Odum School of Ecology Graduate Student Symposium

January 27 & 28, 2017

Welcome and Acknowledgements

Welcome to the 23rd annual Graduate Student Symposium at the Odum School of Ecology! The Graduate Student Symposium (GSS) is organized by graduate students and serves as a medium to showcase ongoing student research at all stages of development. The goals of the symposium are to offer opportunities to give professional presentations, enhance communication between students and faculty throughout the University of Georgia, and provide a forum for interacting with a successful and prominent keynote alumnus or alumna.

This year's symposium could not have happened without the input of numerous graduate student volunteers on the following seven committees. Their roles in organizing this event are appreciated!

- Program Committee: Kaylee Arnold, Jeffrey Beauvais, Amy Briggs, Michelle Evans, and Reni Kaul
- Undergraduate Poster Committee: Robbie Richards, Alex Lee, and Julie Tierney
- Judging Committee: Elizabeth Hamman, Kelly Petersen, Cecilia Sanchez, and Nate Tomczyk
- Food and Beverage Committee: Emily Johnson, Elise Krueger, and Claire Teitelbaum
- Souvenir Committee: Daniel Harris, Keysa Rosas, and Julie Ziemba
- Prospective Student Committee: Anya Brown, Paige Miller, and David Vasquez
- GSS Documentation and A/V: Wes Flynn and John Vinson

Many undergraduate and graduate students also cheerfully volunteered to serve as poster and presentation authors, session moderators, audio-visual coordinators, and countless other roles. Furthermore, faculty, post-docs, and students all contributed as presentation judges. The critical, yet friendly feedback obtained from these judges is one of the hallmark components of GSS, and one of the most beneficial elements of the event. Thank you all!

The staff of the Odum School of Ecology provides administrative and technical support throughout the event ranging from computer problems to event publicity to speaker arrangements. In particular, Katherine Adams, Beth Gavrilles, Allison Walters, Elaine Dunbar, Brenda Mattox, Emily Schattler, Brian Perkins, Tyler Ingram and Shialoh Wilson are to be acknowledged with highest praise! We also want to thank Seth Wenger for hosting our keynote speaker.

Finally, we thank you for making time out of your busy schedule to attend the event. We hope you will not only hear something new, but will also provide feedback to the student participants, enjoy yourself, and consider contributing next year!

Sincerely,
Caitlin Conn and Kelsey Solomon
2017 Graduate Student Symposium Coordinators

History of the Graduate Student Symposium

The Institute of Ecology Graduate Student Symposium was founded in 1995 by Janice Sand, Liz Kramer, Bob Hall, and Anne Dix as an outlet for graduate students to give oral presentations in preparation for national and international meetings. The first symposium involved approximately 10 student presentations on rotary slide trays from 35mm film developed in Ecology's dark room! Presentations were followed-up with a convivial potluck dinner. The success of GSS was immediately apparent with all involved having a great time and students winning presentation awards at national meetings! Other academic units at the university soon followed suit by establishing their own student symposia.

The event has grown in popularity and size over the years as the Institute has morphed into the Odum School of Ecology. In 1996, a keynote lecture was invited to the event, and soon thereafter it was decided that the keynote should be an alumna or alumnus of the UGA ecology program. Faculty, post-doctoral researchers, and graduate peers were enlisted to provide friendly feedback on presentations. An undergraduate poster session was established after ecology began a bachelor's degree program. Meals and coffee breaks were catered by local eateries to keep bellies full and attendees alert. Prospective students were soon invited the week of GSS to "get a feel for what ecology is all about." Additional administrative roles were needed to adjust to a growing symposium, and conference committees were organized to take care of invited speakers, program and scheduling, judging, food and drink, prospective student housing, and souvenirs. The table below lists *some* of the people who have been instrumentally involved in GSS.

Year	GSS Organizer(s)	Keynote Speaker	Affiliation at the time
1995	Janice Sand, Liz Kramer, Bob Hall, Anne Dix	NA	NA
1996	Janice Sand, Patty Saunders, Karen Bushaw, Elaine Hardwick, Jen Tougas	Rebecca Sharitz	Savannah River Ecology Laboratory
1997	Larkin Powell	Ronald Pulliam	National Biological Service
1998	Unknown	Unknown	Unknown
1999	Alice Miller	Karen Holbrook	Provost, University of Georgia
2000	Theresa Thom	Karen Kind Eckert	Wider Caribbean Sea Turtle Conservation Network
2001	Laura England	H. Kay Austin	International Joint Commission
2002	Unknown	Jack Webster	Virginia Polytechnic Institute
2003	Dawn Drumtra, Stephanie Madson	Jianguo (Jack) Liu	Department of Fisheries and Wildlife, Michigan State University
2004	Gretchen L. Peltier	Peter Groffman	Cary Institute of Ecosystem Studies
2005	John Kominoski, Caralyn Zehnder	Carol Couch	Georgia Department of Natural Resources
2006	Chrissa Carlson, Carol Flaute	William Cale	University of North Alabama

2007	Andrew Mehring, Sonia Harnendez	Johnathan Ambrose	Georgia Wildlife Resources Division
2008	Ching-Yu Huang, Chip Small	Nick Haddad	North Carolina State University
2009	Dean Hardy, Jamie Winternitz	Evelyn Gaiser	Florida International University
2010	Jessica Joyner, Shafkat Khan	Elizabeth Anderson	Field Museum of Natural History
2011	Peter Baas, Megan Machmuller	Ned Gardiner	National Oceanic and Atmospheric Administration
2012	Kimberly Kellett, Kyle McKay	Matt Whiles	Southern Illinois University – Carbondale
2013	Courtney Collins, Ethan Epps	Wyatt Cross	Montana State University
2014	Carly Phillips, Sam Woolford	Bob Hall	University of Wyoming
2015	Katie Brownson, Elise Krueger	Mike Strickland	Virginia Tech
2016	Jessica Chappell, Rachel Smith	Doug Parsons	Society for Conservation Biology
2017	Caitlin Conn, Kelsey Solomon	Elizabeth Suddoth	Georgia Gwinnett College

This year marks the 23nd annual Graduate Student Symposium, and we hope the tradition continues well into the future.

A note on talk formats

Talks are scheduled to start every 15 minutes with the expectation the presenter will speak for a maximum of 12 minutes. The remaining 3 minutes are allocated for questions and transition to the next speaker. The year Session IV will be a rapid fire session consisting of 2 blocks. Each presenter will have 5 minutes. Time for questions for any of the speakers will be at the end of the block.

Schedule of Events

Friday, January 27, 2017

Session I moderated by Greg Jacobs

9:00 – 9:30	Coffee and Refreshments	
9:30 – 9:45	Dr. John Gittleman	Welcoming remarks
9:45 – 10:00	Wes Flynn	Relationships between the environment, gut microbiota, and host phenotype
10:00 – 10:15	Daniel Becker	Host movement ecology and feeding behavior influence how resource provisioning affects infection risk for wildlife
10:15 – 10:30	Rachel Smith	Widening the Window of Opportunity: Effects of Saltmarsh Wrack on Mangrove Propagule Establishment
10:30 – 10:45	Cecilia A. Sanchez	Foraging Movements of Grey-Headed Flying-Foxes (*Pteropus poliocephalus*) Roosting in Adelaide, South Australia
10:45 – 11:00	Coffee Break	

Session II moderated by Kelly Petersen

11:00 – 11:15	James Wood	Assessing the Elemental Composition and Response to Land Use of a Widespread Riverine Macrophyte, *Podostemum ceratophyllum*
11:15 – 11:30	Anya Brown	Ghost Effects: lasting impacts of vermetid gastropods on succession in coral reefs
11:30 – 11:45	Kelsey Solomon	Response of stream algal primary producers to hemlock death from infestation of hemlock woolly adelgids
11:45 – 12:00	Amy Briggs	*Aedes* Mosquito Oviposition Behavior in Response to Larval Habitat Density

Lunch

12:00 – 2:15	Lunch provided

Session III moderated by Kaylee Arnold

2:15 – 2:30	Rebecca Atkins	Consequences of Intraspecific Variation within Consumer Snail Populations in Southeastern US Salt Marshes

2:30 – 2:45	Emily Johnson	Utilizing Conductivity and Macroinvertebrate Response to Inform Watershed Management
2:45 – 3:00	Chao Song	Warming Reduces Temperature Sensitivity of Soil Respiration
3:00 – 3:15	Robert L. Richards	Spatial Patterns of Host Species' Transmission Dominance on the National Bison Range
3:15 – 3:30	Julie Tierney	Nitrogen fixation dynamics during ecosystem recovery in longleaf pine savannas
3:30 – 3:45	Philipp Nussbaum	Building Public Confidence in Wastewater Treatment through Constructed Wetlands
3:45 – 4:00	Coffee Break	

