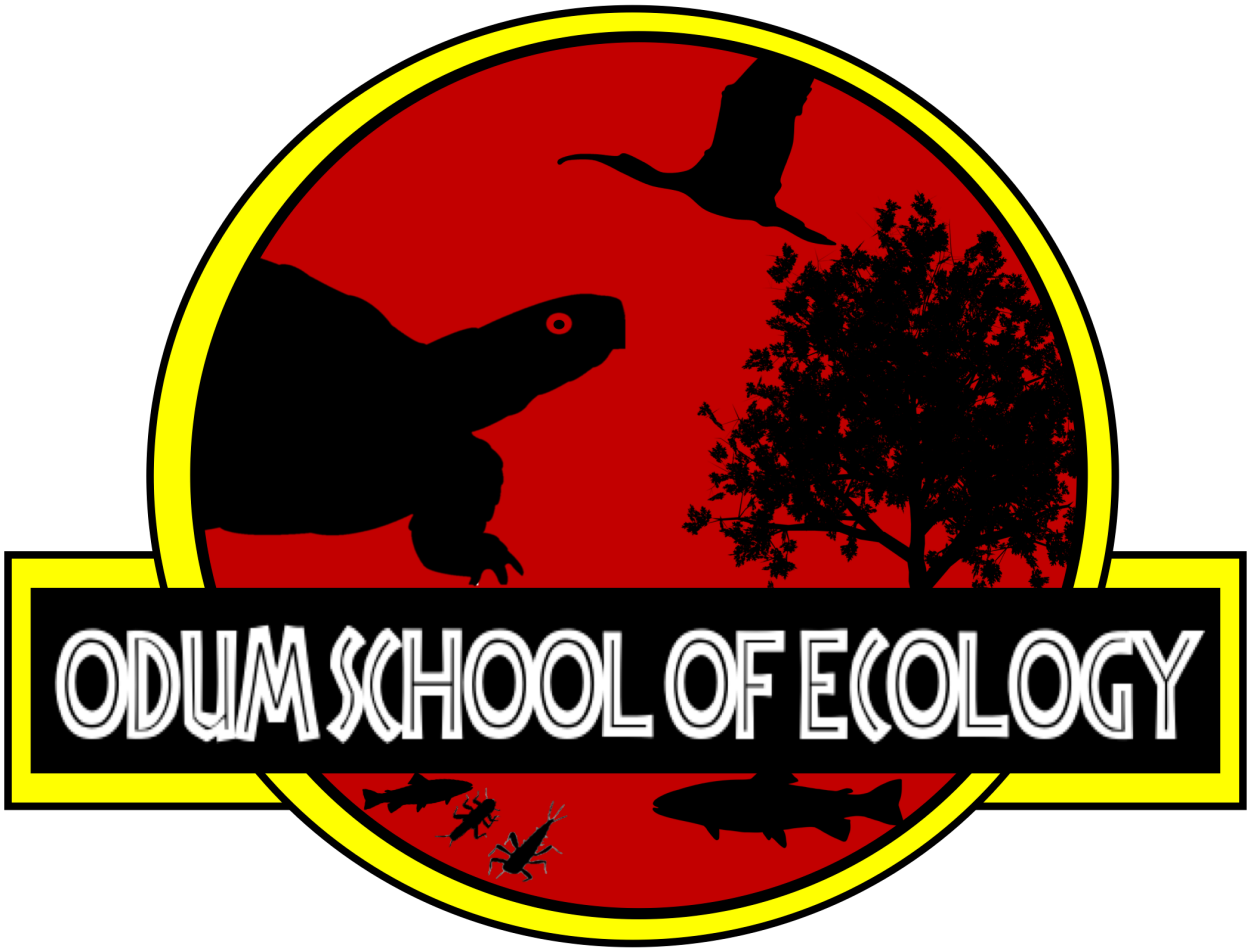
Graduate Student Symposium

January 31– February 1, 2020



Graduate Student Symposium 2020
An Adventure 26 Years In The Making

Welcome and Acknowledgements

Welcome to the 26th annual Graduate Student Symposium (GSS) 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, and their roles in organizing this event are appreciated!

- Program Committee: A. Briggs, M. Tomamichel, C. Teitelbaum
- Undergraduate Poster Committee: J. Blaze, J. Motes, I. Ragonese, N. Solano-Asamoah
- Judging Committee: D. Gokhale, L. Naslund, K. Petersen, D. Suh
- Food & Beverage Committee: K. Connelly, D. Cross, L. Rack, J. Skaggs
- Souvenir Committee: A. Schatz, M. Taylor, C. Working
- Prospective Student Committee: R. Atkins, C. Cummins, C. Wilson
- GSS Documentation and A/V: K. Rosas-Rodriguez, K. Solomon, N. Tomczyk

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 troubleshooting computer problems to publicizing the event to coordinating speaker arrangements. In particular, Julie Gunby, Beth Gavrilles, Tyler Ingram, Caitlin McDonald, Brian Perkins, Emily Schattler, Mica Turner, Kya Odum, Benjamin Taylor, and Allison Walters are to be acknowledged with highest praise! Additionally, we would like to thank the generous support from the Eugene and Will Odum Ecology Fund.

Finally, we thank you for taking 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,
Kaylee Arnold and David Vasquez Jr.
2020 Graduate Student Symposium Coordinators

History of the Graduate Student Symposium

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 Hernandez	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 Sudduth	Georgia Gwinnett College
2018	Daniel Harris, Talia Levine	Dave Walters	U.S. Geological Survey
2019	Michelle Evans, Claire Teitelbaum	Virginia Schutte	Louisiana Universities Marine Consortium (LUMCON)
2020	Kaylee Arnold, David Vasquez Jr.	Rebeca de Jesús Crespo	Louisiana State University

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 by 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 lecturer 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 above lists *some* of the people who have been instrumentally involved in GSS.

This year marks the 26th 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. This year there will be two Rapid Fire Sessions. Each presenter will have 5 minutes to speak. During speaking transitions there will be time to ask a single short question. Longer, more detailed questions should be raised at the Q & A period at the end of the session where all presenters will return to the stage. Moderators will attempt to ensure that all speakers receive questions during this time.

Keynote Speaker

Rebeca de Jesús Crespo

Assistant Professor, Louisiana State University

Baton Rouge, Louisiana

Zooming out and in: applying geo-spatial technology and stakeholder engagement to study eco-health linkages in coastal communities

A common theme through my career has been the use of geo-spatial technologies to describe trends at the landscape level (zooming out) and engaging with stakeholders (zooming in) to help define research priorities and the practical implications of research findings. I have applied these approaches for the study of watershed management to improve stream integrity, and more recently, to study the linkages between ecosystem services with human health and well being. This seminar will describe projects developed for the US Environmental Protection Agency's Sustainable and Healthy communities program to better understand eco-health linkages. These projects characterized ecosystem service indicators at the landscape level in association to health outcomes identified as important by coastal communities in Puerto Rico, including gastrointestinal infections due to flooding, and mosquito borne diseases. Through ongoing projects on these topics, my work seeks to provide strategies at the community level to improve coastal resilience to environmental hazards, and manage ecosystem services for human health benefits.

Friday, January 31

9:00–10:00	**Breakfast**	
10:00-10:15	Dr. Craig Osenberg	Welcoming remarks

Session I (Moderator: Claire Teitelbaum)

10:15-10:30	Ashley LaVere	Testosterone-mediated immunosuppression depends on bacteria species and temperature in American alligators
10:30-10:45	Michelle Evans	Socio-demographic, and not environmental drivers, explain fine-scale spatial patterns of diarrheal disease in Ifanadiana, rural Madagascar
10:45-11:00	Dexter Strother	Priming of Black Carbon Degradation in a Laboratory Experiment
11:00-11:15	Kelsey Solomon	Characterizing stream algal communities in southern Appalachian headwater streams, pre- and post-hemlock die-off
11:15-11:30	**Break**	

Session II (Moderator: Kelsey Solomon)

11:30-11:45	Laura Rack	Evaluating effects of low streamflow on biotic components in the upper Flint River
11:45-12:00	Annakate Schatz	Parasite acquisition by non-native terrestrial mammals is predictable
12:00-12:15	Gregory Jacobs	Geomorphology, Climate, and Fire: Understanding the Distribution of Chinook Salmon Redds in a Large River Network
12:15-12:30	Julie Blaze	Population and Community-Level Effects of Sublethal Predation
12:30–2:00	**Lunch**	

Session III (Moderator: Cait Conn)

2:00-2:15	Claire Teitelbaum	Landscape connectivity by a highly mobile species in an urbanized landscape
2:15-2:30	Michael Belovitch	Whole-Plant Water Use of South African Trees and Grasses
2:30-2:45	Cara Love	Exploring the legacy of a nuclear disaster: a transcriptomic story of wolves from the Chernobyl Exclusion Zone
2:45–3:15	**Break**	

Session VI (Moderator: Michelle Evans)

3:15-3:30	Emily Bertucci	Characterization of the age-related DNA methylome and development of an epigenetic age predictor in medaka (*Oryzias latipes*)
3:30-3:45	Daniel Suh	Relating Characteristics of an Amphibian Metacommunity to Ranavirus
3:45-4:00	Anna Willoughby	Social media records expand knowledge of distribution, behavior, and species interactions of elusive wildlife
4:00-4:15	Supraja Rajagopal	Can infection of individuals in social groups affect collective performance?
4:15-4:30	**Break**	

Rapid Fire Session I (Moderator: Daniel Suh)

4:30-5:20	Sarah Ottinger	Can *Robinia pseudoacacia* and fire help maintain oak dominance in southern Appalachian forests?
	Samantha Bock	Epigenome-by-environment interactions underlying temperature-dependent sex determination in the American alligator
	Laura Naslund	Does stream warming decouple the connection between aquatic and terrestrial food webs?
	Kate Sabey	Does social context influence gut microbiota resilience?
	Cece Working	Effects of Simulated Climate Change on Parasite Development

