ABSTRACTS

IGC Symposium April 22, 2016

Oral Presentations

Platform Session 1

11:30 am – 2:30 PM

Session Chair: Laura Schoenle

Comparison of survey techniques on detection probability of northern flying squirrels: Live trapping, camera traps, and ultrasonic acoustics

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The ability to detect a species during surveys or monitoring is important for conservation and management, especially if the species is rare or endangered. Traditional methods can be labor intensive, invasive, and produce low detection rates. Technological advances may provide opportunities to efficiently survey for a species, while reducing field effort. We conducted a comparison study of one traditional technique (live trapping) and two novel non-invasive techniques (camera trapping and ultrasonic acoustic surveys) on detection rates of the *Glaucomys sabrinus coloratus* at Roan Mountain Highlands in North Carolina. We established three 5 x 5 trapping grids (6.5 ha) with four camera traps and four acoustic detectors systematically embedded in each grid. All three techniques were surveyed simultaneously over two 4-day survey periods. We compared techniques by assessing probability of detection (POD) and latency to detection (LTD), as well as survey effort and cost. Acoustics had the highest POD (0.37±0.06 SE), followed by camera traps (0.30±0.06), and live traps (0.01±0.005). Acoustics had a significantly lower LTD than camera traps (p=0.017), detecting flying squirrels during the first survey night at 75% of survey units. Total field effort was highest with live traps (111.9 hrs) versus acoustics (8.4) and camera traps (9.6), although laboratory effort for data analysis non-invasive techniques made overall effort similar between the three methods. Our study demonstrates that both non-invasive methods are a better rapid-assessment technique of Carolina northern flying squirrel detection compared to live traps. However, protocol for both non-invasive techniques needs further development prior to widespread application.

Hypoxia-induced trade-offs on zooplankton vertical distribution and community structure in reservoirs

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As a result of global change, hypolimnetic hypoxia is increasing in lakes and reservoirs worldwide. Hypoxia can have many detrimental effects on freshwater ecosystem functioning, such as increased internal nutrient and metal loads from bottom sediments. Although the effects of hypoxia on nutrient release has been well-studied, less is known about how hypoxia impacts plankton communities, especially zooplankton. Typically, zooplankton migrate to the dark bottom waters (hypolimnion) during the day to escape visual fish predation in the surface waters (epilimnion). However, due to the physiologically-stressful conditions of hypoxic hypolimnia, zooplankton may remain in the epilimnion during daylight, trading oxic stress for increased predation risk. We sampled five reservoirs weekly to biweekly in southwestern Virginia from May-September 2014 to examine how hypolimnetic oxygen concentrations impact the vertical distribution, abundance, and community composition of zooplankton. These reservoirs varied on a gradient of hypolimnetic oxygen concentrations, from hypoxic to oxic at the sediment-water interface during most of the thermally-stratified period. We also conducted a 36-h sampling campaign on a reservoir with a hypoxic hypolimnion to examine how zooplankton were vertically distributed over an entire day. In hypoxic conditions, zooplankton were predominately found in the epilimnion, and had overall lower abundances than in reservoirs with oxic hypolimnia. Because of the critical role zooplankton play in lakes and reservoirs as the dominant grazers of phytoplankton, it is vitally important to better understand how they may respond to hypoxia, and what the resulting impacts are for lake and reservoir water quality.

Variation in thermal tolerance in an invasive lizard (*Anolis sagrei)*

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Biological invasions allow researchers to assess phenotypic responses to novel environments in a natural setting. *Anolis sagrei* is a tropical lizard that has successfully invaded geographic ranges with climatic variables that differ substantially from its native range. A climate niche shift in this species has been observed between its native range in the Caribbean and its invasive range in the southeastern United States. This shift is expected to lead to population differences in thermophysiological traits such as thermal tolerance between these two ranges. This study provides data on thermal traits from native and invasive populations of *A. sagrei* across a latitudinal gradient, and examines how metabolic and locomotive performance varies across different temperatures and populations. In conjunction with previous work on invasive populations of *A. sagrei*, our results will be important in further understanding the phenotypic adjustments that occur in populations exposed to new environments.

