes, and key biological events of many organisms around the globe. Among such processes and biological events is phenology. The effects of climate change on phenology are seen easily in plant pollinator systems. Such is the case for wild flowers at the Rocky Mountain Biological Laboratory (RMBL) and broad-tailed hummingbirds. In high elevation sites, like RMBL, early snowmelt is triggering plants to flower earlier, often at times before their pollinators are available. Broad-tailed hummingbirds migrate to RMBL for their breeding season and give birth during the peak of the wildflower season. Shifts in plant phenology are causing a temporal mismatch, because the Broad-tail hummingbirds often arrive after the flowering of their first food plants, which could influence their pollination behavior. One such flower species affected is the hummingbird-pollinated *Delphinium nuttallianum*. Here, we measured nectar volume, concentration, and flower color over the course of *D. nuttallianum* flowers' lives, paired with field experiments to determine which cues broad-tailed hummingbirds use when foraging, and we determine if they demonstrate preferential foraging behavior towards male or female flowers. Our overall project aims to understand how climate change is affecting the pollination behavior of broad-tailed hummingbirds.

**Patrick O'Shea, Robert Harbert**

*Stonehill College, Easton, MA, USA*

## **Using convex hulls to identify outliers in population distribution models**

A key challenge in Ecology over the next few decades will be to predict the impact of climate change on global patterns of biodiversity. Future conservation success is critically dependent upon the successful modeling of species distributions both now and under potential climate change scenarios. However, the data with which we can perform this kind of modeling consists of incomplete and often spatially biased collections. To counteract spatial clustering and sampling biases we propose novel algorithm that simultaneously identifies natural groups and explores sampling potential. We apply a genetic algorithm which uses a location-based survivability heuristic to evaluate the fitness of a point while mutating the locations of points between generations to explore adjacent space. Points from each generation are clustered using the Mean-Shift clustering algorithm and the convex hull of each cluster is found using the Jarvis-March algorithm. The pool of convex hulls across generations then sort the original occurrence points into highly supported groups, returning a statistic showing natural groups and the probability that a point is or is not an outlier or anomaly. The data returned from each run of the genetic algorithm can be used as material to create a neural-net, which can help evaluate sets of species for similarity to those which have previously been evaluated. The goal of this research is to test and develop a streamlined set of anomaly and group detection tools for the species distribution modeling community to aid in dealing with complex, structured, and biased species distribution samples.

**Tatianna Peralta<sup>1</sup>, Yelda Balkar<sup>1,2</sup>**

*<sup>1</sup>American Museum of Natural History, New York, NY, USA; <sup>2</sup>Manhattan College, Riverdale, NY, USA*

## **Determination of heavy metals in Tibbetts Brook**

This experiment consists of the use of Atomic Absorbance Spectrometry to determine the different levels of heavy metal concentrations inside of Tibbetts Brook. Atomic absorption is an analytical method used for elemental analysis of a compound or a mixture. In partnering with The Friends of Van Cortlandt Park Organization, water samples were collected from nine different sites along Tibbetts Brook to determine the levels of iron, manganese, calcium, zinc, and lead. We are also interested in determining whether heavy metal concentrations co-occur with adjacent industrial land use. This research project highlights the importance of environmental science, in the context of determining the various ways that the human population affects our environment.

**Santiago Said, Benoit Cote, Cynthia Kallenbach**

*McGill university, Montreal, QC, Canada*

## **20 years of beech scale: impacts on diversity and silicon cycling in Quebec's forests**

Quebec forests are being threatened by record breaking temperatures along with the emergence of beech scale disease, which has decimated adult American beech populations. These declines in beech are of special environmental

significance since beech trees have recently been linked to coupled soil carbon-silicon cycling and thus may help regulate atmospheric CO<sub>2</sub>. The potential importance of the joint carbon-silicon cycle as a critical forest ecosystem service is largely unexplored and insight into its response to abiotic and biotic changes needs to be better understood to help guide conservation practices and species loss assessments. In particular, the interacting effects of changing temperature and precipitation with beech mortality on forest biodiversity and the carbon-silicon cycle remains uncertain. The aim of this study is to quantify the changes in species composition and forests' carbon and silicon concentrations across a 20-year period, to determine how these biotic and abiotic changes are disrupting forest processes. Preliminary results show an overall decrease in forest carbon and biogenic silicon, which can be attributed to the extended mortality of beech trees and the increase of temperatures. This, in turn, has reduced species biodiversity with beech thickets that sprout from dead adults dominating the understory. These results help identify the largely unassessed impacts of the invasive beech scale insect on forests' carbon-silicon cycling while also help to determine the tree species most efficient at increasing soil silicon. Our results provide new insight towards which species conservation should target to preserve the soil Carbon-Silicon ecosystem service.

