

Explorations

SUMMER 2024 NEWSLETTER

Multicultural Team Researching in West Africa



In the Anthropocene, human activities can change the way species interact with each other and alter biodiversity. It is also important to train the next generation of scientists how to conduct complex research in the tropics where some of the highest environmental degradation is taking place and where US students often have limited opportunity to study. Associate Professor **Orou Gaoue** received funding from the National Science Foundation to develop a three-year International Research Experience for Students (IRES) to address these problems.

In summer 2022, Gaoue took the first five US students to Benin in West Africa to investigate the causes and demographic consequences of mutualism disruption by chronic human disturbance.

Five students from the University of Tennessee, Knoxville, were recruited and paired with five Benin students to form multicultural research teams. The US students also participated in peer-led learning activities on statistical data analysis, to teach to their peers in Benin, where the field component of this project was implemented. The first week in Benin included visiting labs at the universities in Cotonou and Parakou, meeting local mentors, and teaching statistical data analysis to Benin students. This opportunity for peer-led learning was one of the highlights of the program.

These peer-learning sessions reinforced students' knowledge of statistical data analysis and presented opportunities for students from Benin and the US to bond and discuss mutual interests.

Every year each multicultural team selected a research topic to work on from topics that are an integral part of Gaoue's long-term research program in Benin. Students undertook field data collection in forest sites, half of which were perturbed by chronic human disturbance. Thus, students learned how to do research from project conception to data analysis and then communicated these results to mentors, faculty, and post-doctoral researchers from the University of Parakou.

Multicultural research teams collected demographic data on mahogany trees and their mutualistic weaver ants. Teams were focused on populations and behavior of the weaver ants, how harvesting by the Fulani people altered endophytes, and experimentally assessed the growth-defense hypothesis.

With opportunities to learn, teach peers, design research, collect data, and analyze data in Benin, UT students learned how to work in multicultural teams and how to navigate and conduct research in a foreign country—they also will be forever changed and enriched by this experience.

Scopes Centennial Celebrates Study of Evolution

In 1925, high school teacher John T. Scopes was accused of violating Tennessee's Butler Act, which prohibited the teaching of evolution. Scopes was unsure that he had taught evolution, but he deliberately incriminated himself so the case could have a defendant, and he coached students to testify against him. He was found guilty and fined \$100. The trial drew Williams Jennings Bryan for the prosecution and Clarence Darrow for the defense, in what was a national test of the right to teach the theory of evolution. The trial was broadcast nationally and put Dayton, Tennessee, on the map.

While Darwin's theory of evolution was well established by 1925 and supported by the rediscovery of Mendel's work in 1900, science was a long way from a clear understanding of the biological basis of evolution, or descent with modification. The elusive language of molecular evolution, DNA, was not known as the genetic code until the 1940s, and the structure of DNA was determined in the 1960s. In the 1970s the burgeoning field of molecular evolution expanded our understanding of evolutionary processes, such as gene duplication, gene conversion and recombination, molecular selection, intragenomic conflict, transposable elements, and symbioses. Paralleling advances in our understanding of genetic architecture, advances in computing capacity gave rise to significant advances in modeling evolution mathematically (phylogenetics and beyond).

As we approach 2025, two additional factors have become critical for all life on Earth: One, our planet is warming at a pace mirrored only by past extraordinary geologic disasters; and two, we have entered a time when the extinction of species due to human activities is unprecedented (the Anthropocene). Will the processes of evolution be sufficient for organisms to adapt? Can hidden genetic diversity provide new mechanisms for survival? What kinds of genetic changes are most effective in generating novel diversity? Can symbiosis effectively change in time?

Scientists in the Department of Ecology and Evolutionary Biology are working hard to address these questions. In the 2024-2025 academic year, EEB, along with partners within the College of Arts and Sciences and across campus, will be recognizing the centennial of the Scopes Trial and celebrating the study of evolution. With a series of seminars, Darwin Day events, public talks, a new production of *Inherit the Wind* at Clarence Brown Theatre, and much more, EEB will be working to showcase the continued importance of the study of evolution at UT to highlight new innovations in evolutionary scholarship. Join us for as many of these events as you can; visit the EEB website, eeb.utk.edu, for a full schedule of events in the coming year.