Demography of Eastern Hellbenders (*Cryptobranchus alleganiensis*) Along a Land Use Gradient

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Habitat loss due to deforestation is one of the greatest threats to freshwater biodiversity. Many studies have linked land use to changes in abundance and occurrence of freshwater biota. However, few studies have described how land use acts on demographic rates to elicit population level effects. We used mark-recapture data collected between 2007 and 2015 to describe demography of eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*) populations in six stream reaches stratified across a land use gradient. We tested the hypotheses that loss of forest cover negatively affects hellbender density and population growth rates due to reduced recruitment (evidenced from demographic structure) and/or reduced adult survival. We also investigated relationships between forest cover and potential mechanisms (water quality and substrate) linking land use to hellbender demography. Mean sub-adult/adult densities in 2014-2015 were three- to 9-fold higher in reaches with ≥ 65% forest in riparian areas throughout the catchment relative to reaches with 53-64% forest. Apparent survival of adults did not vary with forest cover. However, population structure reflected a decline in recruitment as riparian forest decreased and populations composed of relatively few (≤ 10% of the population) young adults declined during our study. Water temperature, salinity and predominance of fine substrates increased as riparian forest cover decreased. Our findings suggest hellbender population viability is sensitive to loss of forest cover in riparian areas and that alterations to water quality, substrate or some other correlate

of riparian land use acts specifically on demographic rates that determine recruitment to the adult population.

Platform Session 2

3:00 PM – 4:15 PM

Session Chair: Tamara Fetters

Greenhouse gases respond to whole-ecosystem oxygenation and thermal stratification manipulations in a eutrophic reservoir

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Climate models predict increased air and water temperatures for many regions, thereby increasing the magnitude of freshwater hypoxia and thermal stratification in waterbodies. Simultaneously, the frequency of intense storms is rising, resulting in intermittent periods of oxygenated, mixed conditions and hypoxic, stratified conditions. Changing oxygen concentrations and thermal stratification could significantly alter the production of greenhouse gases, particularly carbon dioxide (CO2) and methane (CH4), and the redox conditions leading to their production in freshwaters. To examine the effects of these climate change impacts, we directly manipulated hypolimnetic oxygen concentrations and thermal stratification at the whole-ecosystem level and explored the responses of carbon dioxide (CO2) and methane (CH4), as well as the electron acceptor pathways that lead to carbon mineralization. We mixed the epilimnion of a small, eutrophic reservoir and intermittently oxygenated the reservoir's sediments during the summer of 2015. Throughout the summer, we observed dissolved CH4 concentrations ~7500X higher than atmospheric levels. Interestingly, these high CH4 concentrations occurred at the metalimnion during periods of hypolimnetic oxygenation, after epilimnetic mixing events ended. During hypolimnetic oxygenation, CO2 concentrations increased to >13,000 ppm near the sediments, likely due to stimulated aerobic respiration. In the anoxic metalimnion, we observed shifts in the availability of electron acceptors that coincided with the initiation of methanogenesis. Our preliminary data suggest that altered thermal stratification and hypolimnetic oxygen conditions will considerably alter greenhouse gas production in eutrophic reservoirs. Given the global increase in reservoir construction, it is

vital that we understand how greenhouse gas production in these ecosystems will respond to a changing climate.

Context-dependency of amphibian-Bd-microbiome interactions in the Neotropics: implications for future ecological research and conservation

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Dramatic declines in amphibian diversity have been documented throughout the Neotropics, in part, due to the skin disease chytridiomycosis, caused by the fungus *Batrachochytrium dendrobatidis* (Bd). Studies suggest that amphibian skin bacterial communities can alter the outcome of the amphibian-Bd interaction, and that Bd might be posing a selective pressure upon these communities in wild populations. However, an understanding of how environmental conditions impact the function of these bacterial communities is scarce. Variable functions of these symbiotic bacteria under different contexts might explain why experiments testing potential amphibian probiotics have obtained mixed results. Given the variation in chytridiomycosis outbreaks across elevations, we aimed to determine how the diversity, structure and function of these symbiotic bacterial communities changes with elevation. We collected skin swab samples in Panamá from three high and three low elevation populations of *Silverstoneia flotator*. Skin bacterial communities and metabolite profiles were assessed using 16S rRNA gene amplicon sequencing and HPLC-MS, respectively. Our results indicate that across high and low elevations, individuals harbor similar skin bacterial communities, although one lowland site appeared to differ from the others. The metabolite profiles suggest that there is significant variation among frog populations (i.e. sites) and between elevations. Overall, these results suggest that while the frogs have similar bacterial community structure, the local environment might be shaping the metabolites profiles, which indicate a potential functional plasticity that could influence the interaction with Bd. Thus, it is critical to consider the context-dependence of amphibian-microbe-Bd interactions to inform amphibian conservation efforts in the Neotropics.

