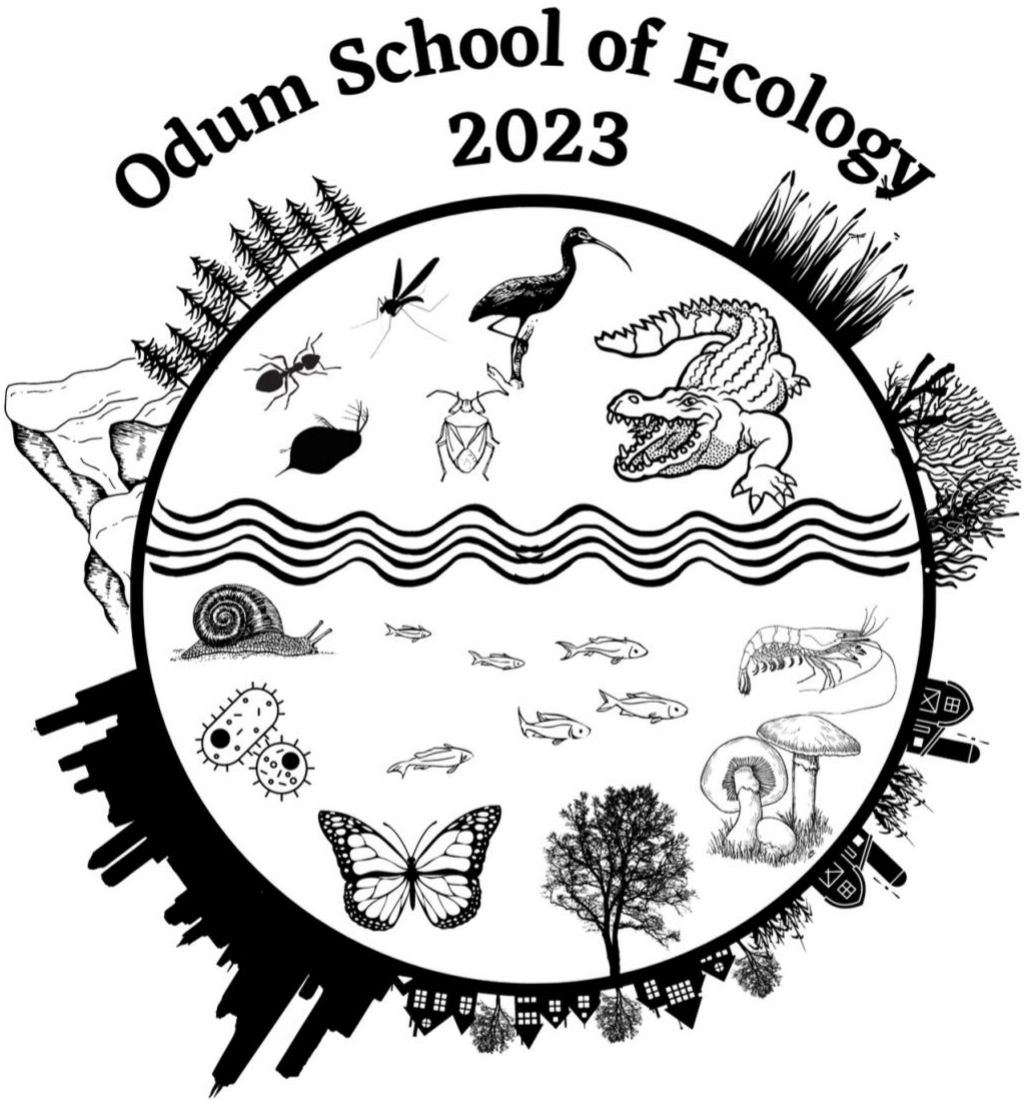
# 29th Annual
# Graduate Student Symposium

## January 27-28, 2023



# Welcome and Acknowledgements

Welcome to the 29th annual Graduate Student Symposium (GSS) at the Odum School of Ecology! GSS is organized by graduate students and serves as a forum to showcase student research at all stages of development. The goals of GSS are to provide opportunities for graduate students to give professional presentations and stimulate communication and camaraderie between students and faculty throughout the Odum School of Ecology and the broader UGA community. GSS serves as a crucial event for graduate students to reconnect with one another or make new friendships across cohorts.

This year's symposium could not have happened without the time and effort of numerous graduate student volunteers. We thank all of you for helping us plan this year's event!

Program Committee: C. Molinero, T. Odom, I. Ragonese, A. Schatz
Undergraduate Poster Committee: C. Brown, C. Nivison, K. Schroeder, K. Vaughn, A. Willoughby
Food and Beverage Committee: D. Cross, A. Mital, A Quan, L. Rack
Feedback Committee: J. Argrett, L. Naslund, D. Suh
Souvenir Committee: A. Gentles, J. Hoyos, T. Odom, K. Zemaitis
Prospective Student Committee: J. Longmire, M. Pierce, K. Vaughn, C. Wilson
A/V: S. Bauer, C. Hanns, E. Jones, M. Tomamichel
John Spencer 5K: S. Bauer, C. Hanns, J. Longmire, F. Lopez-Avila, N. Tomczyk

Many undergraduate and graduate students also volunteered to present posters and give presentations. Furthermore, faculty, post-docs, and graduate students all contributed to provide feedback on presentations. Constructive, friendly feedback obtained from these judges is one of the most beneficial elements of GSS. Thank you all!

The staff of the Odum School of Ecology provides administrative and technical support throughout the event and have been especially important for this year's hybrid symposium. In particular we want to thank Julie Gunby, Tyler Ingram, Allyson Mann, Ashley Weed, Lacey Botsford, Joanne Greenway, Benjamin Taylor, Amanda Rugenski, and Leslie Sitz for their assistance and work to keep Odum running! Additionally, we would like to thank the generous support from the Eugene and Will Odum Ecology Fund.

Finally, we thank you for taking time to attend the event. We hope this GSS will help kick off an amazing 2023 and give you the space to see old friends, make new ones, and foster a welcoming community here at the Odum School. Please enjoy the talks, provide constructive feedback to the student participants, and consider contributing next year!

Sincerely,
Supraja Rajagopal and Eric Walther
2023 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 |
| 2021 | Jeffrey Beauvais and Nate Tomczyk | Ethell Vereen | Morehouse College |
| 2022 | Andrew Nagy, Megan Tomamichel | Marcelo Ardón | North Carolina State |
| 2023 | Supraja Rajagopal, Eric Walther | Jacob Allgeier | University of Michigan |

**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 to 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 29$^{th}$ annual Graduate Student Symposium, and we hope the tradition continues well into the future.

***A note on talk formats and accessibility***

*Talks are scheduled to start every 15 minutes with the expectation that the presenter will speak for a maximum of 12 minutes. The remaining 3 minutes are allocated for questions and for participants to transition to the next recording. Additionally, this year there will be two Rapid Fire Sessions, in which each presenter will have 5 minutes to speak. During presentation 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 be available to address questions. Moderators will attempt to ensure that all speakers receive questions during this time.*

# Keynote Speaker


## Jacob Allgeier

Assistant Professor
Department of Ecology and Evolutionary Biology
University of Michigan


## Farming the coastal oceans with fish pee: Applying ecological theory to help sustain ecosystem services in tropical coastal ecosystems

Understanding the controls on ecosystem production underpins our ability to effectively manage coastal ecosystems and the services they provide millions of people worldwide. In this talk I will describe how our research uses experimentation, observation and modeling to test how ecological theory can be applied to create potential solutions to stem the rapid degradation of tropical coastal ecosystems.

## About Dr. Allgeier:

Dr. Allgeier is an ecologist with broad interests in how human-induced changes alter ecosystem processes and the services that they provide. His work is rooted in basic ecological theory, but motivated by increasing need for food security, particularly in coastal societies. Much of his research takes place in tropical coastal ecosystems (mangroves, seagrass beds, and coral reefs) where he studies gradients created by anthropogenic impacts to test theory directly within the context of environmental change and biodiversity loss. He received a B.S. in Biology from Centre College in Danville, Kentucky before coming to the University of Georgia, where he got his Ph.D. in Ecology under the supervision of Amy Rosemond. Following his time in Odum, Jake held multiple postdoctoral appointments, including an NSF postdoctoral fellowship at the University of Washington. Since 2017, he has held a position as Assistant Professor in the department of Ecology, Evolution, and Biology at the University of Michigan. In 2020, Jake was elected an ESA early career fellow.