	Jon Skaggs	Spatial Conservation Prioritization in the Upper Coosa
	Q & A	
5:20–7:15	**Poster Session**	

9:00–10:30 **John Spencer 5K Run and Walk**

Session V (Moderator: Anna Willoughby)

1:00-1:15	Kristen Zemaitis	Ecotoxicology and Diet of the American Alligator as a Function of Ontogenetic Shift and Prey Selection
1:15-1:30	Shishir Rao	Assessing hydrological alteration at two spatial scales in the Western Ghats biodiversity hotspot of India with implications for environmental flows.
1:30-1:45	Melanie Taylor	An integrated framework for understanding changes to eastern North American forests
1:45-2:00	Robbie Richards	Do predators keep prey healthy? Or just make them sicker? A meta-analysis.
2:00–2:15	**Break**	

Session VI (Moderator: Kaylee Arnold)

2:15-2:30	Jessie Motes	Can symbiotic nitrogen fixation have deleterious effects on ecosystem function?
2:30-2:45	Isabella Ragonese, Megan Tomamichel, Cali Wilson	Disease Emergence: Multi-scale Factors that Tip Host-Parasite Relationships from Relatively Benign to Pathogenic

2:45-3:00	Philip M. Newberry	The distribution of the arbovirus vector *Aedes aegypti* across St. Kitts in relation to human activity and potential impacts on disease vector population structure
3:00-3:30	**Break**	

Rapid Fire Session II (Moderator: Megan Tomamichel)

3:30-4:15	Nate Tomczyk	Influence of warming on nutrient uptake in heterotrophic headwater streams
	Kyle Connelly	A pooey proposition: Faulty human waste treatment infrastructure as a novel pollution source, a research proposal
	David Vasquez Jr	Variation in parasite abundance
	Carolyn Cummins	Temperature effects on aquatic insect growth, consumption, and survival
	Megan Hopson	The ecological contribution and economic feasibility of phosphorus recovery from small municipalities with current technologies
	Q & A	
4:15–4:30	**Break**	

Keynote Address

4:30–4:45	Dr. Catherine Pringle	Introduction
4:45–5:45	Dr. Rebeca de Jesús Crespo	Zooming out and in: applying geo-spatial technology and stakeholder engagement to study eco-health linkages in coastal communities
6:00–8:00	**Dinner**	

Talk Abstracts

Whole-Plant Water Use of South African Trees and Grasses

Michael Belovitch[1], Jules Nesmith[1], Ricardo Holdo[1]

(1) Odum School of Ecology, University of Georgia

Savannas are defined by a discontinuous tree layer with grass understory. In southern Africa, savanna plant communities can vary widely from total grasslands to tree-dominant woodlands. Across broad spatial scales, increasing tree cover appears to be correlated with mean annual precipitation. The mechanism behind this is unclear, in part because we lack the physiological understanding of how species in southern Africa change their water use with increasing soil water availability. The goal of this project was to quantify water use and drought tolerance among trees and grasses at the whole-plant level. We predicted that grasses would have higher daily transpiration, relative to leaf area, than tree species, and be able to continue transpiration at lower soil water availability. We measured whole-plant transpiration for 23 tree and 19 grass species native to southern African savannas (N=3). Plants were watered to field capacity before being moved into a growth chamber for seven- to fourteen-day measurement periods without watering. While in the growth chamber, pot weights were logged in 5-minute intervals to measure water loss via transpiration. Soil water potential and transpiration rate for each species were correlated from gravimetric soil moisture samples taken before and after time spent in the growth chamber and corrected by leaf area and biomass. Preliminary analyses have indicated that there is large interspecific variability in water use and drought tolerance among southern African species. Grasses as a whole tend to use water more quickly and can continue to transpire in drier soil than most tree species.

Characterization of the age-related DNA methylome and development of an epigenetic age predictor in medaka (*Oryzias latipes*)

Emily Bertucci[1,2], Marilyn Mason[2], Benjamin Parrott[1,2]

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

Age specific patterning of DNA methylation (“epigenetic aging”) is the single best marker of biological age as it is strongly correlated with chronological age, the onset of age-related disease, and all-cause mortality. Epigenetic age predictors use loci specific changes in the status of DNA methylation across the genome to predict chronological age with astonishing accuracy. Discrepancies between chronological and epigenetic or “biological” age can be used to explore the molecular underpinnings that determine different aging trajectories. Further, important life history characteristics such as the onset of reproductive maturity and

senescence are associated with epigenetic age, suggesting that accelerated epigenetic aging may have implications on the timing of ecologically important life history events. We aimed to identify and describe the age-related DNA methylome and develop an epigenetic clock for a model fish species, medaka (*Oryzias latipes*), using reduced representation bisulfite sequencing of 2-, 6-, and 12-month old animals. Our findings suggest that a substantial portion of methylation changes correlate with chronological age, with a greater proportion of change occurring early in life relative to late. Using just 39 of these age-associated loci, we have developed a model that is highly predictive of chronological age (cor = 0.9495) and provides the ability to assess biological age acceleration in the response to environmental factors. Here, we present preliminary tests for epigenetic age acceleration and provide a characterization of the age-related loci. This demonstrates the genomic distribution and functional associations of the age-related methylome and contributes towards ongoing research attempting to elucidate the functional role of DNA methylation in aging.

Population and Community-Level Effects of Sublethal Predation

Julie Blaze[1], James E. Byers[1]

(1) Odum School of Ecology, University of Georgia

Sublethal predation, the partial consumption of prey that does not lead to immediate mortality, occurs commonly in invertebrate systems. Effects of sublethal predation have been shown to influence a suite of physiological, morphological, and behavioral traits across individuals, and has been proposed as a mechanism for population regulation. However, the effects of sublethal predation on community-level processes has been largely unexplored. These effects may be pronounced when acting on ecosystem engineers, which disproportionately affect their environment by physically altering habitat structure. The decorator worm, *Diopatra cuprea*, engineers its environment by altering sedimentation and erosion patterns on mudflats, as well as increasing local biodiversity by creating refugia for other benthic species. Sublethal predation is common in *Diopatra*, with an estimated 22-24 percent of populations exhibiting evidence of recent head-loss. My research will broadly examine the factors driving spatial variation in the prevalence of sublethal predation and the resultant population and community level effects. This work will provide insight into the effects of sublethal predation on ecosystem engineers and provide a useful framework for incorporating sublethal effects into community interactions across systems.

Epigenome-by-environment interactions underlying temperature-dependent sex determination in the American alligator

Samantha Bock[1,2], Benjamin Parrott[1,2]

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

The ability of organisms to integrate transient environmental signals experienced during development into lasting physiological responses forms the basis for adaptive shifts in phenotypic trajectories. During temperature-dependent sex determination (TSD), incubation temperature acts on a bipotential genome to coordinate two vastly different developmental fates. How do thermal signals during discrete periods in

development irreversibly determine offspring sex? Epigenetic mechanisms including DNA methylation appear to play a central role in integrating thermal signals into transcriptional changes that ultimately produce sexually dimorphic phenotypes. Here, we implement reduced-representation bisulfite sequencing to resolve the developmental dynamics of the DNA methylome during TSD in the American alligator (*Alligator mississippiensis*). Eggs were incubated across a range of temperatures that produce varying sex ratios and sampled at different developmental timepoints encompassing the thermosensitive period and gonadal differentiation. Differential methylation analyses revealed a total of 1417 unique differentially methylated regions between temperature groups in embryos sampled after the thermosensitive period. Ongoing investigations into the developmental time-course and genomic context of temperature-sensitive differentially methylated regions stand to reveal insights into the temporal hierarchy of events through which environmental cues steer developmental trajectories and shape lasting patterns of phenotypic variation.

A pooey proposition: Faulty human waste treatment infrastructure as a novel pollution source, a research proposal

Kyle Connelly[1,2]

(1) Odum School of Ecology, University of Georgia
(2) River Basin Center, University of Georgia

Our nation's waters are impaired. In Georgia, over 5,100 miles of streams are impaired due to fecal coliform (FC) contamination, 70 percent of which is from nonpoint source pollution. High FC concentrations indicate fecal pollution from warm blooded animals and potentially the presence of pathogens. Anthropogenic sources of fecal pollution include wastewater treatment plants, leaking sewer pipes, and failing septic system, all of which are also likely contributors of nutrient pollution. Fecal pollution and resultant nutrient loading turn freshwater, one of our greatest assets, into a liability. Additionally, the State of Georgia is scheduled to adopt nutrient criteria for all its freshwater lotic systems by June 2020. Faulty waste treatment infrastructure is a potential nonpoint source of FC and nutrient pollution which is often generalized in watershed nutrient loading and water quality assessments. To minimize risks to populations and ensure compliance with forthcoming nutrient criteria, a need exists to better understand how human waste treatment infrastructure influences stream water quality. Likewise, disentangling nonpoint source nutrient inputs remains a substantial challenge for water managers. By using spatio-temporally explicit county-level septic system failure rates, a suite of site attributes (e.g. soil characteristics, slope, system age, etc.), and available water quality data, this project aims to infer the contribution of septic systems and failing sewer lines on in-stream water quality conditions in Athens-Clarke County, Georgia. This project will help elucidate where and when these systems may fail and provide guidance to municipal decision makers about wastewater treatment infrastructure tradeoffs and investments.