Session IV: Rapid Fire Talks moderated by Rebecca Atkins

4:00	Richard Bauer	Prevalence of Polychlorinated Biphenyls (PCBs) in Aquatic Reptiles around Superfund sites in Glynn County, Georgia
	Carly Phillips	Shrub Expansion: Oh the Places Carbon Goes!
	Austin Coleman	Drivers of Community Structure and Implications for Diversity-Disease Relationships
	RajReni Kaul	Implications of Environmental Noise on Population Stability
4:25	Darren Fraser	Terrestrial Wildlife at the Salt Marsh-Maritime Forest Ecotone
	Claire Teitelbaum	How do nomadic species and their pathogens respond to changing resource distributions?
	Caitlin Conn	Quantifying Stream Functional Responses to Hydrologic Variability: If They Go Low, Does the Other Go High?
4:40 – 5:00	Questions for Rapid Fire Talks	

Poster Session

5:00 – 7:00 Refreshments and light fare provided

Saturday, January 28, 2017

Session V moderated by RajReni Kaul

10:00 – 10:45	Coffee and Refreshments	
10:45 – 11:00	Elizabeth A. Hamman	Biogenic habitat, propagule redirection and patch occupants create spatial patterns
11:00 – 11:15	Michelle V. Evans	Fine-scale Variation in Mosquito Abundance and Predicted Disease Transmission
11:15 – 11:30	Gregory R. Jacobs	Using life history theory to inform population models of an intermittent breeding fish
11:30 – 11:45	Paige Miller	Spatial patterns of disease indicate progress towards elimination
11:45 – 12:00	John Vinson	Phenology and the disease-diversity relationship: West Nile virus in NYC

Lunch

12:00 – 2:30	Lunch on your own

Session VI moderated by Michelle Evans

2:30 – 2:45	Katie A. Mascovich	Human Dimensions of the Jekyll Island Sea Turtle Project
2:45 – 3:00	Nathan Tomczyk	Dissolved Organic Carbon as a Potential Vector for Metal Bioaccumulation in Aquatic Food Webs
3:00 – 3:15	Lance Paden	Gopher Tortoise Translocation and Research Methods
3:15 – 3:30	Kaitlin J. Farrell	Source or Sink? Integrating Biogeochemical and Landscape Processes to Model Lake Carbon Budgets
3:30 – 4:00	Coffee Break	

Session VII Keynote

4:00 – 4:15	Laurie Fowler	Introduction of Keynote Speaker
4:15 – 5:15	Elizabeth Suddoth	Keynote Speaker
5:15 – 8:00	Dinner provided	

Rapid Fire Abstracts

alphabetical order by speaker last name

Prevalence of Polychlorinated Biphenyls (PCBs) in Aquatic Reptiles around Superfund sites in Glynn County, Georgia

Richard Bauer[1], and Kimberly Andrews[1,2,3]
(1) Odum School of Ecology, University of Georgia
(2) Georgia Sea Turtle Center, Jekyll Island Authority, GA
(3) Savannah River Ecology Laboratory, University of Georgia

Environmental pollution is a major long-lasting health problem for both humans and wildlife. Persistent organic pollutants, such as polychlorinated biphenyls (PCBs), have contributed to mass mortality events and reproductive failures in upper trophic level organisms. Brunswick, Georgia is home to four Superfund sites whose production facilities have resulted in contamination of adjacent aquatic habitats with PCBs. Here I present research from a pilot study of heavy metal contamination in American alligators from Jekyll Island, a barrier island located 12 kilometers from Brunswick. Additionally, I will outline prospective thesis topics involving the prevalence of PCBs in aquatic reptiles around Brunswick. Researchers from the University of Georgia and the Jekyll Island Authority's Georgia Sea Turtle Center have been monitoring populations of American alligators (*Alligator mississippiensis*), diamondback terrapins (*Malaclemys terrapin*), and loggerhead sea turtles (*Caretta caretta*) that use freshwater, salt marsh, and ocean habitats around the barrier islands and mainland Brunswick. Blood and tissue samples have been collected from alligators in order to test for the presence of heavy metals such as copper and mercury as a pilot study. Blood and tissue samples have been stored from alligators, sea turtles, and terrapins in order to test for the presence of Aroclor 1268, a PCB that is endemic to the area and was manufactured at the highest priority Superfund site in Georgia. This research hopes to determine the prevalence and distribution of Aroclor 1268 accumulation in three ecologically important and federally and state threatened species to investigate the threat of PCBs to aquatic ecosystems.

Drivers of Community Structure and Implications for Diversity-Disease Relationships

Austin Coleman[1], and Stacey Lance[2]

(1) Odum School of Ecology, University of Georgia
(2) Savannah River Ecology Laboratory, University of Georgia

Biodiversity is being lost at an alarming rate due to anthropogenic activities. Concurrently, emerging infectious diseases affecting both wildlife and human populations are becoming an increasing concern suggesting a link between biodiversity and infectious disease. The dilution effect hypothesizes more diverse communities constrain pathogen infection due to an increased abundance of incompetent hosts. We aim to explore the relationship between amphibian community structure and dynamics of two infectious diseases-Ranavirus (RV) and (*Batrachochytrium dendrobatidis*) (Bd). Previous research supports a dilution effect for amphibian diseases, but was conducted in areas with low host diversity. The Savannah River Site (SRS) in South Carolina contains 100's of wetlands and over 30 species of pond-breeding amphibians. Preliminary surveys indicate widespread occurrence of RV and Bd on the SRS. In order to investigate the relationship between amphibian biodiversity and disease, we need to 1) determine the environmental drivers of the amphibian assemblages and 2) to characterize infection prevalence of the communities. In 2016, we gathered amphibian community data for 20 ephemeral wetlands using standardized capture methods. Greater than 30,000 individual amphibians were captured representing 23 species. We are using ordination methods to assess how these wetland habitats differ from each other and linear models to examine how these

environmental factors influence species richness. Preliminary analysis shows the top models include some combination of sampling time, wetland group and/or hydroperiod. We are processing individuals collected from these wetlands to determine disease prevalence and ultimately assess how environmental factors and species diversity influence RV and Bd dynamics.

Quantifying Stream Functional Responses to Hydrologic Variability: If They Go Low, Does the Other Go High?

Caitlin Conn[1], Phillip Bumpers[1,2], Amy Rosemond[1], Seth Wenger[1, 2], Mary Freeman[3], , and Kyle McKay[4]

(1) Odum School of Ecology, University of Georgia
(2) River Basin Center, University of Georgia
(3) U.S. Geological Survey
(4) U.S. Army Corps of Engineers

Stream flow has a major influence on ecosystem structures, functions and the corresponding services provided to us by rivers. Because river biota are adapted to a specific set of flow conditions in unmanaged rivers, alterations to land use, climate, and river management can affect hydrologic variability in ways that degrade – or perhaps enhance – ecological characteristics. While there are decades of well-supported research on how flow variability impacts ecosystem structure, there is relatively little known about how these changes affect ecological functions. Nevertheless, scientists have proposed that these functions be considered as management objectives alongside ecosystem structural attributes due to their importance in maintaining ecosystem services. With funding from the US Army Corps of Engineers, we are studying the effects of different flow conditions on primary productivity in the Middle Oconee River. We measure biomass of different primary producers monthly, and are measuring biomass-specific primary productivity rates through chamber studies. By modeling productivity in response to biomass changes and antecedent flow conditions, we aim to quantify the effects of different flow conditions, and thus different management strategies and climate scenarios, on important ecosystem functions.

Terrestrial Wildlife at the Salt Marsh-Maritime Forest Ecotone

Darren Fraser[1,2]

(1) Odum School of Ecology, University of Georgia
(2) Center for Research and Education at Wormsloe

Different habitat types provide different benefits to an organism. Having access to the benefits provided by multiple habitats make ecotones, the transition zone between habitats, attractive to wildlife. The salt marsh-maritime forest ecotone may be one system in which terrestrial wildlife experience benefits from both habitats simultaneously. Salt marshes are often thought of as highly productive systems that export both nutrients and energy through tidal flow. While we assume the salt marsh-maritime forest ecotone is productive, very little is known about energy flow between the two systems. We will assess how wildlife in this diverse system drives energy movement between the salt marsh and maritime forest. Remote sensing camera traps were placed at salt marsh-maritime forest edges at sites at the Wormsloe Historic Site to document the species using this edge habitat. Cameras were oriented to look along the edge and set to record a still image and a 15 second video to an SD card when the IR trigger was tripped. Cameras were checked once weekly to ensure proper operation of the equipment and to collect pictures. A total 1048 images were captured of 12 species over 1006 trap nights. Of these images a single species, :*Procyon lotor* (raccoon, 751 captures), accounted for a large majority captures followed distantly by :*Sciurus carolinensis* (Eastern gray squirrel, 91 captures), :*Odocoileus virginianus* (white-tailed deer, 87 captures), and :*Vulpes vulpes* (red fox, 32 captures). Future work will examine how some of these species utilize the salt marsh for foraging and movement.