# Friday, January 27

| | | |
|---|---|---|
| 10:30-10:45 | Dean Sonia Altizer, Supraja Rajagopal, Eric Walther | Welcoming remarks |

## Session I

| | | |
|---|---|---|
| 10:45-11:00 | Matt Pierce | Effect of wrack disturbances on *Spartina alterniflora* and invertebrate communities |
| 11:00-11:15 | Emma N. Kelsick | Nitrogen-cycling microbial community response to compounded disturbances of fertilizer and drought |
| 11:15-11:30 | Michael W. Belovitch | Carbon balance of tree seedlings and grasses in mixed savanna systems |
| 11:30-11:55 | **Break** | |

## Session II: Rapid Fire

| | | |
|---|---|---|
| 11:55-12:30 | Christian H. Brown | Testing Range Limit Theory using latitude-based presence partitioning in ecological niche models |
| | Anna R. Willoughby | Modeling effects of host behavioral defenses and parasite Allee effects on ectoparasite aggregation |
| | Jasmine N. Longmire | Benefits and drawbacks of varied water quality analysis methods |
| | Q&A | |
| 12:30–2:00 | **Lunch** | |

## Session III

| | | |
|---|---|---|
| 2:00-2:15 | Annakate M. Schatz | Patterns of host-parasite co-invasion promote enemy release and specialist parasite spillover |
| 2:15-2:30 | Benjamin Zane Taylor | Nest area estimation in *Temnothorax rugatulus* |
| 2:30-245 | Eric J. Walther | Demographic variability in spawning migration of Sicklefin redhorse (*Moxostoma sp.*) |
| 2:45-3:00 | **Break** | |

## Session IV

| | | |
|---|---|---|
| 3:00-3:15 | Isabella G. Ragonese | Modeling phenological and physiological responses to climate warming predicts infection outcomes in a migratory songbird-mosquito system |
| 3:15-3:30 | Viviana P. Bravo | Evaluation of aquatic macroinvertebrates communities and habitats using molecular and morphological identification on streams at Savannah River Site |
| 3:30-3:45 | Meanie K. Taylor | The return of fire alters soil invertebrate community and removes ectomycorrhizal suppression of decomposition |

## Poster Session

| | |
|---|---|
| 4:00-5:30 | **Poster Session** |

# Saturday, January 28

## Session V

| | | |
|---|---|---|
| 10:15-10:30 | Megan M. Tomamichel | The effect of temperature, host, and parasite traits on parasite-induced mortality in fisheries: a meta-analysis |
| 10:30-10:45 | Christopher R. Smaga | Environmental determinants and genetic pathways responsible for reproductive disorders in alligators |
| 10:45-11:00 | Laura C. Naslund | Nonpoint source pollution measures in the Clean Water Act have no detectable impact on decadal trends in nutrient concentrations in U.S. inland waters |
| 11:00-11:10 | **Break** | |

## Session VI: Rapid Fire

| | | |
|---|---|---|
| 11:10-11:45 | Camilla L. Nivison | Expansion beyond the bay: Do life history traits and currents help explain which invaders spread? |
| | Colin R. Peterson | Bird conservation in traditional wasabi farming landscapes |
| | Kelsey M. Vaughn | Size and predation on coral growth and survival |
| | Q&A | |
| 11:45-1:00 | **Lunch** | |

## Session VII

| | | |
|---|---|---|
| 1:00-1:15 | Carolyn Cummins | Temperature dependence of leaf litter breakdown in headwater streams depends on consumer group and leaf species |

| | | |
|---|---|---|
| 1:15-1:30 | Brendan Haile | Resource availability alters host population dynamics and parasite burden via shifts in behavior and demography |
| 1:30-1:45 | Kayla A. Bonilla | Posthumous MVPs: Mycorrhizal fungal necromass and soil organic matter |
| 1:45-2:00 | Maria L. Muller-Theissen | Cross-species infection in milkweed butterflies: Host resistance, tolerance, and immune defense to protozoan parasites |
| 2:00-2:15 | **Break** | |

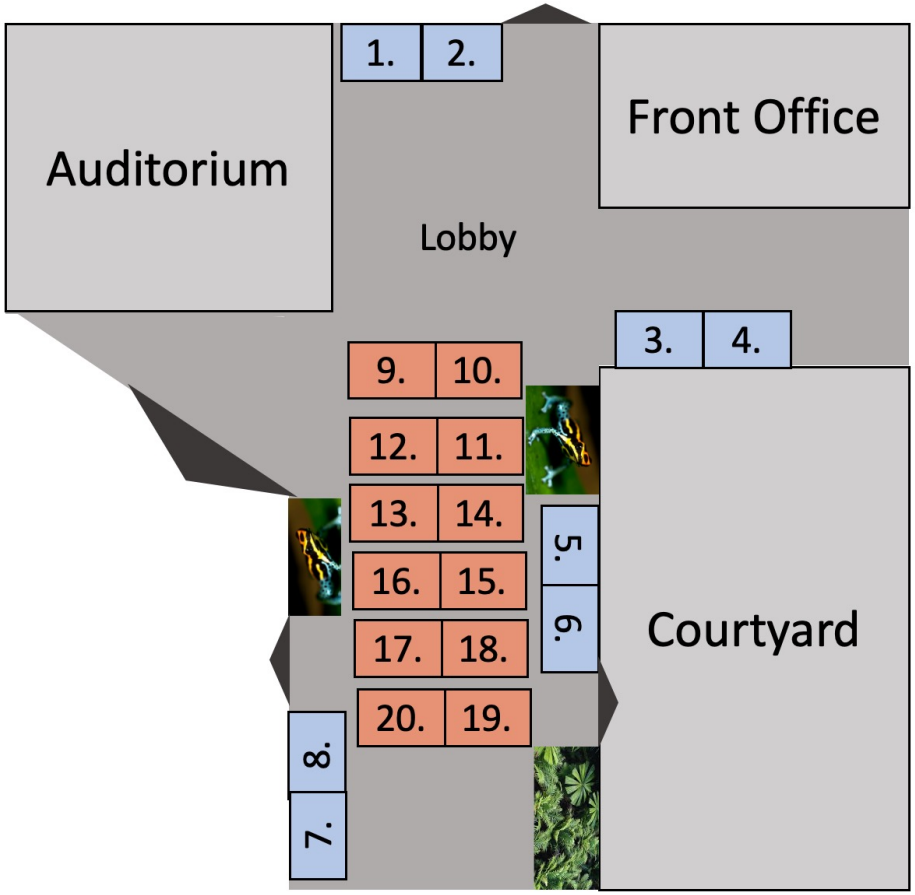
## Keynote Address

| | | |
|---|---|---|
| 2:15-2:20 | Amy Rosemond | Introduction |
| 2:20-3:30 | Jacob Allgeier | Farming the coastal oceans with fish pee: applying ecological theory to help sustain ecosystem services in tropical coastal ecosystems |

# Odum School of Ecology's GSS Undergraduate Poster Session

## January 27, 2023

odd # posters: 4 pm – 4:45 pm
even # posters: 4:45 - 5:30 pm




## Presenters

1. Caroline Anscombe
2. Henry Beckham Climie
3. Christian Deneka & Birkley Heynen
4. William Ellis
5. Riley Forrestall
6. Elianna Fox
7. Benjanmin Frick
8. Ethan Hackmeyer
9. CJ Jones
10. Catherine Kearney
11. Sarah Dean
12. Caitlin Lyons
13. Kate Moore
14. Sam Nestor
15. Victoria Pagano
16. Skye Remko
17. Mackenzie Ward
18. Tyler Washburn
19. Carter Watson
20. Isaac Wood

## Key

Window

White Board Stand

Entry / Exit

Frogs

Plants

# Abstracts

**Carbon balance of tree seedlings and grasses in mixed savanna systems**

Michael W. Belovitch[1], Ricardo M. Holdo[1]

(1) Odum School of Ecology, University of Georgia

Understanding the co-occurrence of trees and grasses in African savannas is an ongoing ecological debate. The most well-established upper bound on tree cover is defined by mean annual precipitation, leading many models to consider water availability their primary driver. These models rely on assumptions regarding tree and grass survival and growth under a spectrum of wet to dry soil conditions. Grasses are generally thought to have a competitive advantage under dry soil conditions; however, there has yet to be rigorous empirical support. We tested the photosynthetic rate between tree seedlings and grasses across a representative spectrum of soil moisture. We wanted to capture this critical stage of direct competition for soil water in tree-grass dynamics and do so at the whole-plant level rather than individual tissues. Using an enclosed carbon flux chamber, attached to an infrared gas analyzer, we measured gross photosynthetic flux across twelve tree and grass species (n=3) common in southern African savannas. Individuals were watered to field capacity and measured on alternating days during a dry-down until no CO2 absorption was detected. Soil water potential was measured at the beginning and end of the study, and soil water was tracked gravimetrically by day. Individuals were harvested at the end of the study and dry biomass was used to calculate carbon assimilation on a per gram basis. Distinct patterns of carbon assimilation emerged for trees and grasses. Paired with water use data, this represents a plant's potential for survival and growth across their environment's range of water availability.

## Posthumous MVPs: Mycorrhizal fungal necromass and soil organic matter

Kayla A. Bonilla[1,2]

(1) Odum School of Ecology, University of Georgia
(2) Plant Biology, University of Georgia

Mycorrhizal symbioses have been identified as drivers of biogeochemical cycling. Much of our understanding about mycorrhizal contributions to soil organic matter (SOM) formation and nitrogen (N) cycling have focused on above-ground inputs such as leaf litter. However, recent studies are shifting attention to below ground fungal inputs, particularly mycorrhizal fungal necromass. Certain groups of fungal necromass have been shown to decompose slowly, especially ericoid mycorrhizal (ERM) fungi whose hyphae are commonly highly melanated. Melanin has a highly complex structure that resists decay which contributes to the slow decomposition of ERM fungal necromass. ERM-associated shrubs commonly co-occur with ectomycorrhizal (ECM) trees whose fungi can also possess melanated hyphae to a lesser extent, as well as utilize similar nutrient uptake strategies as ERM fungi. The role of melanin and fungal necromass on SOM formation has only recently emerged as a mechanism for mycorrhizal biogeochemical cycling, so much is unknown about how these factors contribute to global SOM formation and N cycling. My proposed work will investigate the effects of melanated mycorrhizal fungal necromass on SOM formation and N cycling using greenhouse and field studies. I will quantify movement of isotopically labelled carbon (C) and N from mycorrhizal fungal necromass of varying melanin content into SOM and plant material respectively using ERM shrubs and ECM trees as host plants. I expect that higher melanin content will result in less movement of C and N from fungal necromass and that ECM trees will show less movement of C and N than in ERM shrubs.

