ABSTRACTS

IGC Symposium April 21, 2017

Oral Presentations

Platform Session 1

9:15 am – 10:15 AM

Session Chair: Heather Govenor

Surviving or thriving with malaria: the role of stress hormones in mediating resistance and tolerance

Authors: **Laura A. Schoenle** 1***,*** Ignacio T. Moore 1, Fran Bonier 1,2

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Glucocorticoid hormones provide a mechanism for individuals to rapidly adjust their physiology and behavior to meet the challenges of a variable environment. An individual's baseline concentration of glucocorticoids can reflect life history stage and resource demands and affect a suite of physiological and behavioral responses that include immune modulation and resource allocation. Thus, glucocorticoids could facilitate a response to parasites that is optimized for an individual's specific challenges and life history stage. We used an observational field study and a controlled experiment to test the role of glucocorticoids in mediating the response to *Haemosporidian* parasites (including those that cause avian malaria) in red-winged blackbirds (*Agelaius phoeniceus*). Among free-ranging birds, individuals with higher baseline concentrations of glucocorticoids experienced reduced costs of infection. However, we found no relationship between hormone levels and parasite burden. We then experimentally increased glucocorticoid concentrations in adult birds held in outdoor aviaries. In the aviaries, high-dose glucocorticoid treatment increased both birds' parasite load and the cost of infection. Interestingly, the effects of treatment depended on co-infection status. Glucocorticoids might influence the response to infection by activating tissue repair or altering the strength of the inflammatory immune response. Our results suggest a potentially adaptive role for glucocorticoids in mediating the response to infection that could vary depending on the extent of the change in circulating glucocorticoid concentrations.

Life histories and invasions: accelerated laying rate and incubation time in an invasive lizard, *Anolis sagrei*

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During biological invasions, non-native invaders often experience environments that differ substantially from those found in their native range; these novel conditions can impose strong directional selection and lead to rapid phenotypic divergence between native and invasive populations. The brown anole (*Anolis sagrei*) is a small lizard native to Cuba and the Bahamas that has invaded the southeastern United States over the past century. Native and invasive populations experience different climatic variables with more northern invasive populations experiencing lower mean annual temperatures and shorter breeding season lengths than more southern native populations. Because invasion success hinges on the ability of a population to survive and expand, we hypothesized that invasive populations whose reproduction is limited by a shorter breeding season would experience strong selective pressure to decrease egg incubation time and the spacing between egg lays. We collected brown anoles from a native island population in the Bahamas and from 3 populations in the southeastern United States ranging from southern Florida to Georgia. We found that eggs from invasive populations hatched significantly faster than those from native populations, and that females from invasive populations had shorter intervals between egg lays than did females from native populations. Our results indicate that life-history traits have rapidly diverged during the brown anole invasion, potentially facilitating the species' successful establishment and expansion.

How are we doing? Estimating lemur abundance in northern Madagascar

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Primate populations face a myriad of threats related to climate and land use change, making long-term population monitoring critical to prioritizing conservation efforts. Ground-based line transects are typically conducted to estimate and monitor primate populations, unfortunately, this method may be inaccurate, costly, and logistically challenging. We sought to test whether unmanned aerial vehicles (UAV) could effectively monitor primate populations in a poorly studied region of northern Madagascar compared to traditional walking surveys.

Critically endangered golden-crowned sifakas and endangered crowned lemurs were found in all five of the surveyed forest fragments during walking surveys. Preliminary estimates suggest

a 36% sifaka population decline from ~18,000 individuals in 2006/2008 to a current estimate of ~11,500 individuals (95% CI: 7,128-18,682). Crowned lemur densities are low (~15 individuals/km2) compared to other sites (29.81 individuals/km2) and abundance in the region is ~7,000 individuals (95% CI: 3,287-13,539). Evidence of lemur poaching was detected along several transects and active poaching was encountered in one forest fragments.

Sifakas generally did not exhibit a negative behavioral response to the UAV. However, it was difficult to detect lemurs from drone-captured imagery due to persistent leaf cover and a reduced overhead profile. Additionally, technical issues with the drone limited our ability to perform a complete cost-benefit analysis between walking and aerial transects and to collect new imagery for monitoring land cover change. Based on these field trials, we identified several improvements for future UAV primate surveys (e.g., FLIR camera, autopilot software) and for continued global change research in the region.