Sincerely,

JEN SCHWEITZER
Professor and Head
Department of
Ecology and
Evolutionary Biology



EEB Research Reaches Around the World

The University of Tennessee's Department of Ecology and Evolutionary Biology has a vibrant community of researchers exploring important ecological and evolutionary questions that enrich understanding of global issues, training students to think broadly, and helping find solutions to important problems around the world. Three EEB researchers have won prestigious Fulbright awards to work and study abroad in recent years: Associate Professor **Orou Gaoue**, South Africa (2022-2023), **Timothy Meidl**, Taiwan (2022-2023), and **Colton Adams**, Latvia (2023-2024). Below are a few EEB faculty and students working on important questions in international locations around the world.

Professor **Joe Bailey** and **Alivia Nytko** take a phylogenetic approach to understand the evolution of rarity using the hyperdiverse genus *Eucalyptus* found in Tasmania, Australia. In contrast to ecological determinants of rarity, an evolutionary basis to species rarity suggests that the traits that determine rarity can be selected upon. Nytko recently won the Ecological Society of America Excellence in Ecology Award for this work.

Associate Professor **Liz Derryberry** and **Renata Seco** study the evolution of song in female antbirds, a large, diverse group of neotropical birds in the Amazon, to understand how morphology and environmental conditions are shaping song structure. Bird size, morphology, and habitat are related to song frequency and pace.

The **Gaoue Lab** has projects in Benin studying anthropogenic effects on plant species interactions. It has the longest-running demographic study of plants in Africa and is working on a range of questions in population ecology, ethnobiology, and species interactions with anthropogenic change.

The **Giam Lab** conducts research on how land-cover and land-use are changing biodiversity in the tropics. With PhD candidate **Guido Herrera-Rodriguez**, and a global group of researchers, lab members are building a pantropical database of fish assemblages to investigate the impact of land-cover change on stream fish in the Amazon, Afrotropics, and Southeast Asia.

The **Kwit Lab** is working on seed dispersal ecology of rock iguanas, the largest frugivore and seed disperser in the Bahamian archipelago. Associate Professor **Charlie Kwit** and his colleagues work on tourist-visited and nontourist-visited islands in the Exumas to assess the health and population dynamics of iguanas and whether supplemental feeding affects the dispersal of native seeds.