## Evaluation of aquatic macroinvertebrates communities and habitats using molecular and morphological identification on streams at Savannah River Site

Viviana P. Bravo[1,2], Raven Bier[2], Krista Capps[1]

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

## Testing Range Limit Theory using latitude-based presence partitioning in ecological niche models

Christian H. Brown[1], Jacqueline E. Mohan[1]

(1) Odum School of Ecology, University of Georgia

Range limit theory (RLT) predicts that in environments with high abiotic stress, biotic factors play a minimal role in determining distribution limits. Conversely, RLT predicts species distributions in low abiotic stress environments will be primarily limited by biotic factors. However, RLT remains untested in many temperate tree species. In the Eastern United States, abiotic stress increases with latitude, as cooler temperatures impose physiological limitations for many species. Ecological niche models (ENMs) are statistical tools used to predict species distributions, forecast anthropogenic impacts on species, and test biogeographic hypotheses by using species presence as a response to environmental variables. It is common practice in the field of ecological niche modeling to only include abiotic predictors in models, as this type of data is more freely available in comprehensive datasets. However, species which follow predicted patterns of RLT and have distributions spanning a large latitudinal gradient may not only be limited by abiotic factors, particularly at their southern distribution extremes. It is therefore predicted that partitioning species presence data by latitude in models only using abiotic predictor variables will produce differential performance outcomes as latitude partitioning becomes more extreme. Specifically, models are expected to perform better when only using high-latitude presence points and more poorly when exclusively using low-latitude presence points. Poorer model performance in low-latitude models is predicted due to increased influence of biotic factors at southern distribution limits. Improved model performance with increasing latitude would support RLT and suggest that implementing biotic factors in ENMs would enhance model accuracy.

## Temperature dependence of leaf litter breakdown in headwater streams depends on consumer group and leaf species

Carolyn Cummins[1], Amy D. Rosemond[1], Nathan J. Tomczyk[1], Seth J. Wenger[1,2], Phillip M. Bumpers[1,2], Vladislav Gulis[3], Ashley M. Helton[4], Jonathan P. Benstead[5]

(1) Odum School of Ecology, University of Georgia
(2) River Basin Center, University of Georgia
(3) Coastal Carolina University
(4) University of Connecticut
(5) University of Alabama

Organic matter breakdown rates are increasing with climate warming, accelerating the global carbon cycle. Organic matter breakdown in headwater streams is driven by microorganisms and detritivorous macroinvertebrates, but differences in temperature dependence for breakdown mediated by these consumer groups remain unresolved. Determining differences in thermal responses among consumers, as well as how these responses shift for different leaf species, can aid predictions about how stream carbon (C) fates will shift with warming. We conducted monthly litterbag incubations for two years in 20 forested headwater streams across a temperature gradient in the southern Appalachian Mountains (USA). We compared temperature dependence (activation energy, $E_a$) for microbial and detritivore-mediated breakdown of recalcitrant (*Rhododendron*) and labile (*Acer*) leaves. We also assessed how fungal biomass (FB) shapes temperature dependence by comparing $E_a$ between FB-corrected breakdown and uncorrected breakdown. Detritivore-mediated breakdown had a higher $E_a$ than microbial breakdown for both *Rhododendron* (1.44 eV > 0.53 eV) and *Acer* (1.10 eV > 0.26 eV) leaves, and the $E_a$ of *Rhododendron* breakdown was higher than that of *Acer* breakdown for both consumer groups. Correcting microbial breakdown for FB in a subset of litterbags reduced $E_a$ by 56 percent, highlighting the importance of FB in determining temperature dependence. Our results imply that detritivores may contribute to litter breakdown more than microbes as temperatures warm, shifting stream C fates toward particle generation and invertebrate production. The higher $E_a$ for recalcitrant litter indicates that warming could also homogenize breakdown rates across leaf species and exacerbate summer resource limitation in temperate headwater streams.

## Resource availability alters host population dynamics and parasite burden via shifts in behavior and demography

Brendan Haile[1], Richard J. Hall[1,2]

(1) Odum School of Ecology, University of Georgia
(2) Center for the Ecology of Infectious Diseases, University of Georgia

Infection with macroparasites is the norm rather than the exception for most organisms, with rodents showing a particularly diverse assemblage of parasites. Resource availability may shift seasonally or sporadically via anthropogenic feedings. This project uses mathematical modeling to simulate how differences in resource availability effect the population dynamics of rodents and their macroparasites. Resource supplementation likely effects all facets of rodent and macroparasite life whether it be behavioral or physiological. We suggest that resources alter the foraging behavior of rodents thus changing the likelihood of infection by macroparasites however the directionality of this effect can vary by resource distribution. Allowing resources to effect only the infection parameters would limit the scope of this project. Therefore, we allow resources to effect rodent and macroparasite demography as well as rodent immune system function. Our model tracks the rodent host population as well as average worm burden.

## Nitrogen-cycling microbial community response to compounded disturbances of fertilizer and drought

Emma N. Kelsick[1,2], Raven Bier[2], JinJun Kan[3], Yichao Rui[4]

(1) Odum School of Ecology, University of Georgia
(2) Savannah River Ecology Laboratory, University of Georgia
(3) Stroud Water Research Center
(4) Rodale Institute

Microorganisms are critical to ecosystem nutrient cycling and microbial ecology frequently explores the dynamics of that functional role. Yet, important questions remain on the resistance and response of different microbial functional groups to ecosystem disturbances. Disturbances are commonly studied separately but are rarely evaluated sequentially despite the potential for multiple stressors to have emergent effects. The nutrient-cycling role of the microbiome is essential in agricultural ecosystems, but the extent of its change and recovery from multiple disturbance types under different agriculture managements is limited. The proposed research investigates how well the familiarity of a pulse disturbance determines the ability of a microbial community to maintain functional capacity during a secondary drought disturbance. A greenhouse experiment was conducted to determine how fertilizer and drought, alone and in combination, affect microbial processes in conventional, organic, and new organic farming. Environmental data and extracted RNA and DNA from rRNA genes and ribosomal RNA will allow the identification of microbial communities predicted to be responsible for nitrogen cycling and determine community changes.

## Benefits and drawbacks of varied water quality analysis methods

Jasmine N. Longmire[1,2]

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

For my 5 minute talk I'll be discussing the benefits and drawbacks of varied freshwater water quality analysis methods. There are a variety of ways to test the quality of a stream or enclosed lake such as: fish assemble (IBI), macroinvertebrate identification, pH, conductivity, visual evaluation, chemical testing of water samples for fecal matter, chemical testing for species (fish) within the area, distance from point sources, etc. The downfall is there is no standard way of determining water quality for all streams. It's hard to mitigate a system that has a historically different landscape due to human activity, meaning there's new water problems that need new solutions. Acts such as restoration are becoming harder due to rapid changing events. The benefits are when there is an

apparent problem with a body of water that can't be identified with one test, another analysis might be able to highlight the problem. The ability to have various methods of water quality allows also these methods to be used in many areas.

## Cross-species infection in milkweed butterflies: Host resistance, tolerance, and immune defense to protozoan parasites

Maria L. Muller-Theissen[1,2], Sonia M. Altizer[1,2]

(1) Odum School of Ecology, University of Georgia
(2) Center for the Ecology of Infectious Diseases, University of Georgia

To understand and predict outcomes of pathogen transmission in insects, it is important to identify intrinsic and extrinsic mechanisms driving insect-shared pathogen interactions at the individual and population levels. This research examines causes and consequences of host specialization and cross-species infection, focusing on a debilitating protozoan *Ophryocystis elektroscirrha* (OE) that infects wild monarch butterflies (*Danaus plexippus*). Similar OE-like parasites also infect several other milkweed butterfly species that overlap in geographical range with monarchs. We used transmission experiments on monarchs and the sympatric queens (*D. gilippus*) to ask the following questions: (1) How do resistance and tolerance to infection differ among milkweed butterfly species exposed to native vs. non-native parasite strains? (2) Does differential investment in immunity account for variation in infection between host species? Results showed that monarchs are more susceptible to infection than queens, and that queens are highly resistant to monarch-origin parasites. Queens were more tolerant to infection than monarchs, experiencing less reductions in lifespan with increasing spore loads. Queens also showed greater immune defense in the form of phenoloxidase activity, and a higher concentration of phagocytic hemocytes. This work is part of a broader effort examining the host range and geographic distribution of OE and OE-like parasites, parasite genetic and phenotypic divergence, and the dynamic consequences of cross-species infection. Because OE is widespread and prevalent in monarchs and can reduce monarch abundance, identifying the degree to which parasites have specialized across different butterfly species and the fitness consequences of infection are crucial.