**Nicole Rowe**, Konrad Hughen, James Cervino, Ben Van Mooy, Anna Ducroiset  
*Woodshole Oceanographic Institute, Falmouth, MA, USA*

### **Lipidome changes in coral symbionts exposed to elevated thermal and chemical stress**

In recent decades, global increases in oceanic temperatures, anthropogenic run-off and land-based pollution have decimated coral reefs worldwide. Coral bleaching and mortality sometimes occur before the magnitude or sources of stress can be identified, hindering efforts to mitigate damage. Many studies have examined the effects of thermal stress on coral symbionts, but less is known about impacts of chemical stressors. Glyphosate is a prevalent herbicide used worldwide, and a number of studies have demonstrated that it poses a threat to non-target aquatic organisms. Here, we quantified changes in the lipidomes of two clade types of the coral symbiont *Symbiodinium* following exposure to elevated levels of temperatures, Glyphosate, and both together. This study aims to identify novel stress markers, as well as diagnose and differentiate specific sources of stress (i.e., warming versus pollution). The results showed significant decreases in intact polar membrane lipids (mono- and di-galactosediacyldiglycerides) and increases in molecular breakdown products (triacylglycerides). Investigating the entire lipidome also provides insights into changes in metabolism and molecular mechanisms of stress. Dominant, highly unsaturated membrane lipids known to cause apoptosis declined by 85–95%. This suggests a mechanism whereby the alkyl side chains are lysed into polyunsaturated aldehydes, known to be toxic to algal cells, and provides a potential mechanism for symbiont programmed cell death. A greater understanding of the magnitudes and mechanisms of coral stress from multiple sources will help managers of marine protected areas mitigate against environmental causes of coral decline.

**Marie Laure Rurangwa**, Jesús Aguirre-Gutiérrez, Protais Niyigaba, Robert J. Whittaker  
*University of Oxford, Oxford, England*

### **The effects of land-use change on bird communities in a Rwandan montane rainforest**

Among the leading causes of biodiversity loss worldwide, land-use change figures prominently. Before the designation as a National Park, Nyungwe forest, a tropical montane rain forest in Rwanda, particularly rich in the avifauna, over fifty years underwent a massive degree of transformation due to human-induced forest fires, and clearings for agriculture and settlements. There is scant information on the extent to which such land-use changes have affected birds and associated ecosystem services in Rwanda, and the Afrotropical region at large. The study aimed to determine how different degrees and forms of habitat transformation affect bird's species composition and diversity, functional trait structure and phylogenetic diversity in and around Nyungwe national park. Data on morphological traits of study birds were measured from museum specimens. Further data on occurrence, abundance, and functional traits indicative of habitat type and use were collected using point counts, mist netting and vegetation sampling conducted in relatively pristine areas, secondary forests, restored sites, non-native forests and cultivated areas. In comparison to relatively undisturbed areas, land-use change altered species composition, and reduced species diversity and phylogenetic diversity. In contrast, functional diversity remained stable across land-use types. The study emphasizes the need to apply complementary diversity metrics when quantifying ecological resilience to anthropogenic changes, and to treat dimensions of avian diversity separately for a more informed and comprehensive landscape management.



