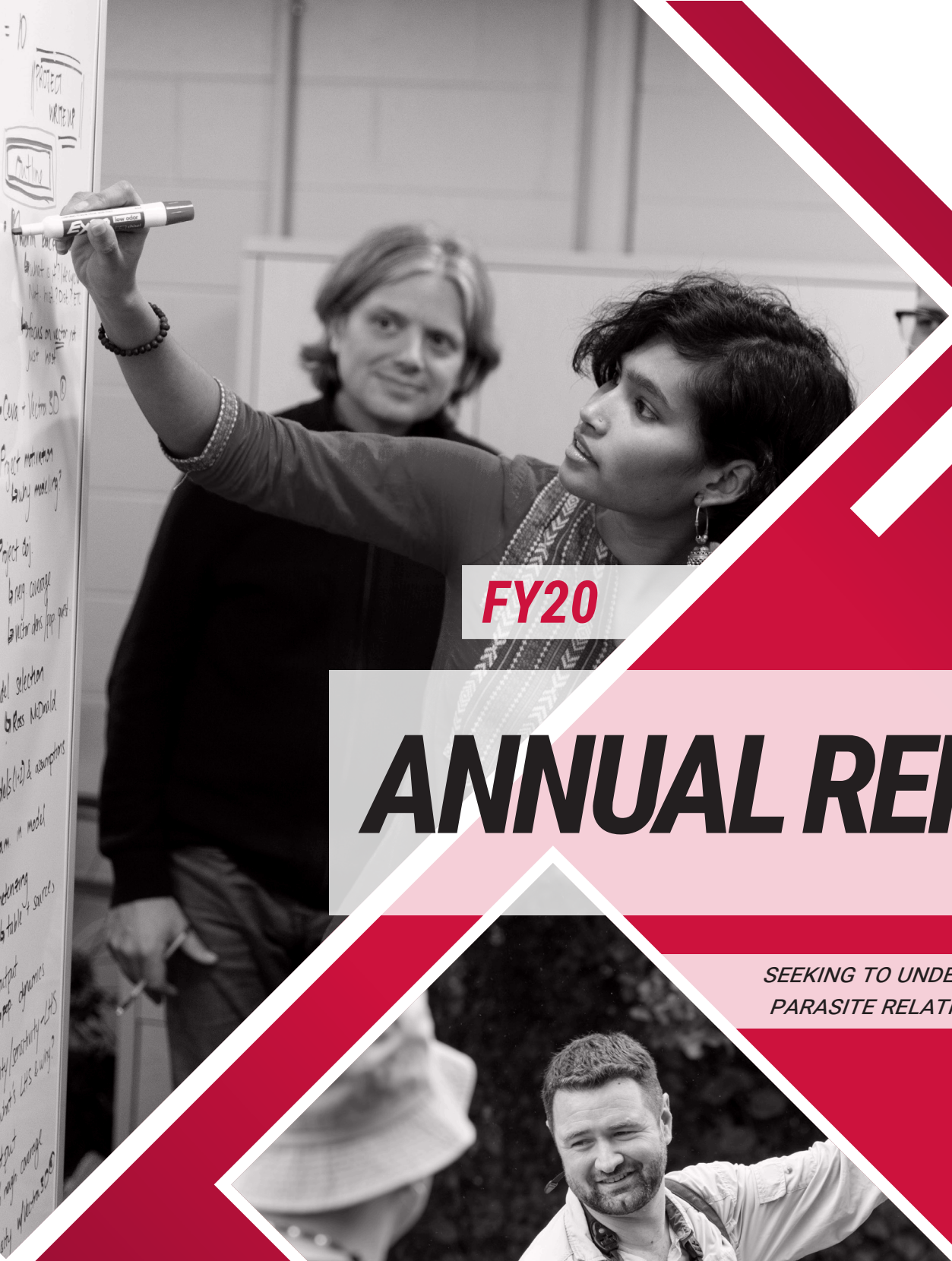
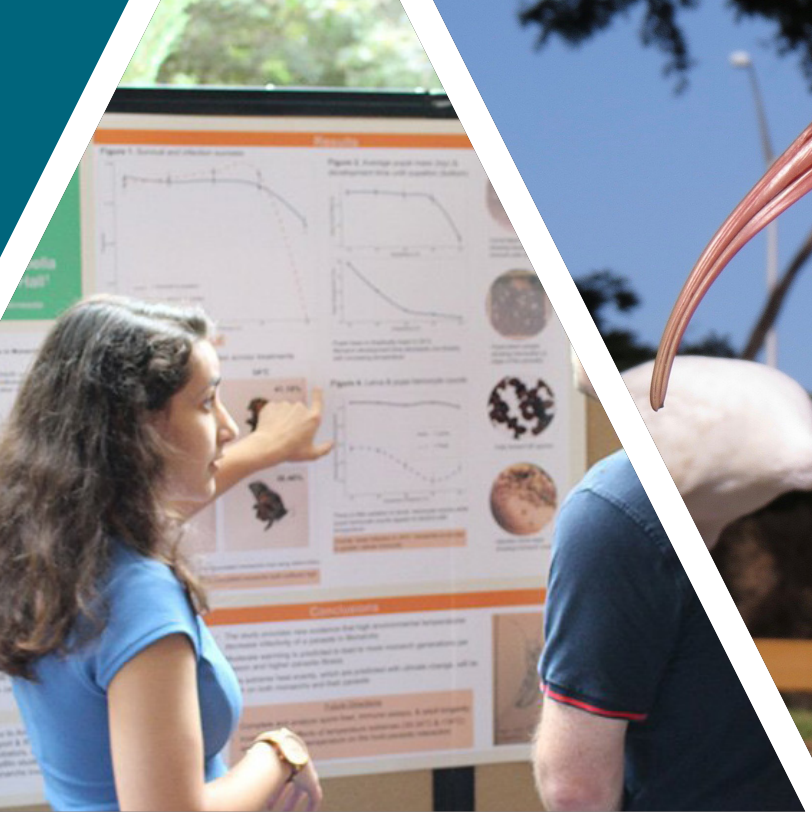