## Nonpoint source pollution measures in the Clean Water Act have no detectable impact on decadal trends in nutrient concentrations in U.S. inland waters

Laura C. Naslund[1], Nathan J. Tomczyk[1], Carolyn S. Cummins[1], Emily V. Bell[2], Phillip M. Bumpers[1], Amy D. Rosemond[1]

(1) Odum School of Ecology, University of Georgia
(2) School of Public and International Affairs, University of Georgia

The Clean Water Act (CWA) of 1972 regulates water quality in US inland waters under a system of cooperative federalism in which states are delegated implementation and enforcement authority of CWA provisions by the U.S. Environmental Protection Agency. We leveraged heterogeneity in state implementation of the CWA to evaluate the efficacy of its nonpoint source provisions in reducing nutrient pollution, the leading cause of water quality impairment in US inland waters. We used data from the National Aquatic Resources Surveys to estimate changes in nutrient concentrations in streams, rivers, and lakes over the past decade and evaluated the explanatory value of indicators of state-level policy implementation. We found no evidence to support an expected effect of i) grant spending on nonpoint source pollution remediation, ii) nutrient criteria development, or iii) water quality monitoring intensity on 10-year trends in nutrient concentrations. These results suggest that the scale and scope of implementation under current federal policy frameworks for improving water quality is not leading to desired outcomes.

## Expansion beyond the bay: Do life history traits and currents help explain which invaders spread?

Camilla L. Nivison[1], James E. Byers[1]

(1) Odum School of Ecology, University of Georgia

Marine invasive species are often transported in ship ballast water or by ship fouling, arriving first at port cities. In order to become invasive, enough individuals must survive and establish in the new location. As many port cities are in sheltered bays, these establishing populations benefit from a high degree of larval retention - many of their offspring do not wash away to unfavorable habitats and instead help contribute to a new population dense enough to overcome the Allee effect. In this project, we are investigating what factors determine if an invasive species establishes populations on the coastline beyond the bay - that is, spreading beyond the sheltered coastline and establishing where the currents are much more advective. To investigate this, we are

obtaining data on occurrences of species from invasive lists for each port from the Oceanographic Biodiversity Information System and ocean currents from the Mercator Oceanographic Model. We hypothesize that both the speed of the along-shore currents and traits of the species will impact which species spread to the outer coast. A long pelagic larval duration increases dispersal potential, but may cause too low densities for successful population establishment. If they arrive, species with direct development may be more successful on an advective outer coast. We expect to find more invasive species in the downstream direction from the ports, and the strength of the currents may determine to what degree development type and pelagic larval duration correlate with new population establishment beyond the bay.

## Bird conservation in traditional wasabi farming landscapes

Colin R. Peterson[1]

(1) Odum School of Ecology, University of Georgia

Traditional farming systems are a unique type of agricultural landscape, and their historic stewardship practices are gaining recognition not only for their cultural significance, but also for their ability to conserve biodiversity. Japanese wasabi farming has existed for centuries in the form of aquatic terraced fields along steep mountainous slopes. In streams, a multi-tiered layering of stonework slows water flow to create the shallow, nutrient-rich aquatic environment required for wasabi plants to flourish. Previous ecological studies in wasabi fields have demonstrated high rates of biodiversity for rare plant and insect species, yet no research has been conducted on their conservation value to other taxa, including birds. In addition, pressures such as climate change and rural depopulation are leading to the abandonment of many wasabi farms, and the effect of this abandonment on local biodiversity is unknown. To test if and how wasabi agroecosystems function as important water habitats for forest birds, I propose exploratory field research in Shizuoka Prefecture, Japan, the birthplace of wasabi cultivation. I aim to elucidate the taxonomic and functional diversity of avian communities around wasabi fields compared to natural habitats and abandoned farms, examine the extent to which avian species rely on wasabi fields for foraging and nesting behaviors, and identify relationships between avian diversity and various environmental characteristics of wasabi fields. The goal of this research is to progress global understanding of how conserving traditional cultural practices and agricultural systems may play a role in mitigating biodiversity loss.

**Effect of wrack disturbances on *Spartina alterniflora* and invertebrate communities**

Matt Pierce[1], Julie Grissett[2], Sydney Williams[2], Tyler Lynn[3], Shelby Ziegler[1], Christine Angelini[2], Merryl Alber[4], Steven Pennings[5], Deepak Mishra[3], James E. Byers[1]

(1) Odum School of Ecology, University of Georgia
(2) Engineering School for Sustainable Infrastructure and Environment, University of Florida
(3) Department of Geography, Franklin College of Arts and Sciences, University of Georgia
(4) Department of Marine Sciences, Franklin College of Arts and Sciences, University of Georgia
(5) Department of Biology and Biochemistry, University of Houston

Disturbances are perturbations that negatively affect the stability of an ecosystem. The deposition of wrack (dead plant material) onto live vegetation is a naturally occurring disturbance in highly dynamic tidal saltmarshes. However, the effect of this natural and regularly occurring disturbance on the salt marsh plant and invertebrate community is not well understood. To better understand how wrack impacts the salt marsh community, we sampled wrack disturbance plots between July 2020 and September 2022 on Sapelo Island, Georgia. Using drone imagery, wrack patches that remained in the same location for two months were identified and monitored monthly for the number of adult crab (*Uca pugnax*, *Sesarma reticulatum*, and *Eurytium limosum*) burrows, adult snail (*Littoraria irrorata*) densities and saltmarsh cordgrass (*Spartina alterniflora*) stem density and height. To determine the influence of wrack disturbances on each measured response variable, we ran two-sample t-tests. We found that *S. alterniflora* stem density and adult snail density were depressed in wrack disturbance plots compared to undisturbed controls. The results of this study provide information on how resistant marshes are to natural disturbances and insight into how the salt marsh community will respond to increased wrack deposition from increased storm events and sea level rise.

**Modeling phenological and physiological responses to climate warming predicts infection outcomes in a migratory songbird-mosquito system**

Isabella G. Ragonese[1,2], Courtney C. Murdock[1,2,3], Sonia M. Altizer[1,2], Richard J. Hall[1,2,4]

(1) Odum School of Ecology, University of Georgia
(2) Center for the Ecology of Infectious Diseases, University of Georgia
(3) Department of Entomology, College of Agriculture and Life Sciences, Cornell University
(4) College of Veterinary Medicine, University of Georgia

Climate warming is expected to have pervasive effects on host-parasite interactions, especially those transmitted by arthropod vectors, whose physiology is tightly linked to environmental temperature. However, warming can also influence endothermic hosts by altering the timing of life history events such as seasonal migration and reproduction. Because rising temperatures could differentially affect thermal responses of parasites, vectors and hosts, it is important to incorporate both physiological and phenological responses to temperature into predictive models of vector-borne disease transmission. Here, we extend the Ross-McDonald model for a vector-borne disease to incorporate temperature effects on host and vector phenology and vital rates. Parameter estimates are based on West Nile Virus transmission between a migratory avian host, the American Robin, and *Culex* mosquito vectors. We find that in response to seasonal temperature shifts, differences in vector physiology and host phenology impact the magnitude and timing of peak infection prevalence, host population size, and cumulative host infections. By considering host, vector, and parasite responses to temperature together, our modeling framework could be employed to help decipher otherwise non-intuitive infection outcomes under current and future climate conditions.

**Patterns of host-parasite co-invasion promote enemy release and specialist parasite spillover**

Annakate M. Schatz[1,2], Andrew W. Park[1,2,3]

(1) Odum School of Ecology, University of Georgia
(2) Center for the Ecology of Infectious Diseases, University of Georgia
(3) Department of Infectious Diseases, College of Veterinary Medicine, University of Georgia

Species invasion and redistribution, driven by climate change and other anthropogenic influences, alter global biodiversity patterns and disrupt ecosystems. As host species move, they can bring their associated parasites with them, potentially infecting resident species, or leave their parasites behind, enhancing their competitive ability in their new

ranges. General rules to predict why invading hosts will retain some parasites but not others are relatively unexplored, and the potential predictors are numerous, ranging from parasite life history to host community composition. In this study, we used machine learning modeling methods to predict parasite retention during host invasion. Our results show that retention is non-random and predictable across hosts and invasions. It is broadly shaped by parasite type and parasite specialism, with more specialist parasites that infect many closely related hosts more likely to be retained. This trend is pronounced across parasite types; helminths, however, show a more uniform likelihood of retention regardless of specificity. Overall, we see that most parasites are not retained (11 percent retained), meaning many invasive species may benefit from enemy release. However, species redistribution does have the potential to spread parasites, and this also has great relevance to understanding conservation implications of species invasions. We see that specialist parasites are most likely to co-invade with their hosts, which suggests that species closely related to the invasive hosts are most likely to be affected by parasite spillover.