**Kimberly Samson<sup>1</sup>**, Rajesh Prasad<sup>1</sup>, Monal Lal<sup>2</sup>

<sup>1</sup>University of the South Pacific, Suva, Fiji; <sup>2</sup>University of the Sunshine Coast, Queensland, Australia

### **Identifying the aquaculture potential of an endemic Fijian fish species**

Aquaculture, conducted within sustainable and environmentally friendly parameters is the way forward for the future to ensure long-term food security, reduction of pressure on wild fisheries and an alternate source of income for Pacific Island communities. For over twenty years, countries in the Pacific region, in particular, Fiji, have investigated the aquaculture of different species. To enable further aquaculture development in Fiji and the rest of the Pacific region, it is necessary that new species be considered. The endemic Fijian fish species, *Mesopristes kneri*, known locally as "Reve" was identified as a candidate for aquaculture in the country. This research identifies the potential for the aquaculture of Reve by determining its ecology, diet and reproductive biology. A total of 80 fish samples of various sizes were caught using fishing nets within the Navua River system at four sites from the river mouth to 10 km upstream. While collecting field samples, environmental data was collected. The samples were taken back to a laboratory to conduct diet and biology studies. The study finds that the species has aquaculture potential based on the results which show that the species has a wide habitat range, omnivorous diet as well as a non-seasonal spawning period. However, more research is needed before the species can be adequately cultured, such as feed experiments and the nursery stages of the farming of the species.

**Umer Hameed Shansaz**, Mustahson Farooq Fazili, Bilal Ahmad Bhat, Iqram-ul-Haq, Hameem

Mushtaq, Rouf Ahmad Bhat

University of Kashmir, Srinagar, J&K, India

### **Status and conservation issues of some Pheasants in Dachigam NP, Kashmir Himalayas**

Pheasants belonging to the order Galliformes, one of the most threatened avian orders, with nearly 25% of the 300 species considered at risk of extinction compared with the overall 12% of all birds in the world (McGowan and Garson, 2002). Many pheasant species are likely to become extinct within the next 100 years, if over exploitation and habitat destruction continues (Ramesh, 2003). In Kashmir Himalayas the information about the current status on pheasants was lacking as none of the study was targeted in the area since last two decades. A study was designed to assess the current status and conservation issues of pheasants in Dachigam national park, (34°8'14"N 75°2'16"E) from November, 2017 to November, 2018. The park is an ideal site for studying Himalayan Monal (*Lophophorus impejanus*) and Koklas (*Pucrasia macrolopha*) as it harbours both the pheasant species (Wani, 2012). Our study revealed that the birds are threatened because of high human activities in their habitats. The major conservation issues include habitat destruction (mining), poaching (using shot guns and noozes), forest fires and high anthropogenic pressure (Army establishment in the core zone of the park and high vehicular movement).

**Kayla Sheeger<sup>1</sup>**, **Samantha Adrianzen<sup>2</sup>**, Maria Strangas<sup>3</sup>

<sup>1</sup>Fiorello H Laguardia High School of Music & Art and Performing Arts, New York, NY, USA;

<sup>2</sup>Stuyvesant High School, New York, NY, USA; <sup>3</sup>American Museum of Natural History, New York, NY, USA

### ***Enyalius*: good places to live, and not so good places to live**

Through our project, we aimed to analyze the thermal tolerances and ranges of six lizard species in the genus *Enyalius*, native to the Atlantic Forest of Brazil, to understand how each species will be affected as global warming's impact gets stronger. By combining environmental temperatures and thermophysiological traits, we found the optimal locations for our lizards based on their temperature tolerances. We created an elevation map depicting the number of hours in their preferred temperature range each individual lizard experienced. We found that, across species, there is more variability in their critical thermal minima than their critical thermal maxima, which was always around 42 degrees Celsius.

We also saw that *Enyalius* is more often in their preferred temperature range in the northern Atlantic Forest than the southern Atlantic Forest. Our results suggest that climate change may affect *Enyalius*, but there are various other factors to include such as competition amongst species and food accessibility. Thus, temperature is not the sole factor in seeing how *Enyalius* will be affected.





**Bintou Sow**<sup>1</sup>, Diana Miranda<sup>1</sup>, Mark Weckel<sup>1,2,3</sup>, Konstantinos Krampis<sup>4,5</sup>, Claudia Wultsch<sup>1,4,6</sup>

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<sup>3</sup>Youth Initiatives, American Museum of Natural History, New York, NY, USA; <sup>4</sup>Bioinformatics and

Computational Genomics Laboratory, Hunter College, City University of New York, New York, NY,

USA; <sup>5</sup>Institute for Computational Biomedicine, Weill Cornell Medical College, New York, NY, USA;

<sup>6</sup>Sackler Institute for Comparative Genomics, American Museum of Natural History, New York, NY, USA

### **Invisible Big City Life Revealed: Microbiomes of NYC Coyotes**

As a result of increasing urbanization, wildlife face unprecedented pressure to adapt to human environments.