Implications of Environmental Noise on Population Stability

RajReni B. Kaul[1], and John M. Drake[1]

(1) Odum School of Ecology, University of Georgia

Incorporating environmental noise into stochastic population models lead to two general observations. On one hand, minor environmental noise in the model simply increases fluctuation of the population's size around the stable upper bound equilibrium. On the other hand, when environmental noise is significantly large the population is not simply pushed to a different equilibrium at extinction but the upper bound equilibrium disappears and an equilibrium at extinction appears. Under large environmental noise extinction is the only stable equilibrium. This is a type of noise-induced phase transition (NIPT). As long as the noise persists interventions to maintain the population will not have any lasting impact. Looking forward, the IPCC predicts climate change will also bring increased environmental variation. Given the stochastic model predictions, this increase in environmental noise as opposed to the shift in mean environment has the potential to be more detrimental to population survival. However, the possibility or prevalence of NIPT in biological systems is unknown. The proposed work will explore the possibility of NIPT in a biological system using a microcosm approach. Chemostats of the cyanobacteria *Aphanizomenon* will be grown under light regimes with varying levels of noise. A model of this system predicts a NIPT when the environmental noise is greater than one-third of the ideal environment ($\mu = 600$PAR, $\sigma^2 = 280$PAR).

Shrub Expansion: Oh the Places Carbon Goes!

Carly Phillips[1]

(1) Odum School of Ecology, University of Georgia

The response of arctic ecosystems to global change will have critical effects on future climate. Climate warming has already triggered the expansion of shrubs across tundra, raising questions about how shrubs will affect ecosystem carbon balance. Shrub litter quality and mycorrhizal symbionts may accelerate the activity of soil microorganisms that facilitate the release of large stores of soil carbon. We investigated how shrubs affect the activity of soil microorganisms by creating soil mesocosms from areas with and without shrub species as dominants of the plant community in arctic Alaska. We created mesocosms with root-free soils at constant moisture and temperature, and quantified basal heterotrophic soil respiration rates, and the response of respiration to litter. We found that the presence of shrubs generally produced higher rates of basal soil respiration in both horizons, suggesting that shrubs stimulate microbial activity. Litter addition increased respiration across both horizons with no differences in response between shrub and non-shrub soils. These findings provide evidence that shrubs stimulate heterotrophic microbial activity to enhance carbon loss, but generate new questions about the mechanisms driving these patterns.

How do nomadic species and their pathogens respond to changing resource distributions?

Claire Teitelbaum[1]

(1) Odum School of Ecology, University of Georgia

Unlike seasonally migratory species, whose movements have predictable timing and direction, nomadic animals move irregularly as they track unpredictable resources. In comparison to migratory movements, nomadism is not well understood despite its potentially important effects on ecosystem functions and population dynamics. Relationships between movement and pathogen spread or prevalence are well studied for migratory species, but how nomadic movements affect pathogen spread and persistence is entirely unknown. Understanding these relationships is particularly important in a world where human activities are rapidly altering animal behavior and natural landscapes. I propose study how changing resource distributions alter population dynamics and pathogen persistence in nomadic animals. To do so, I will develop a modeling framework based on migratory networks to examine how changing resource distributions alter movements and pathogen dynamics of nomadic animals. I will then use empirical data on White Ibis (*Eudocimus albus*) in South Florida to investigate how changes in resource distributions alter population dynamics, pathogen spread, and pathogen persistence. White Ibis, a nomadic waterbird, live in highly developed areas where provisioning wildlife is common and are exposed to *Salmonella*, including serovars that infect humans. By combining these models and empirical data, this research will go beyond the current paradigm of movement ecology – which has focused on identifying patterns – to uncover how resources drive both animal movement and landscape-scale pathogen dynamics.

Talk Abstracts

alphabetical order by speaker last name

Consequences of Intraspecific Variation within Consumer Snail Populations in Southeastern US Salt Marshes

Rebecca Atkins[1]

(1) Odum School of Ecology, University of Georgia

Southeastern US salt marshes are some of the most productive ecosystems in the world. Within these marshes, the marsh periwinkle, *Littoraria irrorata*, is a dominant grazer of saltmarsh cordgrass, *Spartina alterniflora*. At high densities, *Littoraria* can denude expansive swaths of cordgrass, destroying associated ecosystem services. My previous research in a Georgia saltmarsh has demonstrated that both small and large *Littoraria* can shift the *Littoraria-Spartina* interaction from beneficial (+) at low densities, to deleterious (-) at high densities, and that changes in consumer interaction strength with pant biomass can be predicted based upon the total metabolic demands of the consumer population (i.e., as determined by both size-structure and density). However, factors driving *Littoraria* size structure and density within and among salt marshes, and how the resulting *Littoraria* population biomass relates to aboveground *Spartina* productivity, have yet to be explored. Initially, I've quantified spatial variation in *Littoraria* populations and *Littoraria-Spartina* interactions in salt marshes spanning Florida to Virginia. I expect that changes in temperature (related to latitude) will lead to variation in consumer mean body size and population biomass; however, site-specific variation in predator abundance and *Littoraria* recruitment may affect the strength of both this temperature-size relationship and the resulting *Littoraria-Spartina* interaction.

Host movement ecology and feeding behavior influence how resource provisioning affects infection risk for wildlife

Daniel Becker[1], Daniel Streicker[2], and Sonia Altizer[1]

(1) Odum School of Ecology, University of Georgia
(2) Institute of Biodiversity, Animal Health and Comparative Medicine, University of Glasgow

Food provided by human activities such as agriculture, recreational feeding, and conservation management can be less seasonal and more spatially reliable than natural resources, and subsequent changes to wildlife ecology can have profound impacts on host–parasite interactions. Identifying behavioral or physiological traits of species associated with increases or decreases in parasitism with resource provisioning could improve assessments of infectious disease risk to hosts in changing environments. To address this gap, we conducted a phylogenetic comparative analysis of 285 host–parasite interactions across 55 wildlife species and two broad parasite taxonomic groups to identify host traits that influence whether resource provisioning is associated with increases or decreases in infection. After accounting for shared evolutionary history of hosts and uneven sampling effort, we found that supplemental resources increase infection with bacteria, viruses, protozoa, and fungi for wide-ranging species, herbivores, and migrants. Yet for helminths and ectoparasites, provisioning was associated with reduced infection for generalist foragers, which could suggest human-provided foods enhance defenses against macroparasites or interrupt transmission for helminths with intermediate hosts. This analysis highlights host movement and feeding behavior traits as determinants of whether species experience greater infection measures under resource provisioning. Our results could help prioritize monitoring certain wildlife taxa to reduce infectious disease risk in provisioned populations.

Aedes Mosquito Oviposition Behavior in Response to Larval Habitat Density

Amy Briggs[1], and Craig Osenberg[1]

(1) Odum School of Ecology, University of Georgia

The spatial distribution of habitats can determine the movement of organisms, local densities of species that occupy that habitat, and strength of species interactions. *Aedes* mosquitoes rely on small, ephemeral aquatic habitat for oviposition, and can lay eggs from a single batch in multiple oviposition sites. Larval density in these patches can have important implications for the strength of density-dependence effects, and thus mosquito dynamics. We hypothesized that high densities of aquatic habitats could induce females to distribute their eggs across more habitats, leading to reduced egg densities within each habitat, thereby reducing larval competition and increasing survival and fecundity. Alternatively, we hypothesized that high habitat density could attract more ovipositing females, leading to increased density of eggs in sites with high densities of larval habitats. We tested these hypotheses by conducting a field experiment in which we compared oviposition in habitats that were separated from each other by 20 m (i.e., at low density) with oviposition in habitats that were separated by 1 m (i.e., at high local density). There was no significant difference in the number of eggs laid in the low-density (isolated) vs. high-density (clustered) treatments. However, isolated habitats were more likely to have zero eggs laid in them compared to clustered habitats. Overall, these results indicate that clustered habitats tended to attract more female mosquitoes, compensating for any dispersion of eggs among available habitats. Thus, areas with higher larval habitat densities should generate more mosquitoes with no change in density-dependent effects on larvae.

