ECOLOGY & EVOLUTIONARY BIOLOGY

Explorations

SPRING 2020 NEWSLETTER

LEADERS IN BIODIVERSITY AND CONSERVATION SCIENCE

The University of Tennessee is nestled in an important global biodiversity hotspot. The Great Smoky Mountains National Park (GSMNP) is the most biodiverse park in the National Park system, named a UNESCO World Heritage Site, and an International Biosphere Reserve. Scientists in the UT Department of Ecology and Evolutionary Biology (EEB) and others have helped document more than 19,000 species in the park and think there could be an additional 80,000 to 100,000 species within the GSMNP. Many consider this region a naturalist's paradise. Those of us in the EEB community agree and feel fortunate to be able to conduct research in the park.

This regional biodiversity also faces local challenges, such as urbanization, population density, and fires, and global challenges such as climate change. Understanding and conserving the ecosystems and their functions are critical to safeguarding the many life sustaining and enhancing benefits people in the region derive from nature. For example, GSMNP is the most visited national park in the US, bringing more than $950 million in visitor spending in 2019 that supported 13,737 jobs in the local area, but overuse is a park management concern. Likewise, the mighty Tennessee River provides water to five million people and is home to more than 250 species of native fishes. East Tennessee is becoming increasingly important as a significant carbon sink because of its intensively managed, highly productive forests.

The rich local biodiversity and the expertise at UT and UT Institute of Agriculture puts our university at the forefront of the both studying biodiversity and helping address the biodiversity crisis. With the Smokies at our own backdoor, UT is uniquely positioned to be the leader on the science of biodiversity and conservation in the Eastern United States.

The emerging Tennessee Center for Biodiversity and Conservation (TCBC) is being spearheaded by a group of faculty in EEB, but includes more than 89 faculty and researchers across campus. TCBC will serve as a hub of expertise to train students and to generate, synthesize, organize, and analyze biodiversity data in ways that will not only conserve biodiversity, but also benefit our partner organizations and the people of East Tennessee.

"Our department at UT is already ranked among the top 10 percent of all ecology programs at public or private institutions in North America" said Susan Kalisz, professor and head of the Department of Ecology and Evolutionary Biology. "Recognizing this strength, we have partnered with other departments across UT/UTIA and made further investments into EEB faculty and infrastructure to position TCBC to achieve a leadership role in the nation."

Federal and state government agencies, nongovernmental organizations, and other institutions such as museums, herbaria, and natural history collections maintain data that serve as the foundation of our biodiversity knowledge in Tennessee. One goal of the new TCBC will be to help unify existing strengths across campus with current efforts across the state through data analyses and modeling.

"The scope of biodiversity and conservation science questions means that an interdisciplinary approach is required to elevate UT as a national leader in biodiversity research," Kalisz said. "Through our coalition of partnerships, we aim to advance community-engaged research centering on biodiversity data integration with field studies and remote sensing of environment to foster evidence-based biodiversity conservation."

TCBC is still in its infancy, but when realized, it will act as the fulcrum for the rich expertise in biodiversity and conservation at the University of Tennessee and position our students and faculty at the forefront of conservation, exploring a variety of biodiversity topics from microbes and organisms to species and ecosystems.

what's inside:

MESSAGE FROM THE DEPARTMENT HEAD

A NECESSARY **EVOLUTION**

How did they do it?!

Many people are asking how we managed the changes in teaching, research, and administration required to keep everyone as safe as possible while doing our jobs and serving our students. Instead of a quiet time of catching up on research and writing, members of our department used "spring break 2020" to become a hive of activity. Faculty and graduate students sprang into action and emerged at the end of the week with online versions of all of EEB's spring term courses.

Faculty created lectures using voice-over techniques of the PowerPoint images usually presented in class. They posted the presentations, along with readings and videos, to Canvas course websites and made them accessible for viewing at any time. We facilitated interactive class discussions via Zoom and smaller breakout discussions in Zoom chat rooms. Faculty even gave quizzes and exams simultaneously online. Finally, we created a buddy system for each class so that students could finish their courses even if an instructor fell ill.

The EEB front office staff moved fully to telecommuting while handling purchase orders, hiring, payroll, generating budget spreadsheets, and much more all from home. To maintain social distancing and the safety of all, new research efforts are on hold and most labs are dark. Instead, faculty and students are analyzing data, writing papers and grant proposals, while creating new course material for their online offerings.

