

Seventeenth Annual  
Odum School of Ecology  
Graduate Student Symposium

*28-29 January, 2011*

*Ecology Auditorium  
Odum School of Ecology  
University of Georgia  
Athens*

*Brought to you by:*

*The Ecology Graduate Students*

*Symposium Coordinators: Peter Baas, Megan Machmuller*

*Administrative Support: Brian Perkins, Beth Gavrilles & Brenda Mattox*

*Program Committee: Tyler Kartzinel, Kyle McKay, & Andrew Mehring*

*Undergraduate Poster Committee: Carolyn Keogh & Charlie Braman*

*Judging Committee: Jessica Joyner & Rachel Katz*

*Audio-visual Committee: Jamie Winternitz, Carissa Ganong, Athena Anderson & session volunteers*

*Moderator Committee: Kimberly Kellett, Alexa Fritzsche, Alyssa Gehman & session volunteers*

*Food & Beverage Committee: Rebeca de Jesús-Crespo, Alexa Fritzsche & Stribling Stuber*

*Souvenir Committee: Katy Bridges, Kaitlin McLean, Fern Lehman & Jeremy Sullivan*

*Prospective Student Boarding Committee: William McDowell & Blair Prusha*

*Special thanks to all other students, faculty & staff who made this possible!*

# Schedule of Events

# Friday

- 8:00am      Coffee available in exhibit hall
- 8:30 - 8:35      Introduction by Megan Machmuller and Peter Baas, Symposium Coordinators
- 8:35 – 8:45      Welcome by Dr. John Gittleman, Dean, Odum School of Ecology
- SESSION I** – Introduction by Virginia Schutte, Session Moderator
- 8:45 - 9:00      “Hitting snooze on the molecular clock: seasonal inactivity of bats puts the evolution of rabies virus in slow motion” by Daniel Streicker
- 9:00 – 9:15      “Unraveling the mechanisms of the nitrogen cycle with respect to anthropogenic land-use changes in southern Appalachian riparian zones” by Peter Baas
- 9:15 – 9:30      “Use of remote sensing data and stream chemistry to predict groundwater/stream interaction in a Karst region: lower Flint River Basin, Georgia, USA” by Kathleen Rugel
- 9:30 – 9:45      “Assessing the trophic role of salamanders in stream ecosystems: seasonal, species-specific and individual variation” by Amy Trice
- 9:45 – 10:00      “The consequences of soil warming on carbon dynamics” by Megan Machmuller
- 10:00 – 10:15      **A.M. Coffee Break**
- SESSION II** – Introduction by Megan Machmuller, Session Moderator
- 10:15 – 10:30      “Demographics of *Acropora palmata*, a declining Florida Keys reef icon” by Meredith Meyers
- 10:30 – 10:45      “Predicting shrimp densities across a solute richness gradient with occupancy modeling in lowland Caribbean streams, Costa Rica” by Marcia Snyder
- 10:45 – 11:00      “Elevated dissolved organic carbon in sub-tropical blackwater rivers may be a result of anoxia rather than an explanation for it” by Andrew Mehring
- 11:00 – 11:15      “Host foraging behavior varies with the spatio-temporal abundance of lone star ticks (*Amblyomma americanum*)” by Alexa Fritzsche
- 11:15 – 11:30      “The influence of landscape heterogeneity and symbiotic mycorrhizal fungi on the distribution of a Neotropical epiphytic orchid and its genetic diversity” by Tyler Kartzinel
- 11:30 – 1:10      **Lunch (in exhibit hall—catered by Jason’s Deli)**

# Friday

# Schedule of Events

## SESSION III – Introduction by Peter Baas, Session Moderator

- 1:15 – 1:30 “Estimating parasite diversity using non-parametric methods” by Shan Huang
- 1:30 – 1:45 “Parasite dynamics in a naturally fluctuating rodent population” by Jamie Winternitz
- 1:45 – 2:00 “Human activities decrease the frequency of synergistic responses to nutrient enrichment” by Jake Allgeier
- 2:00 – 2:15 “Seasonal phenology of bumble bees near Athens” by Athena Anderson
- 2:15 – 2:30 “Assessing isolated wetlands in the Dougherty Plain, Georgia: linking past and present land use to current condition” by Stribling Stuber
- 2:30 – 2:45 “Shifts in macroinvertebrate functional feeding group biomass across an urban land use gradient in the Upper Oconee Watershed” by Jessica Sterling
- 2:45 – 3:00 **P. M. Coffee Break**

## SESSION IV – Introduction by Jamie Winternitz, Session Moderator

- 3:00 – 3:15 “Modeling the distribution and habitat preferences of the invasive Asian clam *Corbicula fluminea* in the southeastern United States” by William McDowell
- 3:15 – 3:30 “Direct and indirect costs of co-infection: linking GI parasite communities, host hematology, and immune function” by Sarah Budischak
- 3:30 – 3:45 “Use of occupancy modeling for rapid assessment of land-use effects on stream biota in the southern Appalachians” by John Frisch
- 3:45 – 4:00 “Known *Serratia marcescens* virulence genes as insights into the unknown mechanisms of white pox disease” by Jessica Joyner
- 4:00 – 4:15 “Using stable isotopes to investigate spatial and temporal variation in agricultural nutrient loading in the Conasauga River” by Christina Baker

## SESSION V – Undergraduate Poster Session

- 4:15 – 5:00 **Poster judging in exhibit hall**
- 5:00 **Refreshments in courtyard**

# Schedule of Events

# Saturday

8:00 am Coffee available in exhibit hall

**SESSION VI** – Introduction by Kyle McKay, Session Moderator

8:30 – 8:45 “Colonizing a new world: life history strategies of a tropical plant outside of the tropics”  
by Kimberly Kellett

8:45 – 9:00 “Evaluating the effectiveness of the rainforest alliance certification criteria to mitigate the  
impacts of coffee agriculture on streams” by Rebeca de Jesús-Crespo

9:00 – 9:15 “Nutrient biogeochemistry of N and P in past, present, and future southern Appalachian  
forests” by Kaitlin McLean

9:15 – 9:30 “Effects of the removal of invasive Chinese privet on earthworm species densities”  
by Joshua Lobe

9:30 – 9:45 “Cross-boundary ecosystem effects: a mechanism for dilution in vector communities”  
by Sarah Bowden

9:45 – 10:00 “Using the PHA test as a measure of immunosuppression in wild amphibian populations”  
by Kristy Segal

10:00 – 10:15 **A.M. Coffee Break**

**SESSION VII** – Introduction by Shafkat Khan, Session Moderator

10:15 – 10:30 “In situ measurement of tree root architecture” by Kyle McKay

10:30 – 10:45 “Variability as an initial filter for the selection of fish IBI metrics for a sandhills stream  
assessment program” by Blair Prusha

10:45 – 11:00 “The coweeta ‘hazard’ site project: a long-term study of stream ecosystems and how they  
change in response to different land use trajectories in the southern Appalachians”  
by Jeremy Sullivan

11:00 – 11:15 “Larval mosquito distribution and development in isolated wetlands in the Dougherty Plain of  
southwestern Georgia” by Gina Botello

11:15 – 11:30 “Foliar insect herbivory in response to climate change: feeding trials with *Cissusa spadix* on  
*Quercus alba*” by Fern Lehman

11:30 – 12:40 **Lunch (on your own – transportation provided)**

# Saturday

# Schedule of Events

## SESSION VIII – Introduction by Kimberly Kellett, Session Moderator

- 12:45 – 1:00 “Survival and growth of tropical tree seedlings to simulated changes in climate along an elevation gradient” by Shafkat Kahn
- 1:00 – 1:15 “Physiogeographic links in the mycorrhizal host specialization of a rare orchid, *Cypripedium acaule*” by William Bunch
- 1:15 – 1:30 “Assessing the economic value of water: a contingent valuation approach in tropical mountains in Costa Rica” by David Cotacachi
- 1:30 – 1:45 “Leaching and bioavailability of dissolved organic carbon among freshwater autotrophic macrophytes” by Stephen Shivers
- 1:45 – 2:00 “Structure of an algal-based food web in a Neotropical stream before and after amphibian extirpation” by Thomas Barnum
- 2:00 – 2:15 **P.M. Coffee Break**

## SESSION IX– Introduction by Alyssa Gehman, Session Moderator

- 2:15 – 2:30 “Do invasive populations released from parasites benefit from reduced investment in immunity?” by Carolyn Keogh
- 2:30 – 2:45 “Effects of elevated soil temperatures on mycorrhiza in a temperate forest ecosystem” by Kathleen Bridges
- 2:45 – 3:00 “Patterns of seasonal acidification and effects on tropical stream macroinvertebrates” by Carissa Ganong
- 3:00 – 3:15 “Where does terrestrial carbon go in aquatic ecosystems? Predicted variation in microbial and invertebrate contributions to litter breakdown rates due to nutrient and lignin content” by David Manning
- 3:15 – 3:30 “Sight or scent?: sensory reliance in foraging lemurs with varied diets” by Julie Rushmore
- 3:30 – 3:45 **P.M. Coffee Break**
- 3:45 – 4:00 **Plenary speaker introduction by Thomas R. Jordan, Department of Geography**
- 4:00 – 5:00 “Visualizing Earth with a Landscape Ecologist's Lens”  
Dr. Ned Gardiner, National Oceanic and Atmospheric Administration (NOAA)
- 5:00 – 7:00 **Reception in the exhibit hall (Dinner catered by Dondero’s Kitchen)**

# Plenary Speaker

## VISUALIZING EARTH WITH A LANDSCAPE ECOLOGIST'S LENS

Dr. Ned Gardiner, National Oceanic and Atmospheric Administration (NOAA)

Ph.D. 2002, Institute of Ecology, University of Georgia



Photo: Ned Gardiner “at work” with some of his collaborators on the Congo River Project

Source: <http://www.smithsonianmag.com/multimedia/photos/?c=y&articleID=68887342&page=4>

This year’s speaker took his research on small streams of western North Carolina to the mighty Congo River, where he used remote sensing, GIS, and sonar surveys to quantify hydraulic barriers to dispersal among cichlids which are rapidly evolving in the river's "species pump" formed by torrential rapids and expansive plunge pools. He has spent the bulk of his career explaining conservation biology, ecosystem processes, and Earth system science to non-scientists through data visualization. His efforts use high definition video, the web, and three-dimensional installations including spheres and domes. Dr. Gardiner has presented his work across the country, in London, and at the Copenhagen climate negotiations in 2009. Weaving together these research and communication efforts, the plenary will articulate a vision for how ecological principles are serving proactive efforts to build dialogues among decision-makers at all levels of society.

