EVOLUTIONARY STUDIES

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Chancellor Diermeier Visits ESI

Spring 2024

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EVOLUTIONARY STUDIES

VANDERBILT UNIVERSITY

VANDERBILT ESI

Dear Evolutionary Studies Community,

I am pleased to share with you the exciting developments and achievements from Evolutionary Studies. As the Director of ES, it is my privilege to witness the remarkable progress and contributions made by our faculty, staff, and students. Earlier this semester, several members of our initiative had the chance to meet with Chancellor Diermeier, introduce our research and accomplishments, and discuss how the university can help our initiative's global footprint and impact.

One of the many measures of our success is the outstanding achievements of ES-affiliated faculty and trainees. For the faculty, recent achievements include, but are not limited to, Dr. Allison Walker's appointment as the Steven and Bunny Fayne Dean's Faculty Fellow (page 24), Dr. Eric Gamazon's well-deserved promotion to associate professor in the Department of Medicine, and Dr. Jada Benn Torres' election to AAAS Fellow (page 25). Not ones to be outdone, our fantastic trainees have continued receiving national and international prizes and awards, including the Zuckerkandl Prize (to Dr. Sarah Worthan for the top paper published in the *Journal of Molecular Evolution*; page 19) and the NSF Graduate Research Fellowship (to Olivia Riedling; page 7). These recognitions underscore the depth of talent and commitment within our program, driving us towards continued excellence.

I also want to express my sincere gratitude to our dedicated faculty, staff, and students for their active participation and engagement in our journal clubs, named lectures, and outreach activities, including this year's Darwin Day, which drew nearly 100 guests at the Nashville Zoo. Your contributions enrich our academic community and inspire us to reach new heights.

In Fall 2024, we have several exciting events and visits planned. In July, we anticipate a significant turnout at the Evolution 2024 conference in Montreal, Canada, where our researchers will engage with peers and present cutting-edge research. In the Fall, we are looking forward to host Dr. Anne Yoder (Duke University) for the Biodiversity Day Lecture and eagerly anticipate our very own Ken Catania's Halloween Talk, which promises to be fun, captivating, and a little scary. We will wrap up the year, with our second-annual retreat in December, which will feature talks from three outstanding scientists, Drs. Caiti Heil (North Carolina State University), Amy Goldberg (Duke University), and Martha Muñoz (Yale University).

Looking ahead, we are excited about the opportunities that await our program. The prospect of establishing an NIH-funded T32 graduate training program in *Computational Evolutionary Approaches to Disease* is particularly promising, since we recently received a competitive score (keep your fingers crossed!). I am also thrilled to announce that we are planning a significant celebration in Spring and Summer 2025 to mark the 100-year anniversary of the infamous Scopes "Monkey" Trial. The Scopes Centennial Festival will be a momentous occasion that not only honors and allows us to reflect on our history but also underscores the ever-increasing relevance and impact of evolutionary studies in our world. Stay tuned for more details as we prepare for this landmark event.

I invite you to join us in our journey of discovery and advancement within evolutionary studies. Together, we can continue to make meaningful contributions to science and shape the future of our field.

Thank you for your continued support and dedication to our shared mission.

Sincerely,

Antonis Rokas

Antonis Rokas, Director
Evolutionary Studies Initiative
Cornelius Vanderbilt Chair in Biological Sciences
Vanderbilt University

Photo credit Dr. Hao Yin

Dr. Antonis Rokas at Nashville Earth Day 2024

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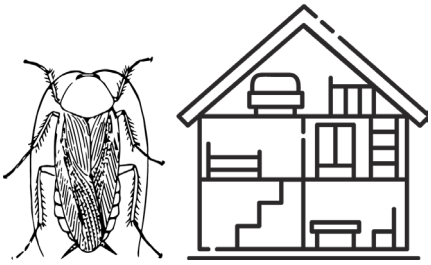
SEMINAR SERIES

9/25 - Anne Yoder
Duke University, Braxton Craven Professor of Evolutionary Biology,
Department of Biology
Biodiversity Day
Integrative Evolutionary Genetics in the Service of Conserving Biodiversity

10/30 - Ken Catania
Vanderbilt University, Stevenson Professor,
Department of Biological Sciences
Halloween Talk
The Cockroach, the Wasp, and the Dollhouse

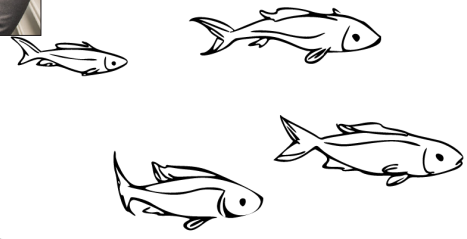


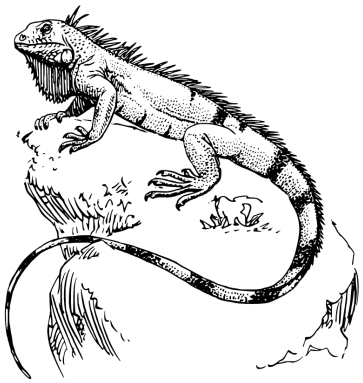
Retreat - 12/10

Caiti Heil
North Carolina State University, Assistant Professor
Department of Biological Sciences
Evolutionary Genetics of Budding Yeasts

Amy Goldberg
Duke University, Assistant Professor
Departments of Evolutionary Anthropology, Biology, and Mathematics
Population Genetics of Humans, Our Primate Relatives, and Our Parasites

Martha Muñoz
Yale University, Assistant Professor
Department of Ecology & Evolutionary Biology
Rate and Pattern of Evolution in Fishes, Amphibians, and Reptiles





Find more information about our virtual seminar series on Vanderbilt.edu/evolution

*Photos submitted by the speakers

Mosquito Immune Systems Weaken with Rising Temperatures

By Sarah Ward, Evolutionary Studies Communications Assistant

Climate change may shorten mosquito lifespan by speeding up aging and weakening the immune response.

A study published in January 2024 by biological sciences graduate student Lindsay Martin in the Hillyer Lab found that mosquitoes age more quickly when temperatures are higher. This aging, in turn, weakens mosquito immune systems and makes them more likely to get infected with disease. Because global temperature is expected to rise due to climate change, Martin's results could have grave implications for mosquito populations and disease transmission.

According to the World Health Organization, vector-borne illnesses such as Malaria and Zika virus cause more than 700,000 deaths annually. They account for approximately 17% of all infectious diseases, and they're transmitted by blood-sucking insects like mosquitoes. The dire impact of vector-borne disease is due, in part, to an eerily simple, rapid transmission mechanism – a bite from an infected mosquito.

Generally, when you or I get sick, our bodies mount a series of immune responses (think that nasty fever that accompanies COVID-19) to eliminate the infection. Mosquitoes also mount immune responses to kill infections, but their immune systems are far more sensitive to the surrounding environment. This is because mosquitoes are ectotherms, so their body temperature fluctuates relative to environmental temperature.

According to Martin, "this means that [mosquito] body temperature will increase in a warming climate."