Essential personnel in the greenhouse and live animal facilities continue their on-campus efforts to ensure that plants and animals used in teaching and research remain healthy. We have all become more adept at Zoom—lab meetings, faculty meetings, student-advisor meetings, graduate student committee meetings, and more are all virtual.

With school and daycare closings, work hours have flexed and the pace of work has changed as people take on the important 24/7 roles of caring for children and other family members. The EEB buildings may appear quiet, but our community is alive and well, caring not only for the education and research, but also for the non-work needs of everyone in the department. The speed, quality, and thoughtfulness of EEB's response to the coronavirus-induced shutdown of our lives speaks to the dedication and humanity of all the people who work in this amazing department. I am grateful and proud of Team EEB!

Wishing you and your family health,

SUSAN KALISZ
Professor and Head
DEPARTMENT OF ECOLOGY & EVOLUTIONARY BIOLOGY

For more department updates and faculty news, visit **eeb.utk.edu**.

UNDERGRADUATE SPOTLIGHT

THE **DUNG BEETLE** & CLIMATE CHANGE

MORGAN FLEMING is a senior working in the Sheldon Lab. She has always loved the sciences and the outdoors, and quickly found her home in the EEB department after arriving at UT. Recently, Morgan completed an independent project investigating how early life stages of the dung beetle, *Onthophagus taurus*, change their metabolism in response to temperature, a key question in response to climate change. Specifically, she examined metabolic plasticity in response to increasing temperature mean and variance and potential fitness tradeoffs.

Dung beetles provide a variety of ecosystem services by removing and processing dung, including nutrient cycling, reduction of parasites, and secondary seed dispersal, that may be altered in a warming world. Understanding how dung beetles respond to temperature changes can thus lead to better predictions of how climate change may affect key ecosystem services. While there is abundant research on thermal responses of adult insects, less is known about physiological responses in earlier life stages that could help mitigate the impacts of climate change. Morgan reared beetles in incubation treatments that varied in temperature mean and fluctuation. She completed metabolic trials on beetle pupae and then measured body size of the beetles when they emerged as adults. Morgan found that pupae in the warmest, most variable temperatures reduced their energetic demands but had much smaller adult body sizes compared to pupae reared in other temperature treatments. Results of this study suggest that plasticity in early life stages could mitigate impacts of climate change on dung beetles, but this may come at a cost to fitness later in life since small-bodied adults have reduced reproductive success.

Earlier this year, Morgan received the EEB Outstanding Undergraduate Research Poster Award, the Award of Excellence at the EURēCA conference, and a summer research grant from the UT Office of Undergraduate Research. In August 2019, she presented her work at a national conference. She also won a prestigious National Science Foundation Graduate Research Fellowship. Looking ahead, Morgan plans to continue on to the EEB PhD program.

MECHANISMS LIMITING SPECIES RANGES

JACOB MOUTOUAMA was born and raised in the Atacora Mountain chain, a biodiversity hotspot of Benin in West Africa. Several important species live in the area, but they are biologically endangered, as Benin is also a threatened ecosystem.

Jacob first became sensitive to conservation issues in his community after an internship with the Benin National Forest Office and his participation in Tropical Biology Association Courses. He developed a particular interest in the impact of human disturbance on rare species. Jacob's experiences inspired him to pursue further training and to perform research that can positively impact conservation in the tropics, and so he applied to become a doctoral student in the UT Department of Ecology and Evolutionary Biology.

In fall 2018, he joined the department as a PhD student and member of the Gaoue Lab. Through his research, Jacob seeks to understand the evolutionary and ecological mechanisms that limit species ranges. To do so, he studies *Thunbergia atacorensis*, an endemic plant of West Africa in a research system that aims to understand how biotic and abiotic factors can explain weak population dynamics at the edge of species ranges. His research approach includes manipulative and common garden experiments, field demographic data, structural equation models, and developing integral projection models.

"Even though I have only been here a year, I have been accepted warmly into the department and Professor Gaoue's lab," Jacob said. "I've made lifelong friends and mentors and the support I have at UT has helped me to be very productive."

Jacob has already received seven grants and the Best Progress Toward a Dissertation award from the EEB department.

ENHANCING THE GRADUATE STUDENT EXPERIENCE

Graduate Researchers in Ecology, Behavior, and Evolution (GREBE) is the graduate student association in the Department of Ecology and Evolutionary Biology and plays several roles in enhancing the graduate student experience in the department.

"GREBE strives to foster an inclusive, dynamic, and enthusiastic atmosphere where graduate students feel supported, able to pursue their passions, and have access to the resources, training, and tools they need," said Amanda Benoit, GREBE president.