FY20

ANNUAL REPORT

SEEKING TO UNDERSTAND THE HOST PARASITE RELATIONSHIP IN NATURE



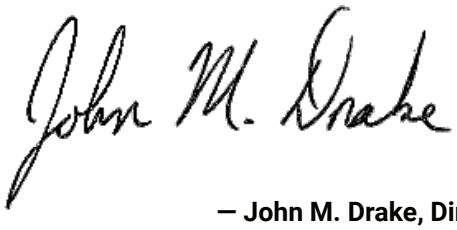
A Letter from the Director

This has been a year like none of us can remember, and we've all been challenged in different ways. While humanity has had to adapt to pandemics before, as with the 1918 flu pandemic, the devastation caused by COVID-19 is unprecedented in our lifetimes. In that same vein, the importance of infectious diseases, and the work being done by the Center for the Ecology of Infectious Diseases (CEID) has never been more apparent. I'm sorry that we've not been able to see each other as much, and that the pandemic has prevented us from hosting some of our normal activities, but I'm proud of our community for rallying, adapting, and responding to the great challenges before us by undertaking new projects that will guide us in these uncertain times.

In January of this year, we launched our Coronavirus Working Group and began work on more than 30 projects aimed at tracking the spatial spread of SARS-CoV-2, identifying and estimating important characteristics related to transmission, and assessing the effectiveness of public health interventions on containment. To facilitate the public understanding of the state of the pandemic, we launched our COVID-19 Portal, which continues to be a resource to policymakers and our fellow researchers.

At the same time, we've maintained our commitment to developing knowledge about other current and emerging infectious diseases. For example, in FY20, faculty associated with our spillover working group were awarded a large grant to elucidate the mechanisms that drive spillover of Ebola and other filoviruses. This is just one of the many examples of great work being done in the Center, and in the labs of Center members.

While our work continues to grow in impact and in reach, we know our work is just beginning. The challenges we've experienced with COVID-19 continue, but this year has also proven that our dedicated team of faculty, students, and staff researchers has the power to guide us through this pandemic, and help prevent the next. Through it all, CEID will continue to be here to lead scientific inquiry, and prepare our students to respond to the challenges of tomorrow.



— John M. Drake, Director

OUR STORY

168 Published peer-reviewed articles in FY20

from our ***82*** members

led by ***28*** world class faculty

18 total events in fiscal year 2020

612 event participants

6 seminars led by visiting scientists

6 workshops led by CEID members

2 computational modeling workshops

1 communications workshop, co-hosted with the IDEAS Program

4 other events, promoting research & driving collaboration

Research led by ***4*** working groups, focused on...

Zoonotic Spillover

Disease Mapping

Disease Forecasting

Coronaviruses & COVID-19

Center for the Ecology of Infectious Diseases
UNIVERSITY OF GEORGIA

COVID-19

How is the CEID responding to COVID-19?

Our world has changed. The COVID-19 pandemic has resulted in death, disruption, and economic damage in countries around the globe. Researchers from our state, nation, and world have turned to the Center for the Ecology of Infectious Diseases for leadership during this difficult time, and we have rallied a team of experts in ecology, quantitative biology, and computational statistics to track the virus and provide guidance on how we can beat this pandemic. Our work is helping our world understand COVID-19 transmission, predict future outbreaks, and identify the interventions that will be most effective in guiding our way to a safer future.

The Coronavirus Working Group

The CEID Coronavirus Working Group was formed on January 24, 2020, three days after the Centers for Disease Control and Prevention (CDC) activated its emergency response system in response to the outbreak of the novel coronavirus SARS-CoV-2 in Wuhan, China. The group includes more than 30 researchers with data science expertise in data analysis and interpretation, visualization, GIS, machine learning, computational statistics, and dynamical modeling.

Major Findings and Accomplishments

- Launched an interactive tracker that allows users to visualize the spread of COVID-19 worldwide
- Developed a "Nowcast," which estimates the total number of unreported cases by U.S. State
- Analyzed the effects of government intervention in China following the initial COVID-19 outbreak, demonstrating the importance of early intervention
- Developed Forecasts for each U.S. State, predicting how various mobility scenarios and personal interventions will affect the number of cases, deaths, infections, and relative transmission strength six weeks into the future
- Modeled the spatial transmission in U.S. Counties, demonstrating how the novel coronavirus spread throughout the country during the first wave of the pandemic
- Conducted scenario analysis for an outbreak of COVID-19 on a university campus
- Released the US COVID-19 Importation Risk Model that shows which U.S. ports of entry have the highest probability of receiving persons infected with the novel coronavirus

Support COVID-19 Research

Our research will guide us in a safe return to work, help maximize the effectiveness of vaccines, and build robust tools for disease surveillance. Donor support enables us to recruit additional researchers and take on projects that will help us contain this virus, save lives, and safeguard against future threats. Please aid us in these vital endeavors by visiting http://ceid.uga.edu/support/ and making a contribution.