Mosquitoes, like humans, also undergo senescence, which is a weakening of their physiology with age. "If mosquitoes are aging, they're undergoing a weakening of their immune system while being exposed to higher temperatures," said Martin, "we wanted to know: what are those compounded effects?"

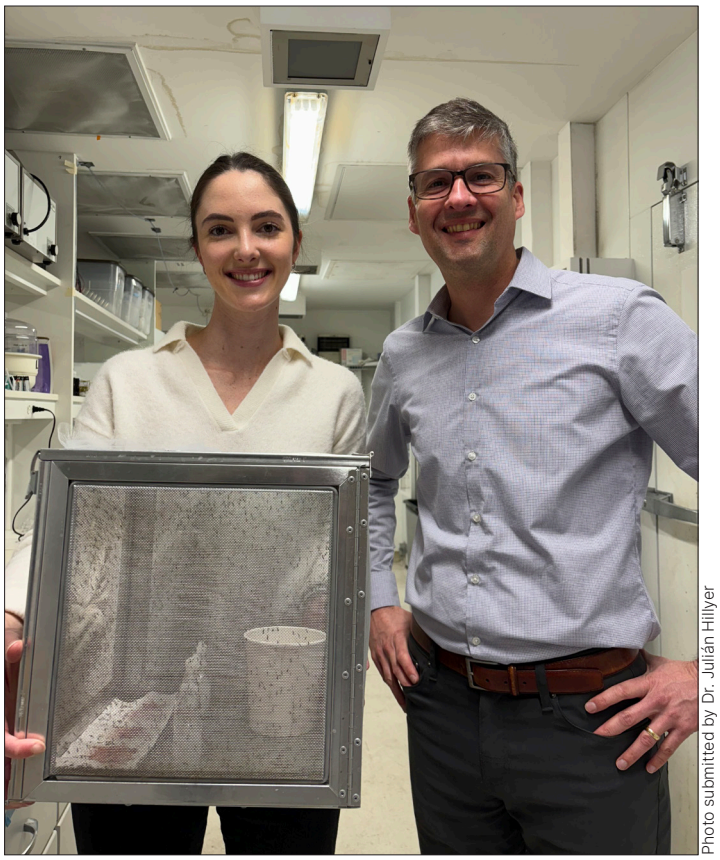


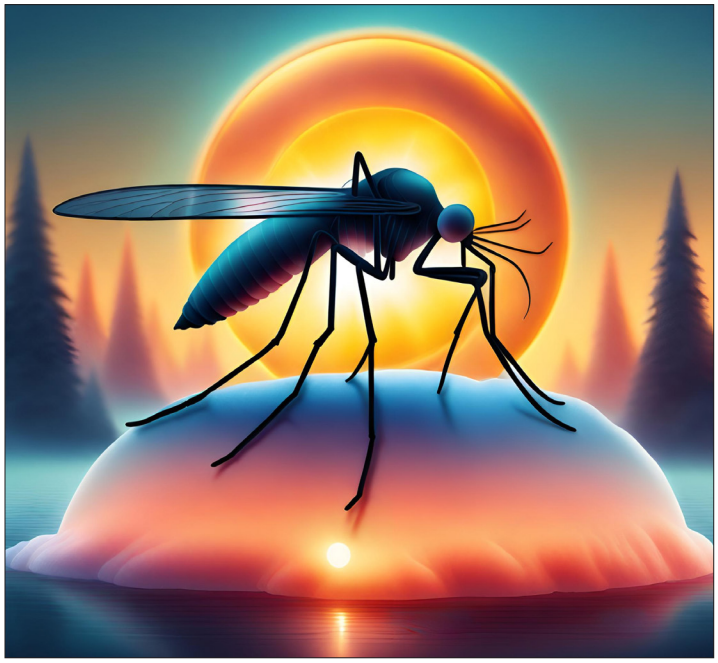
Photo submitted by Dr. Julián Hillyer

To measure mosquito response to changing temperature, Martin reared mosquitoes from birth to death in three separate temperature and humidity controlled walk-in refrigerators. She then infected over 7000 mosquitoes and studied their immune responses at three different ages and temperatures.

"If you do the math, that ends up being 48 different combinations across three different variables," said Vanderbilt biologist Julián Hillyer, who is Martin's PI and a co-author on the paper, "the analysis is, computationally, quite complex."

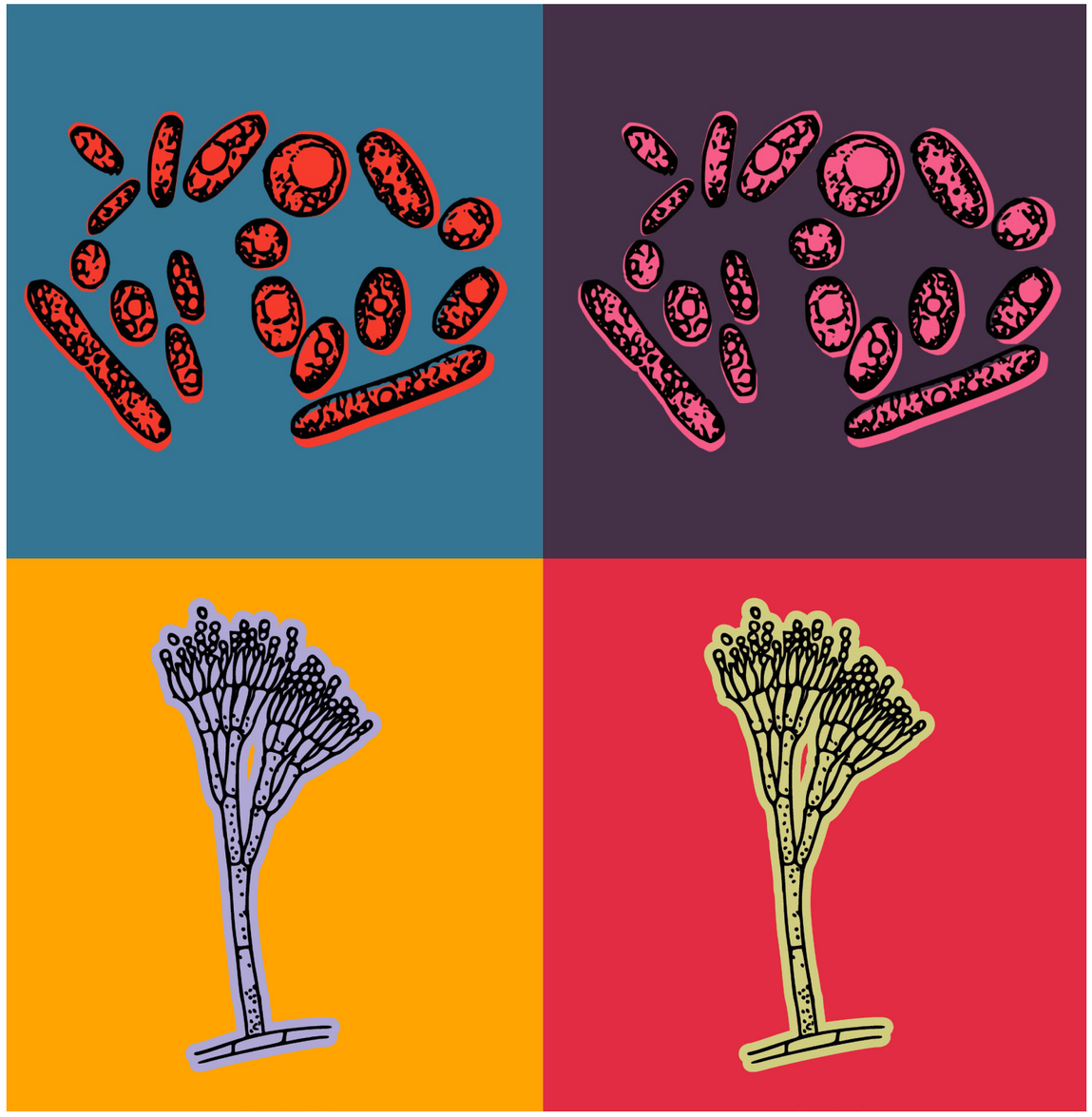
Martin's paper focused specifically on one immune response called melanization, by which mosquitoes form hard shells of melanin around pathogens to starve them of nutrients. Melanization can be observed along a mosquito's abdominal wall under a microscope. Martin found that mosquitoes aged more rapidly at higher temperatures, which in turn weakened the melanization response.