Members of GREBE advocate for graduate students and organize elections for students to serve on departmental and university committees, contributing graduate student perspectives to decision-making at various levels. Members also organize professional development and science-based outreach opportunities, provide funding to support student travel to conferences, and link students to internal and external resources such as grants and fellowships.

Through GREBE, graduate students have been working with faculty in EEB to streamline the process of adding experts from outside UT to doctoral committees to serve members better as they pursue diverse lines of inquiry. GREBE created a new teaching and learning committee, which focuses on working with the department to create opportunities for graduate students to improve their teaching and to serve as instructor of record.

In fall 2019, GREBE welcomed a new cohort of passionate and talented graduate researchers from around the US and the world (including students from South Korea, South Africa, and Cameroon). To help them settle in, get to know one another, and learn about East Tennessee, GREBE organized a welcome picnic and retreat at the EEB field station in the Great Smoky Mountains National Park.

All smiles on a morning hike in the Smokies, during the graduate student retreat in August 2019.

"One of our main goals this year was to provide a space for graduate students to connect with their peers academically and socially," said Krista DeCooke, GREBE vice president. "These connections lead to mentorships, collaborations, and friendships that last."

EEB graduate students organized sessions on mental health resources and drafting a personal mission statement. They hosted an ice cream social, trivia night, and more events and sessions. They are also working to help keep students connected virtually while they are dispersed physically.

In addition to a website, graduate students can learn more about GREBE and connect via social media. Follow **@GREBE_UTK** on Twitter or join the **GREBE UTK** Facebook Group.

Have a topic of interest to share with GREBE? Email them at **grebeemail@gmail.com**.

Members of the group welcome ideas and input from fellow EEB graduate students.

Alix assists on a prescribed burn in Cades Cove. Photo credit: Matt Jernigan

WORKING AT THE BOUNDARY OF **SCIENCE AND LAND MANAGEMENT**

ALIX PFENNIGWERTH, a vegetation ecologist and UT EEB alumna ('11, '17), has spent the past several years working in land management and science with the US Geological Survey (USGS) and National Park Service (NPS). Now, she works as a biologist with the Inventory & Monitoring Program at Great Smoky Mountains National Park (GSMNP). She credits a lot of her success today to her time spent in EEB.

"I often tell people that earning my master's degree in ecology and evolutionary biology at UT was one of the hardest but most rewarding things I've done in my life," Alix said.

Working at the boundary of science and land management, Alix wears many hats. Her primary responsibility at GSMNP is to design, implement, and manage a variety of long-term vegetation monitoring projects, but she also has many collateral duties. Alix collects ecological data from one of the park's 160 long-term forest monitoring plots, teaches visitors and students about wetland ecology, and consults with park managers to help them carry out park activities in an ecologically sound manner. Sometimes, she also swings a Pulaksi on a prescribed burn fire line on trails with the park's Search and Rescue team.

"The diversity of my work as a federal scientist is part of what I find so rewarding," Alix said. "Due to my scientific training, I can be confident that I'm conducting the highest-caliber, most meaningful research and monitoring possible. I also find it incredibly satisfying to be able to apply that science to help answer the many questions and decisions that park managers are faced with every day."

Alix credits EEB for preparing her for her career path. Some she realized at the time, but other things took a bit longer for her to appreciate fully. One easy connection is the successful grant proposals and papers Alix authored in graduate school and her continued success in writing grant proposals, scientific papers and agency reports. Alix also served as the undergraduate lab coordinator throughout graduate school in Jen Schweitzer's lab. She credits this experience as well.

"I've continued to hire, manage and mentor interns and technicians with the USGS and NPS, and I'm comfortable doing this because I learned how to in Jen's lab."

During graduate school, Alix sought out roles and experiences that felt meaningful and relevant to her interests and career, such as serving on the board of the nonprofit Tennessee Invasive Plant Council, volunteering weekly with the GSMNP vegetation monitoring program, and presenting at the Natural Areas conference. This may have made an already busy graduate student busier, but Alix feels strongly that taking on these roles set her up for success.

"Success is accomplishing the many essential duties of a federal scientist, such as effectively managing interns and staff, communicating and collaborating productively with scientists and non-scientists, managing time and resources," Alix said. "It is also being passionate, but level-headed about your work."

