Fifteenth Annual
Odum School of Ecology
Graduate Student
Symposium
23-24 January, 2009

Ecology Auditorium
Odum School of Ecology
University of Georgia
Athens

Brought to you by:
The Ecology Graduate Students

Symposium Coordinators: Dean Hardy and Jamie Winternitz
Administrative Support: Anisa Jimenez and Jeremy Sanderlin
Program Committee: Andrew Mehring, Fern Lehman and Jeff Turner
Undergraduate Poster Committee: Nicole Gottdenker and Amy Trice
Judging Committee: Ashley Helton, Cynthia Tant and Marcia Snyder
Souvenir Committee: Rachel Katz, Kathleen Frey and Jessica Joyner
Prospective Student Boarding Committee: Meredith Meyers and Bill McDowell
Audio-visual Committee: Rachel Katz, Margaret Shearin and many AV volunteers
Culinary Logistics Committee: Andrew Binderup, Jason Westrich and Shafkat Khan

The Eugene P. Odum and William E. Odum Endowment provided funding for this event. Thanks to all additional students, faculty and staff who made this event possible.
Schedule of Events

Friday, January 23

8:30am Coffee available in exhibit hall

9:00 - 9:05 Introduction by Dean Hardy and Jamie Winternitz, Symposium Coordinators

9:05 – 9:15 Welcome by Dr. John Gittleman, Dean, Odum School of Ecology

SESSION I – Introduction by Session Moderator

9:15 - 9:30 “Closing the gap: Connecting science and policy for private lands conservation” by Dean Hardy

9:30 – 9:45 “The keystone role of fungi in organic matter transformation in detritus-based streams” by Cynthia Tant

9:45 – 10:00 “Influence of nutrient limitation on secondary forest productivity: Is there a possibility of interaction with changing climate?” by Shafkat Khan

10:00 – 10:15 “Behavioral determinants of pathogen transmission in African apes” by Julie Rushmore

10:15 – 10:30 A.M. Coffee Break

SESSION II – Introduction by Session Moderator


10:45 – 11:00 “Foraging decisions, parasites, and predation risk” by Jamie C. Winternitz

11:00 – 11:15 “How detritivores mediate leaf litter species effects on benthic oxygen demand” by Andrew S. Mehring

11:15 – 11:30 “Meta-analysis, mycorrhizas, and molecular markers: Conservation of diverse tropical epiphytes in disturbed habitats” by Tyler Kartzinel

11:30 – 1:00 Lunch (on your own – transportation provided)
### Schedule of Events

**Friday, January 23**

#### SESSION III – Introduction by Session Moderator

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<td>1:00 – 1:15</td>
<td>“Long-term nutrient enrichment alters aquatic-terrestrial linkages along a detrital-based headwater stream” by John M. Davis</td>
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<td>1:15 – 1:30</td>
<td>“Populations at risk: Microbial interactions may be key for understanding anthropogenic disturbance and sponge diseases” by Jessica Joyner</td>
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<td>1:30 – 1:45</td>
<td>“Does glass frog tadpole excretion stimulate microbial respiration in leaf packs?” by Thomas Barnum</td>
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<td>1:45 – 2:00</td>
<td>“Estimating benthic darter (<em>Etheostoma incriptum</em>) survival during record low-flows in a bedrock shoal” by Rachel Katz</td>
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<td>2:00 – 2:15</td>
<td>“Host-specific viruses identify land-based sources of human pollution in south Florida coral reefs” by Carrie Futch</td>
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<td>2:15 – 2:30</td>
<td><strong>P. M. Coffee Break</strong></td>
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#### SESSION IV – Introduction by Session Moderator

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<td>“Can we maximize biodiversity by maximizing the number of species?” by Shan Huang</td>
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<td>2:45 – 3:00</td>
<td>“Micro-niche partitioning and photobiology of <em>Symbiodinium</em> associated with the Caribbean coral <em>Montastraea faveolata</em>” by Dustin Kemp</td>
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<td>3:00 – 3:15</td>
<td>“Northwest Georgia practicum scoping project” by Katherine Edmonds</td>
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<td>3:15 – 3:30</td>
<td>“Holistic management: A new framework for decision-making and its role in ecological research” by Josh Egenolf</td>
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<td>3:30 – 3:45</td>
<td>“Measuring biological effects of development: A paired watershed approach” by Amy E. Trice</td>
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<td>3:45 – 4:00</td>
<td>“A molecular test of the ‘dilution effect for the zoonotic parasite <em>Trypanosoma cruzi</em> in a fragmented forest landscape” by Nicole L. Gottdenker</td>
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#### SESSION V – Undergraduate Poster Session

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<td>4:00 – 5:00</td>
<td><strong>Poster judging in exhibit hall</strong></td>
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<td>5:00</td>
<td><strong>Refreshments in courtyard</strong></td>
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Schedule of Events

Saturday, January 24

8:30 am  Coffee available in exhibit hall

SESSION VI – Introduction by Session Moderator

9:00 – 9:15  “Impacts of warming on aboveground belowground interactions” by Fern Lehman

9:15 – 9:30  “Copepod abundance drives the seasonality of pathogenic Vibrio species” by Jeff W. Turner

9:30 – 9:45  “Survival at the surface: Enhanced photoprotection pathways in shallow water Symbiodinium” by Jennifer McCabe Reynolds

9:45 – 10:00  “Aquatic insect response to Autumn leaf quality ” by John Frisch

10:00 – 10:15  A.M. Coffee Break

SESSION VII – Introduction by Session Moderator

10:15 – 10:30  “Spatial patterns of granite rock outcrop flora in the Piedmont of Georgia” by Melissa Caspary

10:30 – 10:45  “How does stream nutrient loading affect the importance of consumer species identity in controlling rates of ecosystem nutrient recycling?” by Gaston E. Small

10:45 – 11:00  “Predictions of biotic health in urban streams with reduced streamflow” by Jessica Sterling

11:00 – 11:15  “Ability of terrestrial and tropical forests to act as carbon sinks based on nitrogen and phosphorous ratios” by Kaitlin McLean

11:15 – 11:30  “Using streamflow records and stream/aquifer end member mixing to analyze surface water and groundwater connectivity in the lower Flint River basin, southwest Georgia” by Kathleen Rugel

11:30 – 1:00  Lunch (on your own – transportation provided)
Schedule of Events
Saturday, January 24

SESSION VIII – Introduction by Session Moderator

1:00 – 1:15  “Mitigating non-point source pollution in Georgia: A guide book” by Daniel O’Brien

1:15 – 1:30  “The impact of submerged aquatic vegetation (SAV) beds on water quality in a reservoir located in the southeastern United States” by Stephen D. Shivers

1:30 – 1:45  “Mosquito community composition, arbovirus prevalence, and host-feeding patterns in a southwest Georgia ecological preserve” by Eva Whitehead

1:45 – 2:00  “Vibrio cholerae: An ecological examination of virulence” by Jason Westrich

2:00 – 2:15  P.M. Coffee Break

SESSION IX – Introduction by Session Moderator

2:15 – 2:30  “Sources and cycling of nutrients under different flow regimes in a subtropical reservoir” by Julie McEntire

2:30 – 2:45  “Occupancy estimation and modeling of the Etheostoma brevirostrum species complex within the Etowah River System” by Gregory B. Anderson

2:45 – 3:00  “The effects of the red imported fire ant (Solenopsis invicta) on seed fate in the longleaf pine ecosystem” by Margaret Shearin

3:00 – 3:15  “Competitive responses of Imperata cylindrica and Aristida beyrichiana to various simulated precipitation regimes” by Dameron Black

3:15 – 3:30  “The influence of physicochemical characteristics and interspecies interactions on the invasion success of a non-native crayfish” by Lindsey Sargent

3:30 – 3:45  P.M. Coffee Break

3:45 – 4:00  Plenary speaker introduction by Dr. Amy D. Rosemond, Odum School of Ecology

4:00 – 5:00  “Expecting the unexpected: Pandora’s box of paradox in an upside-down estuary” by Dr. Evelyn E. Gaiser

Florida International University

5:00 – 7:00  Reception in the exhibit hall
EXPECTING THE UNEXPECTED: PANDORA’S BOX OF PARADOX IN AN UPSIDE-DOWN ESTUARY

Dr. Evelyn E. Gaiser, Florida International University

http://www.fiu.edu/~gaisere/

Evelyn Gaiser is an associate professor in the Department of Biology and Southeast Environmental Research Center at Florida International University. Her research focuses on measuring community response to environmental change in lakes and wetlands on long temporal scales. Her laboratory specializes in taxonomy and ecology of algae, particularly diatoms, which are useful in tracking long-term change in both modern and retrospective ecological studies. She has used both spatially-intensive surveys and experimental studies to define algal species responses to changes in water quantity and quality, the key driving variables in wetlands and shallow lakes. In collaboration with paleoecologists from a variety of disciplines, she has applied autecological species data to infer the frequency and magnitude of past environmental changes to put current alterations in a long-term context.