**Environmental determinants and genetic pathways responsible for reproductive disorders in alligators**

Christopher R. Smaga[1,2], Samantha L. Bock[1,2], Matthew D. Hale[3], Benjamin B. Parrott[1,2]

(1) Odum School of Ecology, University of Georgia
(2) Savannah River Ecology Laboratory, University of Georgia
(3) Department of Biology, University of Virginia

Exposure to endocrine disrupting compounds (EDCs) has negative consequences for reproductive health, yet the relevance of these exposures to ecological systems is not fully resolved. The alligator population at Lake Apopka, Florida is exposed to a suite of EDCs and displays disrupted ovarian phenotypes accompanied by broad scale transcriptional changes. Many of the EDCs present at Lake Apopka can activate nuclear estrogen receptors and our previous work revealed that treating embryos from a reference site with estrogen prior to ovarian differentiation recapitulates the transcriptomic and histological perturbations observed at Lake Apopka. Findings to date suggest that disrupting the timing of estrogen signaling may be a critical event in the etiology of these phenotypes. However, we lack a basic understanding of the molecular pathways that are differentially impacted by the timing of embryonic estrogen signaling. Here, we compare ovarian transcriptomes of alligator embryos treated with estrogen or vehicle at two developmental stages critical for gonadal differentiation. We find distinct sets of genes impacted from early vs late exposure, with only two genes shared between comparisons. Further, functional enrichment analyses suggest vastly different processes are impacted by estrogen at the timepoints tested. Ongoing work aims to further

characterize the physiological relevance of ovarian genes differentially impacted by the timing of estrogen signaling, along with their relevance to genes differentially expressed at Lake Apopka. Our results provide insight into how timing affects the molecular pathways influenced by estrogen, which is important for understanding mechanisms of EDC driven reproductive disorders in natural systems.

## The return of fire alters soil invertebrate community and removes ectomycorrhizal suppression of decomposition

Melanie K. Taylor[1], Dana O. Carpenter[1], Irenee Payne[2], Mac A. Callaham Jr.[2], Joseph J. O'Brien[2], Nina Wurzburger[1]

(1) Odum School of Ecology, University of Georgia
(2) USDA Forest Service

Mycorrhizal associations of plants are key drivers of biogeochemical cycles. For example, forests dominated by either arbuscular mycorrhizal (AM) or ectomycorrhizal (ECM) trees demonstrate distinct biogeochemical syndromes that are likely driven by interactions of plants, mycorrhizal fungi, and microbes. Our understanding of this dichotomy is hampered by the exclusion of two fundamental forest attributes: 1) soil invertebrates, and 2) fire. We sought to understand how fire affected mycorrhizal patterns in decomposition and soil invertebrate communities. To do this, we established twenty plots across a gradient of ECM tree basal area in areas burned by wildfire (paired with unburned areas) in an area of the southern Appalachians (USA) that had not burned for decades. We measured leaf litter mass loss and abundances of soil invertebrates. We found that fire removed the ECM suppression of decomposition and altered the composition of soil invertebrate communities. Further, we found that community compositions of soil invertebrates were linked with ECM basal area. These results suggest that the return of fire alters both the mycorrhizal influence on decomposition and soil invertebrate communities, and that soil invertebrates are likely to contribute to observed mycorrhizal patterns in biogeochemistry.

## Nest area estimation in *Temnothorax rugatulus*

Benjamin Zane Taylor[1], Supraja Ragagopal[1], Takao Sasaki[1], Drew Scott Di Francesco[1]

(1) Odum School of Ecology, University of Georgia

Animals often use simple decision-making strategies to solve complex tasks. Colonies of

rock ants (*Temnothorax rugatulus*) live in rock crevices and must frequently relocate due to the fragility of their nest site. When *Temnothorax* colonies face multiple potential nests, they consider several features, such as nest site area, and select the best - the largest nest site. How can ants measure areas that are magnitudes larger than their own body? Mallon and Franks (2000) proposed a potential solution: ants use Buffon's needle algorithm, in which scouts use the frequency of intersection with their own paths over multiple visits. Here, we empirically tested Buffon's needle algorithm by tracking each scout through an emigration. Based on these detailed data, we explored alternative strategies ants use for assessing areas.

**The effect of temperature, host, and parasite traits on parasite-induced mortality in fisheries: A meta-analysis**

Megan M. Tomamichel[1,2], Kaitlyn I. Lowe[3], Kaylee M. H. Arnold[1,2], Marc E. Frischer[4], Brian J. Irwin[5], Richard J. Hall [1,2], Craig W. Osenberg[1], James E. Byers[1,2]

(1) Odum School of Ecology, University of Georgia
(2) Center for the Ecology of Infectious Diseases, University of Georgia
(3) Franklin College of Arts and Sciences, University of Georgia
(4) Skidaway Institute of Oceanography, University of Georgia
(5) Warnell School of Forestry and Natural Resources, University of Georgia

A growing body of research has addressed how increasing temperatures will affect fisheries host-parasite relationships both theoretically and empirically. However, to date we lack a computational analysis of how warming will affect parasite induced mortality across diverse host and parasite taxa, host and parasite ecological traits, and across study motivations and design. We conducted a meta-analysis of 70 empirical studies that manipulated temperature and quantified mortality of both infected and uninfected hosts from harvested aquatic species. Overall, we found that infected hosts experienced significantly higher mortality than their uninfected counterparts. We also detected a small, positive effect of temperature, with rising temperatures increasing the risk of infected host mortality. Host taxonomic order is an important factor influencing the relationship between hosts, parasites, and temperature, with Salmoniformes experiencing a greater increase in mortality with temperature than hosts from other orders. Species from a sub-tropical temporal zone are more at risk to parasite-induced mortality than the average host, but the effect of temperature on mortality rate is reduced. Interestingly, opportunistic pathogens are less likely to cause host mortality than obligate pathogens, but the risk of host mortality increases with temperature at a faster rate. Our results suggest that while rising temperatures are likely to increase the risk of parasite induced mortality in most harvested species, the magnitude and direction of this relationship varies substantially with both host and parasite traits.

## Size and predation on coral growth and survival

Kelsey Vaughn [1], Craig W. Osenberg [1]

(1) Odum School of Ecology, University of Georgia

## Demographic variability in spawning migration of Sicklefin redhorse (*Moxostoma* sp.)

Eric J. Walther[1,2], Brian J. Irwin[3], Brett Albanese[4]

(1) Odum School of Ecology, University of Georgia
(2) River Basin Center, University of Georgia
(3) U.S. Geological Survey, Georgia Cooperative Fish and Wildlife Research Unit, Warnell School of Forestry and Natural Resources, Athens, Georgia
(4) Georgia Department of Natural Resources, Wildlife Conservation Section, Social Circle, Georgia

Understanding the biological and environmental drivers for the migration of freshwater fishes is important for effective management and conservation. Variation in migration timing among and within populations has been extensively documented for commercial or sport fishes; however, there has been less attention given to other native migratory fishes. Sickelfin Redhorse (*Moxostoma* sp.) is a rare, undescribed sucker species (family *Catostomidae*) endemic to the Hiwassee and Little Tennessee River systems and found in only a small portion of its historical distribution. Adult Sickelfin Redhorse occupy larger rivers and exhibit annual upstream migrations to access spawning tributaries making them particularly vulnerable to habitat fragmentation. The Sicklefin Redhorse Conservation Committee, a stakeholder led partnership, coordinates monitoring and conservation actions for the species. Annual monitoring of the Hiwassee basin population began in 2016 utilizing capture-mark-recapture techniques. In 2017, a passive integrated transponder (PIT) detection array was installed in Brasstown Creek, GA - a main spawning tributary - to detect tagged individuals (male: n = 189; female: n = 114) and monitor movement patterns. We fit a Random Forest model to predict stream temperature to fill data gaps in temperature monitoring. In this talk, we will describe sex-specific migration patterns and potential environmental migratory cues for Sicklefin Redhorse in Brasstown Creek. Understanding phenology of sex-specific variability in migration and environmental drivers is critical for establishing effective monitoring programs necessary for successful conservation.

**Modeling effects of host behavioral defenses and parasite Allee effects on ectoparasite aggregation**

Anna R. Willoughby[1,2], Sonia M. Altizer[1,2], John M. Drake[1,2]

(1) Odum School of Ecology, University of Georgia
(2) Center for the Ecology of Infectious Diseases, University of Georgia

Individual hosts serve as island habitats for ectoparasites like fleas that exploit their hosts for food and habitat, and between which parasites must disperse. Hosts defend themselves by limiting exposure to ectoparasites or reducing parasite loads via grooming. Despite the patchiness of host habitats and ubiquitousness of host behavioral defenses, ectoparasites are pervasive, reaching high infection prevalence across thousands of host species. The distributions of ectoparasite loads within populations, however, are rarely uniform and tend to follow the ”80:20” rule: 80 percent of individuals are never infested or have low burdens, whereas 20 percent of individuals host high burdens and are responsible for the bulk of transmission. Processes that underlie the 80:20 rule are complex and remain elusive for many host-parasite interactions. . Here we develop a mathematical model to investigate how parasite demographic stochasticity through the Allee effect and host regulation of parasites via grooming can drive heterogeneity in ectoparasite burdens. To do so, we integrate invasion biology, individual-based models of animal behavior, and theoretical population ecology to calculate the stationary distribution of ectoparasite population sizes using discrete models. We manipulate key population metrics, notably parasite immigration rate and carrying capacity, to describe behavioral coping of parasite infestations. Model outcomes translate stationary distributions of ectoparasite population sizes to variable parasite loads across a host population. Lastly, we explore how changes in the host population size due to environmental fluctuations in resource availability feedback on the distribution of ectoparasite populations.