STUDYING **SALAMANDERS** IN SOUTHERN APPALACHIA

Students in the Ben Fitzpatrick Lab are encouraged to pose big questions about the origin and maintenance of biodiversity. Over the years, projects have included Matt Neimiller's description of speciation in cave-fishes, Zach Marion's proposal of new methods to measure and analyze diversity, and Cassie Dresser's evaluation of genetic diversity in endangered Bog Turtles.

Fitzpatrick students, however, tend to be enthusiastic about a particular group of organisms: salamanders.

Salamanders symbolize biodiversity in the Southern Appalachians. They also represent all of the major questions in biodiversity science: What determines how many species can coexist in an ecosystem? How do new species arise? What explains individual variation within species? What is a species, anyways?

Ben Fitzpatrick received a faculty development leave for the fall semester so that he could spend long days sampling salamanders in the Great Smoky Mountains National Park. His goal is to re-evaluate patterns of diversity in large woodland salamanders and test hypotheses about the effects of competition, hybridization, and climate on species boundaries and coexistence.

Ben Holt, a second-year PhD student, has questions about diversity on a finer scale. He is investigating the microbes that inhabit the slimy skin of salamanders: the cutaneous microbiome. The diversity and composition of this microbiome might be modified as brook salamanders switch between aquatic and terrestrial life stages. Salamanders might also directly manipulate the cutaneous microbiome via various skin secretions. Holt is using microbial and biochemical techniques (in addition to long nights catching salamanders in the Smoky Mountain streams) to evaluate the importance of these factors in shaping the cutaneous microbiome.

Undergraduate students in the lab are pursuing other threads. Brianna Drake is using population genetics to study hybridization between stream-dwelling salamanders in the genus *Desmognathus*. Alex Funk is using DNA extracted from salamander feces to study their diets. Bryce Wade is studying small salamander occupancy of forest fragments within the city of Knoxville.

The UT Department of Ecology and Evolutionary Biology is the perfect place for students to study salamanders. After all, the Great Smoky Mountains National Park is known as the salamander capital of the world.

SUPPORTING UNDERGRADUATE STUDENT **SUCCESS**

What kind of careers am I qualified for with a concentration in EEB? Do I need to go to graduate school? What should I include on my CV? How can I get research experiences?

These are some of the questions undergraduates ask, or should ask themselves, while working on their undergraduate degrees. For many, however, those questions are not asked until the day after graduation, which makes it harder to reach their career goals. To ensure that students get assistance in how to answer these questions, faculty in EEB have started offering a series of opportunities to help students find answers.

Since 2017, undergraduates in the department have had a range of professional development opportunities to enrich their experiences and preparation. We offer four workshops each year on professional development topics to assist in skill development. We also developed a comprehensive professional development course (EEB 311) that is taught every spring to make sure our graduates are prepared for their futures. Lastly, a graduate student-undergraduate mentoring program, created and led by graduate students, pairs undergraduates with a graduate student with similar interests to provide advice and support from a near-peer as undergraduates navigate decisions about graduate school, careers, and how to find opportunities.

Each of these opportunities help our undergraduates learn the skills they need to make a plan of where they want to go after graduation. Instead of asking "What do I do now?" our graduates are making decisions about which graduate school they will attend or which job offer they want to accept.

Beagle Memorial Fund for Research
Supports undergraduate, graduate or faculty research in ecology and evolutionary biology; generously given by former Associate Dean for Research in the College of Arts and Sciences and Head of EEB, Professor Christine R. B. Boake.

Daniel J. and Donna K. Popek Ecology Scholarship Endowment
Supports undergraduate research and scholarship for EEB majors at UT; generously given by Mr. and Ms. Popek. Mr. Popek graduated from the UT Department of Zoology in 1967.

William Byrne Hartz Biodiversity Endowment
Support for graduate students pursuing studies in environmental biology, biodiversity, sustainability, ecology, and conservation. Created in memory of William Byrne Hartz through a generous gift by Florence Hartz Jones. Awardees will be named *Tennessee Conservation and Biodiversity Center* scholars.

Dr. Clifford Amundsen Ecology Scholarship Endowment
Support for undergraduate research and scholarship through the generosity of Ginny Dant and Kari Admunsen Apter. Amundsen was a faculty member in the Department of Botany at UT for 37 years. His research specialty was plant physiological ecology, working primarily in forests of TN, VA, KY, NC and the West.

The next two for TENN herbarium

Lynne and Bob Davis Herbarium Awards
For undergraduate student research focusing on plant natural history, taxonomy, and/or floristics. Lynne and Bob are passionate naturalists and have been volunteers at the UT herbarium for the past three years. They barcoded/imaged over 16,000 liverwort specimens and have databased/georeferenced thousands of UT specimens collected from around the world.

