THE UNIVERSITY OF MICHIGAN
DEPARTMENT OF ECOLOGY AND EVOLUTIONARY BIOLOGY

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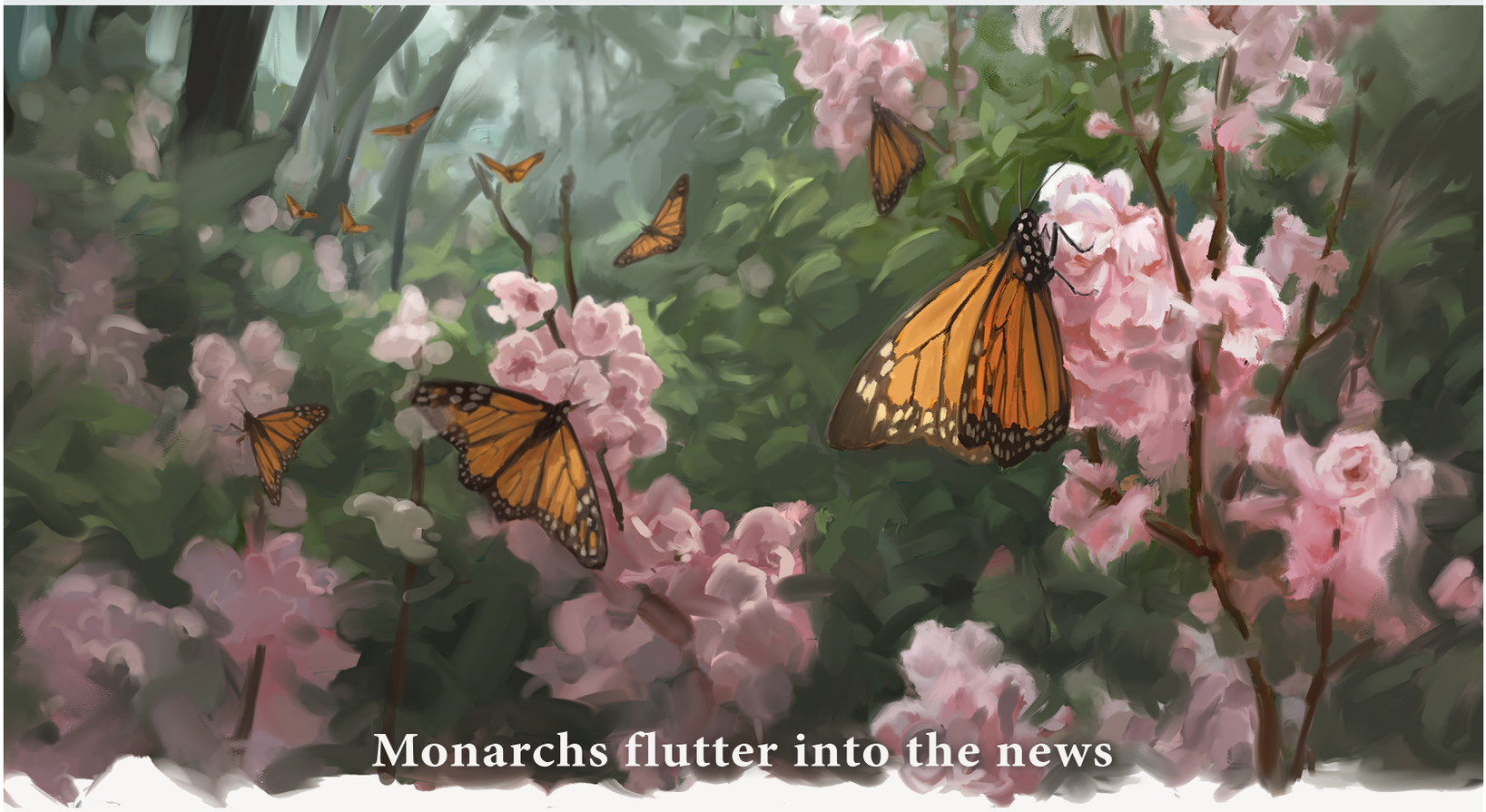

Monarchs flutter into the news

There's not much more iconic in the natural world than the monarch butterfly. We see a flutter of orange and black and feel compelled to point it out to others nearby – "MONARCH!"