How to deal with a mixed up group: unraveling the species of the millipede genus *Pseudopolydesmus* (Polydesmida: Polydesmidae)

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Millipedes are a large, diverse class of terrestrial arthropods found on all continents except for Antarctica. In North America, about 1,000 species are known from habitats ranging from deserts to forests. Despite their ubiquity in terrestrial habitats, the group remains poorly known, even among the common genera. The genus *Pseudopolydesmus* is ubiquitous in eastern North America, but its 12 species are poorly diagnosed and the genus is in need of revision using both morphological and molecular methods. Field work over the past year has resulted in fresh collections of *Pseudopolydesmus* specimens from across the eastern United States, focused particularly in the Appalachian Mountains. This field work, combined with the inspection of *Pseudopolydesmus* holdings from the Virginia Museum of Natural History and the North Carolina Museum of Natural Sciences, turned up three new species hypotheses and more detailed geographic distributions for *Pseudopolydesmus* species. Newly collected specimens form the basis for the first molecular investigation of intraspecific relationships within the genus, with preliminary results showing the species falling into two groups.

Platform Session 2

1:15 PM – 2:30 PM

Session Chair: Derek Hennen

An update on EAB Biocontrol in Virginia

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Since fall 2015, a total of 6 field sites in VA and NC were found where the EAB infestation is recently discovered, infested trees are suffering from less than 50% canopy dieback, and the trees are accessible and abundant. Sites include two private landowners in Blacksburg, VA & Natural Bridge Station, VA; two State Parks, Leesylvania State Park in Woodbridge, VA & Douthat State Park in Millboro, VA; one County Park, Mid-County Park in Christiansburg, VA; and Cherry Research Farm in Goldsboro, NC. EAB infestations varied from newly discovered to established for multiple years. In spring of 2016, 10,000 *Tetrastichus planipennisi* and 200 *Spathius agrili* were requested from USDA APHIS, Dr. Jian Duan provided 500 *S. galinae*. Each site was to receive 2000 adult female *T. planipennisi*, with a minimum of 500 adults per release. Due to field site characteristics, New River Junction in Blacksburg, VA received 1000 adults and Douthat State Park in Millboro, VA received 3000 adults. All other sites received approximately 2000 *T. planipennisi*. Yellow pan trap & larval sentinel log monitoring was set up at each site. So far *T. planipennisi* has been recovered only at Leesylvania State Park. Interspecies competition experiments were set up between *S. agrili* & *S. galinae* to determine the impact of competition. Due to high EAB larval mortality, the majority of trials were lost. Moving forward we have adjusted our sanitary procedures to prevent this from happening in the future. Emergence synchrony experiments are planned for *S. agril*, *S. galinae*.

Effects of coal mining on freshwater salinization and aquatic insect diversity

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Human activities like agriculture resource extraction can increase the dissolved inorganic ion concentration (i.e., salinity) in waterbodies, creating toxic conditions for life adapted to dilute

freshwater. This salinization of freshwaters is a global threat to aquatic biodiversity. In the USA, mountaintop coal mining contributes to salinization of headwater streams in the Appalachian region, a biodiversity hotspot. Salinization has been linked to widespread declines in diversity of aquatic insects, an important group that comprises much of the biomass in headwater streams and performs critical ecosystem functions. To mitigate such biotic impacts, a thorough understanding is needed of the nature of stream salinization as well as how the insect community responds to increased salinity. Toward that end, we measured the salinity surrogate electrical conductivity continuously for four years in 25 minimally-disturbed headwater streams across a gradient of salinity in the Appalachian coalfields of Virginia and West Virginia. In addition, we surveyed the aquatic insect community multiple times over the same period. We found that salinity followed a predictable annual cycle, exhibiting a minimum in spring and maximum in autumn, deviating up to ± 20% from annual mean salinity. We also observed seasonal differences in overall insect community composition, as well as declines in insect diversity and abundance in streams with increased salinity. Finally, we identified salt concentrations likely to cause diversity reductions. Our salinity models, combined with information about insect community responses to salt, can aid management of salinization to achieve aquatic biodiversity goals.