"OUR ANALYSIS SHOWS THAT THE FUTURE SPREAD OF COVID-19 STRONGLY DEPENDS ON THE CHOICES INDIVIDUALS MAKE AND EMPHASIZES THE IMPORTANCE OF CONTINUED BEHAVIORS THAT DRIVE DOWN TRANSMISSION."

- Andreas Handel
Associate Professor
UGA College of Public Health

Projects Underway

The models developed by the Center for the Ecology of Infectious Diseases provide the public, policymakers, and the research community with data and perspectives on the coronavirus pandemic. As our work continues, we will expand our scenario analysis beyond Georgia, identify the effects of humidity and temperature on COVID-19 transmission, and identify the most effective response strategies worldwide.

CEID Mission

The Center for the Ecology of Infectious Diseases brings together social and natural scientists through data science, basic biology, and scientific synthesis. Our community values scientific curiosity, seeks rigorous solutions to the ecological problems of disease transmission and evolution, and prepares a rising generation of scientists with the technical skills needed to advance scientific inquiry and translational practice.

SPILLOVER WORKING GROUP

What is Zoonotic Disease?

Zoonotic diseases are illnesses that can spread from animals to humans. Domestic animals and wildlife are often reservoirs of pathogens that can cause disease if spread to humans, even if they do not pose a threat to their natural host. When a population with a high pathogen prevalence comes in contact with a novel host, this can cause a spillover event, where the pathogen jumps species. Spillover events are common, and more than half of all infectious disease outbreaks worldwide are zoonotic. Many of today's most concerning illnesses are zoonotic, such as Ebola, SARS coronaviruses, and several emerging diseases. To better protect our world from these diseases of major public health concern, the CEID has established our spillover working group. This group aims to develop novel data products, quantitative methods, and theory on the drivers of zoonotic spillover and the geography of emerging infectious diseases. We seek to build new tools for predictive modeling and risk mapping that provide an economic perspective on global disease surveillance. During FY20, the spillover working group launched a large-scale research projects that stand to elucidate the mechanisms of zoonotic spillover.

Spillover of Ebola and other filoviruses at ecological boundaries

Supported by a five-year, $2.4 million grant from the National Institute of Allergy and Infectious Diseases, part of the National Institutes of Health, this project seeks to investigate and model the effects of environmental, spatial and anthropogenic factors on zoonotic disease spillover, focusing on Ebolavirus and related filoviruses.

By gaining a better understanding of how these factors influenced outbreaks in the past, the researchers, led by Patrick Stephens of the Odum School of Ecology, hope to provide information that policymakers can use to predict and prepare for those of the future.

The 2014-2016 West Africa Ebola epidemic was the largest known human Ebola virus outbreak, resulting in more than 11,000 deaths and an economic and social burden of more than $50 billion. In 2002-2003, Ebolavirus killed more than 5,000 wild gorillas, a species of critical conservation concern.

Despite the severe economic toll and threat to human and animal life of zoonotic diseases, there is a lack of scientific consensus about drivers and dynamics of transmission at ecological boundaries where spillover occurs.

"In order to move from wild animal hosts to humans (or other animals), there are a number of challenges that a pathogen has to overcome," said Stephens. "It must come into contact with humans, and it must adapt to living and reproducing in a new species. We refer to this process as crossing the ecological boundary that separates two populations. Understanding the circumstances that make it more likely that this will happen is absolutely critical if we are to anticipate future disease spillover events such as the one that led to the current COVID-19 pandemic," he said.

The researchers will investigate how the characteristics of these ecological boundaries affect the dynamics of zoonotic transmission. They will examine the wild areas in which pathogens already exist; the areas of human encroachment in which a pathogen may spread; and the contact zone between the two where species interact and spillover physically occurs.

These boundaries are often the result of human activity motivated by socioeconomic factors, such as when people move into a wild area to develop land for farming or housing. This project will be one of the first to study the combined effects of ecological drivers with the effects of socioeconomic factors on transmission risk.

The first major goal of the research is to build more accurate statistical models of spillover, using data from past events to understand the factors that influenced them.