Recent research and expertise from the University of Michigan Department of Ecology and Evolutionary Biology has added to the knowledge base on these captivating insects. When the International Union for the Conservation of Nature added the monarch butterfly to their "red list" of endangered species, Professor Emeritus Mark Hunter and Professor André Green made themselves available to the media as experts. They were quoted in the following, among others: Popular Science, Michigan Radio, WEMU, WXYZ-TV Detroit and Fox 17 Grand Rapids.

Mark Hunter, Earl E. Werner Distinguished University Professor of Ecology and Evolutionary Biology, is a leader in understanding how insect and plant populations respond to environmental change. He has studied monarch butterflies and their milkweed host plants for over two decades. "Habitat loss, climate change and disease transmission all impact migrating monarchs as they make their spectacular journey."

Green studies the environmental and genetic basis of monarch butterfly migration and how migration has evolved. Green notes that the public can play a big role in the future of monarch butterflies by planting flowering plants, growing milkweed, and participating in monarch monitoring.

Green has an ongoing research project that he worked on in collaboration with the U-M College of Engineering. The team is developing sensors that will hopefully allow the researchers to track the monarchs' spectacular migration patterns from the United States and Canada to Mexico. "What we can potentially learn by having a lens that combines my background with an engineer's expertise would be amazing."

Samuel Stratton, a new EEB graduate student, was coauthor on a paper published in iScience in April 2022. He was a master's student at the University of Cincinnati for the research. Their research demonstrated that light pollution can have a disorienting effect on monarch migration.

So, turn off those lights and don't touch that dial – there will surely be more monarch updates (and so much more) in the near future.

Chair's column

Image credit: Luna Archey

Patricia Wittkopp
Professor and Chair of Ecology and Evolutionary Biology

Dear Alumni and Friends,

The excitement of a fresh fall semester is upon us as new and returning students arrive on campus. As we enter October (at the time of this writing), the fleeting seasonal beauty surrounds us as we walk through campus.

A quick rewind tells us that our summer field season was reenergized in ways that weren't possible during the height of COVID-19 days. Faculty and students traveled to places such as Panama and the Greek Islands to research snakes and lizards, for example. Graduate student Hayley Crowell visited the Greek Islands of Andros, Naxos and Ios, where the research team collected data on color polymorphism and thermal physiology of snakes and lizards across environmental gradients. EEB graduate student John David Curlis was able to return to Panama, where he added to his long-term study on phenotypic evolution in Anolis lizards. Along with a team of collaborators, they doubled the number of experimental islands where they transplanted populations of lizards, and collected data on several hundred individual lizards in the wild. On top of his research endeavors, Curlis presented at a conference in Spokane, Wash., and attended a field herpetology course led by Crowell in Arizona. Crowell and Curlis are in the lab of Alison Davis Rabosky, EEB assistant professor.

EEB graduate student, Chau Ho, is doing field work in Gamboa, Panama this fall that she prepped for this summer. Her project looks at how tree species differ in their life history strategies of growth and survival, and whether functional traits might be able to describe these differences. Ho's project uses a mechanistic model to link functional traits to plant performance, in order to incorporate more knowledge of plant physiology into the understanding of species' differences. Many different tree species can be measured in the tropics. This summer, Ho presented a talk at the Ecological Society of America annual conference in Montreal. María Natalia Umaña, EEB assistant professor, is Ho's co-advisor with Annette Ostling, visiting adjunct associate professor (University of Texas at Austin). It is so satisfying to see the return of field research in far-flung places as well as in-person conferences and courses.

We're delighted and proud to introduce and warmly welcome four new assistant professors and an LSA Collegiate Postdoctoral Fellow in this issue of Natural Selections. Within these pages, you'll meet Drs. Gideon Bradburd, Mia Howard, Kelly Speer, Thais Vasconcelos, and Marjorie Weber. Howard is a member of the LSA Collegiate Fellows program, which is a major initiative "aimed at supporting, recruiting and retaining exceptional early career scholars who are committed to building a diverse intellectual community."