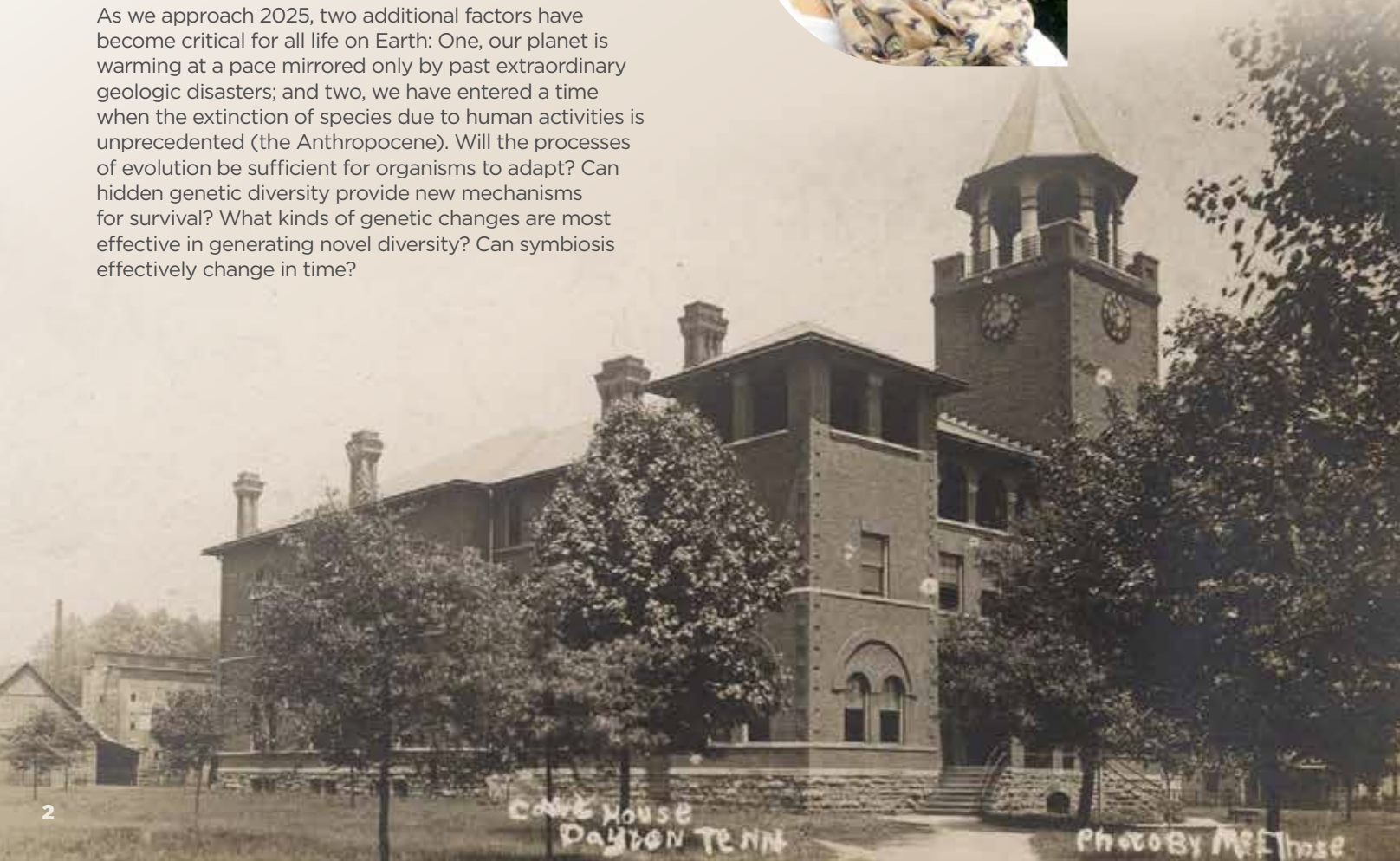
With National Science Foundation funding, Professor **Brandon Matheny** and his lab form national and international collaborations to collect, document, and describe the largely unidentified mushroom-forming fungi throughout the world. Matheny has described new fungal taxa from Africa, Asia, Australia, New Zealand, North and South America, and literally from his own front yard.

Research in the **Sheldon Lab** is using field and laboratory experiments in an NSF-funded project in Ecuador to examine how changes in temperature alter the physiology of dung beetles and whether these tropical insects can shift their behavior to use cooler microclimates. Work by Associate Professor **Kimberly Sheldon** and her team was recently featured on *CBS Saturday Morning*.

Professor **Daniel Simberloff** and **Wieteke Holthuijzen** are working to determine the diet and ecological impacts of invasive house mice on islands. To predict the ecosystem response and prepare for unintended disruptions of non-native and invasive taxa, they are investigating mouse diet using a variety of molecular and stable isotope approaches.

The **Stockmaier Lab** studies how pathogens affect host social behaviors. The lab studies vampire bats because they are highly social and known to transmit pathogens to each other and to other agricultural animals. The fieldwork takes place at the Smithsonian Tropical Research Institute in Panama as well as sites in Belize and in Costa Rica.

The **Hemingway Lab** studies decision-making strategies in neotropical bats at the Smithsonian Tropical Research Institute in Panama. Hemingway's research adopts principles from economics and psychology to investigate how bat species evaluate and choose between multiple feeding and mate options, and differ in decision mechanisms, based on their foraging behavior and other aspects of their ecology.