Read more >>



Top: Lindsay Martin and Julián Hillyer stand together holding a mosquito containment unit. Bottom: a MagicMedia AI representation of a mosquito experiencing climate change.

Rokas Lab



This artistic representation of yeast (top) and *Penicillium* (bottom) was submitted by lab alum Dr. Jacob Steenwyk. Steenwyk's artistic talent is matched only by his scientific accomplishments. Steenwyk currently serves as a Berkeley Science Fellow and Howard Hughes Medical Institute Awardee of the Life Sciences Research Foundation in the lab of Nicole King. He was recognized for his work with an invitation to the Trailblazers of Tomorrow Postdoctoral Symposium at UT-Austin and with the Englund Emerging Scholars Award from John Hopkins School of Medicine. He also serves as the Chair of Alumni Affairs for ESI.

Feature Story

The Lab's Big Year

So far, 2024 has been an important year for the lab of Antonis Rokas. As you'll read below, the lab has had major papers accepted, undergraduate first-authored papers, and had a blast attending and running conferences.

In March, lab collaborator and co-advisor to postdoctoral researcher Kyle David, Matthew Pennell visited from the University of Southern California and led an incredibly fun journal club meeting.

In April, graduate student Olivia Riedling was awarded the NSF GRFP for her work studying biosynthetic gene cluster data to predict fungal secondary metabolites. According to her new paper in the journal Microbiology Spectrum, "many fungal secondary metabolites have... medically and industrially important properties (e.g., antifungal, antibacterial, and antitumor)." This work is a joint effort with the Walker Lab.

Coming up in May, Rokas will be a featured speaker at the Human Fungal Pathogens advanced lecture course in France. Then, he'll be off to Germany to lead the European Molecular Biology Organization hosted workshop "Molecular Mechanisms in Evolution and Ecology.".

The workshop will bring together a diverse array of researchers from around the globe, representing a multitude of disciplines and perspectives. The focus of the workshop series is on unraveling interspecies and cell-environment interactions across various organisms, with particular emphasis on bacteria, microbial eukaryotes, and viruses. By fostering interdisciplinary collaboration and leveraging the latest technological advancements, the workshop aims to advance our understanding of biodiversity and the critical role of microbes in planetary ecosystems.

Along with academic conferences, the lab has been generating high-quality peer-reviewed papers in droves. First, postdoctoral researcher Kyle David published about the ecology of yeasts (pages 12-13), then undergraduate Charu Balamurugan published research about the evolution of biosynthetic gene clusters (pages 10-11). Finally, postdoctoral alumna Abbe LaBella led a study about the genomic factors of niche breadth of more than 1,000 species of yeast (pages 14-15). All of these projects involved multiple members of the lab and show the collaborative nature of the work and lab.

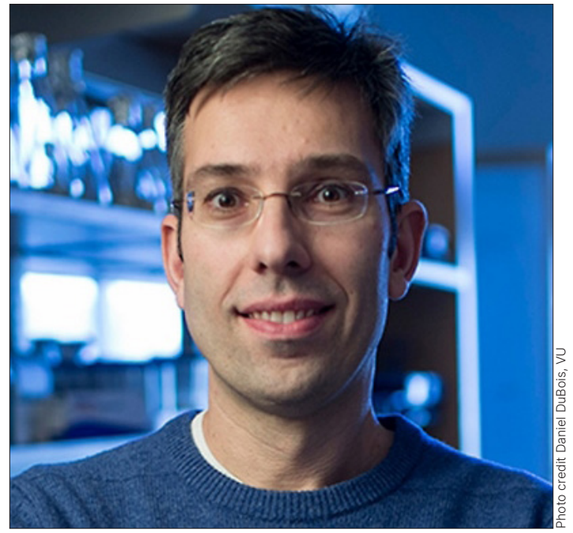


Photo credit Daniel DuBois, VU

Submitted photo

Top right: Antonis Rokas official VU headshot. Bottom: NSF GRFP Fellow Olivia Riedling.

Charu Balamurugan: Beckman Scholar Extraordinaire

Beckman Scholar Charu Balamurugan, an undergraduate researcher in the Rokas lab, shed light on the intricate evolutionary patterns governing secondary metabolite biosynthesis in fungi. Working with former Ph.D. student Jacob Steenwyk, Rokas, and collaborator Gustavo Goldman, Balamurugan published the article *The evolution of the gliotoxin biosynthetic gene cluster in* Penicillium *fungi* in the journal "G3: Genes|Genomes|Genetics." Balamurugan delved deep into the genomes of *Penicillium* species, uncovering fascinating insights into the conservation and evolution of biosynthetic gene clusters (BGCs) and associated resistance genes.

Fungi produce a diverse array of secondary metabolites, which play crucial roles in ecological interactions and human affairs. For example, *Penicillium* molds are famous because they include the species in which Alexander Fleming discovered penicillin, the world's first antibiotic. Another secondary metabolite that has garnered significant attention due to its biomedical relevance is gliotoxin, a potent immunosuppressant. Gliotoxin is so toxic that fungal species producing it often contain genes for resistance to gliotoxin. Balamurugan's study focused on understanding the evolutionary conservation of homologs of the gliotoxin genetic pathway and genes involved in gliotoxin resistance across Penicillium species.

According to Goldman, "very little is known about the distribution of the genes involved in gliotoxin biosynthesis and resistance in filamentous fungi."

Analyzing 35 *Penicillium* genomes from 23 species, Balamurugan and her colleagues found that some species harbored homologous, lesser fragmented gliotoxin BGCs, while others contained fragmented remnants or lacked the pathway altogether. Surprisingly, broad conservation of resistance genes was observed across *Penicillium* genomes.