Evelyn received her B.S. from Kent State University in 1989 and M.S. from Iowa State University in 1991, where she studied the distribution of epizoic diatom communities across lakes in the mid-western United States and Canada with advisor Dr. Roger Bachmann. She received her Ph.D. from the Institute of Ecology at the University of Georgia in 1997, working at the Savannah River Ecology Laboratory with Dr. Barbara Taylor. Her dissertation research investigated the response of diatoms to hydrologic variability in Carolina Bay wetlands. This work resulted in the description of 8 diatom taxa new to science and a definition of hydrologic preferences for 180 benthic diatom taxa. These data were used to infer a ~5000 year-record of hydrology from diatoms in sediments of a South Carolina pond, and demarcated a hydrologic threshold for the formation of wetlands in the region around ~4000 YBP.

Currently, Evelyn is the lead PI of the NSF-funded Florida Coastal Everglades Long-Term Ecological Research Program and is part of several large scale assessment efforts to identify hot spots for restoration in the Everglades ecosystem. She has numerous peer-reviewed journal publications in the field of algal ecology and has won awards for outstanding research and teaching.
OCCUPANCY ESTIMATION AND MODELING OF THE ETHEOSTOMA BREVIROSTRUM SPECIES COMPLEX WITHIN THE ETOWAH RIVER SYSTEM

Gregory B. Anderson¹ and Mary C. Freeman¹,²
¹Odum School of Ecology, University of Georgia, Athens, GA
²U.S. Geological Survey, Patuxent Wildlife Research Center, University of Georgia, Athens, Georgia

*Etheostoma brevirostrum* (the holiday darter) is a sparsely distributed fish species found within the Coosa River system of Tennessee, Georgia, and Alabama. Within the Etowah River system of northern Georgia, two genetically distinct species of holiday darters are thought to be extant, *Etheostoma* sp. cf. *E. brevirostrum* A [Amicalola system] and *E. sp. cf. E. brevirostrum* B [Etowah system]. Patterns of spatial variation of the two holiday darter species were studied in an attempt to refine the known geographic range of these species and to discriminate among competing hypotheses that explain variations in occupancy and detection. Forty-five surveys were completed within the Amicalola Creek system and the Etowah River system. Both *E. sp. cf. brevirostrum* A & B were collected at eight sites within each respective system, including four range expansions for each species. Occupancy models representing competing biological hypotheses (and that account for imperfect detection) will be evaluated using an information theoretic approach. Model parameter estimates will be used to gain a better understanding of the habitat associations and geographical distributions of these imperiled species and will help resource managers evaluate options for species conservation.

DOES GLASS FROG TADPOLE EXCRETION STIMULATE MICROBIAL RESPIRATION IN LEAF PACKS?

Thomas Barnum¹, Catherine Pringle¹, Susan Kilham², Karen Lips³ and Matt Whiles³
¹Odum School of Ecology, University of Georgia, GA
²Drexel University, Philadelphia, PA
³Southern Illinois University, Carbondale, IL

Amphibian diversity is declining on a global scale. The consequences of these declines in tropical streams could be particularly severe as tadpoles are an important component of the food web. As part of the Tropical Amphibian Declines (TADS) project, recent studies in the highland streams of Panama have begun to quantify some of the consequences of tadpole declines. One potential role of tadpoles is the stimulation of fungal activity in leaf packs. In particular, glass frog tadpoles (*Centrolenidae*) are found deep in detrital leaf packs at the bottom of pools. Initial studies indicate that glass frog tadpoles (*Centrolenidae*) may increase fungal biomass in leaf packs, but the mechanism behind observed increases remains unknown. The objective of this study is to quantify microbial activity and respiration in leaf packs in the presence and absence of glass frog tadpoles. Microcosm chambers will be used to measure microbial respiration and anaerobic microbial activity in leaf packs with and without glass frog tadpoles in streams with intact tadpole assemblages. We predict that leaf packs with glass frog tadpoles will have higher respiration levels than leaf pack without glass frog tadpoles. Furthermore, we predict that anaerobic activity will be higher in leaf packs with glass frog tadpoles than in leaf packs without glass frog tadpoles.
Oral Presentations

COMPETITIVE RESPONSES OF *IMPERATA CYLINDRICA* AND *ARISTIDA BEYRICHIANA* TO VARIOUS SIMULATED PRECIPITATION REGIMES

Dameron Black and Ron Carroll
Odum School of Ecology, University of Georgia, Athens, GA

With the prospects of future climate change, experiments measuring competition between the invasive rhizomatous grass, *Imperata cylindrica* (Cogongrass), and the caespitose grass, *Aristida beyrichiana* (Wiregrass), in response to changing precipitation regimes can help predict future impacts of *I. cylindrica* upon Southeastern US plant communities dependent on dominance of *A. beyrichiana*. For the Southeastern US, the Hadley Center in the UK General Circulation Model (GCM) projects increases in precipitation; however, the Canadian Climate Center GCM projects decreases in precipitation. As water availability is one of the most important abiotic factors influencing plant productivity and species composition, changing precipitation regimes are expected to have important impacts upon ecosystems. Morphological and physiological differences between these two grass species may indicate different ecological strategies and, hence, different competitive responses to various precipitation regimes. Frequency of watering for mixtures of *I. cylindrica* and *A. beyrichiana* will consist of 2cm every 1, 2, 4, 8, or 16 days. After 64 days, a simulation of monsoonal rain followed by ample watering for 20 days will allow a chance for recovery following the treatments before the plants are harvested and biomass is measured for each species. Percent cover of each species will be recorded every 8 days. Measuring initial and final biomass will allow answering the questions, ‘which species gains for each treatment level?’ and ‘Is there a relationship between competitive outcome and frequency (amount) of simulated precipitation?’

SPATIAL PATTERNS OF GRANITE ROCK OUTCROP FLORA IN THE PIEDMONT OF GEORGIA

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

The granite rock outcrops of the southeastern Georgia Piedmont host a unique plant community rich in endemic and rare flora. The center of occurrences for these rock exposures lies within the developing reach of the Atlanta urban center and this close proximity poses a constant threat for the rock outcrop habitat and its associated flora and fauna. As part of a comprehensive evaluation of the rock outcrops of the Georgia Piedmont, a spatial analysis is being performed to better understand the species distribution patterns of rare flora in rock outcrop habitats. Plant species location information is used in conjunction with granite outcrop location data to determine geographic patterns in species area and species isolation. Environmental indicator data for soils, precipitation, and elevation are evaluated alongside plant species data to identify significant relationships between environmental variability and rare species locations and will be instrumental in developing models to predict species ranges. Landcover, impervious surface, and tree cover data is being used to observe a thirty-three year snapshot of land use change and to determine land use patterns, assess present habitat threats, and predict future development behavior. Preliminary analyses reveal increasing urban development and deforestation in all areas that were analyzed. This information will be extremely valuable in assessing future areas for conservation, assisting in present management of existing protected areas, and directing and defining priorities for future research.
LONG-TERM NUTRIENT ENRICHMENT ALTERS AQUATIC-TERRESTRIAL LINKAGES ALONG A DETRITAL-BASED HEADWATER STREAM