Temperature effects on aquatic insect growth, consumption, and survival

Carolyn Cummins[1], Amy Rosemond[1], Halvor Halvorson[2], Amanda Rugenski[1], Seth Wenger[3], Phillip Bumpers[1], Nate Tomczyk[1], Jonathan P. Benstead[4]

(1) Odum School of Ecology, University of Georgia

(2) University of Central Arkansas

(3) River Basin Center, University of Georgia

(4) University of Alabama

Aquatic insect shredders are important drivers of leaf litter breakdown in streams and rivers, converting carbon in the form of leaves and wood to secondary production and fine particulate organic matter. Based on their current distributions, shredders are thought to be one of the most cool-adapted groups of aquatic insects. Therefore, they may be particularly vulnerable to rising stream temperatures due to climate change. Specifically, temperature may affect shredder physiological rates like consumption and growth and alter the proportion of stream carbon that is allocated to shredder fates. Additionally, the quality of the food available to shredders may modulate their physiological response to increased temperature. We conducted a streamside channels experiment at the Coweeta Hydrologic Lab (NC, USA) to investigate the effect of temperature on the consumption, growth, and survival rates of the stonefly genus *Tallaperla*. We also tested whether shredder thermal response depends on food quality by feeding two different types of leaf litter (one recalcitrant leaf species and one labile leaf species) to the insects in our study. This experiment will help us gain insight into how rising stream temperatures due to climate change will affect shredder physiology, and thus, stream carbon processing.

Socio-demographic, and not environmental drivers, explain fine-scale spatial patterns of diarrheal disease in Ifanadiana, rural Madagascar

Michelle V Evans[1], Matthew Bonds[2], Laura Cordier[3], John Drake[1], Felana Ihantamalala[3], Ann Miller[2], Courtney Murdock[1], Benedicte Razafinjato[3], Andres Garchitorena[3]

(1) Odum School of Ecology, University of Georgia

(2) Department of Global Health and Social Medicine, Harvard Medical School

(3) PIVOT, Ranomafana, Madagascar

Diarrheal disease is a major cause of mortality in children under five years, with over 700,000 deaths attributed to childhood diarrhea annually. The disease is not equally distributed, with over 75 percent of cases in the Global South, and hotspots of disease at sub-national levels. Precision health mapping has recently emerged as an effective method to identify areas and populations at risk of disease, leveraging increasingly available social and environmental information to explain and predict spatial disease patterns at resolutions finer than those previously possible. However, it is unknown whether these relationships hold true at the village-level scale relevant to public health authorities, and therefore how useful precision health mapping is at those scales. In this talk, I will present the results of a multi-dataset analysis exploring the socio-ecological drivers of childhood diarrheal disease within the rural health district of Ifanadiana, southeast Madagascar. I will discuss the evidence for the strength of hypothesized social and environmental predictors of disease across time and space, and how these relate to the ecology of diarrheal disease transmission. I will end with a discussion of the relevance of precision health mapping at fine spatial scales.

The ecological contribution and economic feasibility of phosphorus recovery from small municipalities with current technologies

Megan Hopson[1], Laurie Fowler[1,2]

(1) Odum School of Ecology, University of Georgia

(2) River Basin Center, University of Georgia

Phosphorus is an essential element to all life on Earth yet it is projected that economically- and technologically-available phosphorus will be depleted in less than 300 years. Ironically, excess phosphorous in water discharged to our streams is creating toxic algal blooms and eutrophication, resulting in significant economic costs. As a result, organizations around the globe are investing in phosphorous recovery projects, removing phosphorus from human and agriculture-produced waste and reusing it, often as fertilizer. My proposed research will use a watershed- scale case study to investigate the contribution of phosphorus released from small (less than 10 million gallons per day released) wastewater treatment plants to environmental degradation and the feasibility of phosphorous recovery at these facilities. While small utilities consider the high initial cost of recovery technology to be prohibitive, they are not taking into account the environmental and economic costs of unmanaged phosphorous. We hypothesize that the small wastewater treatment facilities in the United States are contributing significantly to the degradation of our nation's waters and that by factoring in the true costs of this degradation, phosphorous recovery will be considered economically feasible in more communities. This should result in better informed decisions by utilities and local governments and the management and conservation of phosphorus for a more sustainable future.

Geomorphology, Climate, and Fire: Understanding the Distribution of Chinook Salmon Redds in a Large River Network

Gregory Jacobs[1,2], Russell Thurow[3], John Buffington[3], Daniel Isaak[3], Seth Wenger[1,2]

(1) Odum School of Ecology, University of Georgia

(2) River Basin Center, University of Georgia

(3) Rocky Mountain Research Station, USDA Forest Service

Pacific salmon habitat is a dynamic mosaic of environmental variation comprised of spatial variation in geomorphology overlaid with space-time variation in stream temperature, hydrology, and debris flows from fire, snow avalanches, and precipitation. Informed species conservation and management requires a thorough understanding of how reproductive effort is distributed across such dynamic landscapes, both to identify and prioritize conservation areas, and to project habitat suitability in response to climate change. We leveraged a spatially continuous, long-term database of Chinook salmon redd locations across 777-km of the Middle Fork Salmon River, Idaho, USA, to evaluate spawning site selection relative to contemporaneous variation in landscape covariates. We tested competing logistic regression models constructed of a series of covariate hypotheses predicting redd occurrence within 1-km reaches, and evaluated the effect of projected climate change scenarios on occurrence through these fitted relationships. Redd site selection was strongly affected by substrate size, stream size, stream temperature, wildfires, and conspecific density. Notably, we show positive effects of fire on spawning habitat suitability, namely in unconfined valleys one to 5 years post-fire. Our results suggest that projected changes in stream temperature and flow rates under climate change will lead to only minor changes in habitat suitability. However, we show that Chinook salmon spawning habitat in the Middle Fork Salmon

River may be much more responsive to the fire regime than to changes in stream temperature and flows expected under moderate climate change scenarios.

Testosterone-mediated immunosuppression depends on bacteria species and temperature in American alligators

Ashley LaVere[1], Vanessa Ezenwa[1]

(1) Odum School of Ecology, University of Georgia

Males often use elaborate secondary sexual traits to enhance reproduction, but can experience trade-offs between investment in these traits and other physiological needs. A potential mediator of these trade-offs is testosterone. The Immunocompetence Handicap Hypothesis (ICHH) postulates that testosterone supports the development of secondary sexual traits, but at a cost to immune function. While the ICHH implicates testosterone-mediated immunosuppression as a key mechanism facilitating honest signaling in males, the nature of testosterone-immunity interactions is complex. Conflicting patterns from the literature suggest that testosterone-immunity relationships are variable across both taxa and immune measures, and may be modified by factors both intrinsic and extrinsic to the organism. In this study, we tested the ICHH in free-ranging American alligators (*Alligator mississippiensis*) and explored intrinsic (steroid hormone levels) and extrinsic (temperature) factors that might mediate associations between testosterone and immunity. To do this, the microbial killing capacity of blood was quantified for three bacteria species (*Escherichia coli, Salmonella typhimurium, and Klebsiella pneumoniae*), under two temperature conditions (15°C and 30°C). We found that accounting for circulating levels of the steroid hormone dehydroepiandosterone (DHEA) was important for predicting testosterone-mediated effects on microbial killing capacity. We also found that testosterone-mediated immunosuppression was dependent on temperature and bacteria species, with negative effects of testosterone present only for *S. typhimurium* under 15°C conditions. Overall, our integrative approach of assessing the ICHH across different contexts provides insights into the complexity of relationships between testosterone and immunity.

Exploring the legacy of a nuclear disaster: a transcriptomic story of wolves from the Chernobyl Exclusion Zone

Cara Love[1], Shane Campbell-Staton[2], Sarah Webster[3], Michale Byrne[4], Dmitry Shamovish[5], James Beasley[3], Peter Schlichting[6], Tom Hinton[7], Stacey L. Lance[8]

(1) Odum School of Ecology, University of Georgia
(2) Institute for Society and Genetics, UCLA
(3) Warnell School of Forestry and Natural Resources, UGA
(4) College of Agriculture, Food and Natural Resources, UM
(5) Sosnovy Bor, Vitebsk Region, Belarus
(6) School of Life Sciences, ASU
(7) Institute of Environmental Radioactivity, Fukushima University
(8) Savannah River Ecology Laboratory, University of Georgia

Acute radiation exposure is widely recognized to cause morbidity and mortality in wildlife and is known to influence metabolic processes, cellular apoptosis, endocrine disruption, and immune responses. However,

robust data are lacking regarding the impacts of the more common chronic radiation exposure experienced in contaminated environments. The Chernobyl Exclusion Zone (CEZ, evacuated and excluded since 1986) offers an ideal model system to investigate the long-term chronic effects of radiation exposure on wildlife populations. The CEZ is characterized by a heterogeneous landscape of radiation levels (40 - >7,500 KBq/m2) but also harbors diverse animal communities. Canids are sentinel species for human and ecosystem health and are at higher risk for accumulation of contaminants due to their high trophic level and long lifespan. In this study, we investigated possible effects of chronic radiation exposure on individual health and population persistence. Here we explore gene expression patterns associated with environmental radiation exposure in one of the most commonly occurring canids in the CEZ, the gray wolf (*Canis lupus*). During fall 2014 and 2016, we collected blood samples from canids within the Belarussian portion of the CEZ and a population in northern Belarus. Our data show higher overall gene expression rates in wolves from the CEZ, and expression patterns which correlate with radiocesium body burdens, including altered metabolic and immune pathways. As we explore these data, we help characterize some of the complex mechanisms underlying sub-lethal effects of chronic radiation exposure from the environment.

Can symbiotic nitrogen fixation have deleterious effects on ecosystem function?

Jessie Motes[1], Nina Wurzburger[1], Chelcy Miniat[2], Katherine Elliott[2]

(1) Odum School of Ecology, University of Georgia
(2) Coweeta Hydrologic Laboratory

Anthropogenic activities have created a novel disturbance regime in terrestrial ecosystems, which may alter the role of natural recovery mechanisms. One such mechanism is the emergence of trees capable of symbiotic nitrogen fixation (SNF), which replenish N lost following disturbance. However, SNF may lead to excess available N in ecosystems experiencing anthropogenic N deposition if N inputs exceed plant demands. Thus, disturbance-induced SNF may have deleterious effects on contemporary forests by promoting microbial transformations and losses of reactive N, which cascade through the biosphere. I seek to investigate how SNF influences soil microbial communities and facilitates the mobilization of reactive N in forests recovering from historical land-use disturbance.