# Oral Presentations

## HUMAN ACTIVITIES DECREASE THE FREQUENCY OF SYNERGISTIC RESPONSES TO NUTRIENT ENRICHMENT

Jacob E. Allgeier<sup>1</sup>, Craig A. Layman<sup>2</sup>, Lauren Yeager<sup>2</sup> and Amy D. Rosemond<sup>1</sup>

<sup>1</sup>Odum School of Ecology, University of Georgia, Athens, GA

<sup>2</sup>Marine Sciences Department, Florida International University

Ecological synergies are of great interest because they hinder the accuracy of our predictive ability and are expected to increase in frequency as human impacts to the environment escalate. Of particular interest is the synergistic interaction that has been shown to occur when ecosystems are enriched by multiple simultaneous nutrients. Yet recent findings suggest that this type of synergistic interaction occur less frequently than other non-additive interactive effects (i.e. antagonisms). In fact, recent experimental evidence suggests that human activity may be decreasing the magnitude of these synergistic interactions. We applied the Interaction Effect Index (IEI) to 785 nutrient enrichment experiments that included enrichment by nitrogen (N), phosphorous (P) and N + P in conjunction, across all freshwater and marine ecosystem types. The IEI provides a continuous quantification of the non-additive response to dual nutrient enrichment. We tested the hypotheses that synergistic responses to nutrient enrichment occur more frequently under conditions of low ambient nutrients and that human activity, via nutrient enrichment of aquatic ecosystems, is decreasing the frequency and/or magnitude of these events. We found that synergistic responses decreased under conditions of relatively high ambient algal production and higher nutrient availability (both N and P). We further demonstrated that human activity is decreasing the magnitude of synergistic responses to nutrient enrichment. Our findings highlight the complex nature in which human impacts interact with their environment and demonstrate that previous conceptions of ecological synergies may be over simplistic. Our findings further underscore the utility of the IEI metric in characterizing ecosystem response to nutrient enrichment providing a useful tool to aid conservation and management strategies.

## SEASONAL PHENOLOGY OF BUMBLE BEES NEAR ATHENS

Athena Rayne Anderson

Odum School of Ecology, University of Georgia, Athens, GA

Bumble bees are widely distributed, occurring from the tropics to the polar regions in a variety of habitats. Within a region bumble bees visit a range of sites, from undisturbed primary habitats to highly modified areas such as inner-city gardens. While they are generalist pollinators, they also visit specialized floral resources, such as keeled legume flowers, that many other bees are unable or unwilling to pollinate. Despite their broad geographic, habitat, and floral resource requirements, bumble bee populations appear to be declining. This study investigated seasonal phenology of bumble bees near Athens, GA, USA. I recorded queen emergence times, appearance dates of workers and males, and plant species being visited. I had two primary hypotheses: (1) there would be significant species differences in queen emergence and caste phenology, and (2) bumble bees would preferentially visit the most abundant floral resources. Bumble bees were captured while foraging and identified to species and caste, from March- October. Bee captures began within 1 hour of sunrise and ended when at least four surveys had been conducted at each of three sites. Bees were collected during 10-minute surveys, separated by 20-minute intervals to minimize the effects of capture on foraging activity. Differences were found in general activity patterns, queen emergence dates, and caste phenology among four bumble bee species. Bees did not always visit the most abundant resources, indicating that differences in floral rewards might drive foraging activity.

# Oral Presentations

## UNRAVELING THE MECHANISMS OF THE NITROGEN CYCLE WITH RESPECT TO ANTHROPOGENIC LAND-USE CHANGES IN SOUTHERN APPALACHIAN RIPARIAN ZONES

Peter Baas and Jacqueline E. Mohan  
Odum School of Ecology, University of Georgia, Athens, GA

Increasing anthropogenic land-use in the Southern Appalachia Mountains is resulting in disturbance of the riparian zones which is affecting its ability to remove or retain nutrients before it reaches streams. In addition, the effect of this riparian disturbance can increase the emission of greenhouse gasses due to increased soil respiration and  $N_2O$  (300 times as potent as  $CO_2$ ). Due to the heterogeneity of nitrogen cycling processes, techniques need to be developed that can provide us with high resolution data to enable ecosystem level interpretation. Nitrogen cycling processes are mainly determined by redox potential (i.e. soil moisture) and available nitrogen/carbon. Using electromagnetic induction as a soil moisture indicator and near infrared reflectance for determining C/N ratios, I have developed maps showing potential "nitrogen cycling hotspots" and associated net process rates. Understanding the human effects on riparian zone functioning requires mechanistic assessments of nitrogen cycling processes. Proposed future research will focus on assessing the gross process rates of denitrification, dissimilatory nitrate reduction to ammonium (DNRA) and nitrification for enhanced mechanistic ecosystem understanding using  $^{15}N$  tracer based methods.

## USING STABLE ISOTOPES TO INVESTIGATE SPATIAL AND TEMPORAL VARIATION IN AGRICULTURAL NUTRIENT LOADING IN THE CONASAUGA RIVER

Christina Baker, Megan Hagler, Mary Freeman and Bud Freeman  
Odum School of Ecology, University of Georgia, Athens, GA

Anthropogenic nutrient loading in freshwaters can cause changes in food web dynamics and loss of biodiversity. Fish populations in the Conasauga River in Northwest Georgia have been declining over the past ten years resulting in a loss of diversity and abundance of fishes. Declines have been most drastic in downstream areas which are more impacted by agricultural practices. Stable isotopes have been used recently to determine sources of nutrient loading into freshwater ecosystems, and studies have found elevated  $\delta^{15}N$  in aquatic biota from watersheds that are dominated by urban and agricultural land use. In a preliminary study, we sampled *Campostoma oligolepis*, an algivorous minnow, at three sites along the Conasauga River. We found a significant difference in both  $\delta^{15}N$  and  $\delta^{13}C$  for the most downstream site ( $p < 0.0001$ ; Fig. 1). Values for  $\delta^{15}N$  were high for all three sample locations and were in the range of values found in other studies of primary consumers to indicate agricultural sources of nitrogen. Our objectives to further this study are: 1) to compare spatial patterns of  $\delta^{15}N$  and  $\delta^{13}C$  in biofilm, aquatic macrophytes and primary consumers with spatial patterns of fish and invertebrate communities 2) to identify which major tributaries contribute most to loading of agricultural sources of nitrogen using  $\delta^{15}N$  and 3) to use historical fish collections to look at temporal variation in  $\delta^{15}N$  and  $\delta^{13}C$ .

# Oral Presentations

## STRUCTURE OF AN ALGAL-BASED FOOD WEB IN A NEOTROPICAL STREAM BEFORE AND AFTER AMPHIBIAN EXTIRPATION

Thomas Barnum<sup>1</sup>, Catherine Pringle<sup>1</sup>, Susan Kilham<sup>2</sup>, Karen Lips<sup>3</sup>, Matt Whiles<sup>4</sup> and Therese Frauendorf<sup>4</sup>

<sup>1</sup>Odum School of Ecology, University of Georgia, Athens, GA

<sup>2</sup>Drexel University, Philadelphia, PA

<sup>3</sup>University of Maryland, Baltimore, MD

<sup>4</sup>Southern Illinois University, Carbondale, IL

The consequences of amphibian declines could be particularly dramatic in tropical streams where tadpoles are often abundant and are important in determining stream ecosystem function. Here we examine effects of tadpole extirpation on the topology of an algal-based food web characteristic of stream pools in a highland Panamanian stream. Topological food webs are composed of nodes representing taxa and links representing who-eats-who. Links in our food web were identified through gut content analysis of two grazing tadpole species (*Rana warszewitschii* and *Hyla colymba*) and the ten most abundant insect taxa. We used this information to develop topological webs that illustrated foodweb linkages for both pre- and post- extirpation conditions. We then estimated a connectance value for pre- and post extirpation foodwebs. The connectance value decreased from 0.084, pre-extirpation, to 0.050, post-extirpation. We attribute this decrease in connectance to the loss of linkages between tadpoles and other taxa in the community, including the loss of linkages to large-bodied diatom taxa (e.g., *Terpsinoe musica*). Furthermore, grazing insects do not consume larger-bodied diatoms and large-bodied diatom taxa increased in abundance following amphibian declines, suggesting that grazing insects are not functionally redundant to grazing tadpoles with respect to their top-down effects on algal communities.