Ghost Effects: lasting impacts of vermetid gastropods on succession in coral reefs

Anya Brown[1]

(1) Odum School of Ecology, University of Georgia

Patterns of succession can follow a relatively prescribed set of conditions, where organisms can either facilitate, inhibit or be replaced by the eventual climax community. However, successional patterns are subject to change depending on the physical and biological environment. On coral reefs, little is known about how environmental stressors influence successional patterns, specifically how the ubiquitous, net-feeding, gastropod, *Ceraesignum maximum* affects community development. This large vermetid negative affects coral growth and survival, though it's effects on reef communities are unknown. I hypothesize that vermetids, via their nets, create distinct communities when they are present vs absent. Furthermore, following their massive die off, I expect vermetid history to have a lasting effect on the community that develops. Settlement tiles were places in the field, and their benthic cover was recorded 6months and one year later. After the 1-year data collection point, vermetids experienced a massive die off. Half of the experiment was removed and the other half left in the field to determine potential recovery. We observed vermetid presence delayed community development, which persisted even one-year post die-off. This suggests lasting effects of stressors even after their removal, emphasizing the importance of historical effects on community development.

Fine-scale Variation in Mosquito Abundance and Predicted Disease Transmission

Michelle Evans[1], Nicole Solano[2], and Courtney Murdock[1]

(1) Odum School of Ecology, University of Georgia
(2) Agnes Scott College

Mosquito life history traits relevant to disease transmission are highly dependent on microclimatic variables, such as temperature. The wide accessibility of remotely sensed temperature data allows for mechanistically driven predictions of mosquito-borne disease, but these models are unable to account for mosquito community dynamics. The amount of impervious surfaces and artificial containers varies across a landscape, and the ability to use these parameters to quantify mosquito community composition and abundance can greatly improve the accuracy of predictive models. In order to understand how mosquito communities change across a heterogeneous landscape, we conducted larval mosquito habitat and adult surveys at rural, suburban, and urban sites across Athens, GA in the summer and fall of 2016. Larval habitat density differed across land use and sampling period, and was driven by precipitation. *Aedes albopictus* dominated the mosquito community at all land classes, except for one rural site. Surprisingly, the higher *Ae. albopictus* abundance at urban sites was contrary to results from past experiments focusing on microclimate, suggesting that it is the presence of larval habitat that is driving abundance, and not microclimate. Models focusing solely on microclimate, therefore, may be ignoring the importance of mosquito densities in their disease predictions.

Source or Sink? Integrating Biogeochemical and Landscape Processes to Model Lake Carbon Budgets

Kaitlin Farrell[1], I. McCullough[2], D. Roberts[3], A. Morales-Williams[4,5], Z. Yang[6], F. Scordo[7], H. Dugan[8,9], P. Hanson[8], S. Bartlett[10], S. Burke[11], J. Doubek[12], F. Krivak-Tetley[13], N. Skaff[6], J. Summers[14], and K. Weathers[9]

(1) Odum School of Ecology, University of Georgia
(2) University of California, Santa Barbara
(3) University of California, Davis
(4) University of Minnesota
(5) University of Vermont
(6) Michigan State University
(7) Instituto Argentino de Oceanografía, Universidad Nacional del Sur, Argentina
(8) University of Wisconsin, Madison
(9) Cary Institute of Ecosystem Studies
(10) University of Wisconsin, Milwaukee
(11) University of Waterloo, Canada
(12) Virginia Tech
(13) Dartmouth College
(14) Queen's University, Canada

Lake ecosystems actively transport, transform, and store carbon. These processes result from interactions between the lake and its catchment and in-lake fluxes. Despite their dynamic nature, lake carbon budgets are most often described by equilibrium models and mass balance approaches that may not adequately capture ecosystem functions that drive variability within and among carbon pools over time. In addition, models that are developed and fine-tuned to single lakes make limited contributions to our understanding of the role of lakes in the global carbon cycle. Because ongoing climate and land use changes are altering how carbon subsidies are transported to and processed in aquatic ecosystems, determining the sensitivity of lakes to these changes will be critical to understanding their role in global carbon budgets as net sources or sinks of carbon. Using long-term data from 5 temperate lakes in the United States, Canada, and Sweden, we developed a dynamic, process-based model to better understand variability in organic carbon pools across environmental gradients of land cover, climate, hydrology, and lake morphometry. Preliminary results indicate that the lakes in our study vary in the stability of their carbon budgets over time, and as net sources or sinks of organic carbon. Ongoing work will allow us to investigate the relative importance of different mechanisms in driving organic carbon fluxes, the robustness of the model across lakes, and the sensitivity of these fluxes to environmental change with the ultimate goal of better understanding the role of lakes in global carbon cycles.

Relationships between the environment, gut microbiota, and host phenotype.

Wes Flynn[1,3], Kelsey Thompson[2], Greg Mayer[2], and Stacey Lance[3]

(1) Odum School of Ecology, University of Georgia
(2) Institute of Environmental and Human Health, Texas Tech University
(3) Savannah River Ecology Lab, University of Georgia

Gut microbial communities play critical roles in host metabolism and physiological function and are shaped by host genetics and environmental factors, including contaminants. Globally, coal combustion represents our single largest source of energy and generates toxic waste products. More than half of these coal combustion wastes (CCW) are stored in landfills and surface impoundments that are attractive to wildlife as permanent sources of freshwater. However, CCWs in these habitats create stressful conditions by putting organisms in direct contact with high levels of trace elements. We examined the relative influences of parentage and larval exposure to CCWs on the gut microbiomes of metamorphic southern toads (*Anaxyrus terrestris*). We bred adults in the lab and reared the resulting larvae through metamorphosis in their natal CCW impoundment and in a nearby reference wetland with no history of contamination. To analyze gut bacterial diversity and community structure in a subset of metamorphic toads, we sequenced the 16S marker gene from DNA extracted from the dissected guts. Richness and diversity were negatively correlated with developmental time and positively correlated with growth rate only in individuals reared in the CCW contaminated habitat. Beta diversity was related to rearing environment, developmental time, and female parent within environment. Interestingly, species richness was greater in the guts of individuals reared in the contaminated environment. These results suggest the role contaminants play in shaping these communities is complex and that host gut microbial communities could influence fitness related traits in a wild population of amphibians.

Biogenic habitat, propagule redirection and patch occupants create spatial patterns

Elizabeth Hamman[1], Scott McKinley[2], Adrian Stier[3], and Craig Osenberg[1]

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Here, we build on past models of patch colonization and post-colonization dynamics to investigate the dynamics of residents and patches when patches are comprised of biogenic habitat whose dynamics are directly affected (positively or negatively) by resident organisms. We develop models with a coral reef system in mind. Both corals (the habitat patch) and their occupants (e.g. snails and fish) have pelagic larvae that settle to a reef during pulsed settlement events. Coral growth and survival are affected by occupants, and the occupants undergo density-independent and dependent mortality. We explore how species interactions (direction and magnitude) between habitats and occupants, in combination with larval redirection, alters habitat growth, settlement rates, and spatial patterns of occupants and habitat. The spatial patterns of both corals and symbionts depend on the interaction between coral and symbiont as well as demographic parameters and the degree of redirection. When there is no redirection, corals and symbionts are distributed randomly throughout space, and only coral size is a predictor of symbiont abundance. However, in the presence of redirection of beneficial symbionts, corals display two distinct qualitative spatial patterns: 1) evenly dispersed patches throughout the landscape, or 2) large isolated patches with smaller clustered patches. When symbiont have negative on corals, clustered corals have larger sizes because neighboring corals redirect harmful symbionts. Additionally, demographic parameters influence the resulting spatial pattern. When larval supply is low, heterogeneity is great. The effects of redirection of symbiont larvae are greatest when density-dependent symbiont mortality is low and symbionts are short-lived.

Using life history theory to inform population models of an intermittent breeding fish

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Uncertainty in demographic rates can inhibit effective management of animal populations, especially when those populations are small and exhibit complex life history traits. The Lake Sturgeon (*Acipenser fulvescens*) is a fish species that has been extirpated from much of its historic range and persists in few relict populations at abundances far below those indicated in historic records. Lake Sturgeon have a long life span, exhibit delayed maturation, undergo spawning migrations, and skip one or more annual reproductive opportunities between reproductive attempts (intermittent reproduction). Theory suggests that long-lived organisms may exhibit intermittent reproduction when annual survival probabilities are sufficiently high and reproduction is sufficiently costly, in terms of time, energy, or mortality risk. We focus on a population of Lake Sturgeon in the Niagara River (bordering New York State, USA and Ontario, Canada) that was once thought extirpated, but has recently shown signs of recovery. Management agencies are interested in demographic models to better inform management practices for this population, but data are limited, especially for early life stages. We use hierarchical Bayesian state-space formulations of multi-state capture-recapture models to test competing hypotheses associated with variation in adult survival and migration. Model formulation and selection will allow us to construct population projection models for use in management applications.