The physiological consequences of infection with Haemosporidian parasites

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Haemosporidian parasites, including those responsible for avian malaria, can have substantial, negative fitness consequences for their hosts. In areas where the parasites have been recently introduced, infection can be deadly. For example, in Hawaii, malaria has contributed to the extinction of up to twenty species of honeycreeper. Where the parasites are endemic, infection does not appear to have immediate effects, but chronic infection can reduce both annual survival and reproductive success. Although most infected birds experience chronic infections, the effects of long-term exposure to the parasites on host physiology are unknown. We investigated the physiological consequences of infection in adult male red-winged blackbirds (*Agelaius phoeniceus)* from a population where about 95% of individuals are infected with Haemosporidian parasites. Using both an observational field study and an anti-malarial treatment experiment in an aviary, we examined the effects of Haemosporidian infection on 1) cellular damage, 2) tissue repair, and 3) immune activation. In free living birds, higher parasite burdens were correlated with a decrease in hematocrit and an increase in red blood cell production. The aviary experiment confirmed the relationships found in free-living birds, and additionally showed that infection causes a reduction in mass. We detected no effect of infection on immune function or oxidative damage. The physiological costs of Haemosporidian infection can be substantial and are likely related to the replacement of damaged red blood cells. These results provide a mechanism that could underlie the fitness costs of Haemosporidian infection found in other studies.

Understanding the drivers of temporal variation in wood thrush post-fledging survival

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Between leaving the nest and recruiting into the breeding population the following year, songbirds experience multiple life stages (e.g., post-fledging period, dispersal) with different inherent risks. The post-fledging period is an important period because many songbirds suffer high mortality. Although post-fledgling survival (PFS) has been quantified for a large number of passerines, the drivers of both spatial and temporal variation in survival remain poorly understood. In this study, we used radio telemetry to track fledgling Wood thrush, a declining Neotropical migrant, at 12 sites across 4 years in Southern Indiana. We built competing known-fate survival models to quantify the temporal structure of PFS and to understand which abiotic and biotic factors (i.e., nest parasitism, precipitation and natal habitat characteristics) affect survival probability. Our results show that PFS did not vary within each year (i.e., over the course of the breeding season), but did show substantial variability between years. Models suggest that annual variation in survival is linked to weather, with birds having the lowest survival during droughts. The effect of precipitation deficits showed that young birds that have just fledged the nest are disproportionately impacted in dry years. In contrast, our results did not show a strong effect of either natal habitat characteristics or nest parasitism on survival probability. Overall, this research broadens our understanding of the spatial and temporal drivers of variation in PFS and highlights the impact of region-wide droughts on PFS and subsequent recruitment patterns.

Increased antibiotic resistance – effects on microbial communities and ecosystem function

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In the United States nearly 80% of all antibiotics are used in the livestock industry. This use has become a major health concern given the potential for increased antibiotic resistance in human pathogens. While such concerns have obvious human health implications, the impact of increased antibiotic resistance on soil microbial communities and the ecosystem processes they regulate is unknown. At a national scale, we compare soil microbial communities from paired sites receiving either high or low inputs of dairy cattle manure. Given high antibiotic (i.e. cephapirin, a β-lactam antibiotic) excretion rates in manure, we expected that 1) the composition of soil microbial communities, particularly bacteria, would shift toward taxa with

demonstrated resistance to these compounds; 2) concentrations of antibiotic resistance genes (ARGs) would increase; and 3) increasing maintenance demands in response to antibiotic additions would lead to decreased microbial efficiency (i.e. greater mass specific respiration). The abundance of the β-lactam resistance gene ampC was 5.2-fold greater in the high input sites, likely due to the use of cephapirin in dairy herds. Additionally, bacterial communities in high input sites differed from those in low input sites, driven primarily by a 25-fold increase in Acinetobacter, an opportunistic pathogen known for β-lactam resistance. Finally, ampC abundance was positively correlated with indicators of microbial stress (i.e. qCO2), and microbial mass specific respiration, which increased 2.1-fold under high inputs. These results demonstrate that antibiotic residues and resistance are not just of human health concern but alter soil microbial communities and the ecosystem processes they regulate.