## LARVAL MOSQUITO DISTRIBUTION AND DEVELOPMENT IN ISOLATED WETLANDS IN THE DOUGHERTY PLAIN OF SOUTHWESTERN GEORGIA

Gina Botello<sup>1,2</sup>, Alan Covich<sup>1</sup> and Stephen Golladay<sup>1,2</sup>

<sup>1</sup>Odum School of Ecology, University of Georgia, Athens, GA

<sup>2</sup>J.W. Jones Center of Ecological Research, Newton, GA

Isolated, depressional wetlands are characteristic landscape features found across the southeastern Coastal Plain of the U.S. Because of their lack of protection under the Clean Water Act, they are extensively drained and chronically disturbed by urbanization, forestry and agriculture practices. Isolated wetlands harbor mosquitoes that serve as disease vectors, although little observational data of mosquito assemblages are available from rural areas of the southeastern U.S. The expansion of mosquito-borne disease has increased the need to determine how altered wetland conditions influence mosquito ecology. This project will compare undisturbed, reference isolated wetlands to similar wetlands impacted by agriculture (a combination of row-crop, seasonal, and perennial pasture) in the Dougherty Plain of southwestern Georgia. The goal of this research is to examine to what extent water quality in agricultural and undisturbed wetlands differs and to determine their suitability as breeding habitat for larval mosquitoes. Initial fieldwork results indicate that agricultural wetlands have higher nutrients, pH levels, and suspended sediments, while reference wetlands have higher dissolved organic carbon concentrations. Abundance of mosquito larvae was greater in reference wetlands compared to agricultural wetlands for almost all species observed, suggesting distinct habitat preferences for these mosquito species. Further research will examine how land-use alters basal food resources (e.g. detritus, algae), and how these environmental changes influence the distribution and development of larval mosquitoes.

# Oral Presentations

## CROSS-BOUNDARY ECOSYSTEM EFFECTS: A MECHANISM FOR DILUTION IN VECTOR COMMUNITIES

Sarah Bowden and John Drake  
Odum School of Ecology, University of Georgia, Athens, GA

The importance of biodiversity at global, regional, and local scales to ecosystem health and functioning is becoming increasingly evident in the ecological and biological sciences. Specifically, in host-pathogen systems with frequency-dependent transmission, high (host) diversity is known to decrease pathogen transmission, a phenomenon known as the dilution effect. In present studies, the effects of biodiversity on disease systems are being explored primarily with respect to the host community. However, my previous research has shown that for an ecologically and epidemiologically important multi-host pathogen, West Nile Virus (WNV), it is vector distribution that best predicts human disease. It follows, then, that we should explore the effects of biodiversity on pathogen transmission in the vector community as well as in the host community. Moreover, a deeper understanding of the community ecology and transmission dynamics of WNV in mosquitoes will serve as a model for understanding the ecology of multi-host pathogens in general, since mosquitoes are the most abundant vector of arboviruses in the world and the lynchpin to unraveling the dynamics of such important zoonoses as dengue fever, malaria, and viral encephalitis. The objective of my dissertation research will be to test two hypotheses that aim to answer the following fundamental question: What determines vector community diversity? I hypothesize that a coupling of larval interactions and anthropogenic effects scales up to alter adult mosquito diversity enough to change disease transmission dynamics due to dilution effects in the vector community.

## EFFECTS OF ELEVATED SOIL TEMPERATURES ON MYCORRHIZA IN A TEMPERATE FOREST ECOSYSTEM

Kathleen M. Bridges, Jacqueline Mohan, Richard Shefferson and Paul Hendrix  
Odum School of Ecology, University of Georgia, Athens, GA

Mycorrhiza is a symbiotic relationship in which fungi reside on tree roots and acquire unavailable nutrients such as nitrogen and phosphorus in exchange for carbon from the tree host. As the climate continues to change, soils are expected to warm in conjunction with air temperatures. Warmer soils typically result in greater nitrogen availability. It was predicted that ectomycorrhizal fungal root colonization would decrease due to the increased nitrogen availability, but that arbuscular mycorrhizal fungal colonization would increase or remain unchanged for its ability to acquire phosphorus. The soils of a temperate forest, Barre Woods in Massachusetts, have been heated by buried electrical cables for the past eight years. Seedlings harvested from this site have been analyzed for 1) percent fungal colonization, 2) fungal species composition, 3) foliar percent  $^{15}\text{N}$  and 4) seedling height.

# Oral Presentations

## DIRECT AND INDIRECT COSTS OF CO-INFECTION: LINKING GI PARASITE COMMUNITIES, HOST HEMATOLOGY, AND IMMUNE FUNCTION

Sarah Budischak<sup>1</sup>, Anna Jolles<sup>2</sup> and Vanessa Ezenwa<sup>1</sup>

<sup>1</sup>Odum School of Ecology, University of Georgia, Athens, GA

<sup>2</sup>College of Veterinary Medicine, Oregon State University, Corvallis, OR

Most animals are concurrently infected with multiple parasites and interactions among these parasites may influence disease dynamics and host fitness. Consequences of co-infection may depend on the specific combination of parasite species present, but there is a paucity of data on the direct and indirect (e.g. immune-mediated) costs of co-infection. We examined the effects of gastrointestinal (GI) parasite community richness and species identity on host immune function and condition using hematology data from wild African buffalo (*Syncerus caffer*). After controlling for individual host traits, investment in immunity was associated with lower hemoglobin, hematocrit, and red blood cell (RBC) size. Increasing GI parasite richness was also correlated with decreasing hemoglobin, hematocrit and RBC size. In a subset of hosts where we identified GI nematodes to species, hemoglobin levels and RBC counts decreased as the relative abundance of blood-sucking nematode species increased. By contrast, the abundance of a non-blood sucking nematode species was associated with decreased hematocrit and RBC size. Together these results suggest that increasing parasite taxonomic richness can negatively impact host condition, and specific effects may depend on species identity.

## PHYSIOGEOGRAPHIC LINKS IN THE MYCORRHIZAL HOST SPECIALIZATION OF A RARE ORCHID, *CYPRIPEDIUM ACAULE*

William Bunch and Richard P. Shefferson

Odum School of Ecology, University of Georgia, Athens, GA

Mycorrhizae are a requirement for the germination of orchids in nature. Most conservation efforts have not taken the specialization of mycorrhizal hosts into account when designing management and restoration strategies for rare orchids. Without an adequate understanding of how gene flow, variability in selection, and the evolutionary consequences of interactions shape communities, the long-term consequences of protecting only select populations could lead to a strangling effect on rare and endangered populations. We are conducting this project with two main goals: 1) analyze the physiogeographic dimensions of host specialization in *Cypripedium acaule* 2) determine patterns in mycorrhizal host specialization associated with soil ecotones. Sampling will be conducted across four different physiogeographic regions that cut across Georgia, Tennessee, and North Carolina: Piedmont Province, Blue Ridge Province, Valley Ridge Province and Interior Low Plateaus. Mycorrhizal hosts of these plants will be identified from root samples using DNA analysis of key fungal barcoding genes. I will take soil samples at the site of each population in order to test for base cation concentration, pH, nitrogen content and soil microorganisms. I will then run a variety of statistical and phylogenetic tests to determine the trends in mycorrhizal specificity across geography and habitat. This will give insight into how orchid-host interactions are maintained across large geographic ranges as opposed to within select, local populations.

# Oral Presentations

## **ASSESSING THE ECONOMIC VALUE OF WATER: A CONTINGENT VALUATION APPROACH IN TROPICAL MOUNTAINS IN COSTA RICA**

David Cotacachi  
Odum School of Ecology, University of Georgia, Athens, GA

In Costa Rica, to stop land-cover change and enhance conservation, the government has established innovative programs such as the Payment for Environmental Services (PES). The application of this instrument has resulted in a reduction of land-cover change rates; however, to achieve specific goals, such as protecting forest's hydrologic services, policy and decision making need to be based upon economic assessments that are accurate and realistic as possible. I measured the economic value of forest's hydrologic services in Turrialba and Guácimo using the contingent valuation method. The survey elicited the willingness to pay (WTP) of diverse water consumers to finance a conservation program. Results indicate that the mean WTP is US\$ 19.87 to the logit model, and US\$ 11.23 to the linear model. This information provide value estimates about the benefits of conservation of forest's hydrologic services within an uncertain scenario where the only well known factor is that a conservation policy is required to stop the loss of environmental services. In developing countries, water plays a more important role in the development of rural communities than any other environmental service; therefore, policies and conservation programs need to be coherent with the local context. In particular, developing markets for hydrologic services can constitute an opportunity for water conservation if the program is economically feasible, but it could also result in a negative social return.

## **EVALUATING THE EFFECTIVENESS OF THE RAINFOREST ALLIANCE CERTIFICATION CRITERIA TO MITIGATE THE IMPACTS OF COFFEE AGRICULTURE ON STREAMS**

Rebeca de Jesús-Crespo and Catherine Pringle  
Odum School of Ecology, University of Georgia, Athens, GA

Environmental problems related to coffee farming include stream pollution by agrochemicals and sediment transport due to erosion. Moreover, studies have shown that streams draining coffee farms contain macroinvertebrates that reflect poor biological integrity. In this collaborative study between the University of Georgia and the Rainforest Alliance (RA), I will evaluate the approaches followed by RA to mitigate the impacts of coffee agriculture on stream bio-integrity. These management practices include conservation of riparian buffer zones and reforestation of coffee farms with shade trees. To determine the effectiveness of these practices, four stream types will be assessed: (1) streams draining coffee farms with buffer zones and shade trees (i.e. RA certified); (2) streams draining coffee farms without shade trees but with buffer zones; 3) streams draining unmanaged coffee farms (no buffers or shade); and 4) reference streams draining forest. Streams within each of these categories will be assessed for habitat quality, water physicochemistry and macroinvertebrates. Since buffer effectiveness decreases on steep gradients, and steep terrain is a characteristic feature of coffee plantations, we hypothesize that riparian buffers will not be a good predictor of water quality or macroinvertebrate assemblage. On the other hand, since shade trees have been shown to promote water infiltration and prevent nutrient leaching from coffee farms, we hypothesize that shade tree density will be positively related to stream integrity.