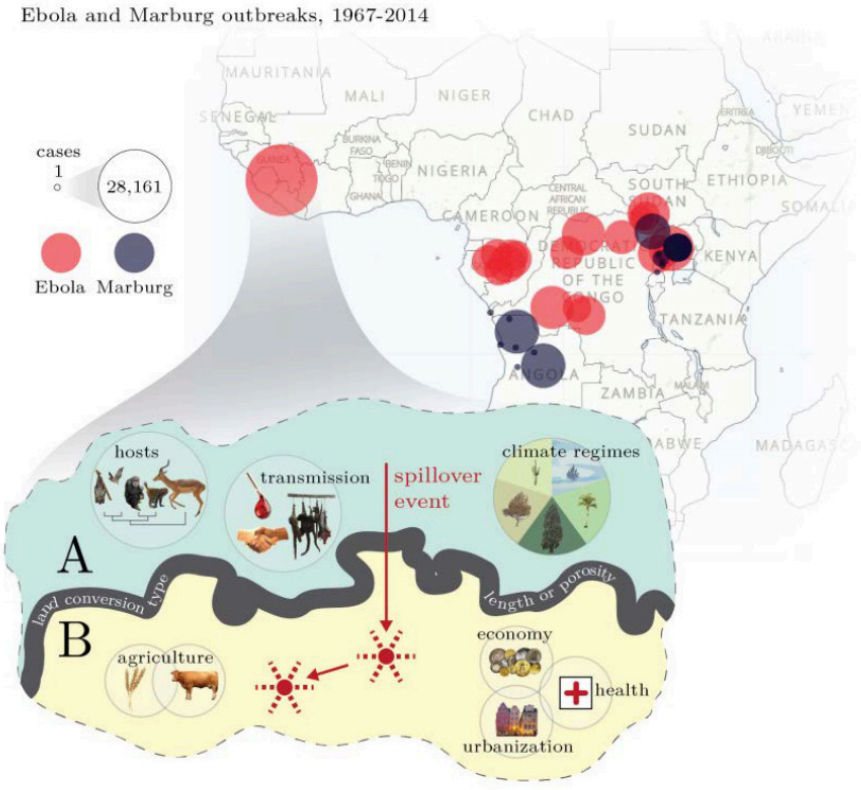
"For example, preliminary analyses showed that past Ebola spillover events in the Democratic Republic of Congo have occurred in areas near roads and where rapid ongoing forest destruction is occurring," said Stephens.

"This may represent areas where humans are encroaching on wild areas where there previously was little contact," he said. "We also found that provinces where outbreaks occurred were ones of unusually low average household income, which may reflect a lack of readily available medical resources."

The researchers will use findings such as these to develop new mathematical models of zoonotic disease spillover at ecological boundaries. They will use these models, and newly developed databases of historical filovirus outbreaks, to build risk maps and other tools that decision makers can use to predict and prepare for future outbreaks.

The insights gathered will be applicable to a number of other zoonotic disease systems as well, including West Nile virus and avian influenza. In addition to the insights and tools developed, this project will provide training opportunities for a number of postdoctoral and graduate student researchers through 2025.

Researchers leading the work are Patrick Stephens, John Drake, and JP Schmidt (Odum School of Ecology); Susana Ferreira (department of agricultural and applied economics, College of Agricultural and Environmental Sciences); and Nicole Gottdenker (department of pathology, College of Veterinary Medicine).



DISEASE MAPPING
WORKING GROUP

Building Mapping Skills for Researchers

CEID's Disease Mapping Working Group aims to develop mapping resources and researcher skills through collaborative projects related to the mapping and spatial modeling of infectious diseases. Recently, this group has been working on a species distribution model (SDM) for *Echinococcus multilocularis*, a parasitic tapeworm of public health concern. *E. multilocularis* is a zoonotic tapeworm commonly found in foxes which causes Alveolar echinococcosis in humans. This highly lethal disease can cause liver failure and other complications. SDM's are useful in understanding the range of a species across a landscape, and identifying areas of risk for transmission. Understanding the distribution of *E. multilocularis* may help researchers identify the factors that drive the presence of other multi-host, complex life-cycle parasites.

To address their research questions, working group members turned to databases and data mining platforms to identify the presence of the parasite and its hosts, as well as relevant literature. They are now using the mined presence data, and data on covariates that influence distribution, to develop SDMs to predict the geographic distribution of *E. multilocularis* and identify the most important variables that influence that distribution. As this project continues, researchers will evaluate the models developed, and conduct analyses to determine if environmental or host factors are more important to predicting the distribution of this parasite.

For more information, or to get involved, contact us at *ceid@uga.edu*

The red fox, *Vulpes vulpes*, is one of the most common hosts of *E. multilocularis*

What is disease mapping?

Disease mapping is a useful tool for analyzing and communicating public health data. By providing a visual representation of the spatial distribution of a disease, researchers can determine the source of an outbreak, or identify risk areas where a future outbreak is likely to occur. While disease mapping has been used since the nineteen century, notably by physician John Snow during the 1854 cholera outbreak in London, recent technological advancements in geographic information systems (GIS) have greatly expanded the use and capabilities of disease mapping. Today, spatial analysis is common in public health research, with maps being used to track the spread of a number of infectious diseases.[1]

Working Group Members

Kaylee Arnold
Michelle Evans
Ania Majewska
Robbie Richards
Claire Teitelbaum
Daniel Suh
Joy Vaz
Anna Willoughby

1. Montana, L. 2008. Geographic information systems. Pages 56-59 in H.K. Heggenhougen, editor. *International encyclopedia of public health.* Academic Press, Cambridge, Massachusetts, USA.

DISEASE FORECASTING WORKING GROUP

How is CEID using Disease Forecasts?

In FY20, CEID's Disease Forecasting Working Group presented the forecasting system they used for the 2018-2019 national influenza-like illness (ILI) forecasting challenge at the annual ILI forecasting conference, hosted by the Council of State and Territorial Epidemiologists in Atlanta. This system was completely overhauled into a more extensible form for the CDC's 2019-2020 ILI forecasting challenges. The working group expanded outputs to forecasts at the state level, and also partnered with the Armed Forces Health Surveillance Branch to produce ILI forecasts for several military bases. The working group also participated in the CDC's first forecasting competition for the presence of mosquito vectors of diseases such as dengue and Zika fevers in trapping sites of counties throughout the United States. In response to the COVID-19 pandemic, the working group has continued to provide forecasts of ILI to the CDC and has been providing forecasts of COVID-19- and influenza-like illness to the Armed Forces Health Surveillance Branch since April. Systems to forecast COVID-19 cases and deaths for US counties and states are in development.