As you'll see in their profiles, three of these outstanding scholars use plants as their primary study system, with Assistant Professor Thais Vasconcelos joining the U-M Herbarium as an assistant curator, reinvigorating studies of botany in the department. If you would like to help us with this resurgence, you can donate to the Emma J. Cole Fellowship in Botany, which is designed to fund one student studying plants each year. Alternatively, if you'd like to help us celebrate tomorrow's leaders in ecology and evolutionary biology, you can donate to our Early Career Scientist Symposium, which is a unique platform where we invite eight outstanding senior graduate students, postdocs and/or assistant professors in their first two years to visit the department and present their work to a broad audience.

Assistant Professor Kelly Speer will become the director of the Michigan Pathogens Biorepository (M-PABI), which leverages the U-M Museum of Zoology's and Herbarium's existing collection of nearly 100K tissue samples and helps researchers add to the collection to assist with infectious disease detection. While the initial focus will be on tissue from bats, rodents and aquatic birds, they expect to include all wildlife groups. As scientists have known, and the general public has become increasingly aware of in recent years, these efforts have the potential to literally save millions of lives.

The M-PABI is part of the Michigan Center for Infectious Disease Threats (MCIDT), which is supported by the U-M Biosciences Initiative. This initiative, started in 2017, provided $150 million and up to 30 faculty positions to synergize with existing strengths at U-M in the biosciences and to propel new areas of discovery. There are many exciting developments afoot and many tools to stay in touch and on top of EEB news, events and more, including through our newsletters, website and social media channels.

With my warmest wishes for a lovely holiday season and new year,

Patricia J. Wittkopp

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Bradburd shines light on the geography of evolution

"How many people get to walk by a life-sized model of a Quetzalcoatlus on their way to the office?" asked new EEB Assistant Professor Gideon Bradburd shortly after arriving in Ann Arbor. Originally from western Massachusetts, Bradburd joins the University of Michigan via East Lansing with his wife, fellow EEB Assistant Professor Marjorie Weber, their two children, and esteemed dog, Banjo.

For the past six years at Michigan State University, Bradburd's research focused on incorporating geography into statistical methods of studying population structure, admixture (when individuals from two or more genetically distinguishable groups have children together), demography, local adaptation, and natural selection in a variety of empirical systems.