# Oral Presentations

## USE OF OCCUPANCY MODELING FOR RAPID ASSESSMENT OF LAND-USE EFFECTS ON STREAM BIOTA IN THE SOUTHERN APPALACHIANS

John Frisch<sup>1</sup>, Kristen Cecala<sup>2</sup>, Catherine Pringle<sup>1</sup> and John Maerz<sup>2</sup>

<sup>1</sup>Odum School of Ecology, University of Georgia, Athens, GA

<sup>2</sup>Warnell School of Forestry, University of Georgia, Athens, GA

Here we investigate the effects of intensifying human land-use in the southern Appalachians on stream ecosystems. We used occupancy modeling to determine spatial distribution of four focal taxa [*Tallaperla* stoneflies, crayfish (*Cambarus bartonii*), snails (*Elimia proxima*), and sculpin (*Cottus bairdi*)] that are important in stream ecosystem function and rapidly identifiable. During summer 2009 we assessed 37 streams draining catchments (18-1670 ha) with varied land-use, quantified by percent forest, residential, and agriculture. In each stream we sampled 31 plots along 150 m transects for 3 consecutive days, using dip-netting and leaf-litter traps containing streamside leaf-litter. We used occupancy modeling to simultaneously estimate occupancy frequency and detection probability for all focal taxa. This allowed us to assess the relative importance of local and landscape variables in distribution of each taxon. We found that: (1) *Tallaperla* were less frequent as forest decreased; (2) crayfish were more frequent as rhododendron increased; (3) snails were more frequent as forest decreased; and (4) sculpin were more frequent as drainage area increased. Occupancy modeling allowed us to rapidly sample many streams to assess local and landscape effects on selected taxa. We will extrapolate our findings with GIS land-use data to predict the distribution of our focal taxa in the larger southern Appalachian region.

## HOST FORAGING BEHAVIOR VARIES WITH THE SPATIO-TEMPORAL ABUNDANCE OF LONE STAR TICKS (*AMBLIOMMA AMERICANUM*)

Alexa Fritzsche<sup>1</sup> and Brian Allan<sup>2</sup>

<sup>1</sup> Odum School of Ecology, University of Georgia, Athens, GA

<sup>2</sup>Department of Entomology, University of Illinois at Urbana-Champaign, Urbana, IL

Recently, the indirect effects of parasites on their hosts' foraging, space use, and other behaviors have been examined using a framework previously only applied in predator-prey ecology literature. A metric known as "giving up density" (GUD), or the amount of food abandoned by a forager in a risky habitat, has been used to gauge how a prey individual responds to the perceived threat of predation in its habitat. We sought to investigate such alterations in foraging and space use in the small mammal hosts of the tick ectoparasite *Amblyomma americanum* using GUD as an indicator of perceived risk of parasitism. At eight sites at the Tyson Research Center in Missouri, we placed two feeding trays: one on the ground, and one at two meters height in a tree, in order to assess how the emergence of ground-dwelling ticks in early July affected foraging on a small spatial scale. Though we did not find that GUD differed between the ground and tree feeders, we did find that among the eight sites, those with higher abundances of ticks had significantly lower feeding by hosts overall. Our findings suggest that hosts may recognize the threat of parasitism and alter their space use, a result which holds significance for tick-borne disease management.

# Oral Presentations

## PATTERNS OF SEASONAL ACIDIFICATION AND EFFECTS ON TROPICAL STREAM MACROINVERTEBRATES

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Anthropogenic damage to aquatic ecosystems often includes acidification, such as acid rain; however, our knowledge of the effects of the anthropogenic threat of climate change on the pH of aquatic ecosystems is limited, and much research in this field has focused on acidification of oceans rather than freshwater systems. Results from our longterm project in lowland Costa Rica indicate that small, poorly-buffered Neotropical streams are vulnerable to decreases in pH due to climatic changes. These streams undergo natural seasonal acidification due to CO<sub>2</sub> influxes as the wet season begins, but climatic extremes (such as ENSO events) cause more severe pH decreases. Changes in precipitation regimes associated with climate change are predicted to exacerbate these acidifications, with potentially negative consequences for stream biota. The goals of this project are twofold. First, we propose to examine landscape-scale patterns of seasonal pH and DIC shifts in Neotropical rainforest streams. This will allow us to determine – and eventually predict – which areas are most vulnerable to acidification. Second, we plan to determine the effects of acidification on growth and survival of insect taxa from a naturally buffered stream and an unbuffered stream to test (1) whether macroinvertebrates are affected by acidification, and (2) whether populations from unbuffered streams are better adapted to acidification than those from buffered streams. This research may provide valuable information on effects of climate change on Neotropical streams.

## ESTIMATING PARASITE DIVERSITY USING NON-PARAMETRIC METHODS

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It is now widely accepted that parasites can have a large influence on biodiversity from ecological, evolutionary and conservation perspectives. On the one hand, parasites can induce serious threats to biodiversity by lowering host fitness and decimating host species. On the other hand, parasites can contribute positively to biodiversity by maintaining host genetic diversity and potentially driving host diversification. It is also important to note that parasite diversity might have conservation value unto itself because parasites are considered to be part of biodiversity, with up to half or more species on earth being parasitic in nature. However, only recently have global-scale databases become available to facilitate investigations of complex interactions across large numbers of host and parasite species. Because it is not possible to have records of all parasite species from every host species (i.e, not all hosts have been sampled exhaustively for parasites), actual parasite species richness (PSR, the number of parasite species) can be estimated using a variety of mathematical models based on the observed PSR. Using carnivores and their parasites as a model system, this study explores the use of non-parametric methods in estimating actual PSR based on the observed richness and the relative abundance of parasite species. This is the first study to apply these methods in estimating wildlife parasite diversity at a broad spatial and taxonomic scale for records compiled from the primary literature. Our results suggest that the actual parasite diversity in carnivores is very likely to be significantly larger than current observed PSR.

# Oral Presentations

## KNOWN *SERRATIA MARCESCENS* VIRULENCE GENES AS INSIGHTS INTO THE UNKNOWN MECHANISMS OF WHITE POX DISEASE

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*Serratia marcescens* is common in the environment but sewage contamination has introduced it into the coastal marine ecosystem. This bacterium is pathogenic to many organisms, including humans and more recently coral. While its mode of pathogenesis is not yet known for corals, its virulence in a *C. elegans* model has been attributed to the expression of at least three key genes. The distribution and frequency of these genes among environmental *S. marcescens* strains has not previously been evaluated. We surveyed strains of *S. marcescens* for known virulence genes from marine and environmental sources in the Florida Keys, associated with outbreaks of white pox disease in elkhorn coral (*A. palmata*). Conventional PCR was used to screen isolates for homologues of *wzm* (LPS biosynthesis), *vibC* (iron transport) and *shfB* (hemolysin). Analyses to date indicate that these genes are not universally present among environmental strains. Ongoing work will discern differences in virulence gene prevalence between known pathogenic and non-pathogenic strains of *S. marcescens* against *A. palmata* and will provide needed basic information about possible mechanism(s) of interaction among this pathogen-coral host system.

## THE INFLUENCE OF LANDSCAPE HETEROGENEITY AND SYMBIOTIC MYCORRHIZAL FUNGI ON THE DISTRIBUTION OF A NEOTROPICAL EPIPHYTIC ORCHID AND ITS GENETIC DIVERSITY

Tyler Kartzinel<sup>1</sup>, Richard Shefferson<sup>1</sup>, Charles Cowden<sup>1</sup>, James Hamrick<sup>2</sup> and Dorset Trapnell<sup>2</sup>

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Deforestation both degrades habitat and isolates habitat patches, substantially increasing the risk of local extinctions—particularly for the diverse communities of epiphytic plants that live in tropical forest canopies. A plant species' persistence in a fragmented landscape depends on its ability to disperse seeds and on the probability that its seeds encounter suitable recruitment sites. However, factors affecting the suitability and distribution of plant recruitment sites are poorly understood. There is growing awareness that symbiotic mycorrhizal fungi influence plant persistence by altering habitat quality and the availability of seedling recruitment sites. Epiphytic orchids have tiny wind-dispersed seeds that can travel long distances in disturbed areas, form discrete populations in tree canopies, and have an obligate symbiotic relationship with mycorrhizal fungi. Thus, conservation of epiphytic orchids in deforested regions is inextricably linked to the quality and continuity of habitat—possibly responding more sensitively to the local fungal biodiversity than the spatial continuity of forest. We are using genetic tools to understand seed dispersal and characterize mycorrhizal communities at multiple spatial scales. Seed pack experiments will be used to gain insight into differences in site suitability for seedling establishment and to assess any differences in mycorrhizal communities that occur among them.

# Oral Presentations

## COLONIZING A NEW WORLD: LIFE HISTORY STRATEGIES OF A TROPICAL PLANT OUTSIDE OF THE TROPICS

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Study of life history strategies of species in new environments plays a critical role in understanding how range shifts caused by climate change affect species as well as predicting the spread of invasive species. Different environments exert diverse selection pressures on organisms. When spreading to new environments, species respond to different pressures by changing aspects of their life histories (i.e. reproduction and survival) via adaptation or plastic response. Species are predicted to allocate more resources toward reproduction when colonizing non-native environments, but how differences in environmental pressures may affect this pattern remains largely unknown. My proposed research uses populations of the widespread tropical milkweed, *Asclepias curassavica*, in its native and exotic ranges to examine differences in reproductive strategies and resource allocation varies and how environmental pressures impact these differences. I will monitor natural populations in Costa Rica and northern Florida over several years and use life tables to examine how basic patterns of life history vary between its native environment and the edge of its exotic range. I will also use a cohort and common garden experiment to look at the specific effects of seasonal changes in climate and differences in herbivory pressures. This research will help us better understand the success of invasive species as well as the effects of range-shifts caused by climate change.

## DO INVASIVE POPULATIONS RELEASED FROM PARASITES BENEFIT FROM REDUCED INVESTMENT IN IMMUNITY?

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Patterns of parasite release experienced by invasive populations of marine invertebrates are well documented in the scientific literature, but the actual fitness consequences of macroparasite release have not been explored. A potential mechanism of fitness benefit for invasive populations experiencing parasite release is relaxation of selection for investment in costly immune defenses. The objectives of the proposed research are: 1) to quantify the macroparasite pressure experienced by invasive and native populations of the European green crab *Carinus maenas*, 2) to quantify investment in immune function by crabs experiencing different levels of parasite pressure, and 3) to investigate putative trade-offs with quantitative fitness parameters such as growth rate, and number and quality of eggs produced. Invasive and native populations will be selected to be as similar as possible in baseline parasite community richness and with well known historical infection prevalence and invasion histories. In addition to observational studies of parasite pressure and host infection rate in natural populations, a laboratory based common garden experiment is proposed to determine changes in immune investment and infection rates between native and invasive individuals when exposed to native parasites. Results of this research will improve our understanding of mechanisms behind invasive species success, and their long term susceptibility to native parasites from whom they may no longer be well defended.