Utilizing Conductivity and Macroinvertebrate Response to Inform Watershed Management

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Increased conductivity of streams is a common symptom of watershed urbanization and is often highly correlated with impaired biotic assemblages. However, we lack an understanding of the mechanisms behind these relationships. We identified the primary constituents and characterized the temporal pattern of conductivity in 12 piedmont streams in Athens, GA. Specific conductance (SpC), stage height, and temperature were measured every 5 min from July 2015 July 2016 in 7 streams, while 5 streams were measured every 2-6 weeks for SpC. Nutrient and ion concentrations were collected every 8 weeks. Calcium and magnesium were the primary drivers of SpC, suggesting weathering associated with urbanization drives conductivity in this region. However, the best model explaining SpC also included nitrate and sodium concentrations ($R^2 = 0.97$), indicating that human sources such as wastewater and runoff (e.g., stormwater) are also important drivers. Patterns of SpC were relatively stable over time, with little evidence of first flush phenomena, and diluted during rain fall events, suggesting chronic rather than acute sources of ions as the primary sources of pollution. For instance, some watersheds may be impacted by ground water contamination, while chronic sewer leaks may be important in others. Ongoing work will examine relationships between macroinvertebrate assemblage characteristics and drivers of conductivity to allow us to better understand how pollution is altering biological communities in Athens's streams. Additionally, we will create a synthesis of results as a tool for watershed management.

Human Dimensions of the Jekyll Island Sea Turtle Project

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On Jekyll Island, Georgia, sea turtles nest annually along the public beach, parts of which are immediately bordered by development. Nesting and hatching season (May through October) coincides with Jekyll's peak tourist season in the summer months. Some of the largest threats to the reproductive cycle of sea turtles result from increased human use of beaches and beachfront land. In addition to researching the nesting ecology and habitat suitability for sea turtles along the Georgia coast, we have studied the effectiveness of public education initiatives regarding sea turtle-friendly behaviors. One of these initiatives involved educating Jekyll Island's Westin Hotel guests on the threats that lights can pose to nesting and hatching sea turtles. This was implemented through the placement of informational cards in each guest room during the 2015 sea turtle season. In 2016 the hotel did not provide guests with these cards; therefore, this season acted as a control against the 2015 season. Surveys were conducted in both years to determine if guests were more likely to close their blinds at night when lighting education materials were present. The results of this study will be discussed as they relate to conservation management strategies.

Spatial patterns of disease indicate progress towards elimination

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Spread of infectious diseases depends on dispersal of the host organism through space. For many disease systems (e.g, White Nose Syndrome, Ebola, and Sudden Oak Death) this results in a patchy distribution of cases. Classical epidemiological theory, based on mean-field models, ignores this spatial aspect of transmission and assumes all individuals have an equal likelihood of becoming infected. Recent work has shown that in non-spatial models of disease spread temporal early warning signals from incidence data change in characteristic ways prior to a large shift the transmission system (i.e., a tipping point). Similarly, spatial statistics change prior to tipping points in spatial models of ecological systems (e.g., grassland-forest transitions). Therefore we wondered how reliable spatial early warning statistics are for predicting tipping points towards disease elimination compared with temporal early warning statistics. We also wondered if spatial early warning statistics are corrupted when transmission of the pathogen is non-constant (i.e., heterogeneous) through space. To examine the reliability of spatial early warning statistics for disease elimination, we first simulated a conceptual spatially-explicit, host-pathogen system. We then numerically calculated when the tipping point occurs (i.e., when $R_{eff} < 1$) in our model due to depletion of susceptible individuals with increasing treatment uptake. We then compared the reliability of temporal and spatial early warnings statistics for disease elimination in homogeneous and heterogeneous environments. We find that spatial statistics for disease elimination are informative predictors of progress towards disease elimination.

Building Public Confidence in Wastewater Treatment through Constructed Wetlands

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In collaboration with the Odum School of Ecology, the University of the South, located in Sewanee, Tennessee, is undertaking a pilot constructed wastewater treatment wetland project. The primary goal of this project is to determine whether constructed wetlands are cost-effective in removing pharmaceuticals and endocrine disruptors that are incompletely and expensively treated by most conventional wastewater systems and are likely to be regulated pursuant to the federal Clean Water Act in the future. The second major goal is to build public confidence in and awareness of constructed wetlands through a comprehensive community engagement campaign. We conducted a survey in fall 2015 and focus groups in spring 2016 to understand the Sewanee community's current knowledge and perceptions of water issues as well as the means they rely on for this information. The data we collected has, among other things, helped us to develop a project website; the first public event at the wetlands was held in October 2016. Overall, we believe that this project has the potential to encourage other communities throughout the southeastern US as well as internationally to adopt constructed wetlands to treat wastewater more effectively and inexpensively.

Gopher Tortoise Translocation and Research Methods

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A large scale gopher tortoise and commensal species mitigation and research project is underway in southeast Georgia on a heavy mineral sand mining site known as Mission Mine operated by Southern Ionics Inc. This project serves as the impetus for my thesis research. I will describe a number of applied research methodologies that we have utilized thus far to successfully clear gopher tortoise habitat on Mission Mine of all amphibian and reptiles prior to mining activity. Methodologies such as transect surveys, burrow-scoping, manual and mechanical excavations, exclusionary fencing, along with the application of prescribed fire to increase tortoise and commensal detection probability will be discussed. Additionally, I will provide an overview of the disease screening and nutrition parameters that I am using to investigate the health of relocated tortoises from the Mission Mine as well as resident tortoises at the Penholoway Wildlife Management Area recipient site as a part of my thesis. Another major focus of my thesis research involves monitoring the relocated tortoises at this recipient site. Monitoring involves a pre- and post-penning study design intended to maximize site fidelity of the translocated tortoises. Monitoring techniques such as radio-telemetry, GPS logger technology, iButton temperature recorders, and game cameras will be described within the context of their utility to aid in determining successful population integration of gopher tortoise relocation projects.

Spatial Patterns of Host Species' Transmission Dominance on the National Bison Range

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When parasites infect multiple host species, hosts that contribute disproportionately to transmission are common. These "transmission dominant" species are, by definition, important to transmission dynamics and often targets for parasite control measures. Here we examine how patterns of transmission dominance vary through space and across a suite of shared parasite species. We used fecal egg counts and DNA-barcoding identification to quantify each of 6 large ungulate host species' contribution to environmental Force of Infection (FOI) of 7 parasitic worms at the National Bison Range, Montana, USA. Our non-parametric

rank-order Friedman Tests show that hosts significantly differ in their transmission dominance rank across the 7 parasite species. Post-hoc analyses emphasize that it is the identity of the most dominant (*Bison bison* and *Cervus canadensis*) and least dominant (*Antilocapra americana*) which drive this relationship. We then fit plug-and-play species distribution models to presence data and predict presence probability across the range. Using these presence probabilities along with our species' contribution metrics we predict the relative contribution of each host species to the FOI of parasite species at a 30m scale. While host species significantly differ in their transmission dominance rank across much of the range, the actual identities of the most dominant hosts tend to differ regionally for 3 parasite species. These results suggest that efforts to target single transmission dominant hosts for community-wide disease control may be effective across multiple parasites at certain spatial scales. Variation in space usage by hosts across broader distributions may, however, require differentially targeted control efforts.

Foraging Movements of Grey-Headed Flying-Foxes (*Pteropus poliocephalus*) Roosting in Adelaide, South Australia

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Flying-fox species occur across a large geographical area of eastern Australia, but their seasonal distribution is dictated by the unpredictable availability of their preferred diet, especially eucalypt blossoms. Recently, human activities, including destruction of native habitat and planting of non-native vegetation that provides predictable foraging, have altered the distribution and foraging patterns of some flying-fox species. The consequences of this change are important for both bat and human health, given that bats harbor viruses that are transmissible to humans. In 2010, a group of grey-headed flying-foxes (*Pteropus poliocephalus*) established a permanent roost in Adelaide, South Australia, several hundred kilometers outside their previously established range. We deployed lightweight GPS loggers on five *P. poliocephalus* to track their foraging movements. Loggers were programmed to record a bat's position every 30 seconds when flying and every 45 minutes when stationary, and also recorded data on acceleration, speed, and altitude. Deployments ranged from 7-12 days and resulted in 47 nights of movement data and 83000 GPS fixes. Two flying-foxes flew along a nearby river each night and fed at patches within 10 km of the roost. The other three flying-foxes foraged widely over the landscape, feeding at multiple, more distant sites. Factors that may affect foraging movement, such as weather and bat sex, age, and body condition, will be discussed. This work provides insight into a recently-established, understudied bat population and is useful both to local Adelaide stakeholders as well as other urban citizens seeking to manage the bats that share their space.