John M. Davis and Amy D. Rosemond,
Odum School of Ecology, University of Georgia, Athens, GA

Aquatic food webs are linked to their surrounding riparian habitats through aquatic insect emergence. Thus, changes in aquatic food web dynamics may have significant effects on the surrounding terrestrial predators that rely on these aquatic subsidies. Previous results from a long-term experimental manipulation of a southern Appalachian headwater stream showed that nutrient enrichment stimulated macroinvertebrate secondary production and biomass. Since resource subsidies typically flow down a productivity gradient, this increase in stream productivity may eventually increase resource flows to the surrounding terrestrial system. Therefore, using a paired-watershed approach in combination with an isotopic $^{15}$N tracer addition, we tested whether this increase in stream macroinvertebrate production would increase aquatic insect emergence and its associated subsidy of terrestrial spiders. During the fifth year of enrichment, the biomass of aquatic emergence was greater in the treatment stream compared to a reference. The biomass of those spiders that specialize on aquatic emergence (i.e., spiders inhabiting terrestrial vegetation) also increased, but ground spiders did not change. These results in conjunction with isotopic mixing models indicate that long-term nutrient enrichment increased aquatic subsidies and their associated nutrient flows to terrestrial spiders, but the effects were limited to the immediate riparian habitat. Therefore, stream nutrient enrichment may not only impact instream food webs, but may feedback to terrestrial systems as nutrient enrichment stimulates aquatic subsidies to terrestrial food webs.

NORTHWEST GEORGIA PRACTICUM SCOPING PROJECT

Katherine Edmonds
River Basin Center, Odum School of Ecology, University of Georgia

Northwest Georgia is an area of great aquatic biodiversity and natural beauty, and it also happens to be an area where the population is growing quickly with little to no development planning. Because of this the River Basin Center has been asked to focus the work of the Environmental Practicum in this region for the next couple of years. The goal of this project is to help stimulate or further conservation efforts in the northwest Georgia, as well as adjacent parts of Alabama and Tennessee, particularly in ways that increase the effectiveness of the states' Wildlife Action Plans. With the help of two fall '08 practicum students, we began this process by interviewing potential stakeholders to determine if they were interested in assistance from practicum students. These stakeholders included representatives of state agencies, advocacy groups, and various other residents of the area. We also compiled information about the demographics of the area, current conservation issues, and identified pending major legislation and other initiatives affecting the watershed. This presentation will discuss the process of identifying and contacting stakeholders, a few potential projects proposed, general information about the area, and the conservation issues we hope to address.
HOLISTIC MANAGEMENT: A NEW FRAMEWORK FOR DECISION-MAKING AND ITS ROLE IN ECOLOGICAL RESEARCH

Josh Egenolf
Odum School of Ecology, AgroEcology Lab, University of Georgia, Athens, GA

The lowest common denominator of human management of any system is decision-making. Management is directed at reaching predetermined goals/objectives. Individual perspectives inform what these are initially and whether they are reached once action is taken. Often not realized are inherent conflicts in goals/objectives because decisions lack an organizing framework. Holistic Management (HM) is not a system of management it is a process; a framework for decision-making. What separates HM from other forms of management is: it explicitly incorporates the attitudes/beliefs/values of those responsible for decision-making at all levels; it recognizes foundational ecosystem processes as relevant to every human endeavor; and, it absolutely relies on consistent monitoring and evaluation. Primary to the HM Model is defining the entity (or whole) being managed in terms of the people responsible for management, and the resources available to them. Essential is the formation of a Holistic Goal describing: the quality-of-life collectively sought; what must be produced to create that quality-of-life; and, the resource base as it will have to be far into the future to SUSTAIN production to create the desired quality-of-life envisioned. Essential is the establishment of consistent, common criteria to evaluate decisions towards the Holistic Goal. Decisions must be sound socially, environmentally, and economically. I will highlight examples of HM successfully used in ecological research and will discuss future opportunities.

AQUATIC INSECT RESPONSE TO AUTUMN LEAF QUALITY

John Frisch and Catherine Pringle
Odum School of Ecology, University of Georgia, Athens, GA

Macroinvertebrates are critical to stream food webs and use leaf packs as both food and habitat. In the southern Appalachians in autumn, diverse deciduous trees provide a large pulse of allochthonous leaf inputs into stream ecosystems. In contrast evergreen Rhododendron (Rhododendron maximum), the dominant riparian species, provides relatively low levels of leaf inputs throughout the year. It is important to understand the role of Rhododendron inputs into streams, given predicted increases in Rhododendron abundance following hemlock extirpation caused by Wooly Adelgid (Adelges tsugae) infestations. While recalcitrant Rhododendron leaves are available year-round, more labile species’ leaves such as Red Maple (Acer rubrum) are available for much shorter periods. Thus during autumn, macroinvertebrates must choose among litter types: (1) labile litter which provides easily-assimilated food but only temporary habitat; and (2) recalcitrant litter which provides more difficulty-to-assimilate food but more permanent habitat. We examined insect colonization on added single species leaf packs (Acer rubrum and Rhododendron maximum) in streams draining the Coweeta Hydrological Laboratory in North Carolina, to assess differences in biomass, abundance, and species presence/absence during this fall period. We expected that insect taxa with different feeding modes (i.e. filter-feeding versus shredding) would respond differently to the tradeoff of habitat stability versus nutrient quality. Initial results show that insect taxa have different occupancy patterns on the two leaf types, and that feeding mode is an important predictor of leaf preference.
As coastal development continues to rise in southeast Florida, the contribution of pollution from runoff, leaky septic systems, and sewage outfalls to the quality of offshore water resources remains relatively unknown. These contaminants may result in degradation or disease in a sensitive reef habitat and introduce human pathogens. As part of a larger study to examine the influence of human sewage on the reefs of southeast Florida, microbial water quality in shipping inlets, offshore outfalls and benthic biota were examined in Broward County, FL. Water samples were collected at surface and mid-water column depth. Coral mucus and sponge tissue were collected at stations impacted by inlets and outfalls. Fecal indicator bacteria (FIB) (fecal coliform bacteria, enterococci and \textit{Clostridium perfringens}) were enumerated using standard methods. Inlet samples collected from 15 stations on an ebbing tide showed a declining trend in FIB levels moving offshore and showed lateral movement such that the inlet plume could be detected along the nearby beaches. Highest enterococci levels were found at the mouth of the inlet at 380 CFU L$^{-1}$ at the surface and 64 CFU L$^{-1}$ at depth. Fecal coliform bacteria were only detected in the surface waters where highest concentrations reached 56 CFU L$^{-1}$ also at the mouth of inlet. \textit{C. perfringens} levels reached 60 CFU L$^{-1}$ in surface water at the inlet mouth, although the highest concentration at depth was parallel to the shore, north of the inlet. FIBs were readily detected from the offshore outfall surface ‘boil’ with fecal coliform bacteria at 212 CFU L$^{-1}$, enterococci at 88 CFU L$^{-1}$ and \textit{C. perfringens} at 48 CFU L$^{-1}$. Analysis of water and tissue samples for human specific viral targets (human enterovirus and adenovirus) is ongoing and will indicate the degree to which a human-sewage signal exists in these offshore environments. This study will provide a snapshot of sewage exposure on southeast Florida reefs and in reef organisms and will begin to fill a critical data gap that links land-based sources of pollution with reef resources.