# Oral Presentations

## **SURVIVAL AND GROWTH OF TROPICAL TREE SEEDLINGS TO SIMULATED CHANGES IN CLIMATE ALONG AN ELEVATION GRADIENT**

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Tropical landscapes are critical for global climate as they are a significant carbon sink globally. Tropical landscapes, especially secondary landscapes, also exhibit exceptional carbon sequestration potentials. How tropical landscapes will respond to climate change, specifically how the carbon storage and sequestration capacities of these landscapes, will depend on how juvenile tropical tree seedlings will respond to changes in climatic variables such as precipitation, temperature and cloud cover. Changes in these climatic variables are also critical for composition of plant communities, especially in montane and cloud forests. To examine the effect of changes in climate on tropical tree species, we are conducting a down-slope common garden transplant experiment with higher elevation species and species with a wide elevation range along an elevation gradient (600-1400 m, 4-5° C differential) in southwestern Costa Rica. We are examining the survival and growth of higher elevation tree seedlings in the warmer climates of lower elevations. We are also examining the survival and growth of tree species common along the elevation gradient transplanted in different elevations to see if individuals from different elevations respond differently to changes in climate. I will present growth and survival data of the experimental seedlings during the second year of the experiment.

## **FOLIAR INSECT HERBIVORY IN RESPONSE TO CLIMATE CHANGE: FEEDING TRIALS WITH *CISSUSA SPADIX* ON *QUERCUS ALBA***

Fern Lehman<sup>1</sup>, Jacqueline Mohan<sup>1</sup>, Kamal Gandhi<sup>2</sup> and Bob Cooper<sup>2</sup>  
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Plant foliar responses to climate change can have a direct effect on foliar insect herbivory. Foliar herbivory can increase when elevated soil temperatures enhance plant available N and leaf N. A large-scale experiment at Duke Forest is already measuring tree physiological and biochemical responses to elevated air and soil temperatures. No-choice feeding trials were used to assess foliar herbivory on *Quercus alba* leaves collected from the Duke Forest warming experiment. *Cissusa spadix* (Lepidopterae) were collected from the State Botanical Gardens (Athens, GA) and fed *Q. alba* leaves from seedlings grown under ambient, +3C, and +5C temperatures (N=3). Leaf total N was quantified to determine the effects of warming on leaf chemistry. I will present the recently analyzed data from this experiment.

## **EFFECTS OF THE REMOVAL OF INVASIVE CHINESE PRIVET ON EARTHWORM SPECIES DENSITIES**

Joshua Lobe<sup>1</sup>, Paul Hendrix<sup>1</sup> and Mac Callaham Jr.<sup>2</sup>  
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Floodplain ecosystems of the southeast have been altered drastically by the non-native invasive plant, chinese privet (*Ligustrum sinense*). Floodplains infested with privet have very low plant diversity and are generally less aesthetically pleasing than floodplains without privet. Extensive removal of privet in certain areas could improve both of these problems, although the ecological effects of removal are not well understood. A current study is in progress to gain a better understanding of belowground soil biota in privet infested floodplains and the effect that the removal of privet has on this biota. The study is being conducted at long-term experimental plots created by the Forest Service at locations around Athens. Seasonal sampling of earthworm populations in privet control sites and at sites where privet has been removed will show how privet removal affects earthworm species and distributions in southeastern floodplains.

# Oral Presentations

## THE CONSEQUENCES OF SOIL WARMING ON CARBON DYNAMICS

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Exchange of carbon dioxide from soils to the atmosphere is one of the largest fluxes in the global carbon cycle and is significantly higher than the release of carbon dioxide from anthropogenic activities. Warming trends associated with climate change have the potential to increase this flux, thus affecting the carbon storage capacity of the terrestrial biosphere. Ultimately this could lead to a positive feedback that would exacerbate projected future warming trends. Previous climate warming studies have all been conducted on nutrient rich soils with relatively abundant organic matter, and not on low-organic matter ancient clay Ultisol and Oxisol soils that typify much of the lower-latitude zones of the world (ie; southeastern U.S. Piedmont, subtropics and tropics). In this study I plan to investigate the biogeochemical responses to warming in a southern Piedmont region of Georgia (Whitehall Forest) and compare these results to other sites along a natural climate gradient using the same experimental warming design (Duke Forest, NC and Harvard Forest, MA). Thus far, we have observed differences in soil respiration. Initially, warming depletes soil organic carbon through microbial respiration. However, depending on environmental conditions and land use, this may be offset by physico-chemical reactions that facilitate stabilization reactions. We will continue to examine these parameters and the results of this experiment will improve our predictions for regions of the terrestrial biosphere that are responsible for a significant portion of global carbon and nitrogen cycling.

## WHERE DOES TERRESTRIAL CARBON GO IN AQUATIC ECOSYSTEMS? PREDICTED VARIATION IN MICROBIAL AND INVERTEBRATE CONTRIBUTIONS TO LITTER BREAKDOWN RATES DUE TO NUTRIENT AND LIGNIN CONTENT

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Models of carbon flux through aquatic ecosystems require quantification of factors that contribute to carbon processing rates. Biological contributions to breakdown rates are likely chemically-mediated, and may vary due to carbon quality of litter (e.g., lignin content) and available nutrients. Under control conditions, losses of carbon due to detritivores can be double loss rates due to microbial activity. Thus, fates of carbon by these pathways either support stream food webs or contribute to carbon loss via microbial respiration. We plan to assess the contribution of microbes versus invertebrates to litter breakdown in 5 streams at Coweeta Hydrologic Laboratory in Macon County, North Carolina, where invertebrates were either excluded or allowed to colonize 4 leaf types with varying lignin and initial nutrient composition. We predict that microbial breakdown of leaves will be pronounced when resource quality is high, with greater loss rates due to respiration of labile leaf litters, particularly in high nutrient environments. Conversely, more recalcitrant resources in low nutrient environments will have relatively greater loss rates to detritivores instead of microbial respiration. Quantification of microbial and detritivore losses of terrestrially-derived litter under a range of litter qualities and environmental conditions will aid in predicting effects of land use change on carbon transformations in aquatic ecosystems.

# Oral Presentations

## MODELING THE DISTRIBUTION AND HABITAT PREFERENCES OF THE INVASIVE ASIAN CLAM *CORBICULA FLUMINEA* IN THE SOUTHEASTERN UNITED STATES

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Data from the nationwide Environmental Monitoring and Assessment Program (EMAP) surveys conducted by the Environmental Protection Agency's (EPA) can be a valuable tool to examine distributions and habitat preferences of aquatic organisms across the United States. Using this dataset, we examined which factors contributed to the presence of *Corbicula*, as well as high *Corbicula* densities. On a nationwide scale, latitude and percent sand were the best predictors of both *Corbicula* presence and high densities. Analyses specific to the Southeastern United States are still in development.

## IN SITU MEASUREMENT OF TREE ROOT ARCHITECTURE

S. Kyle McKay<sup>1,2</sup>, J. Craig Fischenich<sup>2</sup> and Bobby McComas<sup>2</sup>  
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Although significant progress in analytical, methodological, and theoretical understanding of plant-environment interaction has been made, complete mechanistic understanding of plant root architecture and function is lacking. In large part this dearth of below-ground knowledge is driven by methodological challenges in measuring these complex biotic systems and their abiotic and biotic drivers in situ. Although a significant number of procedures exist for collecting root architectural data, these techniques have not been quantitatively compared or calibrated to the extent necessary to recommend technique selection for a particular need. Thus, this study sought to: 1) compare a variety of these techniques (ground-penetrating radar, electrical resistivity, electrical conductivity, and invasive removal and measurement) and 2) examine the accuracy of non-invasive techniques, including the potential for calibrating non-invasive methods with invasive approaches. We applied multiple techniques for measuring root system architecture under a variety of environmental conditions to assess the strengths, weaknesses, and limitations of the methods applied. Four sites were selected throughout the United States with an emphasis on diversity of environmental conditions (Mississippi, New Mexico, California, and Washington). In this presentation, the field data collection techniques will be compared both qualitatively and quantitatively to provide guidance for those interested in assessing tree root architecture.

## NUTRIENT BIOGEOCHEMISTRY OF N AND P IN PAST, PRESENT, AND FUTURE SOUTHERN APPALACHIAN FORESTS

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The natural elevation gradient at Coweeta Hydrologic Lab (Otto, NC) has undergone long-term measurements to infer relations between soil nutrient availabilities and forest composition and productivity. Current and future research along this natural gradient will be complementary to the past measurements to make predictions for future forests of the southern Appalachian Mountains. The natural gradient at Coweeta provides five different representative southern Appalachian forests. Soil biogeochemistry measurements in these forests have been done using soil cores. Foliar and precipitation nutrient cycling are being measured by mixed-bed resin column throughfall collectors. Plant available nutrients in soil solution are being measured by lysimeters. Traditionally there has been little work on phosphorous (P) in these gradient forests. To provide more insight on nutrient cycling, P fractionations have been done on archived soil. The current and past measurements from these representative southern Appalachian forests will be used to create a predictive nutrient model. Thus, current and past research combine will lead to a better understanding regarding potential impact of climate change, nutrient availability, and forest species composition on forest productivity and in future forests of the southern Appalachian Mountains.