Widening the Window of Opportunity: Effects of Saltmarsh Wrack on Mangrove Propagule Establishment

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Tropical mangrove species are expanding into temperate saltmarshes worldwide, representing a global, climate-driven transition. In Florida, black mangroves are rapidly expanding into native saltmarshes, replacing the dominant saltmarsh species, smooth cordgrass *Spartina alterniflora*. The rate of mangrove

expansion is influenced by interactions with both live standing *Spartina* and with substantial subsidies of dead *Spartina* wrack. On high tides, extensive mats of *Spartina* wrack are stranded in coastal wetlands, and wrack presence frequently coincides with the stranding of hydrochorous mangrove propagules. We were interested in how the co-occurrence of wrack and mangrove propagules affects propagule establishment. We hypothesized that wrack presence could increase the window of opportunity available for mangrove establishment by stabilizing propagules and preventing desiccation. To test this hypothesis, we performed an outdoor mesocosm experiment in which propagules were placed in pots with and without wrack under two inundation regimes meant to mimic neap and spring tide inundation. Propagule development was observed over time; dislodgement force and the ability to withstand inundation were also measured. The effect of wrack presence varied with inundation regime, as well as with propagule orientation relative to wrack. In both inundation regimes, propagules rooted faster and had better growth and performance when placed underneath wrack. Propagules placed on top of wrack quickly desiccated in the neap inundation regime, and grew more slowly and took longer to root in the spring inundation regime. When wrack and propagules co-occur in marsh-mangrove transition zones, wrack can promote propagule establishment by stabilizing propagules and minimizing desiccation.

Response of stream algal primary producers to hemlock death from infestations of hemlock woolly adelgids

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Historically, the eastern hemlock (*Tsuga canadenis*) has been considered a foundation species throughout much of eastern North America. However, the invasion of the hemlock woolly adelgid (*Adelges tsugae*) has resulted in widespread death of eastern hemlock trees. In the southern Appalachians, eastern hemlock was abundant along streams and likely played an important role as a riparian species. As a result, hemlock death may have caused significant changes to stream ecosystem processes in this region. For example, hemlock death has significantly increased canopy openness, light availability to streams, and stream temperature. However, little is known about how the loss of eastern hemlock has affected stream algal primary producers. In anticipation of hemlock die-off due to invasion of hemlock woolly adelgids, we collected preliminary data on stream benthic algal communities in eight streams throughout the Coweeta Hydrologic Laboratory in Macon County, North Carolina, in 2005 and 2006. In order to assess the affects of hemlock death on stream algal primary producers, we propose to collect post die-off data of stream benthic algal communities at the same locations in 2016 and 2017. This work will provide insight as to how algal communities in forested headwater streams respond to significant changes in riparian overstory tree composition.

Warming Reduces Temperature Sensitivity of Soil Respiration

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Temperature sensitivity of soil respiration is a critical quantity to predict the feedbacks between carbon flux and climatic warming. However, it remains poorly understood despite considerable efforts in recent decades. In particular, we lack a mechanistic understanding of how the temperature sensitivity of soil respiration

changes with climatic warming. In this study, we performed a soil incubation experiment with different temperature to investigate how warming influences the temperature sensitivity of soil respiration. We found that soils incubated under high temperature had higher respiration rate but were less sensitive to temperature. This is seemingly contradictory because high respiration rate should lead to more recalcitrant substrates with low availability, which corresponds to higher temperature sensitivity. To reconcile such paradox, we quantified the temperature dependence of the Michaelis-Menten kinetics of two enzymes critical for soil respiration, β-glucosidase and N-acetyl-β-D-glucosaminidase. We found that warming increased the temperature sensitivity of both the maximum reaction rate and the half saturation constant. Higher temperature sensitivity of the maximum reaction rate and half saturation constant may cancel each other and result in a lower temperature sensitivity of the respiration rate. Collectively, the temperature dependence of the enzymatic kinetics, together with lower substrate availability under warming treatment, may explain the paradox between lower substrate availability and warming induced lower temperature sensitivity of soil respiration. Our study contributed to mechanistic understanding of the feedbacks between temperature sensitivity of soil respiration and climatic warming and provided critical information to improve our prediction of climate changes.

Nitrogen fixation dynamics during ecosystem recovery in longleaf pine savannas

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Biological nitrogen fixation (BNF) can alleviate nitrogen (N) deficiencies that inhibit ecosystem recovery. Here, we investigated how BNF dynamics change throughout ecosystem development in restored longleaf pine savannas. We conducted this study in 59 1-ha plots of longleaf pine distributed across gradients of stand age and fire frequency at two sites in the southeastern US. We determined BNF contributions by three functional groups of N-fixers (herbaceous legumes, soil crusts, and asymbiotic N-fixing bacteria) by quantifying their abundances, assessing nitrogenase activity, and scaling these estimates up to the plot-level. Additionally, we assessed the N budget (i.e. N demands from tree growth and N losses due to fire) in each plot. We fit linear models to evaluate the effects of stand age and fire frequency on BNF and N demands throughout stand development. We observed distinct temporal patterns of N-fixation across stand development among the three groups of N fixers, such that N-fixation by asymbiotic bacteria remained low until stands reached maturity, while N-fixation by soil crusts was high in juvenile stands and decreased with stand age. Contrary to observations in most temperate forests, we found that legumes fixed N steadily throughout stand development. These patterns suggest a compensatory shift in the importance soil crusts and asymbiotic bacteria over time, while legumes remain an important source of BNF throughout ecosystem development. Our results also suggest that the combined contribution of these three groups to BNF is insufficient to balance the overall N budget, raising questions about potential constraints on BNF.

Dissolved Organic Carbon as a Potential Vector for Metal Bioaccumulation in Aquatic Food Webs.

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Understanding factors that affect biotic uptake of toxic metals is critical to predicting the effects that toxic metals have on aquatic biota and understanding how metals move though ecosystems and across habitat boundaries through animal tissues. The bioaccumulation modeling framework used for some metals, including zinc, nickel and copper is the Biotic Ligand Model (BLM). Two striking features of the BLM are 1) the model estimates metal availability solely from the dissolved phase, ignoring dietary exposure, and 2) the chemical speciation models underlying the BLM predict the amount of metals bound to DOC to be orders of magnitude greater than the amount which is available to be taken up through the gills. We argue this pool of DOC bound metal may be available to some aquatic organisms which consume DOC via the microbial loop. To test this prediction, we exposed filter-feeding black flies (*Simulium vittatum*), an aquatic organism which uses the microbial loop, and a shredding amphipod (*Hyalella azteca*), an organism which does not use this pathway, to a gradient of copper concentrations in the presence or absence of two types of DOC. Our data suggest that the *Hyalella* in high copper concentration treatments with no DOC accumulated more copper in their tissues, suggesting a protective effect of DOC. Conversely, our results indicate *Simuliidae* accumulated metals similarly in the presence/ absence of DOC suggesting DOC is less protective, possibly due to consumption of DOC-Cu complexes. Collectively, these data suggest DOC is not protective of metal accumulation for all aquatic organisms.

Phenology and the disease-diversity relationship: West Nile virus in NYC

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With global changes in diversity an understanding of how decreased host diversity will affect disease transmission is crucial. The dilution effect hypothesis posits that decreased host species diversity may lead to an increase in disease risk. Evidence for the phenomenon has been observed in both West Nile virus (WNV) and Lyme disease systems, which are transmitted through vector species. However, there remains an opportunity to explore the generality of the relationship for vector borne pathogens under both community disassembly and host species phenology. We present a multi-host SI model with vector-borne transmission, and explore the conditions under which decreased disease risk occurs, using the reproductive ratio (R_0) of the parasite. We derive conditions for changes in R_0 with host richness under scenarios where the one community is a subset of another (e.g. community disassembly, or changes due to loss/gain of migratory species). We explore predictions using a WNV case study using data on bird and mosquito abundance in Central Park, New York. Phenology in bird abundance coupled with mosquito emergence through the year combine to provide a peak period of infection risk, which corresponds to peak disease reporting following a five week shift. These results provide a potential method for predicting change in disease risk following predictable community disassembly, including migration.