Understanding how urban areas impact wildlife that persist in big cities is critical. Here, we studied microbiomes associated with an urban mesocarnivore, the coyote (*Canis latrans*) living in New York City. Microbes have a profound impact on an organism's biology, health, and fitness, but remain largely uncharacterized in urban wildlife. We collected swab samples from three live-trapped coyotes and applied high-throughput 16S rRNA sequencing to jointly investigate gut, mouth, skin, nose and ear microbiomes. For the first time, we described the taxonomic composition, diversity and functionality of microbiomes in urban coyotes. We hypothesized that similar to other vertebrates, coyotes harbor unique bacterial communities associated with different body niches, which have distinct taxonomic and functional signatures. We also predicted that microbiome diversity is highest in body sites exposed to the urban environment. We identified 1,315 microbial sequence variants and showed that urban coyotes host unique microbiomes, which significantly differ in their taxonomic composition (PERMANOVA,  $P = 0.015$ ), but not diversity (ANOVA,  $P = 0.152$ ). Microbiomes exposed to outside environments (e.g., skin, ear) were the most distinct microbial ecosystems studied in coyotes due to a high abundance of environmental bacteria. Findings of this study help gather critical baseline data on urban coyote microbiomes, which has broad implications for health monitoring, infectious disease mitigation, conservation and management of wildlife persisting in complex urban landscapes.

**Maria Stahl**, Robert Pringle

Princeton University, Princeton, NJ, USA

### **The Role of Fire in Maintaining Herbivore Diversity in an African Savanna**

Fire plays a major role in determining the structure and dynamics of tropical savannas, removing old biomass and promoting the germination of nutritious regrowth to facilitate the coexistence of grass and trees characteristic of these ecosystems. The frequency with which an area burns may dictate the overall palatability and biomass of savanna grasses, generating heterogeneity in the vegetation available to grazers and promoting herbivore diversity through niche partitioning. Gorongosa National Park presents a unique ecosystem to study the interaction of fire, vegetation, and herbivores because its history of destruction and rebirth. Established by the Portuguese in the early 1900s it was ravaged by decades of war in the latter half of the century after Mozambique declared its independence. Now, after 15 years of restoration efforts, the system is recovering, and wildlife counts are approaching and in some cases surpassing their historic levels, though not all species are rebounding at the same rate, creating an imbalance in the herbivore community structure. This suggests that even though the ecosystem is recovering, it still requires interventions to continue to strengthen the ecosystem as a whole. I have collected data on the biomass and nutritional quality of grass in frequently and infrequently burned areas, as well as the presence and behavior of herbivore species grazing upon these areas. Interpreting these results will shed light on the lasting effects of the Park's controlled burn regimen on herbivore populations, potentially helping in the establishment of a more formal strategy that actively promotes herbivore diversity.

**Edward Tekwa**<sup>1</sup>, Simon Levin<sup>2</sup>, Malin Pinsky<sup>1</sup>

<sup>1</sup>Rutgers University, New Brunswick, NJ, USA; <sup>2</sup>Princeton University, Princeton, NJ, USA

### **Theories and Tests for Path-Dependence in Conservation Behaviour**

Models that predict path-dependent, alternative stable states are prominent in ecology and conservation science, and present special challenges for management institutions aiming to conserve and sustain natural resources. However, such models are rarely supported by independent observations and often have no statistical method to gauge significance. We show that a bioeconomic model of institutional rent-seeking predicts that conservation behavior is



often path-dependent. Conservation and over-harvesting appear as alternative stable states under identical ecological and economic characteristics but different histories. A novel model fitting procedure and significance test using data from 217 global marine fisheries show strong support for the model. We further refine the statistical test for all bifurcation theories that predict multiple attractors and discuss the implication of path-dependence for extinction risks on land and in the sea.