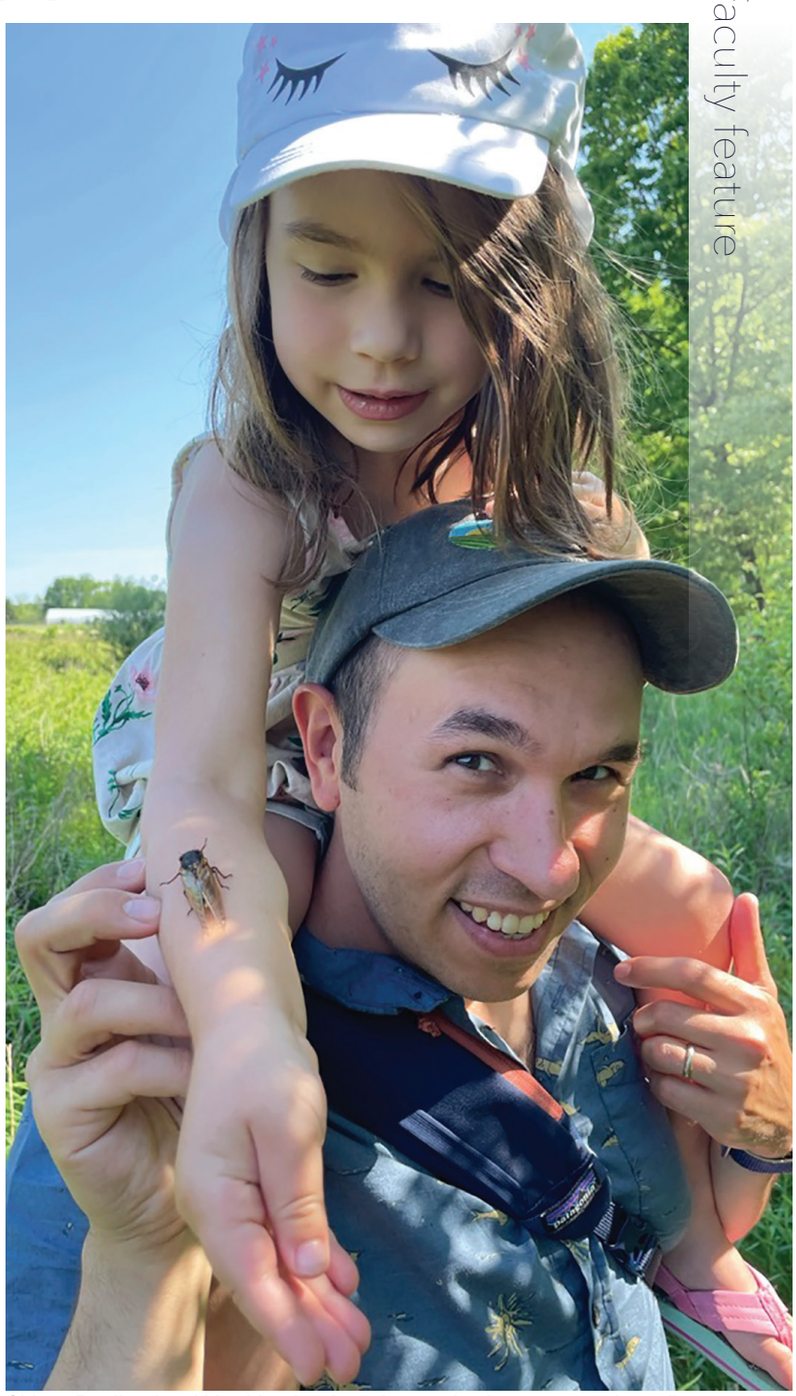
"My research is focused on the geography of evolution, and especially on using statistical and computational approaches to learn about the processes generating and maintaining spatial patterns of genetic variation," Bradburd said. "When I started working in biology, my jobs were all doing fieldwork related to natural history museums; collecting birds, fish, reptiles and amphibians as specimens for the collections. Now I spend much less time in the field and much more time on my computer, but my interests – how are organisms related to each other, and what governs the geography of those evolutionary relationships – are still the same."

In the lab, Bradburd and his team work to develop and implement novel population genetic models and statistical methods for describing population structure and admixture, as well as studying local adaptation, coevolution and natural selection. This work combines population genetics theory, computation, statistics and inference, and a knowledge of the natural history of the empirical systems in which these methods are applied.

> ***"How many people get to walk by a life-sized model of a Quetzalcoatlus on their way to the office?"***

"We've known for a long time that in many species, including humans, population genetic variation is distributed continuously across space, rather than partitioned between discrete groups," Bradburd said. "Historically, limitations in sampling have often allowed for the employment of models of discrete structure. But, with the high-throughput genotyping and sequencing revolution and the massive empirical datasets it has facilitated, like the 1000 Genomes project or the UK Biobank, geography can no longer be ignored.

"The failure to incorporate space into population genetic methods can have far-reaching consequences, from misleading inference of discrete population structure or admixture, to stratification issues in genotype-phenotype association studies, to a weaker basic knowledge of the biology of organisms."



Gideon Bradburd and his older daughter share a cicada moment and a smile. Image: Marjorie Weber

During the winter term, Bradburd will be teaching Introduction to Statistical Model Building in R. "My hope is that students walk away with a working knowledge of how to construct statistical models to answer research questions, and also with a stronger intuition for probability generally. I know that a lot of students (especially in biology) don't enjoy statistics because they think they're bad at it, so I'm hoping to change some hearts and minds!"