"The most interesting result of this work is that the genes encoded in BGCs—like that of gliotoxin—can have complex histories and be retained in genomes long after the loss of secondary metabolite biosynthesis, such as among Penicillium species," she said. "More broadly, among families like Aspergillaceae, where there exists a mix of pathogenic and non-pathogenic species, while the genes responsible for producing certain toxins in various *Penicillium* species show a patchwork of presence and absence, the genes that confer resistance to certain potent compounds are broadly conserved across different species. This suggests that, even after losing the ability to produce certain secondary metabolites, fungi retain their defenses against them. This may be a signature of how fungi survive chemical warfare."

Photo submitted by Charu Balamurugan

> "She has blazed a trail as an outstanding student and dedicated experimentalist."
> Jeffrey Johnston

Evolutionary rate analyses suggested that some of the remaining genes of the gliotoxin genetic pathway are functional or lost their function so recently that they have yet to accumulate inactivating mutations. Analyses of the evolutionary history of gliotoxin genes revealed a complex history of gene duplications, losses, and horizontal gene transfers, highlighting the dynamic nature of fungal secondary metabolite biosynthesis.

Balamurugan's journey of excellence at Vanderbilt University is marked by a trail of accomplishments and profound impact. Notably featured on VU's Instagram Four with a 'Dore series, Balamurugan's visionary leadership showed through her founding of Agni, Vanderbilt's premier South Asian classical dance collective, demonstrating her commitment to cultural enrichment and artistic expression. Balamurugan's dedication and aptitude earned her recognition as a Data Science Institute Summer Research Program Fellow, solidifying her prowess in scientific inquiry and innovation.

In addition to her academic pursuits, Balamurugan is a beacon of social consciousness and activism. As an Ingram Scholar, she champions equity and inclusivity, embodying Vanderbilt's ethos of fostering a diverse and equitable community. Her involvement with Active Minds at Vanderbilt underscores her commitment to mental health advocacy, where she raises awareness and reduces stigma surrounding mental illness. In her Medicine, Health, and Society program, she investigated the issue of mental health among incarcerated youth.

Jeffrey Johnston, Beckman Scholars Program Director, continued, "Charu is a rocketing student-scientist who gracefully navigates within an exceptionally talented crowd. She has blazed a trail as an outstanding student and a dedicated experimentalist that the VU Beckman Scholars Program recognized. Her latest publication continues her growing record of scientific impact in evolutionary studies."

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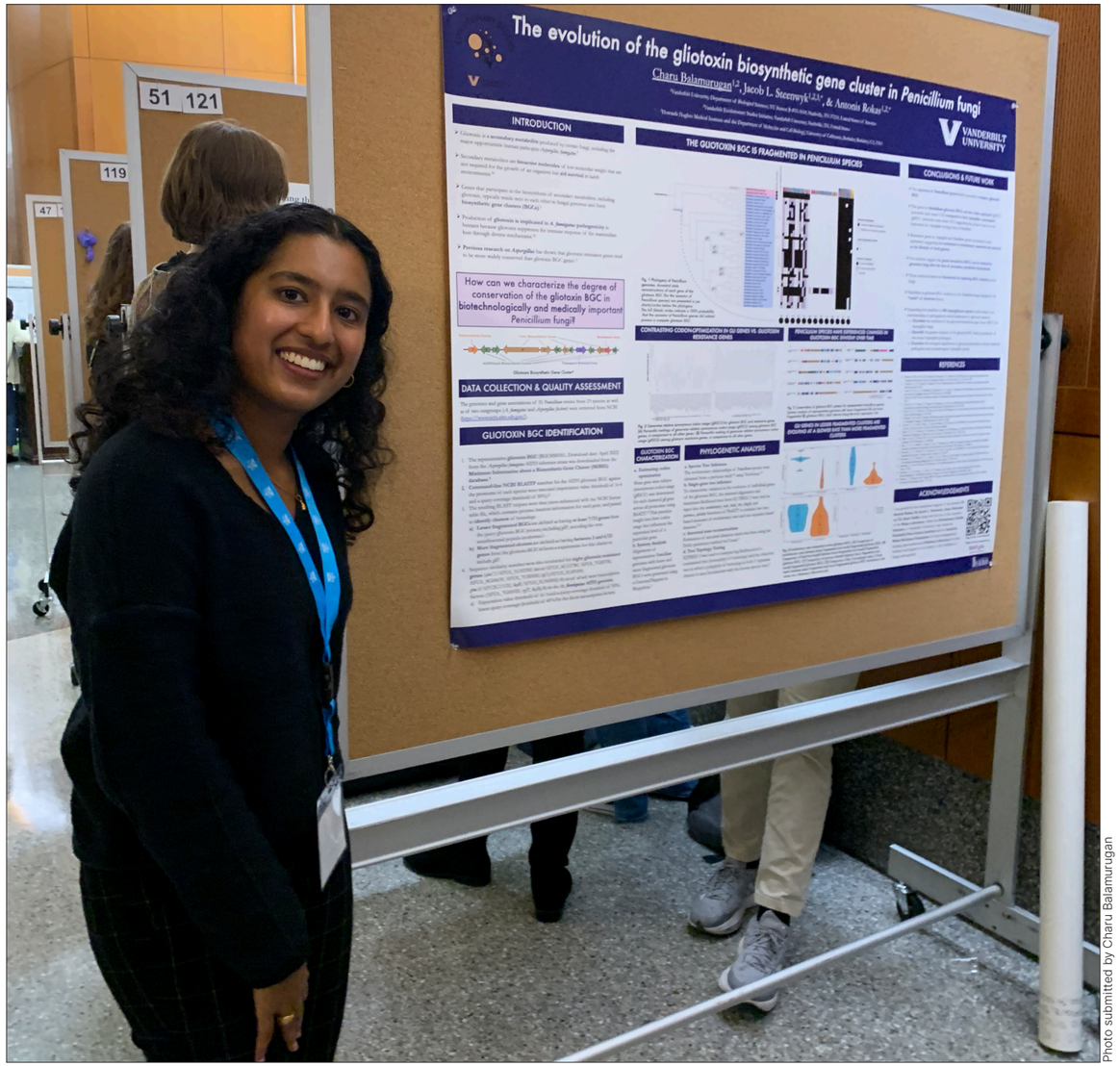


Photo submitted by Charu Balamurugan

Above: Charu Balamurugan headshot. Opposite: Balamurugan at the undergraduate research symposium showing off her research

Kyle David: An Early Career Investigator on the Rise

Kyle David, an NSF postdoctoral fellow in the Rokas lab, and co-authors published a new paper, "Saccharomycotina yeasts defy longstanding macroecological patterns" in the high-impact journal PNAS. This paper, which looks at the ecology of 186 species of yeast, provides evidence that not all life-forms follow the rules. In this case, the rules broken are species distribution hypotheses, specifically, that species diversity should increase near the equator, species should be more diverse in warmer climates, and species ranges should be bigger farther from the equator.

According to David, "they really like these montane forests. I make the pitch that these elevational clines along a mountainside create all these micro-habitats that can host a lot more species."

David's co-mentor, Matt Pennell of the University of Southern California, commented, "biologists have long been fascinated by generalities in the distribution of abundance of organisms and there is a huge body of theory that has been developed to explain these generalities. But this work tends to ignore the many groups of organisms – often the weird and wonderful ones like fungi. By aggregating all sorts of records from different sources and using clever machine learning approaches, we showed that this important group of yeasts break all the rules. We will need to expand existing theory to make better sense of why this is the case."