**A MOLECULAR TEST OF THE 'DILUTION EFFECT' FOR THE ZOONOTIC PARASITE \textit{TRYPANOSOMA CRUZI} IN A FRAGMENTED FOREST LANDSCAPE**

Nicole L. Gottdenker 1, Anamaria Santamaria 2, Humberto Membeche 2, Jose Calzada 2, Azael Saldaña 2, Vanessa Pineda 2, David Peterson 3 and C.Ronald Carroll 1

1 Odum School of Ecology, University of Georgia, Athens, GA, USA
2 Parasitology Department, Instituto Conmemorativo Gorgas de Estudios de La Salud, Panamá, República de Panamá
3 Center for Tropical and Emerging Global Diseases, Department of Infectious Diseases, University of Georgia, Athens, GA, USA

The 'dilution effect' hypothesis states that there is an inverse relationship between host species diversity and infectious disease risk. The goal of this study is to test the dilution effect hypothesis for the vector-borne parasite \textit{Trypanosoma cruzi}, agent of Chagas disease, in protected forests and deforested landscapes surrounding the Panama Canal. \textit{Rhodnius pallescens}, the principal vector of \textit{T. cruzi} in Panama, was collected from its primary habitat, the palm \textit{Attalea butyracea}, in five different habitat types reflecting a gradient of anthropogenic disturbance. Collected \textit{R. pallescens} (N=641) were tested for infection with \textit{T. cruzi} by a polymerase chain reaction (PCR) assay. Vector blood meals were identified by PCR amplification and sequencing a vertebrate-specific fragment of the 12S ribosomal RNA gene. The proportion of \textit{T. cruzi}-infected vectors was significantly higher in mid-secondary forest fragments and peridomiciliary areas as compared to continuous forests. Habitat-specific vector infection prevalence will be compared to host community composition and species diversity data from the molecular analysis of vector blood meals.
CLOSING THE GAP: CONNECTING SCIENCE AND POLICY FOR PRIVATE LANDS CONSERVATION

Dean Hardy and Laurie Fowler
Odum School of Ecology, University of Georgia, Athens, GA

Landscape scale conservation planning informed by stakeholders is necessary for effective conservation action. We developed a stakeholder-informed, regional conservation plan by working with two local land trusts that operate in the Upper Oconee subbasin of northeast Georgia. Emphasizing the interdependency of ecological processes and human livelihood to area residents motivates stewardship; hence, we focused on proxies for ecosystem services. In the United States, private landowner conservation is essential for successful protection of ecological processes and biodiversity. The prevalent route for involving private landowners with conservation is through partnerships with land trusts. A rapid proliferation of land trusts across the U.S. over the past decade indicates the increasing importance of private land conservation efforts. As our primary objective, we developed a GIS model for evaluating nine conservation features in the landscape using a weighted scoring system modified from the Georgia Land Conservation Program evaluation criteria. We extracted the 15 highest-ranking parcels as target recruitment parcels, and visually assessed them with 2007 aerial imagery for accuracy. The land trusts will begin targeting these 15 parcels for easement recruitment immediately. The second objective included quantifying these nine conservation features for current easements to inform the land trusts of the regional context of their holdings and to allow for development of a regional conservation strategy.

CAN WE MAXIMIZE BIODIVERSITY BY MAXIMIZING THE NUMBER OF SPECIES?

Shan Huang¹, Nate Nibbelink² and John Gittleman¹
¹Odum School of Ecology, University of Georgia, Athens, GA
²Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA

Ecologists have focused a lot of effort on explaining the patterns in biodiversity and exploring their implications. Most of surveys measure biodiversity in the number of species observed or estimated to occur within a certain area – species richness with the unrealistic assumption that all species are equal in contributing to biodiversity. Phylogenetic diversity (PD) on the other hand reflects both the phenotypic and genetic diversity of the species assemblage. We used the world’s extant terrestrial mammals as an example group to explore the relationship between species richness and PD at a global scale in order to assess the predictability of species richness for phylogenetic diversity with a conservation purpose. Our results showed a strong global correlation between species richness and PD in 1 * 1 deg (latitude * longitude) grids. However, variations of PD in grids with similar species richness implied potential problems of using species richness as a biodiversity surrogate. We also examined the relationship within the biodiversity hotspots currently targeted by Conservation International and showed that not all of these hotspots are located at the high level of PD to species richness ratio. Our results suggested that species richness can be a general surrogate of biodiversity when used with caution.
POPULATIONS AT RISK: MICROBIAL INTERACTIONS MAY BE KEY FOR UNDERSTANDING ANTHROPOGENIC DISTURBANCE AND SPONGE DISEASES
Jessica Joyner\textsuperscript{1}, Erin Lipp\textsuperscript{1,2} and William Fitt\textsuperscript{1}
\textsuperscript{1}Odum School of Ecology, University of Georgia, Athens GA
\textsuperscript{2}Environmental Health Science, College of Public Health, University of Georgia, Athens GA

Global climate change and anthropogenic disturbances are a growing threat for coral reefs. Disease is one of the threats that marine organisms face and already there is a loss of entire sponge populations due to infections. The etiology of these diseases can be understood by studying natural microbial communities and comparing the communities of different environments. Water quality, specifically the distance from sewage outfall pipes, is an anthropogenic disturbance impacting many reefs and is a potential source of new microbes. The microbial communities of sponges may indicate potential pathogens and quantify the effects of the sewage outfall. The hypothesis is that there is an intake of introduced bacteria from the wastewater into sponge tissue and that the presence of foreign bacteria may out-compete symbiotic bacteria, resulting in diseased individuals. To test this hypothesis the bacterial communities of sponge individuals of the same species will be compared at increasing distances from an outfall site in southeast Florida. We expect to find a set of bacteria that are the same for all individuals and a few bacteria genera that are more common in sponges closer to and likely introduced by the sewage outfall. The applications of this research include improvements of wastewater disposal methods and coral reef conservation.

META-ANALYSIS, MYCORRHIZAS, AND MOLECULAR MARKERS: CONSERVATION OF DIVERSE TROPICAL EPIPHYTES IN DISTURBED HABITATS
Tyler Kartzinel and Dorset Trapnell
Odum School of Ecology, University of Georgia, Athens, GA

The tropical forest canopy is a “high frontier” in ecology. Epiphytic plants that reside in tropical canopies, such as orchids and bromeliads, are vital to biodiversity and ecosystem function. Pertinent knowledge of epiphyte ecology is inadequate for effective conservation in protected areas and/or restoration in disturbed habitats. This research is intended to gain a more comprehensive understanding of epiphyte ecology and address potential shortcomings in epiphyte conservation. Three specific questions will be addressed. First, are there common population genetic characteristics among species of epiphytic orchids? Second, how specific is the relationship between mycorrhizal fungi species and epiphytic orchids or bromeliads? Third, what processes might limit epiphyte population viability in disturbed tropical forest canopies? Results of preliminary studies will be presented and conservation insights will be discussed.
ESTIMATING BENTHIC DARTER (*ETHEOSTOMA INSCRIPTUM*) SURVIVAL DURING RECORD LOW-FLOWS IN A BEDROCK SHOAL

1Rachel Katz and 2Mary Freeman
1Odum School of Ecology, River Basin Center, University of Georgia, Athens, GA
2USGS Patuxent Wildlife Research Center, Athens, GA

Hydrologic changes, such as drought or flow manipulations, can affect the survival of fishes and play an important role in the persistence of river biota. Estimations of fish abundance, dispersal, and survival are important measures of population responses to environmental change, and mark-recapture methods offer an effective approach to measure these parameters. We are interested in evaluating the effects of record low-flows coupled with flow municipal water withdrawals on fish survival. We applied a robust-design, capture-recapture model to estimate abundance, capture probability, and survival of the Turquoise darter, *Etheostoma inscriptum*, during a record drought in a bedrock shoal (1500 m$^2$) in the Middle Oconee River (Altamaha River Basin, GA) from July to November of 2008. We estimated a minimum abundance of 2,600 individuals, a capture probability of 0.11 (per 60-min sampling effort), and a survival rate of 78% per month (95%CI of 0.34-1.00 across all months). We further estimated higher survival rate per month for larger individuals (>42mm SL) compared to smaller individuals (87% and 67%, respectively). Applying this robust-design allowed us to approximate the effort required to reasonably estimate survival. By using these methods, we hope to assess the applicability of open-population models in large-river settings where individuals may frequently move out of the study area and capture efficiencies may be low.