Howard hones in on plants' surprising defense strategies

faculty feature

"I've always loved plants," said Mia Howard, a new Collegiate Fellow for EEB this fall. "My grandmother really has a green thumb and an impressive collection of house plants that I've admired since I was a kid. Before taking a plant biology class in college, I saw plants as pretty or tasty, but largely passive organisms. Learning about how plants alter their physiology to protect themselves from hungry creatures and stressful environments made me realize what fascinating creatures they are."

Mia Howard goofs around while cleaning glassware for nitrogen analyses. Image courtesy: Mia Howard

Originally from Bloomington, Minn., Howard completed her Ph.D. at Cornell University in Ithaca, N.Y., and spent the last two years doing postdoctoral research at Indiana University in Bloomington. "It's nice to be back in the Midwest and around lakes." Although she hasn't been in Ann Arbor long, she's impressed by the Matthaei Botanical Gardens and is excited to work there. "I studied tall goldenrod (*Solidago altissima*) for most of my Ph.D. work and am excited to see that the botanical gardens and Ann Arbor have vast populations!"

She pursued her early interest in plants during her undergraduate education at Wellesley College. Working with Dr. Martina Königer, she studied how plants optimize light absorption for photosynthesis. "While we often think of bright sunlight as being plants' happy place, photosynthesis is dangerous business and excess light absorption can be damaging. So plants use different mechanisms, like rearranging their chloroplasts within their cells to shade one another in high light environments. We usually don't think of plants as moving, especially on the same time scales that most animals do, but they can reorient their leaves and chloroplasts. And due to their lack of mobility, they have evolved lots of other interesting strategies to cope with changing environments, like altering their pigment composition to avoid overstimulating their photosynthetic machinery when they are hit with too much sunlight."

> ***"We usually don't think of plants as moving, especially on the same time scales that most animals do, but they can reorient their leaves and chloroplasts."***

In addition to protecting themselves from the sun, plants also have to fight off hungry animals. As her studies progressed, Howard became fascinated by how plants defend themselves against herbivory. Instead of seeing plants as helpless victims, "They can actually have some pretty deadly defense strategies. For example, the common white clover that you see in the park releases hydrogen cyanide when an herbivore starts chomping on their leaves. They don't produce enough to harm big creatures like us humans, but I'd be worried if I were a caterpillar or slug."

While working on her Ph.D. in Dr. Andre Kessler's lab, Howard began to explore how microbes that live in the soil can affect plants' interactions with herbivores. Like plants, microbes are also impressive chemists that can produce defensive compounds and induce plant defense responses that are effective against herbivores. "In my dissertation research, I studied patterns of herbivory on a native plant, tall goldenrod, over the course of old-field succession. This is an interesting system because herbivore pressure increases over successional time, as does herbivore resistance. Given that microbes can alter plant defenses, I wondered what role changes in soil microbes might play in this escalation of herbivore resistance and inoculated goldenrods with soil microbial communities from different stages of succession. I found that the plants growing in soils inoculated with the latest succession microbes were the most resistant to herbivores, suggesting that changes in soil communities over time contribute to the increasingly resistant phenotype of goldenrods – and the lower levels of herbivory – in more mature old-fields."

Further research as a postdoc in Dr. Jen Lau's lab narrowed down this interest to how plants' mutualisms with microbes affect herbivore defenses. "White clover forms resource mutualisms with nitrogen-fixing bacteria that live in their roots. The plants supply sugars and provide homes for the bacteria and in return, the bacteria generate usable forms of nitrogen to their host plants. In the context of herbivory, this could both support and thwart plants' resistance to herbivores. On the one hand, higher levels of nutrition, like nitrogen content, make plants more attractive to herbivores. However, for plants that use nitrogen-based defenses such as cyanide, forming symbioses with nitrogen-fixing bacteria may enhance plants' ability to produce these defenses, leading to greater herbivore resistance."

Recruited through the College of LSA Collegiate Fellows Program, Howard plans to continue this research at EEB, saying, "I'm interested in looking at these relationships between plants and their mutualists and antagonists through an evolutionary lens, studying how nitrogen-fixing bacteria affect the evolution of plant chemical defenses, as well as how plant defenses affect the evolution of mutualist cooperation."