Case House
Dayton Tenn

Photo by M.E. House

Bats, Bees, and Their Dining Decisions



Claire Hemingway joined the University of Tennessee, Knoxville, in August 2023 as an assistant professor with a dual appointment in the Department of Ecology and Evolutionary Biology and the Department of Psychology.

Hemingway is a cognitive ecologist interested in how animals make decisions in complex environments. She works primarily with two systems, bats and bees, to explore how animals find and choose what to eat.

Decades of research in humans have demonstrated that people make inconsistent decisions across time and contexts, failing to behave rationally. Instead, choices often are highly influenced by a decision-maker's recent experience and the framing of the choice. Whether choosing a meal or a mate, animals also are often confronted with multiple options simultaneously. Hemingway's research adopts principles from economics and psychology to investigate how animals evaluate and choose between multiple options based on their signal and reward properties. She explores how species differ in decision mechanisms based on their foraging behavior and other aspects of their ecology. She also asks how certain decision mechanisms may shape the targets of those decisions, such as floral signals and rewards.

Hemingway was born and raised in Austin, Texas. She has always been passionate about nature and animal behavior. As an undergraduate, she went to St. Edward's University in Austin, Texas, where she began her research career investigating mate choice behaviors in livebearing fishes, such as guppies, mosquitofish, and sailfin mollies. She then completed a PhD at the University of Texas at Austin, where her dissertation research focused on decision-making strategies in Neotropical bats. For her dissertation research, she conducted all of her fieldwork at the Smithsonian Tropical Research Institute in Panama. She then went on to do post-doctoral research at the University of Texas at Austin, studying decision-making behaviors in bumblebees choosing between flowers that vary in their floral signals and rewards. In Tennessee, Hemingway is now focusing on several native bumblebee species, as well as continuing to conduct laboratory-based studies with captive bumblebee colonies. She will also continue to study Neotropical bats in Panama.

While not hanging out in jungles or meadows following bats and bees, Hemingway enjoys running, hiking, and camping. She has only just begun to explore all the local trails and parks close to Knoxville. She is also a huge fan of live music and is excited to explore bluegrass music of East Tennessee.



Bat Behavior and Cross-Species Transmission

Sebastian Stockmaier, who works at the intersection of behavioral and disease ecology, began as an assistant professor in the Department of Ecology and Evolutionary Biology in January 2023. He is interested in how host behaviors affect pathogen transmission and, in reverse, how pathogens affect host behaviors. Most of his work revolves around Neotropical bats in Panama, Belize, and (hopefully soon) Costa Rica. He uses the bats to understand social distancing behaviors and their costs and benefits, how pathogens manipulate host social behaviors, and whether we can predict and understand cross-species transmission by tracking small-scale interactions between different animals.

"My main study organism is common vampire bats. Vampire bats are fascinating animals because they are highly social and form social relationships almost equivalent to human friendships," he explained. "We can use them to understand how the benefits of social relationships are traded-off against the costs of behaving sick (e.g., social withdrawal) but also, in general, how highly social animals deal with their sick conspecifics. In addition, we use them to understand animal-animal interactions that could potentially lead to cross-species transmission. They exclusively feed on blood. Cattle and other livestock are the vampire bat's primary food source at many of our field sites. This really sets up a promising study system to understand and predict how fine-scale behavioral interactions could lead to cross-species transmission because vampire bats not only frequently interact with other animals, but are also known to transmit certain pathogens to them." Stockmaier is from a small mountain town in southern Germany, where he grew up spending a lot of time outside.

"I was always passionate about nature, and especially animals, but also grew an interest in infectious disease biology and immunology during my undergraduate studies in bioengineering. I was able to merge my interests during my master's research at the University of Konstanz and the Max Planck Institute for Animal Behavior (formerly for Ornithology), where I studied wild bats. I then moved to the US and continued my work during my PhD at the University of Texas at Austin, and as a postdoctoral researcher at the Ohio State University before joining the EEB department at UT. I would describe myself as an empiricist, and so I am especially excited about all the collaborations with more quantitative-leaning researchers in the department and across campus."