MICRO-NICHE PARTITIONING AND PHOTOBIOLOGY OF *SYMBIODINIUM* ASSOCIATED WITH THE CARIBBEAN CORAL *MONTASTREA FAVEOLATA*

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The dominant Caribbean reef building coral *Montastraea faveolata* has been known to associate with multiple genotypes of *Symbiodinium*. The unique ability to simultaneously host diverse assemblages of *Symbiodinium* makes *M. faveolata* an ideal species to examine the physiology of genetically different coral-symbiont associations. Using micro-sampling techniques we identified up to three distinct genotypes representing three different clades of *Symbiodinium* co-occurring within *M. faveolata* from the northern portion of the meso-american barrier reef in Puerto Morelos, Mexico. Coral colonies were screened for symbiont diversity using denaturing gradient gel electrophoresis (DGGE) of the ITS-2 region of nrDNA and specific zones were chosen reflecting *Symbiodinium* diversity. *Symbiodinium* zonation patterns were primarily determined by locally prevalent light fields on *M. faveolata* colonies. We found *Symbiodinium* type B17 to be the dominant symbiont found in high light areas within the colony, while type C7 was found to be the dominant symbiont in low light areas. Intermediately, *Symbiodinium* type A3 was found to be mixed among some of the high-light samples but was never observed as the dominant symbiont. Photo-physiological responses revealed genetically different symbiont types displayed differential high-light or low-light photoacclimatory responses suggesting a high degree of *Symbiodinium* niche specialization.
INFLUENCE OF NUTRIENT LIMITATION ON SECONDARY FOREST PRODUCTIVITY: IS THERE A POSSIBILITY OF INTERACTION WITH CHANGING CLIMATE?

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Secondary forests are a significant fraction of global forested landscapes, holding biodiversity and providing ecosystem services. These forests are a major player in global climate change. However, the effect of nutrient limitation on the productivity of these forests is unclear. We also do not have adequate knowledge of how these forests would regenerate and function under changing climate conditions. In this presentation, I propose an experiment examining the possible interaction of increasingly available nitrogen and elevated temperature on the productivity and C sequestration in tropical secondary forests.

IMPACTS OF WARMING ON ABOVEGROUND BELOWGROUND INTERACTIONS

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Global warming is predicted to change species composition and distribution with significant implications for ecosystem processes. So far studies have focused on aboveground flora and fauna reactions to warming. I plan to study interactions between above-belowground flora and fauna and ecosystem properties in response to warming.

SURVIVAL AT THE SURFACE: ENHANCED PHOTOPROTECTION PATHWAYS IN SHALLOW WATER SYMBIODINIUM

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Photoprotections are necessary for the survival of the coral-dinoflagellate symbiosis. However, not all symbiont phylotypes display the same sensitivity to the enhancement of photosynthetic loss at high light and temperatures. We have found that members of different clades in the genus Symbiodinium exhibit distinct physiological responses as measured by a novel serial irradiation pulse (SIP) PAM fluorometry method. We monitored fluorescence patterns indicative of photoprotections using the SIP method from March 2006 to August 2007 in three coral species in symbiosis with different Symbiodinium clades to determine seasonal changes in photosynthetic physiology as ocean temperatures fluctuated naturally and light intensity was increased artificially. The synergism of sustained high light and increased temperature underlies damage to the coral-dinoflagellate symbiosis by causing photosynthetic loss in Symbiodinium cells. Unlike clades B and C, clade A Symbiodinium, in culture and in hospice, show enhanced capabilities for alternative photosynthetic electron transport pathways including cyclic and/or chlororespiratory electron transport. Clade A Symbiodinium also undergo pronounced light-induced dissociation of antennae complexes from photosystem II reaction centers as a major component of non-photochemical quenching. Cnidarians harboring clade A Symbiodinium exhibit sustained cyclic activities coincidental with diminished bleaching during periods of elevated temperature and high light.
Aquatic ecosystems act as sentinels for environmental change through their connectivity to the terrestrial landscape. These sensitive ecosystems play intrinsic roles in the transport of energy, nutrients and contaminants as well as provide habitats to diverse species and municipal water supplies. The Chattahoochee and Flint Rivers and the ground-water fed stream, Spring Creek, merge to form Lake Seminole, a 37,000 acre (15,200 ha) subtropical reservoir. The lake's outflow to the Apalachicola River is significant to Florida because it influences the water quality and quantity that supports a diversity of freshwater and estuarine biota. The goals of this study are to: 1) contrast nutrient inputs from the major rivers as they relate to differences in land use in each watershed, 2) determine if Lake Seminole is a major sink for inorganic nutrients under different hydrologic regimes by creating a water and nutrient budget; and 3) investigate how organic matter derived from the production of the invasive aquatic macrophyte Hydrilla verticillata influences the lake's nutrient cycles. Preliminary data indicates that Lake Seminole is acting as a sink for nitrogen and phosphorous and it is likely that the growth of Hydrilla is contributing to the impediment of nutrient flow. Ultimately, this research will lead to a better understanding of the how land use affects the lake/river system during periods of both low and high flows and to what extent the combination of climate change and human water use will influence important ecological processes.

My proposed master's research falls under the larger umbrella of climate change and the roles of terrestrial forests and tropical forests to act as potential carbon sinks. While there is much climate change research targeting the use of forests as carbon sinks, there is far less known about potential effects of nitrogen and phosphorous limitations on systems’ abilities to store carbon. There may be a synergistic relationship between nitrogen (N) and phosphorous (P), where one may enhance the biological action of the other, while both remain important for forest carbon sequestration. The terrestrial forests of the Southern Appalachian Mountains have traditionally been considered to be N-limited system. In contrast, tropical forests have long been considered as P-limited. I am interested in collecting data from a Southern Appalachian terrestrial forest and a Costa Rican tropical forest to do a comparative study examining N and P dynamics and implications for forest productivity. I am also interested in using natural elevational gradients to simulate climate change in these two forests. I plan to compare N and P dynamics along these elevational gradients and between the temperate and tropical forest systems to better understand their potentials to act as sinks for atmospheric carbon dioxide (CO₂).
HOW DETRITIVORES MEDIATE LEAF LITTER SPECIES EFFECTS ON BENTHIC OXYGEN DEMAND

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Many blackwater rivers of the coastal plain exhibit seasonally low dissolved oxygen, due in part to microbial oxygen uptake as leaves decompose on the river bottom. Forest composition, by determining leaf litter chemistry and indirectly affecting aquatic microbial biomass, may affect benthic oxygen demand. In a hypothetical system that receives equal-mass inputs of leaves from several tree species, contributions to oxygen demand should vary temporally among species for two reasons: because of immediate effects of leaf quality on microbial biomass, and also because the biomass of each leaf species remaining in the system declines at different rates among species. Macroinvertebrates may be the key drivers of this second process. We tested these hypotheses by incubating leaves of five common tree species in two reaches (third and sixth-order) of a blackwater river in Georgia’s coastal plain, and repeatedly measuring oxygen uptake, macroinvertebrate and microbial biomass, and leaf mass loss. Microbial oxygen uptake differed significantly among leaf litter species and was correlated with fungal biomass in the third-order reach. However, no such relationship existed in the sixth-order reach, possibly due to environmental feedbacks or microbial community differences. Macroinvertebrate effects were greatest in the swamp, where labile leaf litter species were rapidly consumed.