As new director of M-PABI, Speer and colleagues work toward preventing pathogen spillover from wildlife to humans

"My current research is a lot different than where I thought I would be when I started college," said Kelly Speer, the new director of the Michigan Pathogen Biorepository (M-PABI). Originally thinking she might pursue English as an undergraduate that changed when Speer started working in the Museum of Southwestern Biology. "The first day on the job, I assisted in preparing a Mexican gray wolf so that it could be added to the collection as a research skeleton and skin. The amazing hands-on biology experience completely changed my career trajectory."

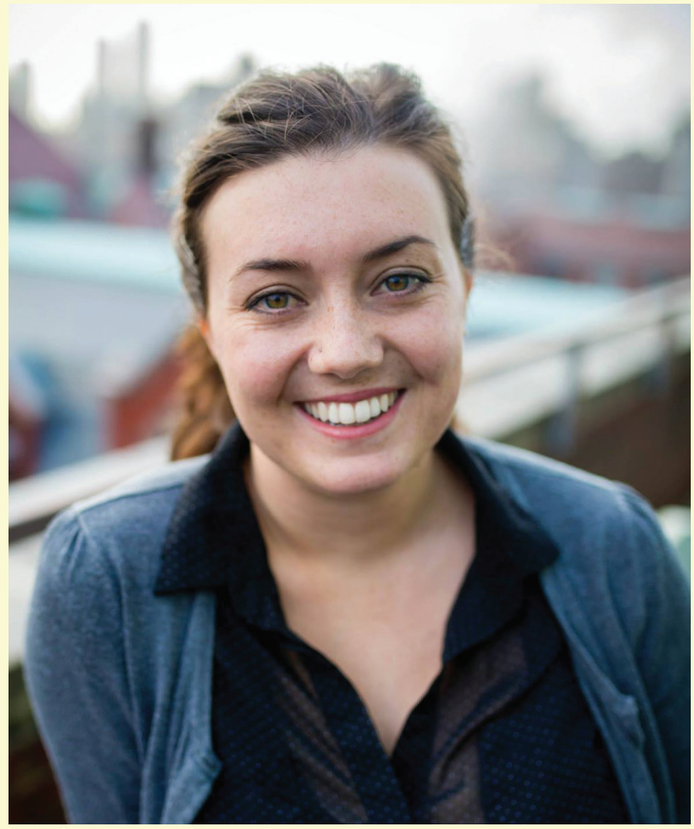
After earning her bachelor's degrees in chemistry and biology, Speer received a master's degree in zoology studying the population genetics of Caribbean bats and their ectoparasites. She went on to complete her doctorate at the American Museum of Natural History's Richard Gilder Graduate School and is currently working on her postdoctoral research with Smithsonian Conservation Biology Institute molecular pathogen scientist Dr. Carly Muletz-Wolz, and a National Museum of Natural History's curator, Dr. Anna Phillips.

Accompanying her to Ann Arbor are her husband, Dr. Richie Hodel, who begins a research scientist position at U-M in 2024, and their cantankerous cats, Linus and Mojave. In addition to the draw of the Ann Arbor campus, Speer is excited about the opportunities offered by the position. "As director of the Michigan Pathogen Biorepository, I will work with the Michigan Center for Infectious Disease Threats (MCIDT) and others at the University of Michigan to build interdisciplinary, effective tools for preventing pathogen spillover from wildlife to humans."

Because wildlife are a significant source of emerging pathogens in humans, the ability to prevent and prepare for the next pandemic is dependent on foundational knowledge of pathogen transmission in wildlife prior to spillover. "My research program contributes to this foundational knowledge

> ***"... the ability to prevent and prepare for the next pandemic is dependent on foundational knowledge of pathogen transmission in wildlife prior to spillover."***

by examining how evolution and ecology shape associations between mammals, ectoparasites, and pathogenic or beneficial microbes," said Speer. Ectoparasites are vectors of viral, bacterial and apicomplexan pathogens in mammals. The competence of these ectoparasite vectors and their ability to associate with a host is mediated by bacteria. "I leverage this assemblage of species to test hypotheses about how communities respond to disease emergence, environmental change, and biodiversity loss, informing our understanding of pathogen dynamics in complex natural ecosystems."