Relative importance of suspended, dissolved, and bedded sediment form on macroinvertebrate community health in Virginia streams

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Human manipulation of the landscape through agriculture, urbanization, and resource extraction has led to substantial increases in sediment loadings to freshwater streams and rivers. Excess sediment is a primary cause of aquatic life impairments nation-wide. Current management practices involve reducing landscape loadings in impaired watersheds to levels consistent with those of paired reference watersheds. This approach does not consider the multiple physical forms sediment takes upon reaching the stream channel (e.g., dissolved, suspended, and bedded states), or the variety of impacts different sediment forms have on aquatic life. Determining the relative importance of the physical forms of sediment on biological response is a necessary first step toward identifying useful management endpoints and improving predictions of the potential effectiveness of restoration efforts. We assessed ten years of Virginia Department of Environmental Quality habitat and macroinvertebrate community monitoring data spanning five bioregions to evaluate the relative influence of 9 sediment metrics on stream health as measured by the Virginia Stream Condition Index (VSCI), a macroinvertebrate community biometric. Metrics reflecting the stream bed had more

influence on the VSCI than did suspended or dissolved sediment metrics. Mean reach embeddedness had the most influence on overall stream condition (VSCI) and other commonly used pollution-sensitive metrics. We are currently developing a sensitivity threshold for embeddedness based on extirpation rates of invertebrate families. Thresholds of response may play a key role in water quality management actions including stressor identification, setting of restoration goals (e.g., total maximum daily load development), and monitoring of restoration effectiveness.

Storms can both stimulate *and* inhibit phytoplankton communities: lessons from a whole-ecosystem lake mixing experiment

Authors: **Mary E. Lofton 1,** Ryan P. McClure 1, Shengyang Chen2, Charlotte W. Harrel 1, Jonathan P. Doubek 1, Nicole K. Ward 1, Madeline E. Schreiber 3, John C. Little 4, Cayelan C. Carey 1

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In lakes and reservoirs worldwide, increased nutrient concentrations have led to an increase in harmful phytoplankton blooms. Blooms can cause hypoxia in the bottom waters of lakes and reservoirs, alter freshwater food webs, and impair drinking water quality. Some evidence suggests that phytoplankton may increase under future climate conditions, but this is largely based on predictions of warmer temperatures, which favor bloom-forming cyanobacteria. The responses of phytoplankton to other climate factors are less clear. Specifically, many regions are expected to experience future increases in storm intensity, which may alter phytoplankton community structure and bloom frequency through increased water column turbulence. To improve understanding of phytoplankton community responses to storms, we used an engineered epilimnetic mixing system to conduct two whole-ecosystem storm simulation experiments in a small drinking water reservoir in summer 2016. We monitored phytoplankton community dynamics throughout the water column with high-frequency fluorescence profiles and compared these data to phytoplankton concentrations in a non-manipulated reference reservoir. Our results suggest that the intensity and duration of storm events can alter phytoplankton community response to mixing. Specifically, we observed that short (<6 hours), intense mixing events stimulated phytoplankton, including cyanobacteria, potentially by entraining nutrients from below the thermocline into the surface waters. In contrast, less intense mixing events of longer duration (>20 hours) had a negative effect on green algae, but did not affect other taxa. Our work indicates that storms may stimulate *and* inhibit

phytoplankton, and underlines the importance of considering whole-ecosystem dynamics when predicting global change effects on phytoplankton.

Multi-level impacts of coal mining on stream fishes in the Clinch River and Powell River watersheds of Virginia

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Mining coal has altered water quality and stream habitats in Appalachian headwater streams beyond tolerances of aquatic communities; however, regulators struggle to agree on water quality standards for coalfields streams proposed by the U.S. Environmental Protection Agency based on macroinvertebrate sensitivities. Our multidisciplinary research evaluates fish responses at community-, population-, and individual-levels to mining stressors to advance conversations about such standards. Water quality, physical habitat, and fish samples were collected at 83 2nd– to 4th-order streams representing a mining-intensity gradient in the Clinch River and Powell River watersheds based on mining extents within watersheds; conductivity and several major ion concentrations from our surveys were positively related to the gradient. We expected occurrence (e.g. species and trait) and physiology (e.g. enzyme activity) responses along these gradients, especially conductivity. We modeled occurrence with boosted regression trees, using mining intensity, watershed characteristics, instream habitat, geomorphology, water quality, and spatial structure among sites as predictors. *Etheostoma flabellare* and insectivore occurrence responded negatively at approximately 330 µS/cm, aligning with proposed regulations. *Campostoma anomalum* occurrence also responded to conductivity, albeit in positively. We also identified suppression of glutathione reductase activity in *E. flabellare* associated with high mining intensity likely related to energetic limitations. *Rhinichthys obtusus* occurrence was not affected by mining intensity but activity of the selenium-dependent enzyme glutathione peroxidase was positively related to mining intensity. Our results may reflect the indirect stress of food resource (i.e., macroinvertebrates) limitation in mining-impacted streams playing a role in trait-specific fish extirpations, confirming the relevance of a macroinvertebrate based standard.