# Poster Abstracts

### Stream drying and nutrient limitation status interact to control of microbially-driven decomposition rates

Caroline Anscombe[1], Shannon Speir[2], Michelle Wolford[3], Chelsea Smith[3], Carla Atkinson[3], Jake Ackerman[4]

(1) Odum School of Ecology, University of Georgia
(2) University of Arkansas
(3) University of Alabama
(4) Rhodes College

In streams, intermittency (e.g., periodic drying) can control biogeochemical cycling and decomposition of organic matter, which represents an important basal resource in headwater streams. However, our understanding of these processes in intermittent streams is lacking. Therefore, it is important to understand the interactions between intermittency, decomposition, and biogeochemistry. Here, we explored how stream drying influences the role of nutrient limitation in controlling decomposition. We first placed litter bags at n = 6 locations in an experimental reach (reduced flow) and at n = 3 locations in the control reach to allow for microbial colonization under ambient flow conditions over a three-week period and collected biogeochemical data in both reaches at litter bag deployment and collection. We used the colonized leaf litter to conduct respiration assays with nitrogen (N), phosphorus (P), and N+P treatments to evaluate the role of nutrient limitation in controlling decomposition. In the reference reach, we observed significant N and P co-limitation of microbial respiration. In the experimental reach, we did not document nutrient limitation of decomposition in pools, while decomposition in riffles was N-limited. We observed increased nitrate in experimental reach pools. This accumulation of nitrate may have relieved N limitation in pools compared to riffles in the experimental reach. Our results suggest the nutrient limitation status in drying reaches may vary by habitat type (e.g., pool vs. riffle). In turn, this may control microbial respiration rates and the breakdown of organic matter. Our findings have important implications understanding basal resources in intermittent stream food webs.

## Asian needle ant migration

Henry Beckham Climie[1], Takao Sasaki[1], Birkley Heynen[1], Christian Deneka[1],

(1) Odum School of Ecology, University of Georgia

Investigation of navigation and migration of Asian Needle Ants using tandem carrying.

## Frequency of aggressive behavior in Honduran red point cichlids (*Amatitlania siquia*) across different environmental conditions

Sarah L. Dean[1], Jessie Cross[2], Sonia M. Hernandez[1,3,4], Jose Aguirre[5], Emmanuel Rojas-Valerio[6]

(1) Odum School of Ecology, University of Georgia
(2) Berry College
(3) Warnell School of Forestry and Natural Resources, University of Georgia
(4) Southeastern Cooperative Wildlife Disease Study
(5) Universidad Complutense de Madrid
(6) Reserva Biologica Tirimbina

The Honduran red point cichlid (*Amatitlania siquia*) is a freshwater fish known for its displays of aggressive behavior towards potential threats in order to defend food resources and nests. While the intrinsic factors that affect levels of cichlid aggression, such as color and personality, are well-researched, the extrinsic factors that affect the level of aggression displayed by cichlids are far less understood. Here, we investigate whether external environmental conditions have any influence on the frequency at which cichlids present displays of aggression. Two separate sites on a freshwater stream on the Tirimbina Biological Reserve (a tropical wet forest on the Caribbean side of Costa Rica) were selected based on differences in canopy cover, leaf litter, and stream depth and width. Displays of cichlid aggression were observed and categorized based on the type of aggression and the organism to which the aggression was expressed (e.g., charge towards juvenile cichlid), and frequencies of each behavior during a given sixty-second period were recorded for an individual selected before the start of the interval. We found aggressive behaviors were more frequent at the shallower, rockier site, possibly because environments with smaller dimensions and more leaf litter decrease resource availability and subsequently increase a cichlid's need to defend its resources via aggression. Considering that a cichlid's aggressive behaviors are vital to its ability to forage and reproduce, our results raise the question of whether global changes in environmental climate conditions could influence the conservation of the species.

## Tracking nest invasion of Asian needle ants

Christian Deneka[1], Takao Sasaki[1], Henry Climie[1]

(1) Odum School of Ecology, University of Georgia

Asian needle ants, *Brachyponera chinensis*, are a species of ant who have an interesting method of invading a new nest. They send scouts to find the new nest. After identifying a new nest, the scouts then return to the old nest to recruit others. They do this by carrying other ants and placing them in the new nest; this process is called tandem carrying. This 1:1 recruitment makes it especially easy to study. In this study, we track the movement of Asian needle ants from one nest to another via video analysis. With this method, we are able to collect information on frequency of invasion, identity of ants, and frequency of tandem carries among a variety of other metrics.

## Do predators prefer bored prey? The effects of Boring sponge infection on prey selection by the Atlantic oyster drill

William Ellis[1], Shelby L. Ziegler[1], James E. Byers[1]

(1) Odum School of Ecology, University of Georgia

Predator-prey interactions are known to help shape community structure and function. Parasites may alter these interactions by changing the physiology and/or behavior of their host organism. There has been extensive research conducted on direct predator-prey interactions, but relatively few studies have examined how parasites mediate predator-prey interactions. In this study, we examined the relationship between boring sponge (*Cliona celata*) infection in Eastern oysters (*Crassostrea virginica*) and prey selection by Atlantic oyster drill (*Urosalpinx cinerea*), an oyster predator. We hypothesized that oyster drills would select infected oysters more often, as boring sponge impacts the integrity of its host's shell, making prey more susceptible to predation. To assess the effect of sponge infection on predator preference, we conducted a series of choice trials with one healthy oyster, one sponge infected oyster, and a single predatory drill. Although not statistically clear, we found a disproportionate selection for healthy prey over parasitized prey (69.6%). We hypothesize this predatory preference is due to the susceptibility of drills to boring sponge infection and an avoidance behavior for infected prey items.

## Variation in the pollinator communities of wildflowers in response to road proximity and microclimates

Riley Forrestall[1], Kris Braman[2], Miriam Edelkind-Vealey[2]

(1) Odum School of Ecology, University of Georgia
(2) College of Agricultural and Environmental Sciences, University of Georgia

Asphalted areas are known to create microclimates with a higher range of temperatures and lower humidity than their forested counterparts and often present optimal conditions for the rooting of many wildflower species. This phenomenon coincides with a crisis focusing on preserving pollinator populations, many of which rely on wildflowers. Particular importance is placed on those that bloom in late-fall as a last source of nectar or pollen before having to overwinter. However, how these wildflower communities change in response to a road's microclimate is largely unknown and would cause a change in the surrounding pollinator community as well. Here we investigate the linkage between local levels of humidity and temperature altered via a road, how these affect wildflower communities present in the Southeastern United States, and how that affects the diversity within the local pollinator community. Sampling was done at least weekly via hand-netting in three-minute sampling periods on currently flowering plants (*Persicaria longiseta, Solidago* sp., *Vernonia noveboracensis, Verbesina occidentalis, V. alternifolia, V. virginica, and Conoclinium coelestinum*) along 7 latitudinal transects with increasing distance from a road. Temperature and humidity loggers were placed in each transect and data was collected in a two-week period. It was noted that there were far more generalists (mainly *Apis mellifera* and *Bombus* spp.) than specialist pollinators caught, but analysis of preference has not yet been quantified. Through this research, we can make better informed decisions about pollinator conservation and how to maintain a properly balanced pollinator ecosystem.

## Factors influencing shrimp black gill intensity in experimental shrimp

Elianna Fox[1], Megan Tomamichel[1]

(1) Odum School of Ecology, University of Georgia

Georgia white shrimp (*Litopenaeus setiferus*), a critical forage species, may be under threat in recent decades as the amount of shrimp landings has declined. A potential cause is thought to be shrimp Black Gill disase (sBG) caused by a parasitic ciliate *Hyalophysa lynni*. Currently, there is no definitive cause and effect relationship between

the shrimp landings decline and sBG. To provide insight on this relationship, it is important to test potential variables that could influence infection and mortality. We aimed to collect the necessary data on these parasitic ciliates and statistically test 1) how the intensity of infection enumerated microscopically correlates with the accuracy of molecular diagnosis, 2) the relationship between intensity and host mortality, and 3) the effects of host sex and density on intensity. We produced a metric to measure *H. lynni* infection intensity by counting the trophonts of the ciliate and the amount of melanized bands produced by the shrimp's immune response. We used this metric to determine that sBG intensity is not correlated to shrimp sex or mortality. However, the longer a shrimp is held in low densities, the less intense the infection becomes. This final point is a particularly important due to its implications for fishery management and future experimentation on the system.

## ***Sarracenia purpurea*** **as an indicator for climate change driven range shifts in the genus Sarracenia**

Benjamin Frick[1], Christian Brown[1]

(1) Odum School of Ecology, University of Georgia

Over the past few decades, the impact of climate change on the ranges and ecology of plant species has been studied intensely. Though many of these studies focus on species used for food and textile production, virtually all plant groups have been or stand to be impacted by climate change and its resultant effects. Alongside crops and other more common species, threatened, endangered, and endemic plants stand in equal or often greater peril due to lower numbers, lower dispersal rates, and/or more limited ranges. The genus Sarracenia represents a unique assemblage of frequently threatened, obligate wetland plants that inherently exist in a more precarious ecological context than most other at-risk groups – this reality manifests by way of the relatively strict environmental parameters in which such plants can persist, i.e. acidic peat-based wetlands. Such an implication is especially pertinent when regarding the environmental phenomena accompanying climate change; over an extended period processes such as desiccation, nutrient deposition, and shifting temperature patterns may render many southeastern wetlands less advantageous or even intolerable habitat for Sarracenia relative to competitive generalist species, in which circumstance the identification of remaining suitable habitat will be critical for the conservation of all species within the genus. *Sarracenia purpurea*, the widest-ranged and most common species in the genus Sarracenia, is the most appropriate study species for investigating the impacts of climate change on the group's distribution due to its ubiquity across eastern North America and relatively broad environmental niche. Given *S. purpurea*'s presence at both the northern and southern range limits for the genus and potential to assess habitat suitability for itself and other members of its genus, this study utilizes its

presence in combination with climatological data and other environmental variables to predict range shifts for *S. purpurea* in the United States by the year 2100.