Southern Appalachian forests provide a model ecosystem for studying the legacy effects of disturbance-induced SNF on the N cycle. Historical land-use practices (i.e., selective cutting, clear cutting, and agricultural abandonment) provide a gradient in disturbance intensity. Following these disturbances, black locust (*Robinia pseudoacacia*), a nitrogen-fixing legume, was the dominant early-successional tree species. Historical SNF by black locust coupled with chronic N deposition have created novel conditions for N transformations over many decades. Our group has found that historical SNF by black locust increased with increasing disturbance intensity. My data show that potential soil denitrification rates track the same pattern, suggesting legacy effects of historical SNF. I propose to determine if this influx of fixed N led to increased N mobilization, *in situ* N losses, and a decline in the diversity of microbial communities.

Does stream warming decouple the connection between aquatic and terrestrial food webs?

Laura Naslund[1]

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Insects that emerge from streams feed terrestrial animals, transporting energy and nutrients from their natal waters to land where they complete their life cycles. Increasing stream temperatures may change the strength of this aquatic-terrestrial connection by altering the quantity, accessibility, and phenology of aquatic insect emergence to terrestrial consumers like birds, bats, spiders, and lizards. Aquatic insect food subsidies can be essential to these consumers as they can be large in magnitude, rich in essential nutrients, and occur during periods of low terrestrial prey production. While warming in the terrestrial environment is predicted to alter characteristics of terrestrial consumers, the first step to understanding how warming affects this aquatic-terrestrial connection is to isolate the mechanisms by which stream warming impacts emergence. I therefore ask: How does stream warming impact the quantity, accessibility, and phenology of aquatic insect emergence? Warming has been demonstrated to affect aquatic invertebrate production and composition in ways that allow us to make predictions about the response of emergence to warming. In this talk, I will review the mechanisms underlying these predictions and outline a proposed study at the Coweeta Hydrologic Laboratory to evaluate them.

The distribution of the arbovirus vector Aedes aegypti across St. Kitts in relation to human activity and potential impacts on disease vector population structure

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The mosquito species *Aedes aegypti* is a vector for Dengue virus, Chikungunya, and other arboviruses of concern for human health. In this study I surveyed larval habitats across the Caribbean nation of St. Kitts, rearing field collected larvae to adulthood to identify the species composition of larval communities. I then matched the species data to concurrently captured adult mosquitoes to analyze population movement. This study describes the spatial distribution of *Ae. aegypti* across the island and identifies common characteristics of the most productive larval habitats. My findings support the understanding of *Ae. aegypti* as an anthropophilic species with sites closest to human habitation and agriculture having the most prominent *Ae. aegypti* populations. The most productive larval habitats were human-sourced containers as compared to natural tree hole habitats in the rainforest. This project will serve as a starting point to analyze population genetic structuring of *Ae. aegypti* across the island using specimens collected from September to October 2019. I hypothesize that routes of human mediated transport of progeny will be evident with more homogeneous populations following highways. Conversely, I expect a higher degree of population heterogeneity in mosquito populations in more isolated agricultural or rainforest areas. Combining spatial and habitat data with population genetics analysis will contribute to understanding the ecology of this medically significant species.

Can Robinia pseudoacacia and fire help maintain oak dominance in southern Appalachian forests?

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Anthropogenic disturbances have altered the structure and functioning of many terrestrial ecosystems. Southern Appalachian forests have experienced land-use disturbances, fire exclusion and the loss of tree species to pests and pathogens over the last century. As a result, these forests are transitioning from being oak-dominated and fire-adapted to being maple and tulip poplar-dominated and fire-intolerant, which has negative effects on biogeochemical cycles. Long-term data from the Coweeta Hydrologic lab show: 1) large pulses of Robinia pseudoacacia (ROPS) follow disturbance events and 2) decades later, oak is more dominant in areas that experienced low to moderate disturbance and a high abundance of ROPS. We propose that the N fixed by ROPS and differences in tree species functional traits (shade tolerance, belowground allocation, mycorrhizal associations, etc.) direct the competitive outcome for oak. Recent prescribed and wild fires have created a disturbance event to test mechanisms for promoting oak recruitment. We hypothesize that under conditions of low to moderate light and presence of ROPS, oak will be a better competitor against maple and tulip poplar, and the reverse will be true at high light. This hypothesis will be tested on plots across the 2016 Rock Mountain fire and a prescribed burn site at Coweeta. Plots containing combinations of study species will be deployed at Rock Mountain, and seedling competition and BNF data will be collected over two growing seasons. Our work has the potential to provide a new ecologically-based management strategy that promotes oak in the southern Appalachians.

Evaluating effects of low streamflow on biotic components in the upper Flint River.

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The increasing frequency and persistence of droughts is becoming a greater concern with a changing climate. Prolonged and more frequent droughts result in low flow conditions that can reduce the health and function of river systems and reduce water availability for municipalities that rely on rivers for water supply. The Upper Flint River Basin in Georgia provides an important water source for multiple municipalities concentrated near the river's headwaters, supports a biologically diverse aquatic ecosystem, and provides recreational services such as paddling and angling. Droughts have occurred historically in the system, but low flow events appear to be increasing in severity. A coalition of engaged water professionals, who are able to influence patterns of water withdrawals, is interested in better understanding drought effects on the ecology of the system. We developed specific hypotheses relevant to water management about ecological responses to low flow, focusing on aquatic organisms that are characteristic of the Upper Flint. We reviewed previous literature on effects of drought and reduced flow on river and stream biota and used Eco Evidence to evaluate the support for the hypotheses. These results aim to identify changes in biotic assemblages that have been found consistently in similar systems, which will be used to inform planning for drought management in the Upper Flint River Basin.

Disease Emergence: Multi-scale Factors that Tip Host-Parasite Relationships from Relatively Benign to Pathogenic

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With the increasing importance of emerging infectious diseases, understanding what factors contribute to disease emergence is critical. Diseases can emerge when the relationship between a host and parasite transitions from being relatively benign to more pathogenic. An ecological context change can cause this transition, and occurs when the ecological environment (e.g. temperature, habitat quality) changes. Here, we examine columnaris disease of freshwater fishes, and investigate how multiple scales of biological organization shape the ecological context in which the parasite and fishes interact. *Flavobacterium columnare*, the causative agent of columnaris disease, is ubiquitous in freshwater environments, however, the bacteria commonly switch from a relatively benign relationship with a host fish to a highly pathogenic infection, causing severe and often infection. We discuss how changes to the host population and community, individual host, and parasite community scales interact to shape processes that mediate disease emergence. The switch to pathogenic columnaris occurs when the bacterial community composition shifts to a majority of highly virulent columnaris strains. This switch can be induced by temperature; at warmer temperatures, more virulent columnaris strains outcompete less virulent strains. Temperature can also affect individual host processes such as immune function, preventing the host from curbing microbial replication and leading to a deadly columnaris infection. Finally, host population density can negatively affect water quality reducing an individual's ability to resist and tolerate disease. Going forward, studying the transition from benign to pathogenic parasites should integrate processes occurring at and connections between multiple scales of biological organization.

Can infection of individuals in social groups affect collective performance?

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While group living confers benefits like higher efficiency of foraging, brood care and defense against predators, social animals are also susceptible to an increased risk of parasitism. Past research has mainly focused on the effect of pathogen exposure on individual behavior and the disease transmission within a group. However, it has been little explored how the individual-level effects of pathogens can scale up to affect colony-level performance. In order to address this question, I will first activate the innate immune system of the rock ant, *Temnothorax rugatulus*, by injecting a bacterial endotoxin (LPS, lipopolysaccharides). I will then monitor how their individual behavior changes and consequently how the colony's performance on foraging and house-hunting gets affected by these "sick" colony members. Finally, as all the individuals within the colony do not behave identically, I will also identify the "keystone" individuals who have important roles in the colony and selectively activate their immune system and study how a colony responds when important colony members are diseased.

Assessing hydrological alteration at two spatial scales in the Western Ghats biodiversity hotspot of India with implications for environmental flows.

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Recognized as a biodiversity hotspot, the Western Ghats of India are a mountainous chain which runs parallel to the West coast of India. The highly seasonal rivers which originate in these dense tropical evergreen forests harbor highly endemic and diverse freshwater biodiversity. However, the ecological integrity of these rivers is imperiled by the construction and operation of numerous dams to meet the growing demands of hydropower, irrigation etc. Mitigating the impacts of existing dams and careful planning of new dam construction necessitates an understanding how these river infrastructure projects alter the natural flow regime. Understanding relationships between altered flow and ecological responses could potentially aid design of restoration measures such as environmental flows (e-flows) which involves re-operating dams such that water released from the reservoir can mimic ecologically relevant component of flow regime. In this talk, I first focus on my research on Small hydropower projects or SHPs which are promoted in tropical developing countries as “green” alternatives to large-scale hydropower under the assumption that reduced power generation capacity equates to reduced ecological impacts. I question this assumption by showing how SHPs can potentially have significant hydrological, ecological and socio-ecological impacts. In the second part of the talk, I talk about my research which tackles the above problem at a larger spatial scale. Using a regional approach to quantifying hydrological alteration, I show how dams vary in their impacts depending on their purpose (hydropower, irrigation, multipurpose) and how dam characteristics warrant consideration in e-flows design)

Do predators keep prey healthy? Or just make them sicker? A meta-analysis.