Working Group Members

Tierney O'Sullivan

Eamon O'Dea

Rutu Gandhi

A forecast is a quantitative, predictive statement about an unobserved event, based on previously observed events. Just like meteorologists make forecasts about the weather, quantitative ecologists develop disease forecasts to predict the characteristics of seasonal epidemics, such as the flu, as well as make predictions about future outbreaks. Disease forecasts are valuable tools in preparing for and mitigating the effects of disease outbreaks.

STUDENT PROFILE

MEGAN TOMAMICHEL

is a second-year PhD student in the Interdisciplinary Disease Ecology Across Scales (IDEAS) program. After seeing firsthand the useful knowledge that mathematical models can provide for ecosystem management, Megan found a passion for infectious disease research.

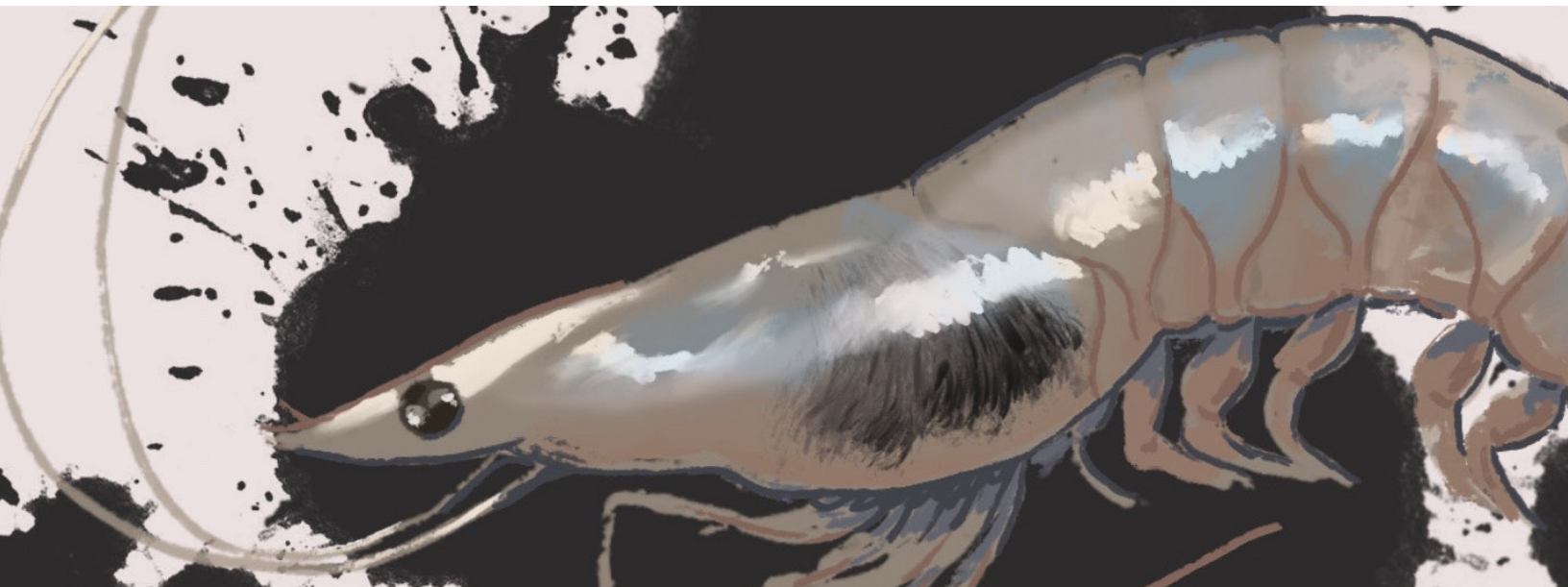
Her previous work in aquatic systems led her to be interested specifically in the relationship between parasites and hosts.

Through her time as an IDEAS student, Megan has involved herself in a variety of projects studying disease ecology in aquatic systems. The first is the Safe Seafood Working Group, which has created a meta-analysis examining how changes in temperature affect the parasite-host relationship in aquatic systems. In addition to learning the methods and skills involved in conducting meta-analyses, Megan has learned how to communicate with different groups of faculty and students working on a single project.

Besides the Safe Seafood Working Group, Megan also studies black gill disease in shrimp off the Georgia coast. Because not much is known about black gill disease, Megan's work provides the opportunity to investigate an emerging disease in an important industry. This project uses experiments to discover the transmission and mortality rates of black gill disease in shrimp. The results are then used to create different models of infection and management scenarios to reduce the prevalence of black gill. Megan's experiments have suggested that transmission can be density dependent. Through this work, mitigation strategies can be created to reduce the spread of black gill on the coast.

Since entering the IDEAS program, Megan has had the opportunity to collaborate with researchers involved in different areas within disease ecology research. In addition, her involvement in different projects has allowed her to work in both the large- and small-scale areas of disease patterns. Megan is particularly proud of a collaborative project with fellow IDEAS students Cali Wilson and Izzy Ragonese. This work studies the emergence of an endemic bacterial disease in freshwater fish known as Columnaris. Because the bacteria that cause the disease are regularly found in the microbiota of the fish, the group studies what environmental conditions cause the bacteria to become pathogenic.