## Investigating microplastic presence in honeybee-collected pollen and honeybee products across the urban-rural gradient

Ethan Hackmeyer[1], Lewis Barlett[1,2,3]

(1) Odum School of Ecology, University of Georgia
(2) Center for the Ecology of Infectious Diseases, University of Georgia
(3) CAES-Entomology, University of Georgia

Recent studies have found evidence that honeybees take up microplastics while foraging, but uncertainty remains whether microplastics transfer to honey, wax and propolis. Large honeybee foraging ranges and microplastic pervasiveness bring into question whether there is a difference in microplastic prevalence encountered by honeybees across landscapes of varying development. It is vital to better measure microplastic contamination in honeybee products to safeguard human and honeybee health through development of monitoring schemes linking local environments of beekeeping operations to risks of microplastic contaminants.
This project will test two linked hypotheses: that honeybee microplastic exposure differs along development gradients, and the severity of microplastic exposure during foraging correlates with levels of microplastics in hive products. These hypotheses will be tested through collection and analysis of foraged pollen and honeybee products. Apiaries will be classified as urban, suburban, exurban or rural, and pollen traps will be randomly assigned to wood-frame hives to source pollen for microplastic analysis. Concurrently, hives from the same apiaries, unadorned with pollen traps, will have hive products harvested for analysis.
With current studies being few and limited in scope, this study will provide valuable insight into microplastic contamination in honeybee products. A difference in microplastic presence across the development gradient is anticipated. If the difference is significant, beekeepers can be better advised on which locations are most suitable for apiaries. If no significant difference is detected, particularly if little to no microplastics are detected, then hive products can be recognized as being largely immune to microplastic contamination.

## Social carrying in Asian needle ants (*Brachyponera chinensis*) during migration events

Birkley Heynen[1], Takao Sasaki[1]

(1) Odum School of Ecology, University of Georgia

Asian Needle Ants use a method called tandem carrying during migration events. That is when the ants pick up ants from their home nest and carry them to their new target nests. Only specific ants perform these tandem carries. The study has used video tracking techniques to watch ants perform these migrations, looking at what factors affect these tandem carriers and the success of the migrations overall. The hypothesis being tested are that individuals who get transported to the new site by tandem carrying cannot go back to the home nest and recruit their nestmates and that recruiters do not use pheromone trails during migrations. To test these hypotheses, we paint a whole colony of ants with a specific color combination, with four dots on their head, thorax, and two on the abdomen. In the experiment, the ant's home nest is placed on one side in an arena with a new target nest on the other side. The arena also has multiple lego's placed in order for the ants to use them as visual markers. The migrations are run and the data is collected.

## Structure use by invertebrates in the American Southwest

C.J. Jones[1], Anna Willoughby[1,2], Sonia Altizer[1,2]

(1) Odum School of Ecology, University of Georgia
(2) Center for the Ecology of Infectious Diseases, University of Georgia

Invertebrates are important indicators of overall ecosystem health; they aid in ecosystem functions such as pollination and provide a major food source for higher trophic levels. Alarmingly, invertebrate populations and diversity are declining. Large- and fine-scale habitat loss as a result of human development can dramatically alter invertebrate habitats. However, some species seem to thrive in human dwellings. Here, I compare invertebrate communities at indoor (n=6) and outdoor (n=6) sites in Zion and Grand Canyon National Parks. I expected to find higher invertebrate abundance and diversity at outdoor sites than building sites. Park buildings represent human dwellings that are in close proximity to wild habitats. Invertebrates captured by sticky traps in the spring and fall 2021 were counted and identified to the lowest possible taxonomic level. Using these data, I compare invertebrate abundance and richness between building and outdoor sites, and calculate diversity for each site type. 839 invertebrates were captured, 45 in buildings and 794 outdoors. Captured invertebrates belonged to 10

orders, seven of which were found at building sites and nine of which were found at outdoor sites. Outdoor sites had higher invertebrate abundance and richness than building sites.

## Impact of larval rearing environment and malarial infection on *Anopheles stephensi* fecundity

Catherine Kearney[1], Justine Shiau[2,3], Ashutosh Pathak[2,4]

(1) Odum School of Ecology, University of Georgia
(2) College of Veterinary Medicine, University of Georgia
(3) Center for Tropical and Emerging Global Diseases, University of Georgia
(4) Center for the Ecology of Infectious Diseases, University of Georgia

Malaria imposes a heavy disease burden and high mortality rate in dozens of countries around the world. Extensive research about Plasmodium and its vectors, various species of the Anopheles mosquito, has been done in an effort to ease the burden of malaria. In a recent study by Kaindoa et. al., the researchers determined that the species *An. funestus* was disproportionately responsible for malarial infections in the research site of Tanzania, and suggested that species-specific interventions be used to reduce transmission. To further examine species-specific interventions in malaria transmission, graduate student Justine Shiau at the College of Veterinary Medicine at the University of Georgia began a project studying how life history traits and fecundity of mosquitoes affects the sporozoite level in the individual. The overall goal of the project is to establish an *An. funestus* colony at the University of Georgia. The species being utilized to establish larval rearing techniques is *An. stephensi*. Rearing conditions for larvae varied in both the water system and food supply. The water system treatments included standing water and water with a minor current, and the food treatments were high or low levels of food. Upon adulthood, the mosquitoes were fed either uninfected rodent blood or rodent blood infected with *P. yoelii*. Females from the four treatment groups were then placed in tubes to lay their eggs. The females were examined to determine their wing sizes and the number of eggs laid was counted for each specimen. The goal for this data is to interpret the impact of water systems and food supply in rearing and infection status in adulthood on the size and fecundity of an individual. Preliminary findings indicate that fecundity significantly varied between the water treatments, regardless of food level or infection status.

## Wildlife camera traps to understand animal responses to invasive species

Caitlin Lyons[1], Elizabeth King[1,2]

(1) Odum School of Ecology, University of Georgia
(2) Warnell School of Forestry and Natural Resources, University of Georgia

Invasive species often outcompete native flora, which can have negative impacts on a forest. The surrounding wildlife can be dependent on the native species for resource acquisition and other services, so the changing understory impacts them. However, the negative, or positive, relationship between wildlife and the invasive flora are not always clear. In this study, we investigated wildlife presence after the removal of invasive Chinese privet (*Ligustrum sinense*) and bush honeysuckle (*Lonicera mackii*) in Oconee Forest Park. I used 7 Spartan wildlife cameras spread amongst three treatment sites, one with invasive removal from a year prior, one with new removal, and another one that had been untouched. Preliminary data from this ongoing project has captured 14 different species, including both predator and prey species. A few rare species such as the Gray fox and the Eastern Screech Owl were identified. Coyotes, deer, raccoons, and rabbits were often active at night, while common squirrels and chipmunks were seen at high levels during the day. This study aims to form testable hypothesis regarding the effects of invasive plant removal, which we will hopefully test with another, more intensive, removal of the Chinese privet and the bush honeysuckle. Furthermore, understanding the potential relationship between flora and wildlife diversity in this forest can be useful to understand the impacts of management decisions.

## Size doesn't matter: the effects of physical traits on filtration by Eastern oysters (*Crassostrea virginica*)

Kate Moore[1], Shelby L. Ziegler[1], James E. Byers[1]

(1) Odum School of Ecology, University of Georgia

Eastern oysters (*Crassostrea virginica*) are a key foundation species within temperate estuaries that provide various ecosystem services such as improving water quality. However, little is known about the effect of an individual oyster's traits on its ability to filter particles out of the water and subsequently increase water quality. Along a coastline, traits of oysters on reefs differ greatly, potentially leading to differences in water quality across space and time. To understand what morphological traits affect an oyster's filtration rate, we conducted a laboratory experiment to examine how body size and condition influence the removal of chlorophyll-a by oysters. During each replicate trial, we recorded chlorophyll-a measurements over the course of three hours for three treatments: large oysters (71-105 mm), small oysters (32-56 mm), and no oyster

control. We found that oysters with better condition had a higher rate of filtration regardless of body size. This is contrary to previous literature that assumes that reefs with larger individuals will filter more than reefs with smaller individuals. Overall, our results suggest size alone may not be the best indicator of increased water quality and that oyster health should be considered in future studies.