# Oral Presentations

## ELEVATED DISSOLVED ORGANIC CARBON IN SUB-TROPICAL BLACKWATER RIVERS MAY BE A RESULT OF ANOXIA RATHER THAN AN EXPLANATION FOR IT

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Dissolved organic carbon (DOC) drives ecosystem metabolism and dissolved oxygen (DO) fluctuations in rivers. However, the process may also work in reverse in sub-tropical blackwater rivers, where low DO during periods of high temperature and low discharge may generate large carbon pulses. Here we present long-term data from the Little River Experimental Watershed, located in Georgia's Suwannee River basin. Weekly data from nested, gauged sub-watersheds from 2002-2009 show large pulses of DOC (increasing 375% from ~20 to ~75 mg/L over two weeks) during periods of low discharge (<2500 l/s) and DO (<1 mg/L). DO, PO<sub>3-4</sub>, Fe and Mn were the best predictors of DOC (among variables: Fe, Mn, discharge, DO, NH<sub>4</sub><sup>+</sup>, NO<sub>3</sub><sup>-</sup>, TKN, PO<sub>3-4</sub>, TP, and ORP) according to model selection results (Akiake's Information Criterion). Temperature and DO were negatively correlated ( $r^2 = 0.66$ ), suggesting that DOC concentrations may be a result of temperature effects on DO rather than an explanation for low DO. Several factors may enhance DOC release during periods of anoxia, including dissolving iron/PO<sub>3-4</sub>/ DOC co-precipitates, concentration through evaporation, and increased microbial DOC release under high temperatures.

## DEMOGRAPHICS OF *ACROPORA PALMATA*, A DECLINING FLORIDA KEYS REEF ICON

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After decades of significant declines of *Acropora palmata* (elkhorn coral) a demographic survey was initiated in 2008 at seven sites throughout the Florida Keys reef system to measure population parameters and identify primary sources of coral loss. Here we present the results after two years of annual fate tracking individual colonies at all seven sites. Of 268 colonies that were geo-referenced and photographed for subsequent identification in 2008, we were able to successfully relocate all individuals or in a few cases positively identify locations from which individuals were missing. Many colonies grew within our survey period, however 13% of colonies were lost. Sources of mortality included predation, disease, and physical damage (fragmentation). Likelihood of whole colony mortality decreased with colony size, although partial mortality occurred in all size classes. Sexual recruits were not observed among any of the survey populations, an observation corroborated by similar studies in the Upper Keys and Biscayne National Park. While signs of disease were absent in 2008, three sites had significant outbreaks of white pox disease in 2009 with prevalence reaching 44% at Looe Key, which was revisited monthly until signs of the outbreak were gone. These data are extremely valuable for reef management in the Florida Keys, particularly in mitigating further losses to the remnant populations of this iconic species.

# Oral Presentations

## VARIABILITY AS AN INITIAL FILTER FOR THE SELECTION OF FISH IBI METRICS FOR A SANDHILLS STREAM ASSESSMENT PROGRAM

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The reference condition for biological integrity (RC(BI)) as approximated at minimally disturbed conditions (MDC) is frequently used to develop indicators to measure stream integrity as defined by the Clean Water Act. Using this reference-site approach, MDC stream sites in the Sandhills ecoregion were selected based on GIS land cover characterization of watersheds in limited access federal installations in the southeast (NC, SC, GA). Fish community assessment was conducted in 2009 and 2010 using a two pass backpack electrofishing technique. Fish community structure and abundance data from MDC sites naturally possess inherent variability. Metrics used for stream assessment based on these data should be selected in such a way as to minimize this variability. Less variable indicators more consistently define the MDC condition and better measure deviations from this condition. The variability of 25 fish IBI metrics used by the states of NC and GA were estimated and the best potential indicators were selected for further consideration. Metrics defining species richness were predicted to be less variable in the streams sampled. Metrics defining abundance and dominance were predicted to be more variable. Metrics were also assessed for scientific rigor. Potentially useful indicators were selected for further consideration.

## USE OF REMOTE SENSING DATA AND STREAM CHEMISTRY TO PREDICT GROUNDWATER/STREAM INTERACTION IN A KARST REGION: LOWER FLINT RIVER BASIN, GEORGIA, USA

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Since the 1970s intensive removal of groundwater for agricultural irrigation has resulted in significant changes in multiple low flow metrics in the lower Flint River Basin of southwestern Georgia. Streams in this region are often incised through the overburden and heterogeneously connected with underlying limestone formations. The presence of multiple endangered and threatened species of unionids (mussels) in the lower Flint River Basin makes gathering hydrologic data on this system a federal, state, and regional management priority. We present results of preliminary studies which seek to identify locations of fracture flow between the Ichawaynochaway Creek, in Baker County, GA, and the Upper Floridan Aquifer. We compare multiple physiochemical parameters with remote sensing data sets in order to find landscape characteristics (creek bearing, creek turn, lineaments, and wetlands) which might predict connections between the surface water and groundwater system in this region. Increasing our understanding of the hydrologic complexities of the stream/aquifer system may aid in updating regional hydrologic models and developing policy to protect vulnerable aquatic biota in this region.

# Oral Presentations

## SIGHT OR SCENT?: SENSORY RELIANCE IN FORAGING LEMURS WITH VARIED DIETS

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Vision and olfaction provide information for foraging animals, yet we know little about how these cues inform food selection within or across species. We examined the reliance on visual versus olfactory cues during foraging in three lemur species with diverse feeding ecologies: folivorous Coquerel's sifakas (*Propithecus verreauxi coquereli*), frugivorous ruffed lemurs (*Varecia variegata* spp), and generalist ring-tailed lemurs (*Lemur catta*). Using foods for which different maturation/quality stages are marked by distinct visual and olfactory cues, we confirmed that lemurs prefer high- over low-quality foods. We then used a discrimination apparatus to conduct two experiments that examine sensory reliance. 1) We presented lemurs with different quality foods and held a cue constant; we conducted this experiment with vision held constant and again with olfaction held constant. Whereas generalists could identify high-quality food using either cue alone, frugivores required olfactory cues and folivores required both cues. 2) We presented lemurs with different cues (vision versus olfaction) but held the food quality constant. Whereas folivores and generalists relied significantly more on visual than olfactory cues, frugivores relied equally on both cues when selecting high-quality foods. Lastly, we observed foraging under semi-free-ranging conditions. Our results emphasize the importance of vision for foraging lemurs, and show that the relative reliance on the two senses varies with dietary differences among species.

## USING THE PHA TEST AS A MEASURE OF IMMUNOSUPPRESSION IN WILD AMPHIBIAN POPULATIONS

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In recent years amphibians have been declining worldwide. One of the hardest hit areas in terms of amphibian extinctions has been Central and South America. A challenge for studying declining amphibians is measuring the physiological immune response to devastating diseases. One technique that is now being utilized in ecology and could be useful to study declining amphibians is the phytohaemagglutinin (PHA) test. The PHA test was originally developed for *in vitro* testing in the laboratory setting, for immune response testing. It was first verified *in vivo* within domestic fowl for studies of pathology and physiology, and ornithologists quickly recognized the utility of the technique for wild populations, and began using the test in ecological studies. The test has now been shown to be useful in other taxa as well, and is used in embryology, physiology, sexual selection and disease studies, among others. I believe that the PHA test can be used as a measure of immunosuppression in wild amphibian populations to detect the effects of land use change. I would like to apply this technique to a study of *Bufo marinus*, a large native toad, and associated amphibian communities in the Rio Tempisque Basin, within the context of changing human land use.

# Oral Presentations

## LEACHING AND BIOAVAILABILITY OF DISSOLVED ORGANIC CARBON AMONG FRESHWATER AUTOTROPHIC MACROPHYTES

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The concentration and bioavailability of dissolved organic carbon (DOC) that is released after the death of aquatic vegetation can vary greatly among plant types. The response by microbial communities in terms of metabolism varies depending on the bioavailability of DOC. In order to evaluate these differences in microbial metabolism, a series of O<sub>2</sub> consumption experiments were conducted on leachates from four different primary producers (*Hydrilla*, *Typha*, *Potamogeton*, and *Lynqbya*); additionally, DOC and monosaccharide utilization were measured for each experiment. Nutrient concentrations in leachates varied significantly among sample types with *Hydrilla* having the highest NO<sub>3</sub>, PO<sub>4</sub>, and monosaccharide concentrations and *Typha* the highest DOC concentration. O<sub>2</sub> consumption also varied significantly among producer types with *Hydrilla* having the highest rates and *Potamogeton* the lowest rates. Therefore the origin of the leachates determined how quickly the microbial community utilized the leachate. The findings of this study help to explain the nutrient and carbon dynamics within aquatic ecosystems and some of the effects that different types of autotrophs have on nutrient cycling.

## PREDICTING SHRIMP DENSITIES ACROSS A SOLUTE RICHNESS GRADIENT WITH OCCUPANCY MODELING IN LOWLAND CARIBBEAN STREAMS, COSTA RICA

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Geothermally-modified springs, which feed into rivers draining the lowland foothills along the volcanic spine of Costa Rica, have created high spatial heterogeneity of stream solute levels (e.g. P, Cl, Na, Ca, Mg and SO<sub>4</sub>). High-solute reaches of streams could serve as refugia for freshwater shrimps because they are buffered from pH drops and have higher quality food resources. Using modified minnow traps we estimated shrimp occupancy at sites longitudinally within three streams with well-mapped solute gradients at La Selva Biological Station. We developed models to predict shrimp occupancy for three species (*Macrobrachium olfersi*, *M. heterochirus*, and *M. carcinus*) using conductivity, substrate, distance to the main stem river, and stream discharge as site-level covariates and turbidity as a sample-level covariate. Shrimp site occupancy varied from 0-80% present. Substrate, discharge and conductivity were the most important predictors of shrimp occupancy and these factors varied by species. Conductivity was an important factor in predicting shrimp occupancy for *M. carcinus* and *M. olfersi* indicating that solute levels were important in determining the distribution of these two taxa.