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Ecological theory suggests that predators keep herds healthy by decreasing parasitism in their prey. This phenomenon can result from selective predation on sick individuals, decreases in host densities due to predation, or changes in prey behavior which consequently limit transmission. Empirical tests of this prediction seem, however, to paint a more complicated picture. Not only do predators often appear to have minimal effects on parasitism in their prey but they also frequently serve to increase the abundance and prevalence of parasites. Differences in predator, prey, and parasite taxa in addition to variation in experimental design likely explain much of this variation in the effect of predators on parasites in prey. We use a meta-analysis of 71 empirical comparisons from 31 studies to determine both the overall effect of predators on parasite prevalence or abundance in prey and the effect of predator, prey, parasite, and experimental design on this response. These differences, and any consistent trends in this response, are likely to be both informative and useful for predicting the effect of predator loss or reintroduction in natural systems.

Does social context influence gut microbiota resilience?

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Disruptions of the gut microbiota can promote parasite establishment, but this relationship may depend on host social behavior. Social interactions increase host exposure to not only parasites, but also beneficial microbes. Thus, more socially connected individuals may recover their microbiota more quickly following perturbation, reducing the likelihood of parasite establishment. To test this idea, we will evaluate if variation in social connectivity shapes the recovery of the gut microbiota in wild mammal (Grant's gazelles, *Nanger granti*) after antibiotic treatment. We will first test if social connectivity predicts the rate at which individuals recover their baseline microbiota composition after treatment. Next, we will determine if rates of microbiota recovery predict eukaryotic parasite burdens. We hypothesize that gazelles with higher social connectivity will show faster rates of microbiota recovery due to increased microbial exposure from social contacts. We also predict that while faster microbiota accumulation may occur alongside increased parasite exposure, it may also provide physiological benefits that protect against parasite proliferation. Therefore, study findings will reveal if social context influences gut microbiota resilience, and if enhanced microbial resilience is a by-product benefit of social behavior.

Parasite acquisition by non-native terrestrial mammals is predictable

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Species invasions, introductions, and range shifts can lead to novel host-parasite communities. As such altered communities become more and more common, we face a crucial question: how will host species interact with the new pools of parasites encountered in non-native ranges? To address this idea, we analyzed parasite records from the non-native ranges of twelve terrestrial mammals (six carnivores and six ungulates) across the globe. Using boosted regression trees, we modeled parasite acquisition within each focal host's non-native range based on a suite of predictors characterizing both the parasites themselves and the host community in which they live. We found that parasites with more mammal hosts, either globally or within a focal host's non-native range, were more likely to be gained by new hosts entering the community. A phylogenetic measure of parasite specialism was also highly influential, though specific trends varied with the new host's relatedness to its non-native host community, as well as across parasite taxonomic groups. Despite such variations, we saw clear commonalities in drivers of parasite acquisition across all twelve focal hosts, which suggests that parasites gained by non-native mammal hosts may be broadly predictable. This work has important implications for our understanding of what happens in novel host-parasite assemblages created by climate change and anthropogenic influences.

Spatial Conservation Prioritization in the Upper Coosa

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The Upper Coosa River System, comprised of the Conasauga, Cooswattee, Etowah, and Oostanaula watersheds, is highly biodiverse and imperiled. Recent protection and restoration of Raccoon Creek (Etowah Basin) by Paulding County, state agencies, federal agencies, and non-governmental organizations has been hailed as a conservation success story. Where could conservation go next? We employ ecological niche models of species of conservation concern, the distribution of currently protected areas, stream network characteristics, and land cost to drive a systematic conservation prioritization algorithm. We expect high priority areas to be characterized by complementary species communities relative to currently protected areas, protected headwaters, and low land cost. Outcomes of this work aim to bridge the gap between conservation science and conservation action in a river system revered for its biodiversity.

Characterizing stream algal communities in southern Appalachian headwater streams, pre- and post-hemlock die-off

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Eastern hemlock (*Tsuga canadensis*) functioned as an important foundation species throughout eastern North America. However, widespread death of eastern hemlock over the last 15 years has occurred in the southern Appalachians as a result of the spread of an invasive hemipteran, the hemlock woolly adelgid (*Adelges tsugae*). Hemlock was once abundant along streams and its death has likely caused changes to stream processes. Little is known about how the loss of hemlock affects stream algae in the southern Appalachians. We hypothesized that algal communities may be affected by enhanced light levels following hemlock die-off. In 2005-2006, prior to hemlock die-off, we collected baseline data on algal biomass (chlorophyll-*a* and ash free dry mass) and diatom community composition in eight stream reaches throughout the Coweeta Hydrologic Lab/Forest in western North Carolina. Densely shaded streams were characterized by low algal biomass dominated by adnate diatoms (*Eunotia* spp., *Achnanthidium* spp., and *Nupela lapidosa*). In 2018-2019, post hemlock die-off, we re-sampled the eight study reaches to evaluate how algal communities may have changed. We hypothesized increased algal biomass, loss of endemic taxa, and an increase in upright-growing diatoms (*Gomphonema* spp. and *Ulnaria* spp.) (associated with higher light levels). We present preliminary findings in this presentation.

Priming of Black Carbon Degradation in a Laboratory Experiment

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Soils makeup one of the largest pools of terrestrial carbon. The black carbon pool (BC = charcoal or pyrogenic C) in soils is important in the global carbon cycle, but little is known about the mechanisms and rates of its production and degradation. This is particularly true for ecosystems which experience frequent fire (e.g., longleaf pine ecosystems of the Atlantic and Gulf Coastal Plains). We investigated the influence of pine litter, fine particle BC, coarse particle BC and their combinations on soil respiration rates. The different carbon sources were either placed directly on top of sterile sand, or mixed with sand and incubated for 694 days. Experimental units each received approximately 2 g of carbon at the beginning of the experiment. Each microcosm also received 10mL of water containing microbial inoculum extracted from annually burned plots of a long-term fire study in Florida. For the incubation, there were also two controls: positive (dissolved sucrose) and negative (inoculum only). We observed that mixed treatments had higher respiration rates ($t_{48}=-2.13$, $p=0.039$) relative to unmixed treatments. We suggest that this is due to two factors: mixing carbon sources into the soil 1) should increase gas exchange (aeration), and 2) allow microorganisms to come into direct physical contact with carbon sources. The treatments that included fine BC, pine litter, and mixing respired more CO2 than any other treatment combination. This study sheds light onto the question of whether BC is recalcitrant upon formation, or more active in short-term C dynamics in fire prone ecosystems.

Relating Characteristics of an Amphibian Metacommunity to Ranavirus

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The composition of species in a community and the connections between communities impact disease transmission. Infections may spread because of the movement of individuals, and the overall susceptibility of a community to epidemic may depend on the composition of a community. Patterns in an amphibian metacommunity over space and time inform changes in Ranavirus prevalence. We use field data for 20 wetlands over 6 months that include the abundance of amphibian species and their viral loads. Using these data, we measured the competence of a community and compared this to metacommunity patterns. The competence of a community is determined by the relative abundance of species and the competency of hosts. We developed a theoretical model for disease transmission that incorporates the relative competency of hosts and the environmental transmission of the virus. For the purposes of the model, the competency of hosts were simplified to be either high or low, as supported by the field data. The goal of this research is to identify how space, time, or other factors inform the movement of Ranavirus throughout a metacommunity. Community competency allows us to observe a relevant characteristic of these communities over space and time and our model helps us to understand underlying mechanisms. Together, these findings help to relate the importance of community ecology to the study of disease dynamics and can be broadened to investigate patterns in other linked communities.

An integrated framework for understanding changes to eastern North American forests

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Changes to eastern North American forests over the last century have been investigated through multiple lenses, but largely in isolation of one another. Forest ecologists have termed the change “mesophication,” the process through which forests become increasingly dominated by fire-intolerant tree species as natural and anthropogenic fire is suppressed. Biogeochemists have noted shifts in the dominant type of mycorrhizal association relating to climate change and nitrogen deposition, with consequences on carbon and nutrient cycles. Concurrently, soil ecologists have noted the prevalence of earthworm invasion and their effects on forest soils and food webs. In my dissertation research, I will synthesize findings from each of these perspectives and propose a conceptual framework for forest change that considers the interacting effects of fire, biogeochemical cycles, and soil food webs. The outcome of these complex interactions will determine the future functioning of these novel ecosystems and provide insight into their management. I will use data from the US Forest Service’s spatially extensive Forest Inventory and Analysis (FIA) dataset to quantify the drivers (fire, disturbance, nitrogen deposition, climate) of forest change in eastern North American forests. Then, I will conduct a localized study to understand the interacting effects of fire, mycorrhizal association, and soil fauna communities on litter decay rates in a transitioning southern Appalachian forest. Together, my research will clarify existing models of forest change including how drivers of change interact and potentially feed back to influence each other.