Stockmaier is passionate about science outreach and, especially, about bats.

"Unfortunately, bats have gotten a bad reputation in recent years, and I like to highlight to the public that concerns are in most cases unfounded and that they are fascinating animals that are an integral part of many ecosystems," he said. "When I am not chasing bats through the forest, I enjoy hiking, camping, paddleboarding, and playing soccer. I am excited about all the public land to explore in and around Knoxville."



Tree Frog Communication in Complex Environments

Jessie Tanner joined the University of Tennessee, Knoxville, in August 2022 as an assistant professor, dually appointed in the Department of Ecology and Evolutionary Biology and the Department of Psychology. An animal behaviorist, Tanner conducts research on the evolution of acoustic communication. She works with animals like frogs and crickets, in which males call or sing to attract females, who in turn use the sounds to choose mates. By experimentally manipulating the sounds and observing how females make mating decisions, the Tanner lab studies how communication is evolving in nature.

As a researcher, Tanner is especially interested in how acoustic communication systems evolve in realistically complex environments. One aspect of this environmental complexity is the noise in the raucous frog choruses that form in the spring. Another is the sheer number of call traits that vary in important ways; individuals may be forced to make less-than-ideal mating decisions if they can't find all their desired traits in the same partner. Finally, individuals do not produce their calls the same way every time. Some traits are quite inconsistent within individuals, even over the span of a few minutes. A major focus of Tanner's recent research has been understanding when and how this inconsistency might conceal the differences among individuals. All of these aspects of environmental complexity may affect how signals evolve.

Tanner is focusing on tree frogs native to East Tennessee, including the two closely related species of gray tree frogs. Before joining UT, she investigated mate choice in the livebearing, clonal fish called the Amazon molly; American black bears' response to the noise made by drones; why some Pacific field cricket males in Hawaii have lost the ability to sing; and the changing shape of the baculum (penis bone) in rodent species native to Australia.

She was born and raised in Tulsa, Oklahoma, and her studies have taken her to such far-flung institutions as the University of Oklahoma (Norman), Université Bordeaux III Michel-de-Montaigne (Bordeaux, France), the University of Minnesota (Saint Paul), and the University of Western Australia (Perth).

Tanner's interest in acoustic communication is defined very broadly, ranging from animal behavior to human language, linguistics, and music. She is an avid learner of Cherokee as a second language, holds a Bachelor of Arts in French, and participates in several communities of language learners and linguistics aficionados. A big fan of live music and an amateur guitarist, Tanner always has a song stuck in her head.



Greenhouses Grow More Than Plants



Perhaps best known for showcasing Rotty Top—the huge, stinky, corpse flower that bloomed a few summers ago—the Department of Ecology and Evolutionary Biology Greenhouse is a remarkable asset and gem on the University of Tennessee's Knoxville campus. It consistently supports departmental research as well as an array of classes across campus—from biology and plant sciences to landscape architecture and art.

More than 12 EEB faculty, 25 graduate students, 50 undergraduate students, and other volunteers use the greenhouses every year to grow a variety of plant species for research. Additionally, 650 students and 12 different classes annually visited the greenhouses from 2022-2024 to explore the plant collections, conduct class experiments, and gain a better understanding of the functionality of greenhouses through part-time jobs and internships.

Under the management of Director **Jeff Martin** and Co-director **Kaitlyn Palla**, the greenhouses also serve many other outreach and service functions to UT and beyond. For example, greenhouse staff maintain outdoor gardens located around the Hill, including a fern garden on the east side of Hesler Biology Building, a moss garden in the courtyard of the Science and Engineering Research Facility (SERF), and a native plant garden in the courtyard behind Dabney Hall.