**Liju Thomas**, Sanitha K Sivasdas, Neelesh Dahanukar, Rajeev Raghavan, Ranjeet K  
*Kerala University of Fisheries and Ocean Studies, Kerala, India*

### **Biogeography of Chitons from the Indian Ocean and its implications for conservation**

Chitons (class: Polyplacophora) are marine molluscs that dominate the intertidal and shallow subtidal zones with some records from the deep-sea. As prolific grazers of rocky intertidal regions, chitons are important bioindicators. Further, the evolution history of chiton makes them an ideal group for understanding species diversification and biogeography pattern. Compared to the Atlantic and Pacific waters, research focussed on taxonomy has only recently begun in the Indian Ocean region. To understand the biogeography pattern of chitons from the Indian Ocean fringing countries, data were collected from published data and GBIF (Global Biodiversity Information Facility) records. Data were analysed using multivariate techniques. Based on species assemblage and taxonomic classification, five distinct biogeographic regions were observed. Of the thirteen families reported, Chitonidae, Acanthochitonidae and Ischnochitonidae showed wide distribution. Some species showed restricted distribution and endemism. The results show a clear pattern of species differentiation driven by changes in the biogeography of intertidal habitats. Intertidal communities including chitons with limited habitat range are vulnerable to climate-change related extinction risk from “coastal squeeze” due to sea-level rise. As environmental changes are predicted to accelerate in the coming decades, spatial extensive monitoring will be required to visualize and quantify their impacts on biodiversity. Knowledge of the biogeography pattern of key intertidal taxa such as chitons will no doubt help improve the understanding and management of the world’s coastal regions.

**Sarah Trabue**, Melinda Rekdahl, Carissa King, Howard Rosenbaum  
*Columbia University, New York, NY, USA*

### **The prevalence of skin lesions on bottlenose dolphins in the New York Bight**

While skin lesions have been documented in bottlenose dolphin (*Tursiops truncatus*) populations worldwide for the past two decades, little is known about the pattern of development and distribution of skin lesions among individuals and populations. Though not typically lethal, skin lesions are considered an indicator of disease or diminished health. The prevalence of skin lesions appears to be increasing in coastal areas and may be linked to anthropogenic influences. In this study, lesions were documented using photo-ID and characterized by apparent texture and color based on previous studies. No previous analyses of skin lesions have been done on the bottlenose dolphins within the New York Bight, though this ecosystem is heavily influenced by human activity. Photos of dolphins were opportunistically collected from June 2017 to October 2018. Of 221 photographed individuals where the skin surface was clearly visible, 49.3% (N=109) of individuals possessed at least one type of skin lesion, and 13.5% (N=30) had two or more types. Dark-fringed spot and white-fringed spot lesions were most commonly found in the New York Bight (N=24 and N=25 individuals, respectively), followed by tattoo-like lesions (N=14). Each of these lesion types have previously been associated with pox viruses and herpesvirus suggesting possible presence of these diseases among bottlenose dolphins in the New York Bight, thus impacting the overall fitness of the population. Further quantitative and longitudinal analyses are needed to better understand the cause and distribution of skin lesions in this area and to support effective population management.

**Frédérique Truchon**<sup>1</sup>, Virginie Millien<sup>1</sup>, Martin-Hugues St-Laurent<sup>2</sup>

<sup>1</sup>*McGill University, Montreal, QC, Canada*; <sup>2</sup>*Université du Québec à Rimouski, Rimouski, QC, Canada*

### **Effect of hiker presence on white-tailed deer spatial use patterns and impacts**

Across most of North America white-tailed deer (*Odocoileus virginianus*) populations are increasing due to anthropogenic effects such as land use changes, habitat fragmentation, and climate warming. These increased abundances often result in more frequent human-deer encounters, especially in areas where recreational activities occur. This study aims at investigating the factors underlying space-use patterns of deer in relation to hiker density and identifying the related impacts on the flora. Previous research suggests that animals can perceive human disturbances as predation risk, and modulate their distribution accordingly. This concept of “landscape of fear” led to our hypothesis

that deer densities would be negatively correlated with hiker density. We also hypothesized that the deer's impact on the vegetation would reflect the skewed distribution of individuals. To estimate deer densities and distribution, we conducted camera trap surveys in a UNESCO Biosphere Reserve near Montreal (QC, Canada). The long-term impacts of deer browsing were assessed using small exclosures. We sampled the exclosures and associated control plots over the years looking at the abundance and size of white trillium (*Trillium grandiflorum*) – a commonly used indicator of deer browsing pressure. We found that the number and size of trillium were greater in exclosures than in areas subjected to browsing. Furthermore, our results show a decrease in the number of trillium over time, which suggests long-term impacts of white-tailed deer on the understory. Results from this study will help inform management decisions in cases of high-density cervids, especially in protected areas with public access.