Landscape connectivity by a highly mobile species in an urbanized landscape

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Landscape connectivity, the movement of organisms and materials across a landscape, is important for gene flow, nutrient cycling, and infection dynamics. Animal movements promote connectivity, but animal movement patterns are changing in response to human activities. In urban areas, species that are highly mobile in natural environments often move less and show stronger site fidelity, which could decrease connectivity between urban and natural areas or affect overall connectivity. In this study, we use graph theory to investigate the role of American White Ibis (*Eudocimus albus*), a nomadic waterbird that is rapidly adapting to urban areas, for connecting patches in Palm Beach County, Florida. After identifying a network of over 300 sites across 56 bird-years, and show that the network is less connected than would be expected if ibis were moving randomly. In addition, the network is highly assortative, such that urban-urban and wetland-wetland connections are more common than urban-wetland connections. We conclude that ibis movement patterns produce low connectivity between sites of different types, which limits the potential for nutrient flow or other benefits of connectivity but also reduces the risk of infection spread between urban areas and wetlands. In general, shorter-distance movements and higher site fidelity in urban areas might isolate these unique ecosystems from surrounding natural habitats

Influence of warming on nutrient uptake in heterotrophic headwater streams

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In the Anthropocene ecosystem processes are impacted by multiple global change stressors, chief among them are increasing temperature and elevated nutrient concentration. A critical ecosystem processes in headwater streams is nutrient uptake, which slows the downstream movement of nutrients – with benefits to downstream ecosystems. It has been demonstrated that nutrient uptake in streams increases with the concentration of nutrients, and temperature has been shown to increase uptake rates in open canopy streams. However, in closed canopy streams a negative relationship between nutrient uptake and temperature has been observed across seasonal temperature gradients. This has been explained as a consequence of resource supply; in closed canopy systems most of the carbon inputs (mainly dead leaves) to the streams come in the coldest part of the year, and they are mineralized as the stream warms. This suggests that the relationship between temperature and nutrient uptake measured in these natural systems is confounded by variability in carbon substrates – making these observed relationships not useful for projecting future rates of uptake. Here we use laboratory data to determine how nutrient concentration and temperature together impact nutrient uptake. Then, we present future research which seeks evaluate these relationships in a more natural setting and model the consequences of these global change drivers across longer time periods.

Variation in parasite abundance

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While we're introducing increasingly sophisticated methods to explain and predict presence and abundance of free-living species, similar advances in parasite ecology are lacking, partly due to good data on parasite abundance. The abundance of a parasite is controlled by its niche, which is partly environmental and partly host habitat. For macroparasites, overall abundance is dictated by host abundance, ability to infect (prevalence), intensity of infection within hosts (re-infection, survivorship within host, parasite fecundity), and the ability to survive and develop outside of the host. Understanding which factors are most important for parasite abundance has not been studied. For example, is host abundance is as important as parasite prevalence or intensity for parasites to be most abundant? In this study, we examine 14 well sampled parasites in white-tailed deer to investigate variation in parasite abundance and what factors are most correlated with parasite abundance (host abundance, parasite intensity, or parasite prevalence).

Social media records expand knowledge of distribution, behavior, and species interactions of elusive wildlife

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Increasingly, animals adapt to anthropogenic landscapes and interact with humans in new ways through the sharing of resources, infrastructure, and direct contact. Despite these ubiquitous animal activities, many species remain poorly monitored due to nocturnal behavior, cryptic traits, and a failure to synthesize local knowledge. Records on social media websites provide a growing and currently untapped resource for natural history knowledge. We capitalize on social media postings of ringtails (*Bassariscus astutus*), a common mammal species native to North America not currently recognized as a synanthropic species, to gain knowledge of ringtail ecology in human-modified environments. We use 490 publicly available videos and photos of wild ringtails from Youtube and Flickr to infer new occurrences, behavioral activities, and interactions with other species. We review the challenges and reliability of social media data, along with potential for formalized pipelines for filtering and standardizing internet-derived data. We emphasize the complementary use of social media-derived species detections with more traditional field methods and citizen science repositories to expand the spatial and sociological knowledge of a common species. Lastly, we suggest other species that may be candidates for social media assessment.

Effects of Simulated Climate Change on Parasite Development

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One reason that increases in temperature are predicted to be highly detrimental to livestock and wildlife communities is due to the acceleration of parasite life cycles. Since many parasitic helminth species have a free-living stage, both rainfall and temperature variations due to climate change have profound potential to impact dynamics of parasite transmission. The carry over effects that climate could have on nematode development outside and inside the definitive host have not yet been explored. To better understand the relationship between environment and life stage progression, we utilized a long-term soil warming experiment at the Whitehall Forest that simulates climate change by raising soil temperature. Fecal samples were placed within experimental plots to compare *Haemonchus contortus* development success across different temperatures ranging from 3-5 degrees Celsius. We are now working to determine if temperature during larval development has further consequences for nematode survival in the definitive host. Larvae which developed at higher temperatures may be physiologically less competent in their ability to evade host immune defenses. By testing larval innate immune responses to sheep plasma, we can quantify the effect of developmental temperature on larval fitness in a definitive host. This work will allow us to connect environmental variation to virulence of nematode larvae.

Ecotoxicology and Diet of the American Alligator as a Function of Ontogenetic Shift and Prey Selection

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Mercury (Hg) is a naturally occurring contaminant whose presence is intensified by anthropogenic activity and is of significant concern for environmental health globally. The American alligator *(Alligator mississippiensis)* is an apex predator that can accumulate Hg in high concentrations through prey consumption. While several studies have aimed to assess Hg presence in blood and tissue throughout their range, little is known about the ecological drivers of toxin accumulation in alligators. The objective of this study it to address how ontogenetic dietary shifts interact with site-specific factors (e.g., pH, freshwater v. marine prey availability) to influence Hg accumulation. This investigation is being carried out by obtaining blood samples and stomach contents of alligators (n=200) at three locations to assess trends across unique habitat types: Okefenokee Swamp, GA (acidic blackwater), Jekyll Island, GA (developed barrier island), and the Tom Yawkey Wildlife Refuge, SC (undeveloped barrier island). We hypothesize a positive relationship between Hg levels and size class that is modulated by ontogenetic dietary shifts and prey base specific to each location. Furthermore, size classes feeding more exclusively at higher trophic levels may demonstrate the highest levels of Hg. The results of this study may provide evidence that varying levels of Hg in apex predators are directly related to dietary shifts and habitat, furthering the value of alligators as biomonitors of mercury in the locations they inhabit.

Poster Abstracts

Not Just Trash Birds: Landfills Harbor Similar Diversity to Surrounding Areas

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Landfills provide seasonally reliable food resources to many species of wildlife, including those perceived to be pest or invasive species. However, landfills often contain multiple habitat types that could attract diverse wildlife. To date, little is known about the characteristics and composition of wildlife communities at landfills relative to local and regional pools. Here we explore patterns of bird species and functional richness at landfills across the United States, using citizen science database eBird, as well as dietary and taxonomic data from EltonTraits. If landfills are dominated by widespread, competitively dominant generalist species, we predicted that (i) landfills would have lower species richness than comparable nearby reference sites; (ii) community similarity would decline more slowly with distance at landfills versus reference sites (biotic homogenization); and (iii) bird families that thrive in human-altered landscapes, and omnivores, would have higher relative abundance at landfills than their representation at the county level. We found no significant differences in species richness, nor evidence for biotic homogenization, when comparing landfills to similarly sampled reference sites. However, bird families containing pigeons, vultures and crows were and species that feed at higher trophic levels, to be disproportionally represented at landfills. Although human-adapted, scavenging species are more frequently encountered at landfills, similarities in local species richness and regional turnover between landfills and natural sites suggest that landfills may have conservation value for birds and thus other wildlife.

The Effect of Yeast and Nectar Robbing on Hummingbird Feeding and Competitive Behavior

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Hummingbird flight has been determined to be the most energetically costly activity for any vertebrate. Consequently, hummingbirds must be very intentional about which flowers are energetically economical to visit and defend. Yeast naturally occurring within flowers serves as a source of protein for nectivorous feeders. We asked how the presence of yeast in a flower effects the feeding and competitive behaviors of hummingbirds and how nectar robbing (i.e. insects drill holes in the bases of flower and sap out the nectar) as well affects feeding and competitive behaviors. We hypothesized that flowers treated with a yeast solution will become more valuable and see greater visitation rates and competitive events and shorter feeding times, and that nectar robbed flowers would receive less visitations, competitive events, and feeding time than non-robbed flowers. We treated flowers with a yeast solution at four sites in Monteverde, Costa Rica and quantified visitation, feeding time, and competitive events and compared to untreated flowers. We also checked and marked nectar robbed flowers at our site and quantified visitation, feeding time, and competitive events and compared to non-robbed flowers. Contrary to our hypothesis, yeast treated flowers did not receive significantly higher visitation rates or significantly different feeding times, yet

they were greatly defended in proportion to their visitation. However, nectar robbed flowers did receive less visitations, feeding time, and competitive events, supporting our hypothesis. We believe that a revision of our yeast experiment's design could find different results that may support our hypothesis.

Landscape and Local Determinants of Non-breeding Bird-Use in Powerlines

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Powerline right-of-ways (ROWs) are an abundant landscape feature that can provide habitat and migration corridors for birds and other wildlife. As the southeastern United States becomes more urbanized, the role of ROWs in providing breeding, stopover, or wintering resources in the form of food or shelter may become more important. While past research has identified attributes of ROWs influencing diversity of breeding birds, less is known about how vegetation structure and the nature of surrounding habitat influences bird species richness and overall abundance through the nonbreeding season. In this study, I conducted bird surveys from September to December in four different ROWs in Athens, two of which were embedded in areas managed for wildlife, and two which were adjacent to residential or industrial areas. I used standardized surveys to record the number of bird species seen, and the number of individuals found of each species. By conducting surveys of plant species and vegetation height within ROWs, and using GIS to quantify land cover in areas surrounding each ROW, I aim to quantify local and landscape drivers of bird abundance and species richness. I predict that (i) species richness and abundance in ROWs will be positively associated with the percentage of natural land cover (e.g. forest) and negatively associated with more urban land cover, and (ii) ROWs with more native plants will host greater bird richness and abundance, and will especially attract birds whose diet includes seeds, fruits, and insects.

Using Leukocyte Profiles to Measure Stress in Overwintering Rattlesnakesand Rat Snakes

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In the winter, snakes reduce their activity and undergo brumation. The process of brumation significantly slows the rate of metabolism in snakes to conserve energy in the colder months. However, abnormal brumation behavior has been observed in populations of black rat snakes and timber rattlesnakes in the Di-Lane Wildlife Management Area. These populations have been emerging from brumation to bask during the winter. Basking elevates body temperature and consumes energy to induce a fever; possibly to combat infection or disease proliferating in these populations. This behavior requires significant energy input, and leaves snakes weaker when they emerge in the spring. Stress of reptiles can be measured by analyzing the ratios of two types of white blood cells. Lymphocytes control immune defense, while heterophils respond to infection, inflammation and stress. Heterophils and lymphocytes are affected by stress in opposite ways. As glutocorticoid, a hormone released during a period of stress, levels increase, the number of heterophils increases and the number of lymphocytes decreases. The ratios are found by counting the number of heterophils per number of lymphocytes. The ratios from before and after brumation for each of the snakes in study will be compared to determine if stress levels increased. It is expected that the abnormal brumation behavior is correlated with increased stress among snakes.