A NEW SPECIES OF CORAL? APPLYING A MULTI-DISCIPLINARY APPROACH TO INVESTIGATE SPECIES BOUNDARIES IN THE GENUS AGARICIA

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The biological diversity of coral reefs is renowned, and yet much of that diversity is still poorly understood. Coral taxonomists have traditionally relied on morphological variation to describe species relationships, but newer phylogenetic analyses have often proved discordant. After finding an undescribed morphotype of coral in the genus Agaricia, we are using multiple tests to examine taxonomic relationships within Agaricia with the goal of determining the species status of the novel coral specimens. First, phylogenetic relationships are explored using several nuclear and mitochondrial loci, comparing 4 extant species with the undetermined specimen. Results thus far show a two clade divergence within Agaricia with further molecular classification uncertain. Morphological comparisons are also made by examining fine-scale skeletal variations among species. Finally, the ecological niches of each are compared, including their typical growth habitats and their symbiotic associations with photosynthetic algae.
Non-point source pollution is an increasingly significant problem threatening the ecological health of Georgia’s watersheds. As impervious surfaces creep across the landscape, pollutants from stormwater are added to Georgia’s streams and rivers in higher concentrations. Sediment from a construction site or fertilizers from a landscaped area can have significant negative effects on the ecology of streams and rivers. Agricultural non-point sources of pollution are also being reexamined as we move into an era with greater opportunities through technologies and raised awareness of watershed protection. Finally, uncovering problems like septic systems failures and identifying previously unknown or clandestine sources of non-point source pollution are also important steps in the evolution of mitigation. As local officials around Georgia struggle to deal with providing water for growing communities and the ecological impacts of development, industry, and agriculture are better understood, mitigating non-point source pollution is one way to foster the sustainability of Georgia’s water resources. We are creating this guidebook to achieve the following goals: 1) educate the typical Georgia citizen and/or policy maker in ways to mitigate non-point source pollution, 2) serve as a tool for policy makers and citizen groups by including practical solutions, 3) create an online information center hosted by the River Basin Center.

Using streamflow records and stream/aquifer end member mixing to analyze surface water and groundwater connectivity in the Lower Flint River Basin, Southwest Georgia

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Recent droughts of record, competition for finite water resources, and climate change projections have heightened the need to examine water consumption in Georgia and throughout the southeastern US. Water demand for row-crop irrigation in the agriculturally-intensive Coastal Plains region of southwest Georgia has increased dramatically since the 1970’s and generated concern over changes in stream behavior in the Lower Flint River Basin. Streams in this watershed, which also function as critical habitat for threatened and endangered mussel species, are hydraulically connected to the Upper Floridan Aquifer, the major source for millions of gallons of water used by center-pivot irrigation systems. Analyses on historical USGS stream flow records reveal that since 1980, and concurrent with increased demand for groundwater and surface water extractions, significant reductions in low-flows in both Ichawaynochaway and Spring Creek have been observed. Baseflow recession curves have also significantly steepened in early summer periods in Ichawaynochaway Creek, where both surface and groundwater withdrawals occur. In addition, zero-flow periods have increased during late summer and early fall in Spring Creek, located in the area of highest demand for groundwater extraction in Georgia. I will present these data and highlight future plans to investigate stream/aquifer connectivity in these sub-basins using end-member mixing investigations to determine where losing stream condition may most likely occur in these streams.
BEHAVIORAL DETERMINANTS OF PATHOGEN TRANSMISSION IN AFRICAN APES

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Infectious diseases are an important threat to the health and persistence of Africa's endangered apes. Currently, little is known about how social contact affects disease transmission among primates. Further, no studies have directly examined how sexually transmitted diseases (STDs), which potentially sterilize their hosts, impact wild ape population dynamics. To better understand the role of pathogens in the conservation of African great apes, I will examine 1) contact-based networks for pathogen transmission, 2) the prevalence of sexually transmitted diseases (STDs), and 3) behavioral defenses against STDs in wild Ugandan apes. I will conduct behavioral observations at Kibale Forest National Park, in Uganda, which has a well-studied and well habituated population of over forty chimpanzees. Further, I will screen previously collected ape urine and blood samples for candidate STDs using genus-level PCR at the UGA College of Veterinary Medicine. An integrative understanding of how behavioral ecology and disease epidemiology affect pathogen transmission in apes will provide crucial information for developing effective management strategies to aid in protecting endangered apes in the event of a disease epidemic.

THE INFLUENCE OF PHYSICOCHEMICAL CHARACTERISTICS AND INTERSPECIES INTERACTIONS ON THE INVASION SUCCESS OF A NON-NATIVE CRAYFISH

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Species invasions have the potential to reduce native biodiversity and alter ecosystem processes. Examining the conditions that allow non-native species to be successful allows for better forecasting of ecosystems that are vulnerable to invasion and those species that are likely to be invaders. We examined two crayfish species in the lower Flint River basin, Georgia, a native, \textit{Procambarus spiculifer}, and a non-native, \textit{Orconectes palmeri}. We correlated abundance of both species with physicochemical habitat variables, examined selective fish predation, and assessed temperature selection of both species in the laboratory. Results suggest that \textit{P. spiculifer} is superior at avoiding fish predation, and \textit{O. palmeri} may be less successful in locations with intact \textit{P. spiculifer} populations. \textit{P. spiculifer} abundance is reduced in the upstream portion of the lower Flint River likely due to warmer water temperatures. It is unclear whether temperatures have increased in recent years due to human water use.
THE EFFECTS OF THE RED IMPORTED FIRE ANT (SOLENOPSIS INVICTA) ON SEED FATE IN THE LONGLEAF PINE ECOSYSTEM

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Biological invasions disrupt the natural relationships of native communities. Solenopsis invicta (the red imported fire ant) is a well-known invasive of the southeast United States. Their impacts include human health, agriculture, and wildlife mainly resulting from their great abundance and aggressive nature. S. invicta’s impacts on native plant communities, however, are not as well known. This is due to the tendency for other factors to already affect the native plant community if S. invicta is present. The longleaf pine ecosystem is one of the few natural areas that have been successfully invaded by S. invicta. S. invicta may cause detrimental effects to the myrmecochorous relationship between ants and plants directly through seed collection, or indirectly though impacts on the native ant community. I will conduct experiments to examine the impacts of S. invicta on the plant community in a longleaf pine ecosystem. I will investigate the direct impact by determining a seed’s possible fate once it is collected by S. invicta. I will investigate the indirect impact by measuring the arthropod community before and after a disturbance within a natural area. The results are important to clarify S. invicta’s impact on the native plant community in light of its continuing range expansion.

THE IMPACT OF SUBMERGED AQUATIC VEGETATION (SAV) BEDS ON WATER QUALITY IN A RESERVOIR LOCATED IN THE SOUTHEASTERN UNITED STATES

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The proliferation of invasive aquatic plants in reservoirs of the southeastern United States can impact those reservoirs by fundamentally changing water quality. Beds of submerged aquatic vegetation (SAV), dominated by Hydrilla verticillata, can potentially alter the water quality within a reservoir when compared to the water quality of inflowing rivers. As a result of preliminary sampling, we found differences in the physical characteristics (DO, temperature, and pH) and chemical components (nitrate, ammonium, and phosphate) between water within a SAV bed and the free-flowing water adjacent to the bed. We plan to study these changes both spatially (horizontal and vertical) and temporally (diurnal and seasonal). These physical and chemical changes produced by Hydrilla verticillata potentially alter the overall water quality within Lake Seminole and other reservoirs across the southeast where introduction and proliferation of invasive aquatic plants have occurred.
HOW DOES STREAM NUTRIENT LOADING AFFECT THE IMPORTANCE OF CONSUMER SPECIES IDENTITY IN CONTROLLING RATES OF ECOSYSTEM NUTRIENT RECYCLING?

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Nutrient recycling by consumers is an important biogeochemical process in aquatic ecosystems, yet we have a limited understanding of what factors control rates and ratios of nutrient recycling under different background nutrient levels. To better understand how the nutrient content of food resources and the nutrient demands of consumers control nutrient recycling, we measured nitrogen (N) and phosphorus (P) excretion rates for 12 fish species ranging in diet across four streams ranging widely in dissolved P. N-excretion increased with the proportion of insects in the diet, while P-excretion was controlled by diet, fish body N:P, and stream P-levels. The relative importance of fish body N:P in controlling P-excretion was high, considering the small range of N:P ratios for fishes in this study (molar ratios 5.0-6.7). Phosphorus excretion rates increased in high-P streams, especially for insectivores with low N:P ratios, indicating that P-enriched food resources in these streams were saturating P-demand for these consumers. Conversely, we found that in the lowest-P stream, a single fish species is responsible for most of the P-recycling due to its insectivorous diet and low P-demand. Our results indicate that species identity plays an important role in determining rates of nutrient recycling, and that community shifts towards species with slightly different N:P ratios may greatly alter ecosystem nutrient availability in low-nutrient streams.