Building off a study that experimentally validated which foods (i.e., carbohydrates) are eaten (i.e., metabolized) by which yeasts, the team also found that species that metabolize fewer carbohydrates have restricted ranges compared to those that metabolize more. David was excited to see the pattern of specialists having restricted ranges come through in this experiment.

"The specialist-generalist relationship we found is really cool," he added. "It wasn't unexpected, like some of the other results, but it's nice to see this biochemical process relate to a macro-ecological pattern."

This paper fills an important gap in our understanding of yeast ecology. Specifically, we know quite a bit about the medical and commercial processes of yeast-human interactions, but very little about the ecology of yeast in nature. David commented that we often treat yeast like they exist in a vacuum, but they do exist in the world and have really interesting ecologies.

David also expressed that the paper was aimed at finding diversity as a function of evolution, rather than by movement from people, for example, in wineries or breweries. Using his machine learning model, David accurately replicated predictions of the yeast *Saccharomyces eubayanus* that was recently discovered in Dublin, Ireland.

"This species was known to exist in Europe as it is used for brewing there. It really had only ever been isolated from Tibet and Patagonia, but two years ago it was found in Ireland and my model, which didn't have any of those isolates from Dublin still identifies that as a place that it could be found. It's nice to have those external validators."

This project was in collaboration with the Y1000 project. This ongoing project, funded by the National Science Foundation, aims to sequence and analyze the genomes of all known yeast species within the subphylum Saccharomycotina. This massive undertaking will result in the first comprehensive catalog of genetic and functional diversity for any such taxonomic rank. By studying the genomes of over 1,000 yeast species, researchers hope to gain insights into the evolution of their diverse metabolic and ecological functions.

Read more >>

Photo submitted by Dr. Kyle David

Submitted photo

Photo submitted by Dr. Kyle David

Opposite: Kyle David in the field in Antarctica. Above: Matthew Pennell headshot. Bottom right: temperate mixed forests surrounding the Vosges mountains in France. This is one example of the kind of environment David predicts harbors the greatest yeast diversity (photo by Donar Reiskoffer).

Flipping the Script on Yeast Ecological Dynamics

A mere decade or two ago, decoding the genome of every organism in a major branch of the tree of life and deciphering their diets was a pipedream. In a groundbreaking study, a team of researchers from Vanderbilt University, the University of Wisconsin-Madison, and other institutions worldwide have done just that for the first time ever. Led by Abigail LaBella, a postdoctoral researcher in the lab of professor of biological sciences Antonis Rokas, an international research team used the genomes and diets of nearly all known species from an ancient lineage of yeasts to understand the evolution of generalists and specialists. Their findings challenge a dominant theory that perceives species that are ecological generalists as jack-of-all-trades that are masters of none. Instead, the team's findings underscore the significant role of genetic factors in shaping yeast metabolic diversity. The study, titled "Genomic factors shape carbon and nitrogen metabolic niche breadth across Saccharomycotina yeasts," appeared in the April 26, 2024 issue of the prestigious journal *Science*.

Yeasts, an ancient group of unicellular fungi that include the baker's yeast used for baking, brewing, and wine-making, exhibit varying degrees of specialization in their diets – while some can grow on just a few sugars and are considered specialists, others can grow on many and are considered generalists.

According to LaBella, who now runs her own lab at the University of North Carolina at Charlotte, "we identified many yeasts that grew on only a few food sources--we called these yeasts specialists. There was one species that only grew on a single food source out of the 17 that we tested. We initially hypothesized that specialist yeasts would grow very well on their preferred foods. Our laboratory experiments, however, showed that the generalists, or yeasts that grow on lots of different foods, typically grew faster than specialists."

"That is not the result expected by the evolution textbooks," Rokas said. "Specialists should be really good at eating those few foods that they've specialized on, whereas generalists should be jacks of all trades but masters of none – they should be able to eat a variety of foods but slowly. But our data show otherwise."

"This absence of trade-offs between diet breadth and growth was very surprising and led us to conduct extensive genomic analyses to try and uncover the ways in which generalist and specialist yeasts differ," added LaBella.

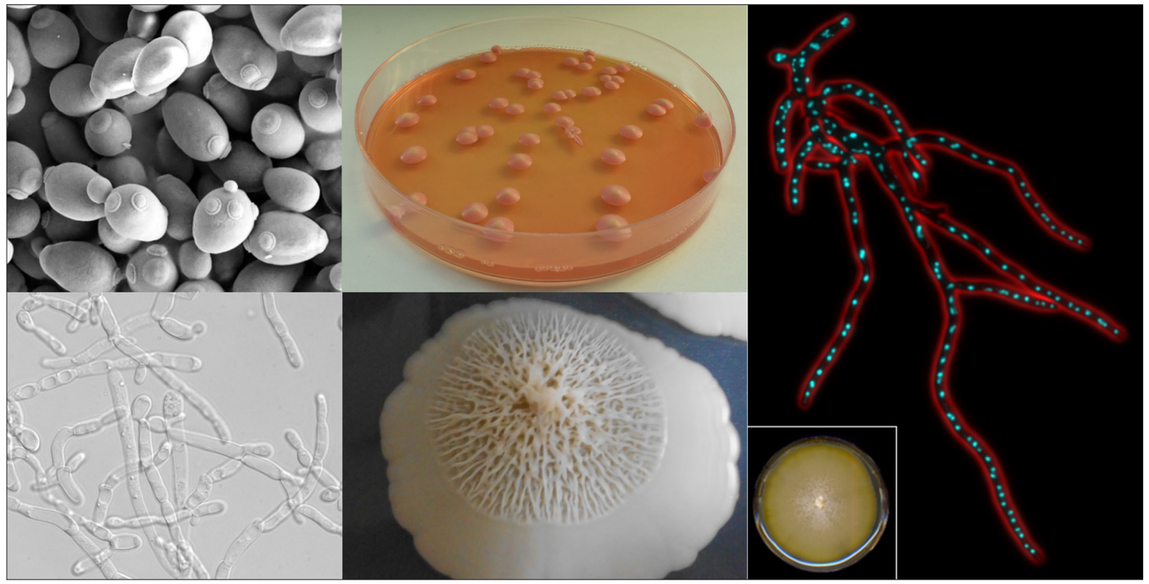
This led the team to wonder what drives variation in yeast diet breadth. LaBella, Rokas, and their collaborators sought to explain the evolutionary drivers behind this variation by integrating genomic, metabolic, and ecological data from nearly all known species of Saccharomycotina yeasts. This comprehensive approach involved analyzing 1,154 yeast strains from 1,051 species, cultivated in 24 distinct foods. More than 900 of the genomes sequenced including dozens that may be new to science. The computational evolutionary analyses of this one-of-a-kind dataset sometimes took weeks of data crunching on supercomputers, like ACCRE, Vanderbilt's hub for high-performance computing and computational research.

The study found that large differences in diet among yeasts were primarily driven by differences in the presence or absence of genes encoding specific metabolic pathways.