Assessing the Elemental Composition and Response to Land Use of a Widespread Riverine Macrophyte, *Podostemum ceratophyllum*

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Podostemum ceratophyllum (aka Hornleaf Riverweed) is a widespread and ecologically important macrophyte of mid-order rivers in eastern North America. The plant grows submerged underwater, attached to stable benthic substrate in fast flowing water. *Podostemum* absorbs nutrients from the water column, is known to support invertebrate biomass, and is consumed by a diverse assemblage riverine fauna. However, little in known about the quality of resources the plant provides to consumer. Additionally, how land use within the watershed affects the elemental composition of *Podostemum* has only tangentially been investigated. Of particular concern is the possibility that the plants may bioaccumulate heavy metals and pass them into the food chain. We collected *Podostemum* from over 60 locations between Georgia and Maine and using optical emission spectroscopy and isotopic analysis, we examined the elemental composition of *Podostemum* to explore how land use may alter the elemental composition of the plant. Our data indicate that *Podostemum* responds to changes in land use in the watershed and that the plant may be useful as a biological indicator of nutrient enrichment in rivers where it grows.

Undergraduate Poster Abstracts

The effect of litter leachate from fresh riparian Rhododendron leaves on microbial respiration in headwater streams in the southern Appalachians

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Our project aims to study the effect of fresh leaf litter leachate from rhododendron on microbial respiration in headwater streams. When rhododendron leaves decompose they release a mixture of labile and refract tory organic compounds into the stream. This leaching process can take up to two months depending on the type of dissolved organic compound (DOC) contained within the leaves. Microbes use mostly labile compounds for growth and energy where as refractory compounds are harder to use and can inhibit growth. One particular management strategy by the USFS- LTER Rhododendron Removal Project allowed an abundant amount of rhododendron leaves and branches to remain in headwater streams for several months before burning. The leachate from these fresh rhododendron leaves may have had implications on the microbial community in that stream, depending on the amount and quality of leachate compounds. The objectives of this experiment are: (1) characterize the compounds that make up leachates from fresh rhododendron leaves as they decompose in the stream over time; (2) identify how compounds from rhododendron leached over time might affect microbial respiration, and (3) assess at what concentrations leachates become inhibitory/ toxic. We hypothesize that: (1) the compounds found in rhododendron over time will be more labile in the beginning and more refractory towards the end of the experiment, (2) microbial respiration will decrease over time; and (3) as leachate concentration increases, microbial respiration will decrease.

Reforestation Effects on Soil Quality in a Montane Tropical Wet Forest

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Deforestation causes loss of habitat in highly biodiverse areas like the montane wet forests of Monteverde, Costa Rica, and because of recent extreme El Niño years, the dry seasons in Costa Rica have been longer, and the wet seasons are shorter with less precipitation. This drier state impacts soil quality as the high decomposition rate is dependent on heavy rainfall. Today, the country is a world leader in reforestation due to its history of clearing forest land for agricultural purposes. To view reforestation effects, the soil in new growth forest undergoing succession, also called secondary growth forest, primary growth forest, and agricultural areas were collected, analyzed, and compared to gauge the process of recovery in an area that was previously used for intensive coffee farming. Soil pH, nutrient levels, and temperature data were collected from each sample and used to determine if a relationship exists between sample type and measures of soil quality using ANOVA tests of significance. Preliminary analysis reveals a relationship between land use type and soil pH, which influences nutrient availability to plants and microorganismal diversity in soils, especially important in the typically nutrient-poor latosols of tropical rainforest. With climate change and pressure of large scale agricultural operations to support a large portion of Costa Rican GDP, it is important to understand the long-term effects of intensive farming on forest regrowth to determine if habitats are recovering to support the same level of biodiversity after reforestation takes place.

Evidence of Critical Slowing Down Prior to Malaria Resurgence in Kericho, Kenya

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When the number of new infections dwindles during a disease elimination campaign, it is difficult to detect re-emergence by merely monitoring case incidence. Methods for predicting disease re-emergence are crucial in mobilizing preventative actions prior to widespread infection. We attempt to detect early warning signals in disease systems approaching critical transitions by applying methods from the Theory of Critical Slowing Down. As the system approaches the tipping point of disease re-emergence, its ability to recover from slight perturbations decreases, resulting in increases in lag-1 autocorrelation and variance. A monthly time series of malaria case incidence on a tea plantation in Kericho, Kenya from 1965 to 2002 was tested for these expected trends leading up to a 1993 malaria outbreak. Autocorrelation, variance, and the first difference of variance were measured across rolling windows and the strength of the trend over time of their values was quantified using the Pearson's correlation coefficient. Null models were generated by permuting the original time series and the corresponding distributions of correlation coefficients was used to evaluate the significance of the trends from the Kericho data. Receiver operator characteristic curves were used to quantify the sensitivity of each indicator against its specificity. As predicted, autocorrelation performs poorly as an indicator, whereas variance and variance convexity yield significant results.

Effect of Invasive Macroalgae *Gracilaria vermiculophylla* on Feeding Behavior of *Callinectes sapidus*

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Within the past decade the invasion of southeastern estuaries by a non-native seaweed, *Gracilaria vermiculophylla*, has greatly altered the physical structure of previously bare mudflats. With the creation of novel habitat, this invader could have major impacts on the trophic relationships of Georgia's estuarine communities. It is possible that predators may benefit from *G. vermiculophylla*'s presence. *Callinectes sapidus*, or the Atlantic blue crab, is a common intermediate predator found on the mudflats along the southeastern United States. Blue crabs feed on a wide range of invertebrates such as worms and clams, which are some of the species that proliferate in mudflats where *G. vermiculophylla* is often present. My study aims to quantify the effect of the emergence of this landscape-altering seaweed on the foraging behavior of *C. sapidus*. To study this effect, I conducted feeding trials in which *C. sapidus* had the option of feeding in the presence or absence of *G. vermiculophylla*. We found that blue crabs showed no preference for foraging in areas with *G. vermiculophylla* versus without the invasive seaweed. A tethering experiment was also conducted in order to study predation on the mudflats. We quantified the foraging pressure on *Mercenaria mercenaria*, a clam commonly found on the mudflats where *G. vermiculophylla* is present. We found that there was no significant difference in foraging pressure within *G. vermiculophylla* mats versus on bare mudflats.

A Comparison of Functional and Fitness Traits of Alliaria petiolata along a Forest Gradient

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Alliaria petiolata, commonly known as garlic mustard, is an invasive herb that has been spreading throughout the United States for over 150 years. In recent decades, garlic mustard has begun to invade the intact forest understory communities of eastern North America. The expansion of garlic mustard's invasive range into novel habitats is a great concern as garlic mustard exudes a chemical compound that inhibits the growth of essential soil fungi. The objective of this study was to determine whether garlic mustard populations located along a forest gradient exhibited different functional and fitness traits. We also sought to determine the average height and fruit body yield between these populations over time. To conduct this study an observational field experiment was set up in which the traits of garlic mustard populations located within the edge of a forest, intermediate forest, and forest understory were measured. These traits include height, number of leaf nodes, and reproductive siliques. Based upon preliminary data analyses, garlic mustard populations found within the edge habitats exhibited, on average, greater heights, leaf nodes, and reproductive siliques than any of the other microhabitats observed. Garlic mustard populations in the intermediate sites exhibited the next greatest heights, leaf nodes, and reproductive siliques, while the forest population produced the shortest plants with the fewest siliques on average. This data along with previous data collected would suggest that a source-sink dynamic is occurring in which edge populations are sourcing propagules into the forest understory.

Long-Term Population Dynamics of the vermetid gastropod, *Ceraesignum maximum*, in Mo'orea, French Polynesia

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Coral reefs form some of the world's most productive ecosystems, but corals are currently being threatened by physical and biological stressors. One of these stressors is the vermetid snail, *Ceraesignum maximum*, which can achieve dense populations on Indo-Pacific coral reefs and decrease coral survival and growth. In 2015-2016, vermetid populations experienced an unforeseen, massive die-off throughout French Polynesia. To better understand vermetid population dynamics, we analyzed an 11-year time series (2006-2016) of photographs from one island, Mo'orea, to quantify snail density and size structure as well as live coral cover. Photographs were taken annually by collaborators associated with the Mo'orea Coral Reef LTER program at 6 different sites around the island, with 100 photographs per site and year. Results indicate that vermetid populations increased at an average rate of 0.26% year-1 from 2006-2010, but that rate of growth decreased in the subsequent 5 years and became negative (-1.0 % year-1. The population crashed (100% mortality) between February 2015 and February 2016. Future work will examine the correlation between different coral species and vermetid densities, as well as how size structure of the populations has changed over time. These data will help us to better understand vermetid population dynamics.