PREDICTIONS OF BIOTIC HEALTH IN URBAN STREAMS WITH REDUCED STREAMFLOW

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Drought is viewed typically as an issue of water quantity, but drought also likely has strong effects on water quality in streams, particularly in urban watersheds. These effects may occur via increased pollutant and nutrient concentrations and streamwater temperature, as well as reductions in instream habitat. We used multiple measures of flow, such as seasonal means, minima, maxima and variability, from USGS gauge data to examine patterns in the macroinvertebrate index for seven tributaries of the North and Middle Oconee rivers in Clarke County, Georgia. Macroinvertebrate samples were collected seasonally from 2000-2008 and scored by trained volunteers using the Georgia Adopt-A-Stream biotic index. Statistical analyses suggest that streamflow is a significant predictor for the biotic index. The index appears to have a peaked response to streamflow and a negative response to flow variability. These results provide insight into the factors structuring benthic macroinvertebrate communities in urban streams in the Oconee River Basin, and may guide the use of this index for bioassessment throughout Georgia. We also present the framework for an additional study assessing microbial community structure and function in urban streams in the Upper Oconee Watershed, whereby breakdown rates of wood will be calculated and bacterial and fungal community structure will be obtained using T-RFLPs.
THE KEYSTONE ROLE OF FUNGI IN ORGANIC MATTER TRANSFORMATION IN DETRITUS-BASED STREAMS

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Heterotrophic microbes are important decomposers of organic matter in forested headwater streams and play key roles in the transfer of energy and nutrients up food webs in detritus-based systems. Fungi, in particular, not only contribute to the quality of coarse fractions of organic matter, but also may indirectly contribute to the generation of fine particulate organic matter (FPOM). Nutrient enrichment may also facilitate increases in the quantity and quality of FPOM through enhancement of fungi associated with coarse particulate organic matter (CPOM) as well as increased bacterial biomass on FPOM, respectively. To quantify the unique role of fungi in heterotrophic stream ecosystems and to determine the impact of fungi in enriched conditions, we manipulated presence or absence of fungi, nutrients, and invertebrate consumers in laboratory microcosms and examined effects on FPOM quality and quantity that occur via invertebrate feeding on CPOM. Nutrient enrichment resulted in increased production of FPOM and this effect was further magnified when fungi were present. Additionally, nutrient content of CPOM increased under enriched conditions, presumably due to increased activity of heterotrophic microorganisms. Our results suggest that fungi not only play a key role in ecosystem response to nutrient enrichment through changes in CPOM, but also impact FPOM dynamics as well, thereby affecting consumers of both these resources.

MEASURING BIOLOGICAL EFFECTS OF DEVELOPMENT: A PAIRED WATERSHED APPROACH

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As human populations continue to increase, the effects of urban development on natural systems are increasingly important to quantify, in order to set limits to potential losses in ecosystem services. Little is known about how ecosystem functions of streams are affected within urban landscapes but they likely respond to altered physical, chemical and biological pathways associated with watershed land use change. Low-impact development (LID) is one strategy that attempts to mitigate environmental degradation and loss of ecosystem functions commonly associated with increased watershed impervious surface cover. A paired-watershed approach using sites in the Etowah drainage in northern Georgia will be used to investigate effects of both LID and conventional development. We will use relatively new approaches to quantify temporal change in stream food webs, which integrate potential effects of physical, chemical and biological change. Stable isotope analysis of salamanders, macroinvertebrates, periphyton, as well as allochthonous and detrital inputs will be used to develop trophic relationships in four headwater streams (two control streams and two slated for development). Specifically, we will develop baseline data of stable isotope abundance to determine future directional change in food webs using circular statistics. Using baseline data to determine primary energy flow pathways within these streams will indicate the qualities of the stream and watershed that are most critical to conserve.
COPEPOD ABUNDANCE DRIVES THE SEASONALITY OF PATHOGENIC VIBRIO SPECIES

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\textit{Vibrio cholerae}, \textit{V. parahaemolyticus} and \textit{V. vulnificus} are important human pathogens that persist in coastal marine environments as a natural part of the microbial flora. Over a one-year period, water and plankton (63-200 and >200 m) were collected from shellfish harvesting waters (Georgia, USA) and analyzed for the presence of total and pathogenic vibrios. Temperature, salinity and dissolved oxygen were significant drivers of pathogenic vibrios. General linear models revealed that seasonal changes in the relative abundance of copepods were related to the concentration of \textit{Vibrio} species in the plankton fractions. In the >200 mm size fraction, every 1\% increase in the relative abundance of copepods corresponded to a 16.68-fold increase in \textit{Vibrio} species concentration. PCR analysis confirmed that copepod abundance was a driver of pathogenic vibrios. Specifically, the relative abundance of copepods in the 63-200 \(\mu\)m size fraction was directly related to the prevalence of \textit{V. cholerae}, \textit{V. parahaemolyticus} and \textit{V. vulnificus}, and genes associated with virulence in \textit{V. parahaemolyticus} and \textit{V. vulnificus}. Our results confirm the role of temperature, salinity and DO in \textit{Vibrio} species seasonality but also highlight an important and independent role for plankton composition in explaining seasonal changes in \textit{Vibrio} species concentration. Current work is focused on the development of new tools, like fluorescent protein markers and Real-Time PCR, to further define the relationship between pathogenic vibrios and copepods.

VIBRIO CHOLERAE: AN ECOLOGICAL EXAMINATION OF VIRULENCE

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Cholera remains an important public health problem afflicting millions of people each year. It is endemic in many parts of the world and continues to cause seasonal outbreaks in highly populated areas of Asia, Africa and Latin America. The overarching goal of this study is to investigate the advantages of virulence genes in \textit{Vibrio cholerae} as adaptive strategies for ecological success. We also plan to examine the environmental signals that drive this adaptive strategy. We hypothesize that the evolutionary drive for ecological fitness and persistence in this species involves production of virulence determinants (i.e. adhesins, toxins etc.) that aid the organism in nutrient acquisition and capture. More simply put, virulence in \textit{Vibrio cholerae} is a trophic strategy driven on a transcriptional level by inputs from the environment. The nature of trophic strategies and the environmental signals that regulate them are a complex web of synergisms, the complexity of which is beyond any one investigation. To simplify for investigative purposes we will distill our investigation down to what we believe to be the least common denominator in marine microbial ecology---iron. We will predominately focus on the implications of iron flux in the environment as a signal for transcription of virulence determinants in \textit{Vibrio cholerae} with special emphasis on the commensal relationship with the gut of the copepod as a form of mutualistic iron management.
MOSQUITO COMMUNITY COMPOSITION, ARBOVIRUS PREVALENCE, AND HOST-FEEDING PATTERNS IN A SOUTHWEST GEORGIA ECOLOGICAL PRESERVE

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The linkages between the environmental variables of an ecosystem, mosquito species supported, and arbovirus prevalence are important because of their possible impact on human health. This project aims to examine these linkages by studying how environmental factors may influence mosquito community composition, arbovirus prevalence, and host-feeding patterns in a southwest Georgia ecological preserve. We hypothesize that mosquito community composition will be influenced by the environmental variables specific to each site. We also hypothesize that arbovirus prevalence found in this study will be lower in comparison to urban arbovirus prevalence due to higher host diversity in the study area. To assess these hypotheses, weekly mosquito collections were made at eight study sites within Ichauway Ecological Preserve during one field season. The environmental variables of rainfall, temperature, and relative humidity were recorded at each site during the course of the season. Pools of mosquitoes were made from the weekly collections and are currently being tested for the presence of arboviruses at the Southeastern Cooperative Wildlife Disease Study in Athens, GA. All blood-fed adult mosquitoes collected are currently being subjected to DNA sequencing to determine the vertebrate source of blood meals at SCWDS also.