"For every additional food that a yeast can eat, we find an additional 36 genes in its genome," said Rokas.

Read More >>

Photo submitted by Dr. Abigail LaBella



This page: Co-first author, Abigail LaBella.

Opposite top: Some of the highly diverse species of yeasts. Clockwise from top left: scanning electron microscopy image of cells of the baker's yeast *Saccharomyces cerevisiae*; colonies of the yeast *Brettanomyces bruxellensis*; fluorescent microscopy image of filaments of the plant pathogen *Eremothecium gossypii*; colony of the pathogenic yeast *Candida albicans*; filamentous cells of the yeast *Yarrowia lipolytica*. Images from Wikipedia

Opposite bottom: Authors from the study in color, from left: Marie-Claire Harrison, LaBella, Jacob Steenwyk, Antonis Rokas, and Carla Gonçalves. Other lab members and alumni, in grey from left: Matt Mead, Olivia Riedling, Annie Hatmaker, Kyle David, Adi Gumilang, Karin Steffen, Thomas Sauters. Lab photo from the Fungal Genetics conference at Asilomar.

Photo submitted by Dr. Antonis Rokas

Machine Learning and Galactose Predictions

Not to be outdone by the paper in *Science*, graduate student in the lab Marie-Claire Harrison published a paper in the journal *Proceedings of the National Academy of Science* the very next day called "Machine learning enables identification of a yeast galactose utilization pathway."

The team used machine learning models to show that the Saccharomycotina yeasts have evolved an alternate pathway to metabolize a food source (galactose). Along with this finding, she noted that these machine learning models may be widely applicable for helping us better understand the evolution of traits, especially when confronted with an unwieldy and large dataset.

In this study, the team created a model using environmental, metabolic, and genomic data to predict whether or not each of the species for which they had data (nearly 1000) could grow on more than twenty carbon sources. After determining the best ways to use the model from these predictions, the group dove deeper into galactose utilization. Their original testing showed that an alternative pathway for using galactose existed in yeasts that did not have the previously known galactose-use genes (*GAL*). The team then went back to the lab and grew the species of yeast without the *GAL* genes in galactose and found that a second pathway did exist, just as the model had predicted.

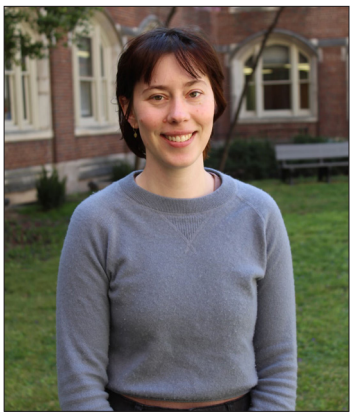


Photo submitted by Marie-Claire Harrison

Harrison noted that the dataset for this paper was the same as for the paper on the previous page. She was also able to use some of the same machine learning methods to predict specialists and generalists in that paper as she used for predicting galactose utilization in this paper.

When asked about her favorite part of this work, she noted, "it was so cool to be able to generate a hypothesis while testing out a method that was new to me and for the Hittinger lab to be able to test out that hypothesis by confirming the alternative galactose-degrading pathway in several species. I also loved being able to apply the method to 28 other carbon substrates to see how predictable metabolic pathways generally are in Saccharomycotina yeasts when a random forest is trained on metabolic, genomic and environmental datasets—there's more variation in accuracy than I would have previously expected!"

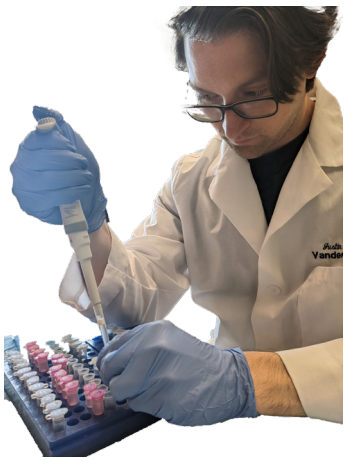
Read more >>

Photo submitted by Marie-Claire Harrison

Top: Marie-Claire Harrison stands outside Medical Research Building III on VU's campus. Bottom: Harrison enjoying the day on the couch