When she is not working on her research, Megan enjoys hiking and canoeing in the various parks around Athens. She is a writer for Athens Science Observer and fosters dogs through Athens Canine Rescue.



POSTDOC PROFILE

ELIZABETH WARBURTON

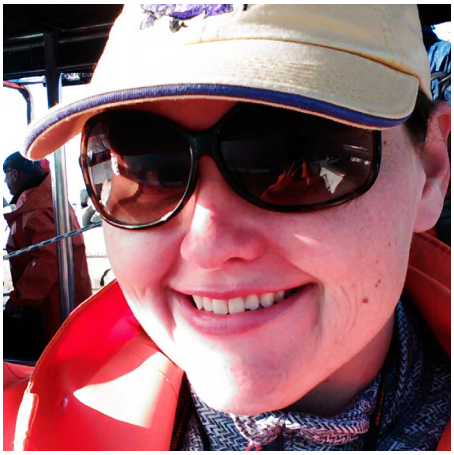
Motivated by a desire to explore the unexplained aspects of parasite-host dynamics, Dr. Elizabeth Warburton's research seeks to expand beyond the current understanding of parasite-environmental interactions. Her projects examine the individual relationships between parasites, hosts, and their environment across a variety of settings to strengthen scientists' understanding of the bigger picture of parasitology. After completing a fellowship at the Blaustein Institutes for Desert Research in Israel, she returned to the United States in August of 2019 to join the Center for the Ecology of Infectious Diseases as part of the first cohort of Postdoctoral Scholars.

Originally interested in becoming a veterinarian, Dr. Warburton's enrollment in a parasitology course as part of her undergraduate studies served as her first introduction to the field. Subsequent involvement in research and with a local veterinary clinic solidified Warburton's interests in the pathogens and diseases affecting animals, particularly wildlife, while cultivating a desire to continue exploring parasite-host systems. Her senior thesis project, involving a parasite common in dogs that has the potential to infect humans, served as an important segue into an impressive career in parasitology research including previous positions as a Fulbright Postdoctoral scholar and a Blaustein Prestigious Fellow. More recently she has been invited to speak at the Australian Society for Parasitology's annual meeting as an *International Journal of Parasitology* lecturer. Additionally, Dr. Warburton provided a review for the journal examining parasite ecology and evolution in extreme, dryland environments that was published in June of this year.

Her new home within the CEID provides an interdisciplinary space for Dr. Warburton's exploration of new perspectives and techniques as she embarks on her own independent research projects. Her upcoming work in Kruger National Park, South Africa, is an exploration of the determinants of parasite community composition of African buffalo, ultimately evolved from a discussion with Dr. Vanessa Ezenwa about previous findings within that system. The multifaceted study examines the selection effects imposed by the bovine host species and the external savanna environment on different nematode life stages, in an effort to map the variation in parasite community composition across the park. Ultimately, she hopes to understand how hosts and environmental conditions determine the infective pool of parasites in an ecosystem.

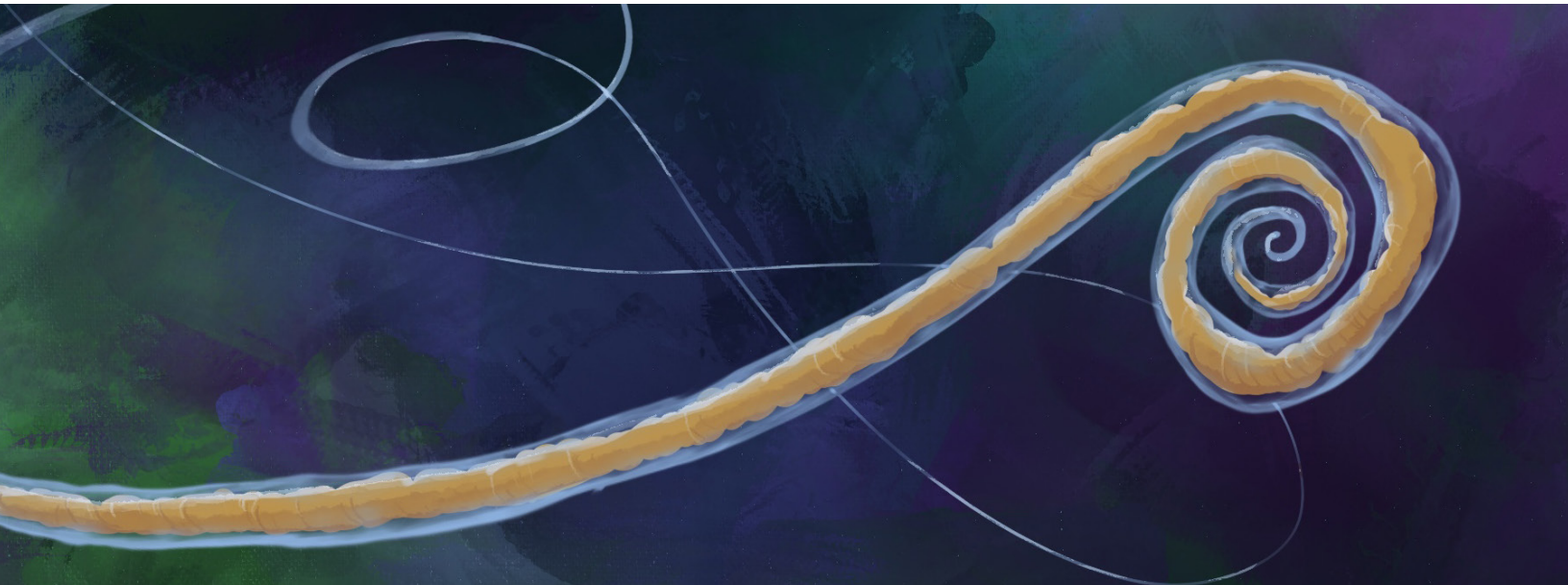
Dr. Warburton cites collaboration as a key component of her research experiences and contributions to the field of parasitology. Indeed, the wealth of knowledge within the CEID attracted Dr. Warburton to her position as she values the opportunity for collaborations, formal and informal, both abroad and closer to home. As one of three CEID Postdoctoral scholars she appreciates the ideas that arise from spur of the moment conversations and exchanges over a fresh pot of coffee.