### Theodore Vincent

*University of Georgia, Athens, GA, USA*

### Examining the development of marine oil aggregations in oil spills

In the Deepwater Horizon oil spill, dispersants, such as Corexit, were used to break down oil particles into more dilute droplets. The method, while eventually helpful to the cleanup of the environmental emergency, had a curious, previously undocumented side effect. Marine oil aggregations, termed MOAs, and consisting of bacteria, zooplankton, and detritus, reached sizes up to 25 centimeters in length. Extracellular polymeric substances (EPS) derived from bacterium gave the MOAs a sticky consistency, somewhat resembling a biofilm. This study uses mathematical modeling techniques to uncover the conditions required for the genesis of these MOAs, exploring the rates and viability of MOA formation from oil depending on its geometry (planar vs. single-drops as a result of dispersant). Once bacteria collect on oil droplets as they rise or moves towards stationary sheets of oil at the water's surface, they weather the oil until the MOA is dense enough to sink, potentially suffocating benthic ecosystems. With a better understanding of the dangers that could arise from various oil spill cleanup procedures, first responders can adjust accordingly to protect surface marine and coastal ecosystems, as well as those which reside on the ocean floor.

**Brandon Wong<sup>1,2</sup>, April Wu<sup>1,3</sup>, Darice Westphal<sup>1,4,5</sup>**

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### Effectiveness of protected forest regions in Madagascar

Today, over 90% of Madagascar's forests are being impacted by deforestation. With deforestation rates accelerating in a biodiversity hotspot region such as Madagascar, issues such as climate change, extinction, and habitat loss can worsen. Madagascar has many protected forested areas in the form of parks and nature reserves, but no studies thus far have examined the success of these protections in terms of reduction of deforestation rates. This project examined deforestation rates in Madagascar from 2000–2016, comparing deforestation rates of protected areas to those of unprotected ones. Protected areas were compared to similarly sized unprotected areas in the same forest type (i.e., dry, humid, or spiny). Data was gathered through satellite imagery and processed with R scripts. In general, protected regions exhibited lower rates of deforestation when compared to unprotected ones. However, this trend differed across forest types. Deforestation rates in dry and spiny forests did not differ between protected and unprotected areas. In humid forests, protected areas significantly reduced the deforestation rate. Differences in deforestation rates could be due to variation in protection level or year protected status was enacted. Overall, protected areas ease deforestation rates somewhat, but more research is needed to understand the role of different attributes between protected areas.

**Yisi Zhu<sup>1,3</sup>, Allison Steinman<sup>1,3</sup>, Peter Galante<sup>1,4,5</sup>**

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### The Bronx: Coyote Country

Over the last several decades, coyotes (*Canis latrans*) have greatly expanded their range across North America. They are now found thriving in urban areas. They have started colonizing one of the most densely populated cities, New York City, specifically the Bronx. As the largest carnivore in such a system, they will function as the top predator and can pose dangers to domestic animals and even humans. Understanding how coyotes use the urban matrix is essential to conservation and management efforts. These efforts are especially important given that there is a higher potential for

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human-coyote conflict now that they reside in this human-dense environment. We are working with the Gotham Coyote Project to track one adult male coyote in the Bronx using GPS collar data. We are evaluating his selection of different land types, with a particular focus on how this selection varies during different time of the day: day, night, and twilight. The coyote typically avoids land types associated with high human activity (buildings, roads/railroads, and other paved surfaces) while he selects for areas associated with low human traffic (bare soil and grass/shrub) regardless of the time of day. These patterns of avoiding areas with high human traffic and selecting areas with low human activity imply that he is a “misanthropic synanthrope.”