Tate Lab

Beetle Immune System Dynamics

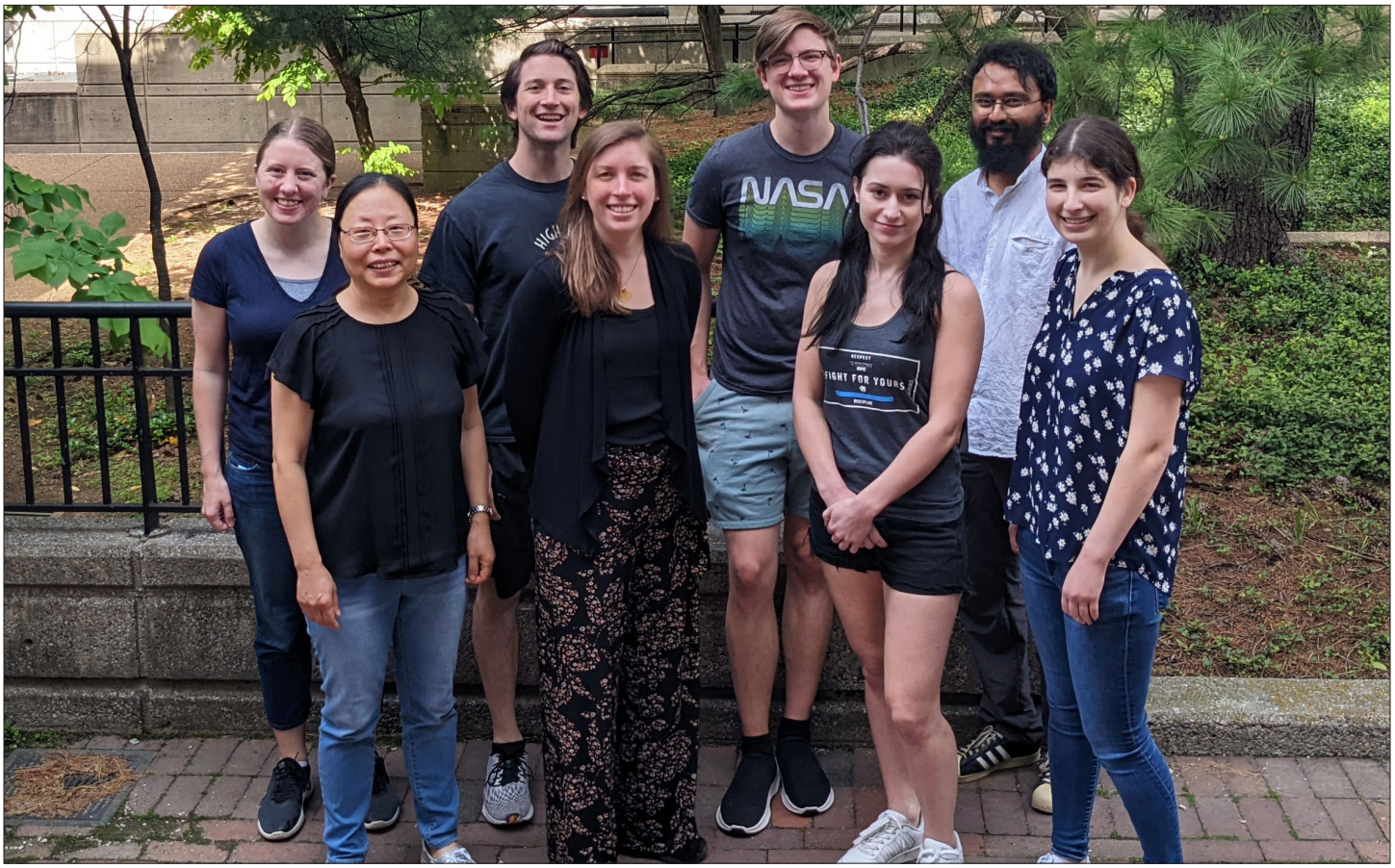


Justin Critchlow, a recent Ph.D. student in Ann Tate's lab, published a paper with the labmates Arun Prakash (postdoctoral researcher), Katherine Zhong (former undergraduate), and Tate, uncovering the intricacies of beetle immune dynamics. The paper was just published in PLoS Pathogens, "Mapping the functional form of the trade-off between infection resistance and reproductive fitness under dysregulated immune signaling." It delves into the microscopic realm and unravels the orchestrated defense mechanisms led by the molecular regulator cactus. This breakthrough reveals the nuanced ballet of beetle immunity, shedding light on the intricate interplay between protection and physiological costs. This paper sheds light on the dynamics of survival, resilience, and the profound complexities inherent in evolutionary adaptations.

The team used a novel approach to vary the expression of the regulatory protein cactus in red flour beetles. This regulatory protein acts as a kind of manager that controls the activity of the immune system in red flour beetles, like a switch that can be turned up or down to adjust how strong the immune response is. They adjusted the magnitude of Toll pathway activation, and observed the consequences on immune output, survival to bacterial infection, and various health and reproductive parameters. The Toll pathway is like a series of traffic lights for the beetle's immune system. When the pathway is activated, it's like the green light is on, signaling the immune system to kick into action and defend against infections.

According to Tate, "we've known for a long time that investment in immunity is subject to many trade-offs, but studies that actually define the functional form are rare. This matters when we want to predict how extra investment, for example against relatively innocuous or virulent parasites, will shake out for organismal fitness."

Read more >>



Above: Justin Critchlow pipetting. Below: The Tate lab posing for a photo. From left, Alissa Williams, Siqin Liu, Justin Critchlow, Ann Tate, Reese Martin, Louise Perrier, Arun Prakash, Carly Stewart.

Darroch Lab

Getting to the Bottom of Burrows

By Sarah Ward, Evolutionary Studies Communications Assistant

Vanderbilt graduate student Katherine Turk and colleagues found that worm burrowing behaviors could have emerged earlier in earth's history than was previously thought. Her work *Archaeichnium haughtoni: a robust burrow lining from the Ediacaran–Cambrian transition of Namibia* was published this January 2024 in Papers in Paleontology, and it could have implications for the onset of complex life on earth.

Turk became interested in better understanding 540-million-year-old (Ediacaran) tubular fossils from the Iziko South African Museum when she realized how indiscriminately the fossils had been characterized in the past.

"They were calling it a wastebasket taxon, which is what you call a fossil when you're not sure what it is," said Turk.

She sought to better characterize the fossil slab using her expertise on large, tubular worm fossils from the Ediacaran period.

Paleontologists have a particular interest in the late Ediacaran because it occurred right before a period of exponential growth in the complexity of life on earth. This phenomenon is mostly commonly known as the Cambrian explosion.

"The Ediacaran-Cambrian transition is important, because it's the beginning of our modern animal dominated biosphere," said Turk, "it's the time we start to see animals and animal behaviors with equal complexity to our modern oceans."

By exploring this transition, paleontologists hope they can determine what may have facilitated a rapid evolutionary boom in the Cambrian.

To better understand the behaviors of Ediacaran animals, paleontologists like Turk look to trace fossils.

"There are two main types of fossils: a trace and a body. A body is a tooth, bone, or shell, while a trace is a record of behavior, like a skin impression, footprint, or burrow," said Turk, "bodies tell us what an animal looked like, while traces tell us what an animal was doing. Because of this, in a lot of ways, traces can be more valuable."

Following characterization of trace fossils, paleontologists can connect information on animal behavior to broader evolutionary patterns.

The worm fossils from this particular fossil slab exhibited evidence of important behaviors which would have made it easier for Ediacaran worms to survive and grow.

"Rather than just hanging out where the sediment and water meet and burrowing to the surface, these animals were actually producing reinforced tube structures, which is quite complex," said Turk.

Read more >>

Photo submitted by Kat Turk

Kat Turk in the field

Dinosaur footprints like this are one of the more well-known trace fossils.

> "They were calling it a wastebasket taxon."

Kelley Lab: Exploring Triassic Adaptations

By Sarah Ward, Evolutionary Studies Communications Assistant

Vanderbilt professor Neil Kelley assisted in a study which characterized the evolutionary response of mammals from 250-million-years ago (Triassic) to habitat transitions. Their work was published August 2023 in the Swiss Journal of Paleontology, and it explores how similar mammals can react differently to the same environmental challenges.

Kelley finds the Triassic period interesting, because it's the only interval of geologic time that starts and ends with major extinction events.

"It was a time of evolutionary experimentation, during which the ecosystem had been wiped clean," said Kelley, "things were re-building during the Triassic. There were opportunities to find new ways to be."

One of those new ways was the movement of land mammals into the ocean. This process is of particular interest to Kelley, as it requires that mammals surmount significant evolutionary hurdles to survive.

"If you're adapted to live on land and you move to living in water, the physics of moving through the water is different," said Kelley, "food availability is different. Getting oxygen is different."

How mammals address these challenges can vary. Sometimes, mammals come up with similar adaptations to these challenges, which is called convergent evolution. Other times, mammals come up with completely different adaptations to the same set of challenges. This is called evolution novelty.

"I think both kinds of evolution can be true," said Kelley, "there are some evolutionary rules mammals play by. And there are also mammals that seem to break the rules and do their own thing."

To examine the evolutionary response of Triassic mammals which transitioned from land to sea, Kelley and colleagues examined their bones, which were found during a 2010 dig in Oregon. To examine them, they sliced open the bones and analyzed their structures under the microscope.

"Bone is a living material. It's deposited through a series of biological processes over the life cycle of an animal, and many animals re-work and alter their bones as they grow," said Kelley, "when you look at the structure under the microscope, you get a little piece of that animal's life story."

Conventionally, paleontologists focus on the exterior of the bone and quantify its size and shape. This can provide insight into an animal's behavior, such as diet and running speed. Looking inside the bone can provide biological information at a finer scale, including metabolism and growth history. Some mammals even deposit annular growth rings which show up yearly like tree rings on a trunk.

The bones Kelley and his colleagues analyzed came from two groups of Triassic mammals which evolved from the same ancestor. Both of these groups adapted to living in water around the same time. As such, the researchers wondered if the mammals would convergently evolve, adapting in similar ways to their new habitat, or exhibit evolution novelty by carving out distinctive niches.