# Oral Presentations

## SHIFTS IN MACROINVERTEBRATE FUNCTIONAL FEEDING GROUP BIOMASS ACROSS AN URBAN LAND USE GRADIENT IN THE UPPER OCONEE WATERSHED

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Macroinvertebrate assemblages are used in bioassessment of stream ecosystems, largely based on species composition and the presence of taxa that are tolerant or sensitive to pollution. Stressed ecosystems are not only characterized by loss of sensitive taxa, but loss in overall macroinvertebrate biomass and production, which are important ecosystem functions. These losses likely occur through a reduction of critical levels of basal food production in streams (primary producers and detrital organic matter). In this study, we use previously described information on the mechanism of macroinvertebrate food acquisition (functional feeding groups) to infer shifts in resource availability and use across an urban land use gradient. Macroinvertebrates were collected in March 2008 in urban, suburban, transitional and forested watersheds in the upper Oconee River basin, Georgia, USA, identified to genus, measured and assigned to functional feeding groups. We predict a decrease in the total percentage biomass of filterers and scrapers due to high sediment loading and a reduction in edible algal taxa in watersheds with more urbanization. We also predict a decrease in the biomass of shredders due to increased loss rates of organic matter due to high levels of dissolved nutrients and flashy hydrology in the more urban watersheds. In addition to providing an understanding of taxa-level shifts in macroinvertebrate assemblages, functional feeding group biomass trends will provide insights into potential resource limitation in urban streams.

## HITTING SNOOZE ON THE MOLECULAR CLOCK: SEASONAL INACTIVITY OF BATS PUTS THE EVOLUTION OF RABIES VIRUS IN SLOW MOTION

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For RNA viruses such as HIV, Influenza, and SARS virus, generation of massive amounts of genetic diversity through mutation is a key mechanism for the evasion of host immune defenses, drug resistance and colonization of new host species. Although viral evolution is typically orders of magnitude faster than in other organisms, the drivers of substantial variation in evolutionary rates among RNA viruses remain poorly understood. Using a dataset of 654 rabies viruses collected from 31 bat species throughout the Americas over a 36-year time period, I undertake the first comparative study of the influence of variation in host life history strategies on the speed of viral evolution. Across 21 host species-associated lineages of rabies virus, I demonstrate that by forcing an annual freeze in transmission, seasonal inactivity of bats during overwintering is associated with rates of viral evolution that are more than 3 times slower in seasonally active bats relative to their non-seasonal counterparts. This variation in evolutionary rates suggests that the mechanisms of long-term rabies persistence differ fundamentally among bat species with different life history strategies. More generally, these results provide a salient example of how host ecology and behavior can have profound effects on viral epidemiology and evolution.

# Oral Presentations

## ASSESSING ISOLATED WETLANDS IN THE DOUGHERTY PLAIN, GEORGIA: LINKING PAST AND PRESENT LAND USE TO CURRENT CONDITION

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Geographically isolated limesink wetlands are particularly abundant throughout the Dougherty Plain, a karst region in southwest Georgia, USA, dominated by high-intensity agricultural fields and pine plantations. In agricultural landscapes, isolated wetlands are especially vulnerable to degradation. Our goal is to validate a previously developed assessment tool to gauge the ecological integrity of isolated wetlands in the Dougherty Plain. This preliminary assessment framework evaluates individual wetlands based on data obtained at three levels of sampling: 1) remotely, with landscape-scale analyses, 2) rapidly, with quick on-site appraisals, and 3) intensively, sampling water quality and macrophyte communities. To calibrate relationships between the condition assessments at each level, we will obtain an independent data set from 30 wetlands sampled across the Dougherty Plain by collecting data at each level. We will also use a chronosequence of aerial photographs to investigate patterns of land use change over the past 61 years to determine the role of historical land use on current wetland condition. Finally, we will investigate the utility of incorporating historical land use when planning and evaluating regional wetland restoration efforts.

## THE COWEETA "HAZARD" SITE PROJECT: A LONG-TERM STUDY OF STREAM ECOSYSTEMS AND HOW THEY CHANGE IN RESPONSE TO DIFFERENT LAND USE TRAJECTORIES IN THE SOUTHERN APPALACHIANS

Jeremy C Sullivan<sup>1</sup>, Edward P. Gardiner<sup>2</sup>, Ted L. Gragson<sup>3</sup>, Cathy M. Pringle<sup>1</sup>, Rebecca J. Bixby<sup>4</sup>, Mark C. Scott<sup>5</sup>, E. Fred Benfield<sup>6</sup>, Paul V. Bolstad<sup>7</sup>, David N. Wear<sup>8</sup>, John F. Chamblee<sup>3</sup>, Thomas R. Barnum<sup>1</sup> and David S. Leigh<sup>9</sup>

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The transition from 'wild' to human-dominated landscapes has changed river ecosystems globally. In the U.S., 42% of wadeable streams are considered impaired, the majority due to increased nutrient and sediment input associated with watershed urbanization. Many studies have illustrated the importance of the surrounding landscape and human activities to the ecological integrity of streams by implicitly substituting space for time, but few studies have captured the changing effects watershed land use through time. The purpose of the Coweeta Long-Term 'Hazard' Site Project is to identify the land use variables which are driving stream condition, and determine thresholds which can inform land management and stream assessment for low-order streams in the southern Appalachians, which are in different phases of urbanization. This research builds on a proactive sampling strategy developed by Gardiner et al. (2009) to document physical, chemical and biological changes in streams where catchment land-uses were predicted to change over the next two decades. I will also expand this approach to examine stoichiometric differences (C:N:P) in stream food webs across a spectrum of land use in the Southern Appalachians.

# Oral Presentations

## ASSESSING THE TROPHIC ROLE OF SALAMANDERS IN STREAM ECOSYSTEMS: SEASONAL, SPECIES-SPECIFIC AND INDIVIDUAL VARIATION

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Amphibians are known to be dominant in both abundance and biomass in some ecosystems and, therefore, are presumed to influence ecosystem processes. Relatively little is known about the trophic ecology of larval salamanders beyond basic diet snapshots. Seasonal  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  of individual larvae were determined for three common species of salamander in four southeastern headwater streams (GA, USA). Trophic distances of salamander species from basal resources were estimated to be similar to those of macroinvertebrate predators. Isotopic signatures ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) were compared with snout-vent length (SVL) to assess size effects on individual variation in data sets that included both Piedmont and Blue Ridge physiographic regions. Larvae became depleted in  $\delta^{15}\text{N}$  as SVL increased, although relationships were species-specific. Sources of size-specific variation may be related to physiological changes within animals such as size-specific growth rates, or may reflect ontogenetic changes in diet. The latter possibility suggests ontogenetic variation should be incorporated into our understanding of the trophic role of salamanders in stream ecosystems.

## PARASITE DYNAMICS IN A NATURALLY FLUCTUATING RODENT POPULATION

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Many wildlife populations have dramatic and predictable population cycles, none more studied than those of voles. Various abiotic and biotic factors have been attributed to these cycles, including climate, specialized predators, and disease. Parasites have been increasingly studied for their effects on population dynamics, but whether they directly influence population fluctuations is still being debated. It is predicted that increased population density results in resource limitation, increased social encounters, and heavy reproductive demands. Collectively, these may result in increased stress and susceptibility to infection. In addition, host contact rates and the transmission of parasites spread by close proximity are predicted to increase with host population density. Thus, as population density increases across a breeding season or between years, parasite prevalence and individual parasite richness are expected to increase as well. This could result in increased selection pressures on hosts during periods of high density, resulting in lower individual fitness or population declines. I will test to see if parasites have fitness effects on their hosts, and if they may be responsible for regular cycles observed in montane vole populations.

# Poster Presentations

## DO BLACK-FURRED ANIMALS COMPENSATE FOR HIGH SOLAR ABSORPTION WITH SMALLER HAIRS? A TEST WITH A POLYMORPHIC SQUIRREL SPECIES

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Animals with black integument absorb solar energy at a high rate and are at risk of overheating, especially in the summer. In this study, we tested the possibility that black-furred animals have shorter or thinner hairs to compensate for this issue. We obtained hairs from museum specimens of fox squirrels (*Sciurus niger*), a species with variation in fur color and used image analysis to examine lengths and widths of 20 body and 20 tail hairs from brown (n=19), grey (n=15) and black (n=9) individuals. While hair lengths did not differ significantly, black individuals had significantly thinner body hairs and thicker tail hairs than the brown or grey squirrels. One explanation for these patterns is that the differences help compensate for color in terms of thermoregulation. It is possible that body hairs of black squirrels are thinner to increase evaporative cooling during the day. The thick tail hairs of black squirrels could allow greater heat retention when the tail is wrapped around the body at night. Collectively, these results show how potentially negative characteristics can be compensated for by slight morphological changes.

## EATING FOR TWO: A SURVEY OF THE INTERNAL PARASITES IN THE MICE OF SAN LUIS, COSTA RICA

Tyler R. Halle and Scott Connelly  
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This study examined macroparasites in two species of mice in Costa Rica. Twenty-one mice, 19 *Peromyscus mexicanus* and two *Heteromys desmarestianus*, were captured and examined for ectoparasites. Sixteen of the *P. mexicanus* and both *H. desmarestianus* were dissected, and their hearts, lungs, livers, kidneys, and alimentary canals were examined under a microscope for endoparasites. Three types of parasitic worms were found in 17 (94%) of the 18 mice that were dissected. Cestodes were found in the alimentary canal of 94% of *P. mexicanus* and both *H. desmarestianus*. The small intestine was the most heavily infested organ followed by the large intestine (50%) and the heart (38%). Several explanations for the high frequency of parasites in these mice and their alimentary canals are suggested.