Trends in shell morphology: Using museum specimen to infer responses to temperature over space and time within Littoraria irrorata

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Global temperature has changed dramatically over the past century and will continue to do so. Changes in temperature can affect organismal traits, particularly those of ectotherms, due in part to shifts in individual physiology and body size. Littoraria irrorata, an ectothermic snail, is a prominent consumer in Southeastern salt marshes. Shifts in the body size of Littoraria has the potential to affect its metabolic demand and in turn the marsh ecosystem (e.g., productivity and abundance of salt marsh plants). To better understand how temperature influences the body size of Littoraria over both space and time I am using museum collections of Littoraria shells sampled over the past 100 years along the Atlantic coast. I will quantify how shell mass and height have changed across latitude and through time, and relate these changes to changes in sea surface temperature. Data collection is still underway and the results I am presenting are preliminary.

Cestode parasites become more specialist as they ascend host food webs

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Parasites are thought to pay a cost of generalism: using many host species makes them a “Jack of all trades, master of none”. Complex life cycle parasites need to move through a food web, developing in lower trophic level (intermediate) hosts and reproducing in higher level (definitive) hosts. The costs and benefits to a generalist strategy for these parasites include host-specific survivorship and fecundity of parasites as well as the strength of links in the food web, which dictate how likely a parasite is to complete its life cycle. This study presents a theoretical model to evaluate the costs and benefits of generalism at the intermediate and definitive host levels. We characterize how parasite survivorship and fecundity interact with feeding link strengths to determine the conditions associated with increases and decreases in the degree of generalism as parasites move through a food web. We then establish patterns of phylogenetic generalism for complex life cycle cestode parasites using a helminth-host database that reveals a statistically significant reduction in phylogenetic generalism as parasites move from lower to higher trophic levels. The combination of theory and data allows us to indirectly estimate costs and benefits of parasite generalism for this parasitic group and helps to explain how variation in specialist vs. generalist parasite strategies may be maintained in nature.

Ant Diversity within three biomes in San Luis de Monteverde, Costa Rica

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In tropical ecosystems, ants have a high diversity, abundance, and behavioral attributes that cause them to play an important role. Costa Rica is home to 881 species of ants, and they are considered as potential

indicators to examine the conservation potential in a mosaic of differently disturbed habitats in Costa Rica. Given their prominent role, it is important to determine the types and distribution of ants in tropical ecosystems. I looked at this distribution between three separate biomes on the CIEE Costa Rica campus: in the forest, under a guava grove, and in open grass areas. To sample, I placed petri dishes baited with tuna, returning to take photos every 30 minutes, additionally taking samples to view under the microscope at 90 minutes. Using these photos and samples, I identified the ants to the best of my abilities. Then I graphed the ant abundance by species and biome, the percent abundance by biome, as well as the ant abundance change over time by both species and biome. I found Solenopsis morphos to be the most prevalent ants in the area, especially in the forest, followed by Pheidole morphos and lastly a Monomorium morpho that only appeared in the open grass area. Future studies will need more expert help with identifying, and should use different sampling methods (pitfalls, ground-litter, etc) to get a more comprehensive look at the ant species in the area. Future work should also look at the impact of the aggressive Solenopsis ants on other species.

Functional traits across South African tree and grass species

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Root morphological traits reveal water acquisition strategies in plants and thus reveal how they may adapt to changing water availability and rainfall regimes. In Southern Africa, where climate change is driving changes in the rainfall regime, determining water resource acquisition strategies of trees and grasses allows us to predict changes in their biomass ratios across the savanna. In this study, 23 species of trees and 20 species of grasses from the African savanna were grown from seed under greenhouse conditions. Aboveground biomass was harvested for leaf area and shoot mass determination. Belowground biomass was harvested and frozen. Subsequently, roots were washed free of soil, and representative fine root (<2 mm) subsets were scanned at high resolution and dried and weighed, while all remaining coarse and fine roots were dried and weighed separately. The program SmartRoot was used to collect diameter, length, and branching pattern data the scans. From this, we found root length per mass, nodes per root length, diameter of root tips, and very fine root fraction. We conducted a preliminary comparison of these traits between tree and grass species and explored their implications for water acquisition strategies. In the long run, this data will allow us to contribute to models of tree-grass dynamics in response to climate change.

Modeling Seasonal Infection Dynamics in Food-Subsidized Wildlife Populations

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During harsh seasons, animals struggle to survive due to lack of food and extreme temperatures. Supplemental food provided by human activities, such as agriculture or backyard bird-feeding, can offset some of these hardships, but can also facilitate transmission of infectious diseases. Previous studies of wildlife-parasite interactions have looked at the effects of seasonality and food provisioning separately, but to date we lack theory for understanding their interactive effects. Here we built a mathematical model to

understand how winter harshness influences pathogen transmission and impacts on host populations in the presence and absence of food provisioning. In the absence of food provisioning, we found that winter harshness could increase host population sizes by disproportionately culling individuals infected with a virulent parasite. Counter-intuitively, food subsidies that improve host winter survival can therefore reduce overall population size, since they promote the persistence of virulent parasites by increasing winter survival of infected hosts. The extent to which winter food subsidies enhanced or reduced impacts of virulent pathogens depended critically on how host contact rates and immune defense changed with the amount of food provided. These results highlight the need for further empirical studies on the disease impacts of winter wildlife feeding for conservation or recreation.

The effects of impervious surface cover on seven Piedmont streams

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Abstract: Streams provide important ecosystem services and urbanization can lead to their functional impairment and thus the loss of those services. One way to estimate impairment is the percent impervious surface cover in the watershed or percentISC. In order to assess the effects of impervious surface cover on seven Piedmont streams in Athens, GA, we compared the following variables to percentISC: dissolved oxygen, pH, specific conductance, temperature, forest cover, nitrate, ammonium, and soluble reactive phosphorus. With increasing percentISC, dissolved oxygen and forest cover significantly decreased while specific conductance, soluble reactive phosphorus, and nitrate significantly increased. No relationship was found between either pH, temperature, or NH4 and percentISC. In order to manage inputs such as nitrate and phosphorous, more riparian buffers could be added around the streams. If nitrate and phosphorus inputs are reduced by the riparian buffers, then the buffers may help decrease specific conductance and increase dissolved oxygen as well.

The use of modern statistical methods and comparative analysis to test the “one-half rule” in mammals

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The one-half rule refers to the concept that mean litter size is usually one-half the number of mammary glands in females of mammal species. This relationship has been widely accepted; however, it has only been tested in rodents and has never been tested using methods that account for the influence of phylogeny on species traits. Therefore, we tested the one-half rule across all mammals for which we had adequate data, as well as in six mammalian orders, and using phylogenetic comparative methods. We tested for the relationship across mammals in six mammalian orders for which we had data for sufficient numbers of species: Rodentia, Primates, Carnivora, Artiodactyla, Dasyuromorphia, and Didelphimorphia. The correlation between teat number and litter size was assessed using Spearman’s rank correlation and phylogenetic generalized least squares (PGLS) analysis, implemented in R. We found a significant correlation between teat number and litter size in the overall mammal dataset ($p < 2.2e-16$) and in all six

orders when using Spearman's rank correlation test. When analyses were repeated using PGLS analysis, we found a significant correlation in the overall mammal dataset ($p < 2.2e-16$) and in all six orders except Artiodactyla ($p=0.129$). Furthermore, our results supported the "one-half rule" given that mean teat number divided by mean litter size fell between 1.5-2.0 for most groups.

Effects of Tropical Storm Nate on the Recovery of Macroinvertebrate Community Composition in Two Neotropical Streams in Costa Rica

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Our study examines the long-term effects of tropical storm Nate on macroinvertebrate community composition in Monteverde, Costa Rica. Two streams, Alondra and Bruja, were impacted by storm Nate in October 2017, which resulted in a major disturbance as a result of debris flows. These streams were sampled monthly for one year prior to Nate (2016) and again in October 2018. We continued sampling in October 2019 to monitor recovery of the macroinvertebrate community. We measured canopy cover and macroinvertebrate community composition from 5 transects in each stream. Additionally, we collected leaf litter from 3 transects in Alondra to compare macroinvertebrates before and after Nate. Macroinvertebrates from both surber net and leaf litter were classified to their lowest taxonomic level (usually genus) and their functional feeding group. We calculated the relative abundance by family and FFG, species richness, and density. There was a 40 percent decrease in canopy cover of Alondra following Nate while Bruja experienced a slight increase. There has been no increase in canopy cover in 2019. Following the storm in 2018, taxa richness decreased 30 percent in Alondra and 50 percent in Bruja and has remained lower in 2019, two years after the major disturbance. Disturbance adapted taxa also continue to dominate both streams and grazers are the most prevalent functional feeding groups in riffle habitats. This change in environmental conditions has impacted community composition of both streams and its impacts are still prevalent two years following the storm, indicating that macroinvertebrate community composition is still dominated by disturbance adapted taxa.