Additionally, she values the center's workshops and member meet-ups for their ability to introduce her to new perspectives and research for consideration as she continues with her own contributions to the field of disease ecology. She explains that the interdisciplinary nature of the CEID creates a space unique to the University of Georgia as many of the top names in disease ecology are a short walk away and many others visit campus to deliver guest lectures.



Beyond research, Dr. Warburton has found Athens a welcoming place to call home as she reacclimates to life in the U.S. following her time abroad. Her involvement with the organization Women in Science introduced her to the role of mentor; she currently works with a PhD student in life sciences, and she hopes to continue providing guidance to students in science throughout her career.

Following the completion of her postdoctoral experience with CEID, Dr. Warburton intends to continue examining parasite-host dynamics across a variety of systems at a research university. She recognizes how her participation in undergraduate research shaped her career, and therefore she hopes to facilitate other students' involvement in the awe-inspiring experiences that ignited her own interest in parasitology.



Dr. Cecilia Sánchez, Ph.D. '19, studies how urbanization affects wildlife behavior and zoonotic disease transmission

How does human activity and urbanization affect wildlife movement and behavior? How can features of urban landscapes influence the transmission of disease among wildlife and humans? These are just a few of the questions Dr. Cecilia Sánchez seeks to answer in her research.

Photo Credit: Michelle Power and Louis Lignereux

Sánchez, a recent Ph.D. graduate of the Odum School of Ecology, developed an early interest in wildlife disease as an undergraduate at Yale University. Through an evolutionary medicine course that encouraged international lab work, Sánchez had her first opportunity to conduct research on zoonotic diseases (those transmitted from animals to humans). She spent a summer studying large fruit bats (also known as flying foxes) and their viruses at the Australian Animal Health Laboratory (AAHL) in Geelong, Victoria. After earning her B.S. in Biology, Sánchez returned to Australia to volunteer with AAHL for a year, solidifying her passion for flying foxes and disease ecology more broadly.

Sánchez came to UGA in 2014 as a Ph.D. student in the Altizer lab, attracted by Dr. Altizer's history of exceptional disease ecology research, previous and ongoing bat research in the lab, and a strong lab community. During her program, Sánchez continued her research on flying foxes, expanding beyond disease to also study movement and contaminant exposure. One of her biggest projects involved using GPS technology to track the movements of flying foxes living in Adelaide, a large city in Australia. Understanding the movement of flying foxes in urban areas has important implications for human health, as bats are reservoirs for a number of viruses that can cause fatal disease in humans. The health of flying foxes can also be affected by living in urban areas; for example, by being exposed to heavy metals or pesticides.

In addition to her research commitments, Sánchez has become an integral part of the Athens community through playing roller derby with the Classic City Rollergirls, and as one of the founders of Women in Science (WiSci) at UGA. WiSci works to promote equality in the sciences through mentoring, networking, and career development; Sánchez led the group for two years as President.

In summer 2019, approaching her graduation, Sánchez sought to put her ecology expertise to use in a non-academic setting, and took on a 3-month paid internship with the Lincoln Park Zoo in Chicago. This experience was funded by the NSF INTERN program, which aims to provide rising scientists with non-academic research experiences.

Working with Dr. Maureen Murray, a wildlife disease ecologist co-affiliated with the Urban Wildlife Institute and the Davee Center for Epidemiology and Endocrinology at the Lincoln Park Zoo, Sánchez developed a project to identify spatial and temporal predictors of rat complaints in Chicago. Previous work led by Murray showed that rat complaints are a strong predictor of actual rat abundance. Sánchez used the Chicago Data Portal, a database that publicly archives a variety of community information, to identify a number of potential predictors of rat complaints, such as human population density, the number of restaurants in an area, the presence of building construction, and season.

Sánchez then developed statistical models to determine which predictors best explained the number of rat complaints. The results suggest that rat complaints (and therefore rat abundance) are associated with both human activity and environmental factors. This could mean that rat control efforts need to be multi-pronged to be successful. Sánchez and Murray are working to publish these results soon.