Kelly Speer. Image: Cami Walker

Using a combination of samples collected on international field expeditions and specimens from natural history collections, Speer applies genomic techniques to estimate population dynamics, phylogenetic relationships, and community interactions of the mammal-ectoparasite-microbe assemblage. "I use ecological interaction networks and machine learning algorithms to examine this complex system within the context of habitat fragmentation and loss occurring in North and Central America."

More specifically, Speer works with bats, bat flies (obligate blood-feeding ectoparasites of bats), and the microorganisms associated with both. "I used bat flies to track fine-scale population differentiation in their host bats between islands of The Bahamas. I was interested in the ways that bacteria might be influencing the interaction between bats and bat flies, which led me to my current research trajectory."

Looking ahead, Speer is eager to teach a field course for EEB and Public Health students that focuses on disease ecology and mammalogy. "I hope students gain an appreciation of how different research fields tackle questions so that they can start thinking integratively about ways to combine their expertise and interests with other fields." Additionally, Speer will mentor graduate and undergraduate students in the lab, and in the M-PABI and U-M Museum of Zoology. "I want to train next-generation thinkers and U-M seems like an amazing place to do that."

faculty feature

Vasconcelos aims to fill in knowledge gaps for tropical flowering plants

"I was super excited with the opportunity to work at the university for several reasons," said new Assistant Professor Thais Vasconcelos. In addition to the opportunity to collaborate with top-notch faculty that have complementary expertise, Vasconcelos was drawn to the University of Michigan Herbarium and will be its assistant curator. "The herbarium hosts a very important collection of Myrtaceae, the group of plants that I studied for my Ph.D. and which I continue to work with through collaborations with several botanists around the world." Myrtaceae, the myrtle family of trees and shrubs, are widely distributed in the tropics.

Rounding out the top three enticements, Vasconcelos added, "U-M is a very progressive university with several initiatives to promote DEI (diversity, equity and inclusion) in science, which I also value greatly. I hope to keep contributing through my research, teaching and mentorship. This is an exceptional place to work."

Originally from Brazil, Vasoncelos arrived in Ann Arbor with her partner, Dr. James Boyko, via Fayetteville, Ark. where she spent the last two and a half years working as a postdoc at the University of Arkansas. Under the supervision of Dr. Jeremy Beaulieu, she worked on a project that aimed at developing and testing new diversification models.

> ***"U-M is a very progressive university with several initiatives to promote DEI (diversity, equity and inclusion) in science, which I also value greatly."***

This fall, Vasconcelos will continue working with undergraduate and graduate students, which she enjoys. "It's great to see their progress from when we first discuss their projects to when it's time to wrap up their first publications. I'm really looking forward to having an active research group of graduate and undergraduate students."

Reflecting on her own discoveries as an undergraduate biology student, she said, "I had two moments that made me fall in love with plants and evolution. When I first learned about pollination syndromes – I was just fascinated by how completely different plant lineages could evolve similar floral morphologies through convergence due to interactions with similar pollinators over time. For example, red tubular flowers in some species of Lobelia and Salvia are both associated with hummingbird pollination, even though these genera belong to completely unrelated plant families. The second was the first time I attended a class on phylogenetics. The possibility of reconstructing the evolutionary history of organisms by comparing their DNA sequences, and how we could use this information to make inferences about the past – this greatly interested me."

"At the time, I was doing an internship at the UB herbarium at the Universidade de Brasilia, and I told my supervisor,

Thais Vasconcelos. Image courtesy: Thais Vasconcelos

Dr. Carol Proença, that I would very much like to work on a project that involved the use of phylogenies and floral traits for my master's degree. She was a specialist in the plant family Myrtaceae, and that led me to continue to study the evolution of this lineage and of other members of Myrtales through my Ph.D. at the Royal Botanic Gardens, Kew, with Dr. Eve Lucas and beyond."

In the years since, her research has shifted towards the biogeography of flowering plants, however, it is still focused on the role that phylogenetic relationships and lineage-specific traits play in how plants diversify. "Because of my work with tropical Myrtales, I'm also still very interested in filling in the gaps in our knowledge on poorly known plant groups, especially those in tropical areas."