## INVESTIGATING EARLY WARNING SIGNALS IN CRITICAL SLOWING DOWN IN CHANGING ENVIRONMENTS

Tierney O'Sullivan, Theresa Stratmann, Amara Channell, Andrew Kramer, Marcus Zokan, Andrea Stilletti and John Drake  
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Extinction has long been a fascination of scientists, but is incredibly difficult to study comprehensively. It is becoming an increasingly important topic of late, due to habitat fragmentation and climate change throughout the world. The difficulty of studying extinction that scientists are often able to predict it, but are unable to reverse it because of late detection. We conducted an experiment using *Daphnia magna* as a test subject to investigate the presence of early warning signals in the form of increases in statistical patterns such as variance, autocorrelation, and standard deviation from the mean. These changes can serve as early predictors of extinction before the bifurcation occurs. The *Daphnia* populations were assigned to 96 chambers, and each chamber was assigned one of four treatments where all environmental conditions were kept constant except temperature. The treatment was determined by the following guidelines: 1) constant chambers stayed at 20°C, 2) increasing by 0.1°C/day, 3) periodic fluctuated between 15°C and 25°C 4) and decreasing by 0.1°C/day. Population sizes in the chambers were recorded daily, and this data is used to determine the presence of the early warning signals of the critical slowing down phenomenon using statistical tests in R. More analysis must be done to determine of the presence of the signals in the data is conclusive.

# Poster Presentations

## DETECTION RATES AND FINE-SCALE OCCUPANCY OF *URSPELERPES BRUCEI* (THE PATCH-NOSED SALAMANDER)

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In March 2007, University of Georgia researchers stumbled upon a new species of Plethodontid salamander, *Urspeleperpes brucei* (the patch-nosed salamander), in the Appalachian foothills of Georgia. While the discovery of this salamander is impressive in itself, very little additional knowledge has been gathered about its life history. So far, this species is known from only a handful of sites, all of which are within a 7km<sup>2</sup> region of the Chattahoochee National Forest. In order to develop a plan of management for this new species, a better understanding of its life history and range must be gained. However, the presence of *U. brucei* at a given site can often be difficult to determine due to its secretive nature, and a system for determining site occupancy, corrected for an imperfect detection rate, is in need of development. We used a combination of leaf-litter traps and dip netting to estimate detection rates of *U. brucei* over time in streams where it is known to be present. Quantifying and understanding imperfect detection rates of *U. brucei* allows us to effectively survey new sites for the species and determine occupancy across its potential range. Furthermore, these fine-scale occupancy studies provide us with a powerful proxy for estimating abundance over spatial and temporal gradients in *Urspeleperpes* and other species. Obtaining a more complete understanding of stream occupancy and range of *U. brucei* is critical in developing a plan of management for its conservation.

## EFFECTS OF PARASITE INFECTION ON MONARCH BUTTERFLY MATING BEHAVIOR

Malavika Rajeev and Sonia Altizer

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Monarch butterflies (*Danaus plexippus*) are commonly infected by a debilitating protozoan parasite *Ophryocystis elektroschirra*. This study examined the effect of infection on monarch mating contests and mating success. Monarch mating behavior involves males chasing and forcing themselves onto females. Although females do not actively choose their partners, they can struggle to avoid mating with certain males, and males may abandon attempts with certain females. Because infected monarchs are often in poorer condition than healthy butterflies, and mating with an infected partner poses the risk of spore transmission to offspring, infected males and females might mate less often than healthy butterflies. This study was initiated using healthy and experimentally infected monarchs raised under standard laboratory conditions. Adult monarchs were placed in large outdoor enclosures. Mating contests and successful matings were recorded over 10 days. Results showed that heavily infected females mated fewer times per day than healthy females and those with low infection levels. Heavily infected males engaged in fewer mating contests per day, although this trend was not statistically significant. Monarchs did not appear to mate assortatively across infection classes: healthy males and females mated with infected monarchs almost as frequently as they mated with each other. The weak effects observed suggest that infected monarchs might mate less often due to reduced activity levels, but there was no strong evidence that monarchs discriminate between healthy and infected mates.

# Poster Presentations

## INVESTIGATING INVASION: EFFECTS OF *LIGUSTRUM SINENSIS* PRESENCE AND REMOVAL ON NITROGEN MINERALIZATION RATES

Rebecca Risser, Joshua Lobe and Paul Hendrix  
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Chinese Privet (*Ligustrum sinense*) is a common invasive in the southeastern United States, particularly in low lying riparian areas. Other invasive shrub systems have been found to have effects on soil characteristics and processes. As a result, nutrient cycling is often affected. This study explores the effects of privet removal on nitrogen mineralization rates at sites in the Oconee River basin. Four sites were studied, each containing three plots: 1) The control in which privet was present; 2) privet felled by chainsaw; and 3) privet chipped by a mulching machine. In addition, three reference, or desired future condition sites which are naturally privet free were sampled. Soil samples were collected from these sites and were incubated for 28 days to determine net ammonia and nitrate mineralization rates.

## "SNAIL MOVEMENT" IS NOT AN OXYMORON: A STUDY OF GASTROPOD BEHAVIORS AND ASSEMBLAGES IN A TROPICAL INTERTIDAL ZONE

Stephanie Simpson<sup>1</sup>, Elijah White<sup>1</sup>, Olivia Gorbatkin<sup>1</sup>, Scott Connelly<sup>1</sup> and Diana Lieberman<sup>1,2</sup>  
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The environmental alterations in the intertidal zone created by tidal changes (including temperature and oxygen levels) make daily life a struggle for creatures living in this habitat. Microhabitats are created which support highly differentiated gastropod communities. Here we investigate species composition and diversity of assemblages of marine snails and document their distribution and movement in the tropical intertidal zone of the Pacific Coast in Costa Rica. Species composition varied based on tidal height, distance from the shore, and the direction of the movement of the tide. We found that certain snail populations move underneath the water during high tides possibly due to food availability or community interactions. Demonstration of these gastropod movements during high tide adds a new understanding of this tropical gastropod community where very little is known. We hope to do a further study to understand why snails are moving and if night versus daytime shows a difference in gastropod behaviors.

## EXTINCTION TIME IN CHANGING ENVIRONMENTS: EFFECT ON EXTINCTION TIME AND DISTRIBUTION

Theresa Stratmann, Tierney O'Sullivan, Amara Channell, Andrew Kramer, Marcus Zokan, Andrea Stilletti and John Drake  
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In an era of increasing species extinctions it is vital to understand processes of extirpation in hopes of eventually predicting and preventing them. We used the ectotherm, *Daphnia magna*, as a model organism to study how deteriorating environmental conditions caused by temperature change affected the populations' extinction times and distributions. Three sets of twenty-four chambers of *Daphnia* ( $N_0 = 20$ ) were subjected to temperature regimes according to three treatments: 1) Increasing temperature and 2) decreasing temperature by 0.1°C/day from 20°C, and 3) Constant 20°C temperature (control). We hypothesized that the treatments would increase extinction risk compared with controls by probing thermal tolerances. In contradiction to these predictions, analysis with Cox proportional hazards regression showed that temperature treatments increased survival time. Further inspection showed that contamination by algae determined extinction time and that contamination time itself was determined by treatment. Chambers subject to temperature manipulations became contaminated significantly later than control chambers (decreasing  $p < 0.001$ , increasing  $p = 0.007$ ). Although the temperature treatments both indirectly increased survival they had different effects on the distribution of extinction times. The decreasing temperatures caused right skew in extinction times whereas increasing temperatures caused left skew. Usually the effects of environmental change are expected to be direct. This experiment shows that indirect effects may be just as significant or more so.

# Poster Presentations

## CUTICULAR PHEROMONES AND FIRE ANT QUEENS: SMELLS LIKE MOM

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The Red Imported Fire Ant (RIFA) *Solenopsis invicta* has been the subject of intense research. One major field of study in ant biology is the use of pheromones for communication. This question applies particularly to the polygyne and monogyne social forms of the RIFA. Previous research has found strong genetic control for the organization of a colony into multiple-queen (polygyne) or single-queen (monogyne) societies. These social forms contain non-recombining genotypic patterns and phenotypic differences in behavior, physiology, and biochemistry. We studied the process of queenless colonies taking new queens. Workers in queenless colonies will accept a new queen in certain circumstances, but polygyne workers will only accept into their colony polygyne queens and monogyne workers will only accept into their colonies monogyne queens. Preliminary studies have indicated this behavior may be determined on a chemical basis. Our study aims to demonstrate worker discrimination on the basis of social form and to show this is a chemical response. We extracted polygyne and monogyne queen recognition pheromones, deposited them onto cloth wicks, and elicited ant behavior discriminating between the wicks on the basis of social form, supporting the hypothesis.

## LONG-TERM VARIATION IN PHOSPHORUS DYNAMICS BETWEEN DETRITAL RESOURCES AS A RESPONSE TO NUTRIENT ENRICHMENT IN A DETRITAL-BASED HEADWATER STREAM

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Increased nutrient mobilization by human activities represents one of the greatest threats to global aquatic ecosystems and one of the most important sources of impairment to US surface and coastal waters. In this study, we examined the effects of nutrient enrichment on phosphorus dynamics in suspended fine organic matter (seston) and leaf transects from both a reference stream and an experimentally enriched stream at the Coweeta Hydrologic Laboratory. Our objectives in conducting this research were to (1) quantify nutrient enrichment effects on P dynamics with a long-term focus, (2) evaluate the implications of changing elemental ratios in enriched streams to stream biodiversity by comparing food quality against an organism's theoretical threshold elemental ratios of resource C:N and C:P, and (3) to observe seasonal patterns in percent increases in the treatment stream as compared to the reference with the noted variables in mind. We determined phosphorus concentrations, and used preexisting data to synthesize a long-term study of temporal variation of P concentrations, N:P ratios, and C:P ratios. Overall, elemental ratios suggested that seston was more affected by nutrient enrichment than leaf samples and C:P and N:P ratios decreased in the treatment stream for both seston and leaf samples. The elemental ratios's potential effects on organisms' abundance were analyzed using the threshold elemental ratio.