These gardens serve as important green spaces for students, faculty, and staff to learn about plants and to de-stress and relax. Most recently, a plant drop on the fourth floor of Hesler Biology was started to share free plant cuttings and propagules. The greenhouse staff members know how satisfying it is to be able to grow something green in your home or office. Because of this, they also have assisted with wellness initiatives on campus, providing plants for a residence hall mental health initiative called De-Stress to Success and to a campus-wide One Health awareness event in spring 2023.

The greenhouse staff and many volunteers also manage a wildflower trail at Dean's Woods (Deanbrook Nature Area), located in South Knoxville. The trail is surrounded by 17 acres of hardwoods and is rich with spring ephemerals. Recently, The Dean's Woods Foundation was created to support the upkeep, new plantings, and plant signage with the generous support of dentist **Walter Fain** ('70).

Greenhouses are open to UT students, staff, and faculty Monday through Friday, 9 a.m. to 4 p.m., with access through a UT ID card or phone. Please email Jeff Martin, jmarti90@utk.edu, for more information and for inquiries about how you can use the greenhouse space for research, teaching, and outreach. For weekly updates visit the greenhouse Instagram page, [@utk_greenhouse](https://www.instagram.com/utk_greenhouse).



Remembering Our Friends



During the past few years, the Department of Ecology and Evolutionary Biology (EEB) has lost many cherished members. Here, we honor the staff, students, and faculty who contributed to our community, including those from the zoology and botany programs that preceded EEB. We are grateful for their time, commitment, and the knowledge they shared.

David A. Etnier, known for his enigmatic saying, "The sleeping dog fears not the chicken," started at UT in 1965. Over 40 years, Etnier and his students increased the number of described freshwater fishes in Tennessee from about 70 to over 350. They were instrumental in the first test of the Endangered Species Act, published *The Fishes of Tennessee*, and initiated numerous conservation efforts. Etnier passed away on May 17, 2023, leaving a lasting legacy.

Ed Clebsch joined UT as a botany faculty member in 1963, pioneering plant ecology by linking plant physiology with population and community ecology. He published on photosynthesis, wild pigs, forest gaps, and radioactive fallout in the Smokies. After retiring, he promoted the use of native plants in gardens and supported the Spring Wildflower Pilgrimage.

Ray Holton, a plant physiologist and phycologist, was a botany faculty member and department head from 1965-1985. He studied the freshwater red algae *Boldia* and its adaptation to freshwater. After retiring in 1996, he volunteered at the UT Herbarium and, with his wife, established an endowment funding undergraduate research.

Jerry Olson, a researcher at Oak Ridge National Lab, co-founded the former graduate program in ecology. He studied succession on sand dunes, ecosystem ecology, and mathematical modeling, including stable isotopes for understanding plant processes and carbon cycling. Olson retired in 1985 but remained active in research and supported environmental and cultural organizations.

David K. Smith, a passionate instructor and field botanist, taught at UT for over 30 years. His courses included Plant Morphology, Field Botany, and Bryology. He traveled extensively, collecting bryophyte specimens to enhance our understanding of plant biodiversity. His wife, Mary Smith, donated his bryology books to the UT Herbarium in his memory.

Gerald L. (Jerry) Vaughan, professor emeritus, was one of EEB's inaugural faculty members. He was a physiologist who researched photobiology, animal pigments, surface mining impacts, and water chemistry on aquatic communities. Vaughan was also a skilled metal sculptor, jeweler, musician, and raconteur.

We also remember these former EEB members: **Clif Amundsen, Bruce Bauer, Frank Bowers, Zeno Brown Jr., Sarah Cait, Danny Cobb, Edward Darden, John Delozier, Scott Duke-Sylvester, Barbara Gudmundson, Walter Heck, John (Bobby) Mullins, Paul Redlearn, Richard Robinson, Edward Smythe, Barnard Vaughn, and Harry Wood**. Our heartfelt condolences to their families and friends for their loss.

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COVER STORY

**Researching
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