How have species interactions impacted diversity across the tree of life?

"I am proud to call Michigan my home!" said Marjorie Weber, a new EEB assistant professor. After completing a postdoctoral fellowship at the University of California, Davis, Weber returned to her home state six years ago to be an assistant professor in the Department of Plant Biology at Michigan State University. Now, both she and her husband, Gideon Bradburd, are new EEB assistant professors, settling in Ann Arbor with their two children and lovable dog, Banjo.

"U-M has always been on my list of dream places to work. Living in Ann Arbor, getting to work with such wonderful colleagues in EEB, and in the new Biological Sciences Building – it's exciting," Weber said, continuing, "I can't wait to get to know the community of faculty, students and staff in EEB!"

> ***"This work … informs solutions to the growing humanitarian crisis of sustainably feeding the world's expanding human population."***

Weber's research focuses on finding the links between species interactions and broad-scale evolutionary patterns, specifically how species interactions have impacted the diversity found across the tree of life. Major topics of study include the role of ecological interactions in the generation and maintenance of biodiversity, historical trait evolution and the coexistence of closely related species in contemporary communities, and linking ecology and evolution via the study of plant defense.

"We are broadly interested in understanding how the evolution of plant defense traits is impacted by different environmental, historical and biotic factors, as well as the consequences of evolutionary changes in these phenotypes for the interactions they mediate. Defensive traits provide beautiful natural experiments with which to ask questions about the evolutionary ecology of plant-animal interactions at varying scales – from the mechanisms of trait function and impacts on plant fitness, to the patterns of deep-time trait evolution. This work is not only important for illuminating our understanding of how evolution operates, but also informs solutions to the growing humanitarian crisis of sustainably feeding the world's expanding human population."

Weber is also cofounder and codirector of Project Biodiversify, an online repository of teaching tools and in-person workshops geared for faculty to promote diversity, equity and belonging in STEM (science, technology, engineering and math) classrooms. "We are interested in reaching biology educators who teach at the undergraduate level. We find that instructors are eager for teaching materials and methods that increase the equity in their classrooms. Our hope is that Project Biodiversify can help make biology classrooms more equitable spaces for learning and discovery."

Now in its fourth year, Project Biodiversify also offers workshops to faculty interested in adapting their curriculum towards equity and accuracy. "As biology is the study of life, many topics covered in biology courses are directly or indirectly related to human biology and human identities, like gender, sex, sexuality, race, ability, among others," Weber said. "Unfortunately, due to omissions, oversimplifications, and overgeneralizations, many identity-related topics can be taught, explained or defined in ways that are exclusionary or harmful to students with marginalized identities, and reinforce stereotypes and harmful ideas associated with identity."

This fall, Weber will be teaching Introduction to Biology (BIO171) to over 600 undergraduates. "I hope my students leave the class with scientific thinking skills that help them navigate the complicated world around them. Working with students, both undergraduate and graduate, is my favorite part of my job – they inspire me and give me hope for the world."

Is something on my head? Marjorie Weber up close with a jay. Image: Scott Taylor

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LOOK UP! Photo contest had us skywatching

John Den Uyl

1st place: John Den Uyl
Rainbow over the Michigamme Highlands, Baraga County, Mich.

2nd place: Will Weaver
Fifteen minutes at the Biostation, U-M Biological Station.

3rd place: Will Weaver
Nightclub, star trails over our campsite, San Juan Mountains of Colorado, Weminuch Wilderness.

Honorable mentions

Teresa Pegan Floof (boreal chickadee on a snowy March day), Peshekee Grade, Marquette County, Mich.

Rumaan Malhotra The moment of totality, solar eclipse along the ruta de las estrellas, in the high desert, Paihuano, Coquimbo, Chile.

Rumaan Malhotra Baby copperhead showing a caudal lure, Atlanta, Georgia.

William Weaver

William Weaver

Teresa Pegan

Rumaan Malhotra

Honorable mentions!

Rumaan Malhotra