Ben Hochman Memorial Awards
For Student Research in organismal biology using primarily genetic data. Ben Hochman was a Geneticist in the Department of Zoology at UT from 1964 to 1988. His research focused on genes of the fourth chromosome of *Drosophila*. By this endowment, his friends remember him and acknowledge his contributions.

Visit us online at **eeb.utk.edu** to learn more about how to support our students.

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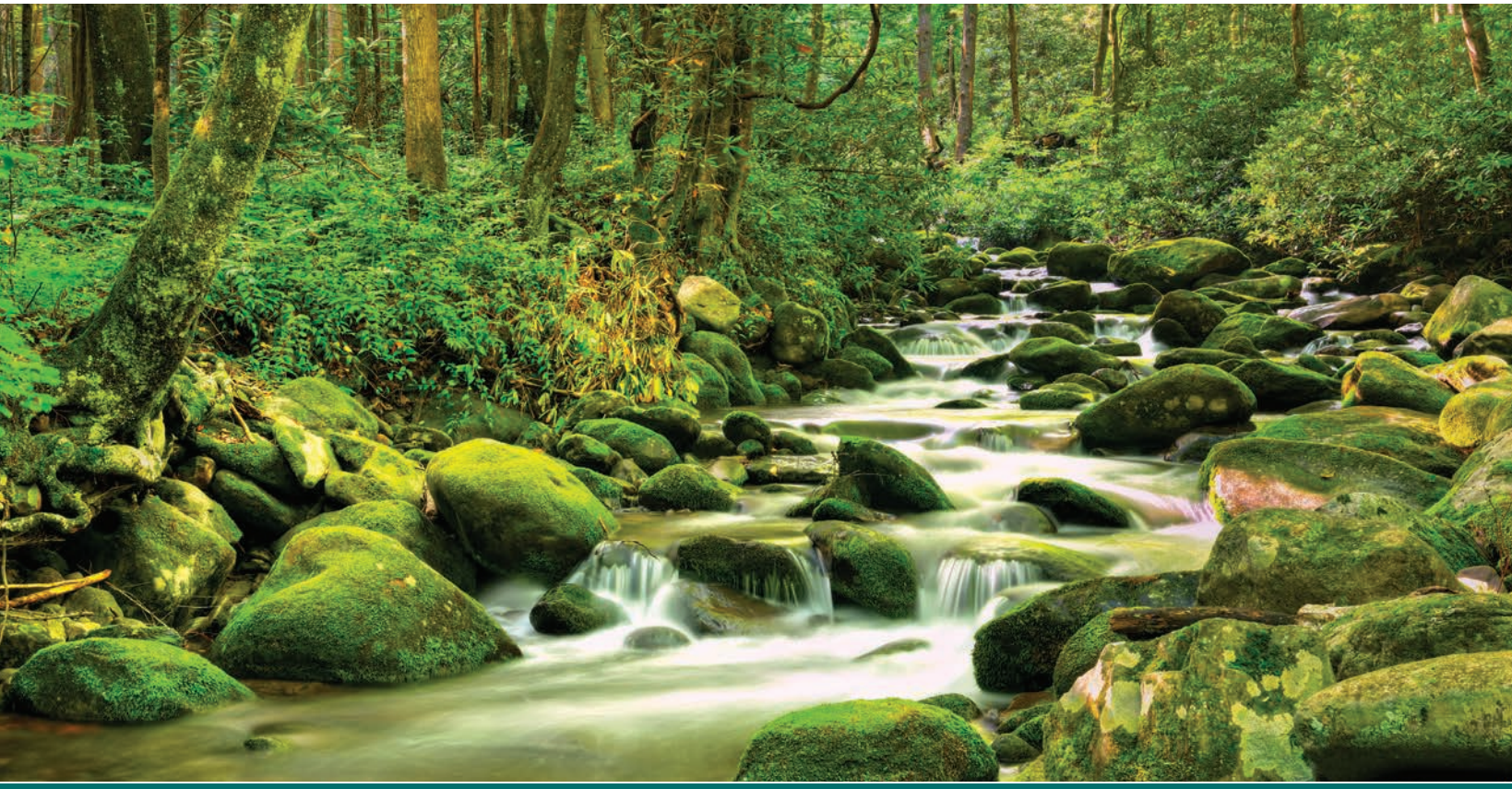

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