## Paper Towel Compost Pilot Program

Sam Nestor[1], Kali Lyons[1]

(1) Odum School of Ecology, University of Georgia

Composting is a sustainable alternative to sending organic material to the landfill. Paper towels are a significant source of compostable waste that leaves restrooms, but they are instead discarded in landfills where they will never break down. The Odum paper towel compost pilot program, also known as “Cawmpost Dawgs,” aimed to divert paper towels from landfill waste by converting bathroom trash receptacles into compost bins. In addition to this change in the waste disposal set-up, signage was added to alert Odum students and staff as to where to discard waste and stickers and buttons were distributed to raise awareness of the program. From 11/18 to 12/08, trash and compost from bathrooms was weighed to determine the diversion rate. In total, 61.5 lbs. of compost was accounted for compared to only 2.25 lbs. of trash, accounting to a 96.47% diversion rate of compost from the landfill. Moreso, survey responses from Odum students who participated in the pilot showed an increase in awareness of paper towel compostability. Data indicates that paper towel composting in bathrooms is a viable approach to waste reduction on the UGA campus and should be considered for future expansion.

## Effect of incubation temperature on American alligator (*Alligator mississippiensis*) telomere length

Victoria Pagano[1,2], Samantha Bock[1,2], Josiah Johnson[1,2], Benjamin Parrott[1,2]

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

Telomere length (TL) may be used as a biomarker of oxidative stress and biological age, with potential repercussions for individual survival and population health. As a result, it has become increasingly important to understand the factors influencing telomere dynamics, especially in the context of both environmental contamination and a rapidly changing global climate. To examine the role of contaminant exposure and temperature on telomere dynamics, we analyzed TL in a population of American alligators, a species with temperature-dependent sex determination. We collected alligator eggs from a mercury contaminated site and incubated them at female- and male-promoting temperature groups (29.5℃ and 33℃, respectively) until hatch. Blood was drawn 7-10 days post-hatch, and DNA was extracted from erythrocytes to quantify TL using qPCR; total mercury was also quantified from blood samples. We ran linear mixed effects models with AICc model ranking to determine the model that best explained variation in TL. Our top model only incorporated the effects of incubation treatment (log-likelihood = -178.1, AICc = 366.6, Akaike weight = 0.522), wherein there was a positive correlation with individuals incubated at the male-promoting temperature ($\beta = 0.423 \pm 0.123$, $p < 0.001$). Forthcoming data will likewise analyze the relationships between TL and hatchling morphology and early growth.

## 4 years after tropical storm Nate: The recovery of macroinvertebrate community composition in a Neotropical stream in Costa Rica

Skye Remko[1], Seth J. Wenger[1,2], Darixa Hernandez-Abrams[3], Amanda T. Rugenski[1,2]

(1) Odum School of Ecology, University of Georgia
(2) River Basin Center, University of Georgia
(3) U.S. Army Corps of Engineers, Engineer Research and Development Center Environmental Laboratory

The goal of our research is to assess recovery of the macroinvertebrate community in Alondra, a neotropical perennial stream, four years after Tropical Storm Nate in 2017. This major disturbance caused debris flows in San Luis de Monteverde, Costa Rica

which led to the loss of the macroinvertebrate community. Our data adds to part of a long-term ongoing study of macroinvertebrate community dynamics in a neotropical stream. Data was collected in 2016, 1- year prior to Tropical Storm Nate, and in 2018, 2019, and 2021. Our results provide data on the four-year recovery of the stream benthic macroinvertebrate community as well as some abiotic indicators of recovery. We collected macroinvertebrate data from Alondra, in October for all years from the same 100-meter reach. All macroinvertebrates were identified down to the lowest possible taxonomic level usually genus, but for the purposes of this study analysis was limited to the family level. We also measured canopy, stream temperature, pH, turbidity, and conductivity. We found that canopy cover decreased by 35.7% after Nate and in 2021 canopy cover increased to 55.2%. After the initial decrease in family richness in 2018 and 2019, we found that Alondra currently has the same number of families it did before Nate. However, the families and functional feeding groups composition is different than before Nate. Overall, our findings indicate that Alondra is recovering from the disturbance in 2017 and may be approaching a new steady state.

**Park pests: rodent behavior in human-manipulated environments**

Mackenzie Ward[1], Anna Willoughby[1,2], Rebecca Myers[1], Sonia Altizer[1,2]

(1) Odum School of Ecology, University of Georgia
(2) Center for the Ecology of Infectious Diseases, University of Georgia

Resource availability impacts the behaviors of wildlife, consequently affecting their health and parasite transmission. Rock squirrels (*Otospermophilus variegatus*), a generalist species habituated to humans, are directly impacted by seasonal swells in Zion National Park tourism that align with peaks in natural food availability. With high levels of tourism, the squirrels have access to human foods and increased contact with humans and their pets. In these disturbed habitats, squirrels optimize their resource intake while avoiding conflict with people and intraspecific competition. To better understand the effects of human manipulation on rodent behavior, we conducted ten minute focal follows for rock squirrels in three sites of varying human-use in Zion National Park System including a campground, high traffic trail, and low traffic trail. We quantified behaviors such as foraging, moving, contact interactions, and vigilance. We then calculated activity budgets for each site population. We found behaviors are site-specific, with squirrels in campgrounds exhibiting the most exploratory behaviors such as sniffing and digging compared to squirrels in trail areas. This study provides novel insights on human-rodent interactions in human-manipulated environments and how natural rodent behaviors are consequently altered. This study can inform tourism management and serve as a baseline for future studies on the relationship between human visitation and behavioral compensation in habituated wildlife.

## Examining the function of hydrogen peroxide in honeybee colonies

Tyler Washburn[1,2], Lewis Barlett[1,2]

(1) Odum School of Ecology, University of Georgia
(2) Center for the Ecology of Infectious Diseases, University of Georgia

Along with sugars and water, honey is also composed of molecules that give it antimicrobial properties, most notably hydrogen peroxide ($H_2O_2$). Hydrogen peroxide is a well-known inhibitor of microbial growth via oxidation and can even be used as a medical antiseptic. Formation of $H_2O_2$ is catalyzed by the enzyme glucose oxidase (GOX), which is ubiquitous across honeys. We have also shown how stable this enzyme is in high heat environments via pasteurization experiments done previously, using $H_2O_2$ concentrations assayed using a ferrous oxidation-xylenol orange (FOX-1) protocol paired with spectrophotometry to infer GOX activity. While shown to maintain its $H_2O_2$ concentration post-pasteurization, we now look to examine how $H_2O_2$ functions in the hive, particularly of how consumption of low levels of $H_2O_2$ will impact the diversity of the gut microbiome of adult honeybees. Gut microbiome diversity often plays an important role in energy metabolism, breaking down the polysaccharides used to create honey. Certain gut microbiota may also be 'catalase positive', capable of breaking down $H_2O_2$. We expect that the $H_2O_2$ concentration the bee gut microbiome is exposed to part regulates the microbiome composition, tentatively predicting that high $H_2O_2$ diets will deplete the diversity of the gut microbiota.

## The influence of parasitism on movement in a snail-trematode system

Carter Watson[1,2], Emlyn J. Resetarits[1,2,3], James E. Byers[1], Kailah Massey[1,2]

(1) Odum School of Ecology, University of Georgia
(2) Center for the Ecology of Infectious Diseases, University of Georgia
(3) UGA Marine Institute, University of Georgia

In freshwater ecosystems, Trematoda parasites serve as bioindicators of ecosystem health, since multiple species must be in healthy equilibrium for them to thrive. While the influence of these parasites on secondary and tertiary host behavior has been

extensively documented, little is known about the influence they have on primary host behavior. Using snails as our primary host species of study, we ask: does trematode infection influence the movement and behavior of snails within the Elimia genus? We predict that infected snails will exhibit behaviors prioritizing food security, internal trematoda production, and therefore will move less overall compared to uninfected conspecifics.
The project is composed of four experiments quantifying both infected and uninfected Elimia behavior and movement. The “Behavioral Choice Experiment” allows for the comparison of total movement in an isolated environment and a differential between stimulus choice. The “Network Analysis Experiment” allows for the comparison of the total distanced traveled by infected and uninfected conspecifics in a communal environment. The “Elapsed Movement Field Experiment” allows for the comparison of the movement differential over the period of a week in a natural environment, and the final experiment, the “Isolated Track Experiment,” allows for the comparison of total movement in an isolated environment.
Testing has identified that alterations in snail movement and behavior occur in a context-dependent basis. The results indicate less movement of infected snails when amongst conspecifics and more movement when isolated. This is contrary to our hypothesis and illustrate complex behavioral dynamics in infected individuals.

## Investigating spatial drivers of Odonate diversity and abundance across an urbanizing region

Isaac Wood[1], Molly Mulhern[1], Denzell Cross[1], Krista Capps[1,2]

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

Urbanization alters the structure and function of stream ecosystems. Odonates, or dragonflies and damselflies, are considered to be important bioindicators of stream health, as they depend on freshwater systems for reproduction. Relatively few studies have considered how urbanization alters the abundance, diversity, and distribution of dragonflies and damselflies. The aim of this study is to address this gap in our understanding and investigate the influence of local (microhabitat, substrate, water quality, etc.) and watershed-level (urban land cover) variables on odonate diversity and abundance in streams in Atlanta, GA (USA). We sampled six stream sites along a gradient of urbanization, ranging from >90% to <30% of impervious surface. We expect that the diversity and abundance of odonates will decline with increasing amounts of impervious surface cover, and that the relative abundance of taxa that are known to be tolerant to declining environmental conditions would increase in more disturbed habitats. The results of our work may inform freshwater management efforts in the future.