Foliar Endophytic Nitrogen Fixation in *Pinus palustris*

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Longleaf pine (*Pinus palustris*) savannahs are highly diverse and once dominated much of the Southeastern United States, covering 94 million acres, but were greatly reduced by human activity. Restoration efforts have brought their area up to 4.3 million acres, but many of these recovering pine stands are young and require nitrogen to grow and develop. Longleaf pine savannahs are extremely nitrogen limited and known nitrogen sources may not fully account for nitrogen uptake by growing pines. In this study, we investigated

the possibility of endophytic nitrogen fixation occurring within longleaf pine foliage and how much nitrogen is fixed by endophytes. Foliage samples were collected from plots of longleaf pine plots along an age gradient at two sites in the southeast US, and we used acetylene reduction assays on surface-sterilized foliage samples to approximate nitrogen fixation rates. Significant fixation levels were discovered in needles from both study sites. Stand age did not have a significant effect on detected fixation levels, but study site did have a significant effect, leading to a much higher estimated yearly N production at one site. Recognizing this newly documented source of nitrogen gives us a better understanding of the nitrogen budgets of recovering longleaf pine savannahs, and endophytic fixation may be a more prevalent phenomenon than previously imagined.

Nitrogen fixation of biological soil crusts from longleaf pine savannas responds to alterations in precipitation frequency

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Biological soil crusts (BSCs) have the ability to fix atmospheric nitrogen (N) into biologically available forms, and therefore may be important to ecosystem recovery in longleaf pine ecosystems. Since BSCs are dependent on moisture to perform N fixation, the amount and frequency of precipitation is important for this process. Yet, future climate scenarios for the southeastern United States predict a shift in the timing and intensity of precipitation, and very little is known about how BSCs will respond to these changes. For this research, we investigated how variable moisture could impact N fixation of BSCs common in longleaf pine ecosystems. We performed a laboratory experiment in which we treated field-collected BSCs with simulated low, moderate, and high precipitation frequency over 8 weeks. Nitrogenase activity was tested before treatment, at 4 weeks, and at the end of the experiment. A repeated-measures ANOVA was used to test whether nitrogen fixation differed among treatments. We found that when exposed to high moisture frequencies, nitrogenase activity of the BSCs was undetectable, meaning the micro-community had difficulty in performing N-fixing activity. However, when exposed to more variable moisture regimes, BSCs fixed a substantial amount of atmospheric N. Since N is necessary for ecosystem recovery, these organisms may be vital in understanding the resiliency of longleaf pine savannas to climate change, and how conservation efforts can be modeled to manage these rare environments.

Effects of Changing Leaf Litter Inputs as the Result of the Removal of a Dominate Riparian Shrub on Growth Rates and Emergence for Aquatic Macroinvertebrates

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Rhododendron is a locally invasive shrub that grows along small southern Appalachian streams and has been found to inhibit the growth of other flora around the streams. The Forest Service is experimenting with removing this shrub along several streams in the Wine Springs watershed in the Nantahala national forest of North Carolina in order to promote the growth of hardwoods. Rhododendron's leaf litter is of lower quality than hardwood litter, and its removal could affect the litter available to streams, which depend on leaves as the base of their food webs. Shredders are macroinvertebrates that feed on leaf litter, primarily as pre-adult insects in streams. When they emerge to reproduce, they also provide an important food source for terrestrial predators. Removing rhododendron from the riparian zone could have several effects on the shredders. Low quality food sources, like rhododendron, are shown to reduce the growth rates in shredders. An influx of high quality litter due to rhododendron's removal could also drastically increase the growth rate

of shredders in the stream. The reproductive success of shredders could be reduced due to excessively high growth rates, which have also been shown to cause shredders to emerge at smaller sizes earlier in the emergence window. This could cause a desynchronized emergence, with a portion of the population emerging before the rest of the population does in a usual mass emergence. When this phenomena of excess growth rates resulting in a desynchronized emergence has been observed in other studies, the group that emerged early have been predominantly males, so a desynchronized emergence could result in fewer females finding mates, which would affect the population's reproductive success. These effects will be explored by sampling the population of two shredders these streams, T. maria and g. Pycnopsyche, in order to find possible differences in their size distribution during the emergence window in late spring 2016 with results expected by the start of fall. Additional experiments will be performed in early winter in order to examine the effects of each streams ambient litter available on growth rates and assimilation rates. The growth rate experiment will ideally run for three months, with result available around early spring.

Organic Fertilizer Improves Re-Vegetation of Roadside Soils

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Urbanization and road construction affects the global carbon cycle by releasing stored soil carbon and reducing inputs of new carbon through plant productivity. Restoration of these disturbed areas with vegetation can offer new inputs of organic matter to soils, thereby increasing fertility and plant productivity, and providing effective management of the carbon cycle. Plant restoration of disturbed roadsides can be facilitated by the application of fertilizers, however, fertilizers (i.e., organic or inorganic) vary in their effectiveness and carbon footprint. We conducted a plant growth experiment using *Elymus virginicus* and soils sampled along disturbed roads in Atlanta, GA to investigate how fertilizer treatments affect plant growth. We established a two-way factorial experiment, with two factors (inorganic and organic fertilizers) each with two levels (with or without), that were crossed to create four experimental treatments. We hypothesized that both inorganic and organic fertilizers would increase plant growth, but that plants grown with organic fertilizer would produce more biomass compared to those receiving inorganic fertilizer. Following ten weeks of growth, we quantified plant growth, root:shoot ratios, soil microbial biomass, and soil nutrient and pH pools. We found that both inorganic and organic fertilizers increased plant biomass and decreased the root:shoot ratio, however addition of organic fertilizer increased plant biomass more than the addition of inorganic fertilizer. Our findings suggest that the addition of organic matter is an effective management tool for revegetating disturbed roadsides, thereby promoting greater carbon sequestration in urbanized areas.

Local Perceptions of Wildlife in Samburu, Kenya

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Wildlife conservation initiatives, guided by threat classification systems such as the IUCN red list, often focus their work on rare species with a high risk of extinction. These threat classifications are largely produced by international organizations that may be geographically and culturally distant from the area of implementation. Local people, who are critical to the success of conservation programs, may have different

perceptions of wildlife in their region, and this disconnect between local communities and conservation organizations has been implicated as a factor in conservation success. Thus, to improve conservation initiatives, it is imperative to understand local human-wildlife relationships and the level of awareness surrounding endangered wildlife. We conducted one-on-one interviews with members of communities in Samburu, a northern region of Kenya which holds the highest abundance and diversity of threatened large mammals in East Africa, to assess local perceptions of wildlife abundance and diversity, the extent to which people believe their actions influence wildlife, and why people believe wildlife should be valued. Our results indicate that people are more likely to care about a species if it is rare but lack awareness about the rarity of Samburu's wildlife. Almost all participants indicated that wildlife abundance and diversity have decreased over their lifetime; however, the majority of interviewees felt that extinction is not possible. This view was largely attributed to the protection of local wildlife by recently established community-led conservancies. These results have implications for how conservation narratives could be shaped to improve conservation outcomes.

Co-infection in *Sigmodon hispidus*

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A majority of disease ecology is focused on solitary infections, however in natural systems, this simple model does not always embody the whole picture. Often animals host multiple parasites at once and typical disease dynamics may take an unexpected turn. We were interested to see whether co-infection influenced parasite burden in Cotton Rat (*Sigmodon hispidus*) populations, specifically the interaction between cestode tapeworms and strongyle nematodes. Because of their differing niches, direct competition is not expected to take place between these parasites. However, because both are macroparasites, a similar immune response is likely to take place, hypothetically resulting in a decreased load of tapeworms in the presence of strongyles, and vice versa. Sherman live traps were used to safely capture Cotton rats at Horseshoe Bend in Athens, Georgia in the summer of 2016. Body mass and length and tail length were recorded, and fecal samples were collected to quantify parasites shed in feces. After lab preparations, we counted and identified the present parasite eggs. Linear models between the two parasites with the addition of body condition (Body Mass/Body Length) to account for any variation, indicated that both tapeworms and strongyles had no significant effect on the load of each other, however, p-values (0.0143) indicated that body condition has a positive significant effect on the load of strongyles present. This unexpected outcome is likely a result of unknown factors, and further experiments would need to be carried out in order to discover the driving factor behind this observation.