Sánchez reports that her internship was one of the most positive experiences of her Ph.D. program. During her time at Lincoln Park Zoo, Sánchez had the opportunity to network with other interns and senior zoo employees including the president and zoo director, and participate in the zoo's educational programs including academic panels and guest lectures. Further, Sánchez feels that the computational skills she developed in her Ph.D. program were of benefit to the zoo, and that working at the zoo strengthened her desire to pursue a research career at a non-academic institution.

After defending her Ph.D. in fall 2019, Sánchez joined the Drake lab at the Odum School of Ecology as a postdoctoral researcher. She recently started a new position as a research scientist with EcoHealth Alliance. She is an active member of the Center for the Ecology of Infectious Diseases, where she continues her research on zoonotic disease, and has been contributing to ongoing efforts to understand the current COVID-19 pandemic.

Having had an exceptional experience during her Ph.D. program, Sánchez has several words of wisdom for rising scientists:

- Apply for many small grants during your program – this is a useful way to distill ideas and gain experience in grant writing that will come in handy when applying for larger grants down the line.
- Collaborate with scientists who are reliable, communicative, and hard-working – this can lead to enjoyable and productive collaborations.
- Focus on your own progress without comparing yourself to others, as all students are coming from different backgrounds.
- Don't be afraid to ask for advice from peers and mentors, as they may have insight from similar experiences or challenges.

SUPPORT OUR RESEARCH

An investment in infectious diseases intelligence is needed now more than ever, and support from individuals and community partners is critical to maintaining and advancing our research on COVID-19, Ebola, Zika, and other emerging threats. Donor support allows us to bring on board new researchers and take on additional projects to help us understand and contain COVID-19 -- ultimately to save lives. Please consider joining us in this effort by making a donation to the Center for the Ecology of Infectious Disease Fund by visiting t.uga.edu/4xa, or contacting us at ceid@uga.edu.

COVID-19 Research

Financial support of the CEID ensures the coronavirus working group has the human and material resources necessary to develop data-driven, information rich tools for situation awareness about the rapidly changing conditions of the COVID-19 pandemic. Financial support allows us to onboard additional researchers, and provide material support for projects including:

- Developing models for understanding COVID-19 transmission
- Estimating the actual pandemic size, given asymptomatic and presymptomatic cases may not be included in case counts
- Assessing the effectiveness of various public health interventions on containment & the effectiveness of potential vaccine campaigns

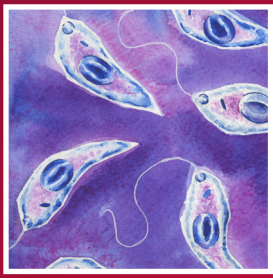
Training for Postdoctoral Researchers

CEID operates a competitive postdoctoral research program, known as CEID Postdoctoral Scholars. This program invites most promising early-career scientists to UGA to join our research on the ecology of all infectious diseases. The “postdoc” – a position similar to residency in clinical medicine – is one of the most important, but overlooked stages of scientific training. CEID Postdoctoral Scholars dedicate themselves to research and training in preparation to assume faculty positions and launch labs of their own. The inaugural CEID Postdoctoral Scholars and their projects are:

- Lewis Bartlett — Emerging pathogens of honey bees
- Emlyn Resetarits — Nutrient cycling by parasites in a marshland ecosystem
- Elizabeth Warburton — Community structure in host-parasite assemblages

Financial support will provide funding for additional cohorts of this program, ensuring high-quality training for tomorrow’s leaders in the study of the ecology of infectious diseases.

MEMBER ACCOMPLISHMENTS



Researchers associated with CEID's **Spillover Working Group** received two large external research grants, resulting in an economic impact of at least $4M

CEID Faculty including **Jeb Byers, Richard Hall, Pej Rohani, & John Wares** received seed funding for a new project, ""Mitigating Emerging Disease Impacts in Fisheries: Adaptive Strategies to Ensure a Safe, Healthy Seafood Supply,"

Doctoral student **Cali Wilson** was awarded the the UGA Graduate Education Advancement Board Fellowship

John Vinson earned his doctorate in Ecology, with his dissertation, "Vector-borne parasite transmission potential in ecological communities."

Doctoral candidate **Reni Kaul** was awarded a dissertation completion award and an Excellence in Teaching award from the UGA Graduate School

Mauricio Seguel won the Robert C. Anderson Memorial Award for his research illustrating the diverse mechanisms by which environmental change can negatively affect wildlife health.

John Drake was named a 2020 Fellow of the Ecological Society of America, recognized for his "contributions to the understanding of tipping points in ecological epidemiological systems and the development of computational methods for modeling the spatial distribution of species."

Ania Majewska also won the Robert C. Anderson Memorial award for her research examining how garden habitats can influence monarch abundance, survival, reproduction and exposure to pathogens and other natural enemies.

Undergraduate student & CEID intern **Culzean Kennedy** won the 2020 CURO award for Best Paper in the Life Sciences for her work, "Enhancing malaria vaccine immunogenicity and stability using VacSIM delivery method."

Doctoral candidate **Claire Teitlbaum** received the James L. Carmon Honorarium, which will support her research developing network models to understand movement patterns and pathogen transmission among nomadic white ibis populations.

CEID would like to acknowledge John Drake, Culzean Kennedy, Eric Marty, Eamon O'Dea, Chloe Parker, Trippe Ross, and Jessica Wenclawiak for their contributions to the writing and design of this report. We thank CEID members who have provided pictures, quotes, and edits.

Center for the Ecology of Infectious Diseases
UNIVERSITY OF GEORGIA

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