FORAGING DECISIONS, PARASITES, AND PREDATION RISK

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Trade-off theory predicts that animals balance the benefits of foraging with the costs of predation. One overlooked factor that may modulate foraging decisions is parasitism. By increasing energetic demands, parasites may increase foraging rates in their hosts, exposing them to greater risks of predation. Alternatively, parasites may reduce the activity level of their hosts through modification of physiology or risk perception, and so reduce the risk of predation. I predicted that during conditions of high predation risk foraging hosts were significantly more likely to be parasitized and that during conditions of low predation risk, foraging hosts infection status would not differ from baseline prevalence levels. To test these predictions I examined capture probabilities of the three most numerous rodent species (Peromyscus manticalatus, Microtus montanus, and Zapus princeps) in an alpine community for three monthly periods. I focused analyses on new moon and full moon phases as animals are sensitive to moonlight as a cue of predation risk. To examine whether parasites had a significant impact on capture probability I measured intestinal parasite prevalence and intensity for each captured individual. Results indicate that foraging decisions can be modified by parasites and predation risk in alpine rodent species.
The interaction between myrmecophytes and their obligate ant colonies, particularly that between ants and acacias, has been a popular example of a mutualism for many years. However, emerging evidence suggests that this interaction is not as simple as was once thought. Myrmecophytes of both the New and Old World are examined with respect to those organisms that are associated with the ant-plant interaction in order to explore the full range of the nature of the interaction. The two extremes of pure mutualism and outright parasitism can both be observed, in addition to varying steps in between. Notably, the plants have never been observed to take advantage of the mutualism in a parasitic manner, but they have been shown to have the ability to maintain mutualism through the use of exclusion filters. Quantitative experiments are cited to support these findings where available, and suggestions are made as to what further research could be done to provide further insight into the nature of myrmecophyte interactions.

MODELING DETECTABILITY OF AQUATIC SNAKE COMMUNITIES

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The global decline of amphibians and reptiles, which play important roles in ecosystems, is well-documented and widely recognized as a paramount conservation concern. Data are rarely available to quantify the status of such cryptic species at population or landscape scales, especially in inaccessible (i.e. aquatic) habitats, which precludes conservation and management decisions. Occupancy (presence/absence) modeling may be the only feasible metric for monitoring population status of such secretive species. For categorical, presence-absence data to be useful, however, estimates of species-specific detection probabilities must be incorporated into surveys. In this study we provide the first estimates of detection probability and site occupancy for aquatic snakes and use aquatic snakes as a model for incorporating detection probability in presence/absence monitoring of herpetofauna. Specifically we surveyed twenty isolated wetlands for aquatic snakes using multiple replicates per day, calculated species-specific detection probabilities and proportion of area occupied estimates using PRESENCE and compared models assessing the ability of site-specific covariates to predict these two metrics. Our results emphasize that extensive effort must be employed to infer absence of rare or cryptic species, and underscore the importance of incorporating detection probabilities into population size and patch occupancy estimates.
SPECIES RICHNESS AND NUTRIENT COMPOSITION OF PRIMARY PRODUCERS IN BAHAMIAN SEAGRASS BEDS

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Ecological stoichiometry provides a theoretical approach to understanding how nutrients are distributed within an ecosystem. Little is known about nutrient distribution and storage within the coastal Caribbean ecosystems, and as commercial development increases in the region, it is important to establish a baseline understanding of this ecosystem parameter. Primary producers serve as good indicators of nutrient distribution within ecosystems because of their ability to differentially store excess nutrients. The goals of our study were to establish an understanding of the primary producer distribution with respect to species composition, biomass and nutrient content across a large spatial gradient within a seagrass ecosystem. To do this we gathered 67 primary producer cores within two sites located on Abaco Island, Bahamas, to quantify primary producer composition, biomass, and nutrient content. Though we were not expecting to find substantial spatial variability with regard to species composition, we did expect to find variability with respect to nutrient content due to a difference in ambient nutrient content in the water as a result of the large spatial gradient. Our results indicated that there was some variability in the nutrient content across the spatial gradient. Future studies conducted in the region will be able to use our data set to observe how the region is changing.

GENETIC VARIATION IN ACER RUBRUM IN RESPONSE TO INCREASED TEMPERATURES AND ELEVATED ATMOSPHERIC CO₂

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The foundation of approaching global change includes increasing concentrations of atmospheric carbon dioxide (CO₂) leading to increased global mean temperatures. Although previous work has observed genetic variation in response to either elevated CO₂ or temperature, this study is the first to examine the concurrent effects of both elevated CO₂ and temperature simultaneously. Acer Rubrum, red maple, is currently one of the most abundant tree species in eastern North America; geographic distribution changes of red maple are likely to have important implications for temperate forest succession and characteristics. We ask whether the impacts of CO₂ on fitness will amplify or negate the effects of rising temperatures, and will attempt to predict how changes in climate and atmospheric composition might affect regional distribution and survivorship of A. Rubrum. In 2002, seeds collected from 28 populations throughout the eastern United States were germinated and monitored in glass houses at Harvard University under two CO₂ concentrations (370 l/l and 600 l/l) and three temperature regimes (23°C day/18°C night, 26°C/22°C, and 29°C/26°C), resembling mean growing seasons in Massachusetts, Virginia, and Georgia. Samples are currently in processing, and analysis is expected to begin early December 2008.
COMPARING POPULATION SIZE ESTIMATORS FOR LARVAL STREAM PLETHODONTIDS
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Plethodontid salamanders are among the most abundant vertebrates of forested ecosystems in the eastern and northwestern United States. Southern Appalachian streams are hotspots of diversity for semi-aquatic plethodontids- a single stream may include more than a dozen plethodontid species and larval densities as high as 60 per m². Larval plethodontids are one of the most profuse predators of first and second order streams and are important nutrient sinks because of their remarkable abundance and metabolic efficiency. Despite their considered importance, very little is known about the effects of plethodontids on ecosystem processes, and few studies have estimated absolute abundances of salamander populations. This research will compare larval salamander abundance estimation of four species by means of the mark-recapture method. The project will use pre-existing data from a study of these species across six streams at the Coweeta Hydrological Laboratory LTER site. The different categories of mark-recapture models will include closed-population, open-population, and robust design models to demonstrate how different model assumptions can result in a wide range of population estimates. Because these abundance estimates will be coupled with data examining the role of plethodontids in nutrient cycling and storage in forest ecosystems, this study will provide a better understanding of the current effects of larval stream plethodontids on stream processes.

MALE SONG PERFORMANCE CORRELATES OF REPRODUCTIVE SUCCESS AND MORPHOLOGICAL CHARACTERS IN THE DARK-EYED JUNCO (JUNCO HYEMALIS)
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Within a given population, there exists a wide range of phenotypic variation and variety within males is commonly used by females to judge male quality. In songbirds, variation in male song performance can be used as a predictor of male quality and subsequently reproductive success. Male Dark-eyed Juncos (Junco hyemalis), small North American songbirds, typically sing a single, repeated, high-pitched trill. Due to motor constraints, a male’s trill rate constrains its frequency bandwidth. A “high performance” song is one which the frequency bandwidth approaches the physiological limit for a given trill rate. Therefore, physically robust males should sing higher performance songs. This study investigates if A) junco song performance is correlated to reproductive success? and B) if junco song performance is correlated to other phenotypic measures of male quality? We recorded the songs of 65 male juncos, measured various morphological characters, took blood samples, and tracked their nesting success over the course of the 2008 breeding season. Results are not statistically significant, yet trends suggest that higher performance singers are more physically robust males. Surprisingly though, better singers had lower apparent reproductive success than poor-singing competitors. However, robust males are known to have higher actual reproductive success due to more extra-pair fertilizations and therefore we expect results of paternity analysis (still pending) to demonstrate equal or higher reproductive success for high-performance singers.