Analysis of Temperature, Dissolved Oxygen, pH, and Zooplankton Abundance in Lake Herrick

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A question posed is how depth affects the nutrient levels, specifically inorganic nitrogen and in Lake Herrick. The goal of the present study is to observe the trends of the changing lake system and any factors affecting zooplankton abundance. As we reach the bottom of the lake, we expect to see a rise in the abundance of zooplankton. We gathered data on the physical and chemical properties of Lake Herrick to later calculate trend graphs. Water sampling tests were done on dissolved oxygen content, pH, temperature, and zooplankton abundance. The patterns observed were indicative of the stratification of the lake, and trends could be depicted graphically. Once we can understand the capacity of lakes to change in their characteristics, we can assist in the production of healthy lakes and reservoirs.

The Effects of Vegetation Characteristics on the Nesting Success and Breeding Behavior of a Desert-Specialist, the Scott's Oriole (Icterus parisorum)

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Desert-dwelling bird species are expected to undergo steep declines under climate warming, lending urgency to efforts to understand their breeding biology. Scott's Orioles (Icterus parisorum) breed in arid regions across the southwestern United States, but there are substantial gaps relating to nest site selection, especially in New Mexico where they nest in junipers rather than Yucca species favored in other parts of the range. In summer 2019 we conducted nest surveys of Scott's Orioles in Sevilleta National Wildlife Refuge, NM, to quantify characteristics of junipers, and the surrounding landscape, on nest site selection and nesting success. We hypothesized that orioles' nest location and nesting success is influenced by perceived predation risk, with nests more likely to be found in clusters of junipers than lone trees, and nest success likely to be higher in when located further from the ground, and in wider junipers. Since we only located 20 nests, we did not have statistical power to detect significant effects of nest site choice on nesting success. However, non-significant trends that Scott's Orioles prefer denser juniper stands for nesting, and nests located higher in trees were more likely to fledge, suggest that Scott's Orioles select for specific nest characteristics of the available vegetation. This study provides a baseline for future research on this species in New Mexico as well as other portions of its range.

Identification of plant communities in a Georgia salt marsh using automated image analysis

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Salt marsh plant species are often found in distinct patterns of zonation, driven by the interaction between interspecific competition and stress factors such as salinity. Previous studies have sought to disentangle the effects of these drivers, but field experiments in marshes are challenging. However, by analyzing photographs of the marsh, we can assess relationships between species as they exist in nature. Manual image analysis is time consuming, but here a convolutional neural network based classifier will be trained to automatically analyze plants in salt marsh images. This project seeks to investigate the relationships and identify communities among the major plant species in a salt marsh on Sapelo island. Using a large raw set of marsh photographs provided by Dr. Steve Pennings from the University of Houston, the images will be annotated to train a classifier to determine presence/absence and percent cover for each species. Once data for each species in each area of the marsh has been generated, data will be analyzed using a variety of statistical and modeling techniques including simple pairwise correlations, multiple regression, and generating structural equations models. We expect to see distinct communities of plants form along gradients of stress factors, such as elevation and salinity.

Does participation in citizen science influence volunteers' perspective on science and conservation?

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Project Monarch Health (MH) is a citizen science project run by the Altizer lab through the Odum School of Ecology. MH's main goal is to understand the distribution and impact of the protozoan parasite Ophryocystis elektroscirrha (Oe), which infects monarch butterflies. Our program supplies volunteers from across North America with the materials and knowledge necessary to sample their local, wild monarchs for Oe. Volunteers mail samples and data to the Altizer lab for analysis and receive their results via email. Altizer lab members give volunteers additional support by answering volunteer questions via email. Our study will examine how participating in MH influences volunteers' understanding of ecology and conservation. Current MH volunteers will be asked to complete an online survey to contrast their knowledge before and after their participation in MH. The survey will contain questions related to demographics, motivation to participate in the project, and knowledge and attitudes concerning scientific research, monarch disease, and conservation. We will analyze demographic patterns of participants and will compare volunteers' understanding of and actions towards conservation before and after participating on MH. We predict that participation in citizen science increases public's understanding and interest in science, and motivations actions towards conservation.

Quantifying patterns in predation across southeastern us salt marshes

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Southeastern US Salt marshes are incredibly productive ecosystems providing numerous benefits to coastal communities. Within marshes, the snail, Littoraria irrorata, is an abundant grazer feeding on the dominant marsh plant, Spartina alternifora. Previous work has demonstrated that the sign and strength of Littoraria's effect on Spartina depends on the abundance and size structure of Littoraria populations. Both of these population attributes have the potential to be influenced by predation. However, little is known about the role that predators play in determining Littoraria population size structure and abundance. Last summer we quantified rates of size-selective predation on Littoraria in four southeastern marshes spanning Florida to Maryland. Specifically, we used tethering experiments to quantify the frequency of predation as a function of marsh site, elevational zone within the marsh and Littoraria body size. Contrary to our initial expectations, predation appears to be unimodally related to latitude. Data analysis is still underway, and the results I am presenting are preliminary.

Examining the influence of canopy cover on arthropod communities in the tank-bromeliads in Costa Rica

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Tank bromeliads are epiphytic plants found in the tropical habitat of Costa Rica that collect water and organic material, providing a habitat for a variety of arthropods and making them great for studying aquatic food webs and community dynamics. Previous studies have suggested that arthropod communities can be influenced by primary producers and water volume. The purpose of our study was to analyze the relationship between abiotic factors and arthropod community structure in bromeliads across open and closed habitat types. We hypothesized that there would be (1) a positive correlation between bromeliad size and water volume and that larger water volumes would allow for greater arthropod abundances; (2) a negative correlation between canopy cover and light (measured as lux); (3) increased available light will allow for higher algal concentrations, thus supporting larger arthropod abundances and taxa richness. We found that bromeliad size and water volume were positively correlated and directly influenced arthropod communities, with bromeliads in open habitats containing greater volumes of water on average. Open habitat bromeliads also received more sunlight and hosted higher algal concentrations compared to those in the closed habitat. Bromeliads in the open habitats had a higher arthropod abundance. The difference in taxa richness, however, was minimal. We suggest that future research projects continue to investigate the influence of chlorophyll on the arthropod communities and attempt to quantify the number of arthropods(<0.5mm) found in each plant.

Characterizing Root Histology and Evolutionary Relationships in African Savanna Trees and Grasses

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Little is known about the way in which trees and grasses in African savannas respond to water availability and precipitation. Such knowledge is important for predicting how the relative proportion of trees and grasses will change, with implications affecting a wide variety of wildlife and human livelihoods. Our research is centered around how tree-grass savanna ecosystems will respond to changes in drought intensity and frequency of precipitation in the future by focusing on the differences in water uptake and transport capabilities between trees and grasses. Previous research has been done to uncover the histological traits that differ between the roots of these functional groups and species. Moving forward, we will build a phylogenetic tree to understand the evolution of savanna tree and grass species. By combining our previous data of root histology with what we will learn about the evolutionary history of these plants, we can ensure unbiased results from our analysis of root histology. Additionally, understanding these evolutionary relationships in conjunction with past and future research will help us as we aim towards developing a profile for how each plant functional type uses and conducts water. Through comparing the profiles of trees and grasses we can predict how the proportion to trees and grasses will respond to changes in water availability and climate. This knowledge will help us better understand tree-grass dynamics in African savannas and how these and other grassland ecosystems will be impacted by future changes in climate.

The role of spatial distribution of open areas in the spread of Coffee Rust (Hemileia vastatrix), in San Luis de Monteverde, Costa Rica.

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Coffee rust, Hemileia vastatrix, is an airborne pathogen that has been plaguing commercial coffee plantations for decades. There has been an increase in prevalence throughout Central America; however, there is a lack of research about spread and abundance of coffee rust in a changing climate. In order to expand this knowledge base, we conducted an observational study in San Luis de Monteverde, Costa Rica during the fall of 2019. We surveyed owners of four coffee plots covering a range of growing practices. Questionnaires were given and the answers were compiled and compared between sites. Questions included information regarding the prevalence of coffee rust in their plots and how it changed with seasonality. At each site, we also took photographs and measurements to create a map marking which plants were present, had coffee rush, and their spatial distribution in the plot. Using a pair analysis and contingency tables we compared variables (beans, rust, fallen leaves) using one of our sites to determine association. The relationship between beans and rust, rust and leaves on the ground and center versus edge plants were not significant suggesting no association between variables. The relationship between leaves on the ground and beans on the tree was significant ($p < 0.01$) suggesting a positive association between those two variables. This, combined with the questionnaire results, suggests that allowing fallen leaves to remain around the base of the plant instead of clearing them could help boost yield in the presence of coffee rust and should be explored further.

Distributions of Mosquito Populations of Biodigester Effluent at CIEE Monteverde Campus

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CIEE's Monteverde, Costa Rica campus has adopted a sustainable and cost affordable sanitation system for both human and farm animal waste - anaerobic biodigesters. While the biodigester is a great benefit to the CIEE campus, the open-air effluent retention ponds are a huge attraction to disease carrying vectors because their oviposition requires stagnant water. Mosquitoes can be vectors for Malaria, Zika, Dengue, West Nile virus, Japanese encephalitis. In previous years, such as 2018, Aedes aegypti, dominated the ponds.Therefore, we predicted that we would identify Aedes to be dominant again. We sampled at four sites taking 50mL water samples to determine population size, species composition, and presence versus absence of mosquitoes across CIEE campus. We determined relative abundance and reared some larvae to adulthood to identify species. We found the genus Culex to be dominating CIEE digester retention ponds, we also found that the highest concentration of mosquitoes across CIEE campus was the digester ponds, we also found a cycle of alternating abundance levels of larvae between ponds 1 and 2 which contained the highest abundance. Our quantitative study of mosquito abundances across CIEE Monteverde campus bodies of water has shown that the Animal Digester Retention Ponds are the most significant breeding ground for mosquitoes. Action, such as netting, is required in order to control mosquito oviposition in these retention ponds. As climate change leads to an increase in temperature, this increases the spread of mosquito populations into warmer climates. Although these harmful diseases have not been documented in Monteverde yet, vector carrying mosquitoes could be a serious problem in the future.