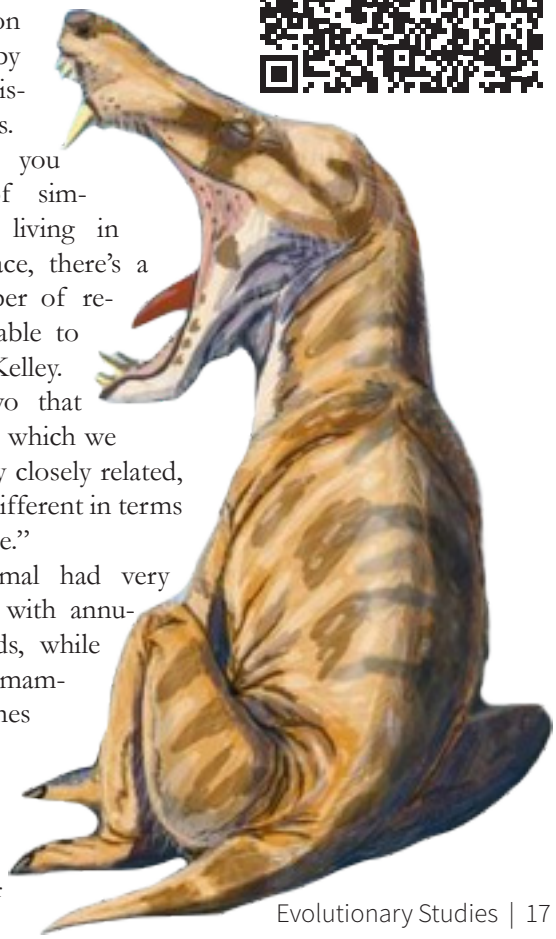
Photo submitted by Dr. Neil Kelley

Dr. Neil Kelley in the field

"Anytime you have lots of similar animals living in the same place, there's a limited number of resources available to them," said Kelley. "Just the two that we looked at, which we think are very closely related, looked very different in terms of bone shape."

One mammal had very dense bones with annular ring bands, while the other mammal's bones were more spongy. These differences in bone type, while seemingly simple, are indicative of significantly different habitats and lifestyles.

Read more >>



A therocephalian, an extinct "Proto-Mammal" from the Upper Permian (~250 mya) of South Africa. Wikimedia commons.

Behringer Lab Feature Story

Thriving in Extremes

Natural environments experience fluctuations in resources, like food, water, and shelter. When times of high resource availability are followed by times of low resource availability, this is known as feast and famine cycles. Microbes experience feast and famine cycles on a regular basis. For example, the microbes in animal guts experience feasts directly after a meal but then must quickly adapt to the conditions of famine between meals. According to a BBC Science Focus article, the average lifespan of a bacterium is about 12 hours; this suggests that in the gut, much of the lifespan of a bacterium is spent in famine with just two or three large feasts in-between.

Assistant professor of biological sciences Megan Behringer published a new paper in Current Biology, "Trade-offs, trade-ups, and high mutational parallelism underlie microbial adaptation during extreme cycles of feast and famine." This paper is one in a series about the effects of feast and famine in *E. coli.*

Last year, Behringer and collaborator Wei-Chin Ho published work testing cooperation in *E. coli* under feast and famine conditions. The bacteria grew in a broth medium and after 10 days, the bacteria were transferred to fresh broth. The bacteria used up most of the resources within the broth after about one day.

According to Behringer, "as natural environments such as the gut microbiome contain micro niches, resource gradients, and cycles of feast and famine, our research is foundational to understand how microbes evolve in the wild, but also in the context of agriculture and human health."

This time, instead of the 10-day feast and famine cycles, the team relied on 100-day cycles for a period of 900 days. The paper explains that E. coli can live more than 250 days in fresh water and for years in the soil. These famine conditions, therefore, are not unheard of for natural populations of *E. coli.* In these feast and famine cycles, there is often a trade-off between survival and growth. For example, the paper points out that some microbes evolve to survive in harsh famine-environments and become poorly adapted to nutrient-rich environments and do not grow as quickly as microbes that did not experience evolution in famine environments.

Photo credit Dr. Megan Behringer

Photo submitted by Dr. Megan Behringer

Opposite top: Dr. Megan Behringer in the field. Opposite bottom left: from left, Gillian Patton, Behringer, and Robert McCarthy. Opposite bottom right: Behringer outside MRBIII. This page top, the Behringer Lab Christmas photo (from left: William McLaughlin, Owen Hale, Carl Stone, Yehchan Kim, Behringer, Michelle Yin, Sarah Worthan, Patton, Zeer Cen, McCarthy). This page bottom: Worthan and Cen presenting at Coon Creek Science Center for a high school outreach day.

Photo submitted by Dr. Megan Behringer

One result the team found was that there was a high degree of similarity in the evolutionary trajectory of the sixteen different populations of *E. coli* they subjected to the 100-day feast and famine cycles. The team determined that this was caused by the strong selective forces of long famine periods – in other words, there may only be a very small number of adaptations available to these bacteria for them to survive in such nutrient-poor environments. One unique feature to this pattern of similarity was that the order in which the genes mutated and evolved was very similar across populations.

Behringer and Ho teamed up with help from old collaborators at Arizona State University and Behringer lab's postdoctoral researcher Sarah Worthan and post-baccalaureate research technician Zeer Cen. Worthan and Cen contributed significantly to the laboratory experiments. Recently, Worthan's first-author paper from the lab won the Zuckerkandl Prize for best paper in the Journal of Molecular Evolution.

Mentorship & Teaching

Including Worthan and Cen, Behringer has built a strong team at Vanderbilt. Behringer's trainees show a strong commitment to outreach activities associated with the Evolutionary Studies Initiative. Owen Hale, a third-year graduate student, and Worthan have led hominid-evolution lessons at Stratford and Overton High Schools. Hale also participated in the 2022 Fossils at the Fort event, to show off differences in some of the hominid and primate skull casts in ESI's collection. Worthan and Cen attended the ESI-sponsored high school trip to the Coon Creek Science Center where students learned about

the different paths to becoming a scientist and compared and contrasted ancient and modern food webs using fossils found at the site.

Behringer hosts, on average, four rotation graduate students per year from either the Interdisciplinary Graduate Program or direct admits to Biological Sciences. Along with her four current graduate students, she serves on the committees of students from chemistry, biological sciences, biochemistry, the medical scientist training program, and the microbe-host interactions program. She has also advised or mentored dozens of undergraduate students, many of which, like Cen, have been recognized with high honors, honors, or outstanding research awards.

With respect to teaching, Behringer is the resident-expert in all thing microbiology. She generally teaches three courses. Microbiomes: Health and the Environment features in-depth discussion of microbiomes of the human body, in agriculture, and the effects of climate change, sustainability practices, and social justice on microbiomes. In Microbiology, she teaches about cell biology, prokaryotic genetics, and viruses and phages. In Microbial Genetics and Genomics, Behringer leads discussions on replication, transcription, translation, and population genetics.

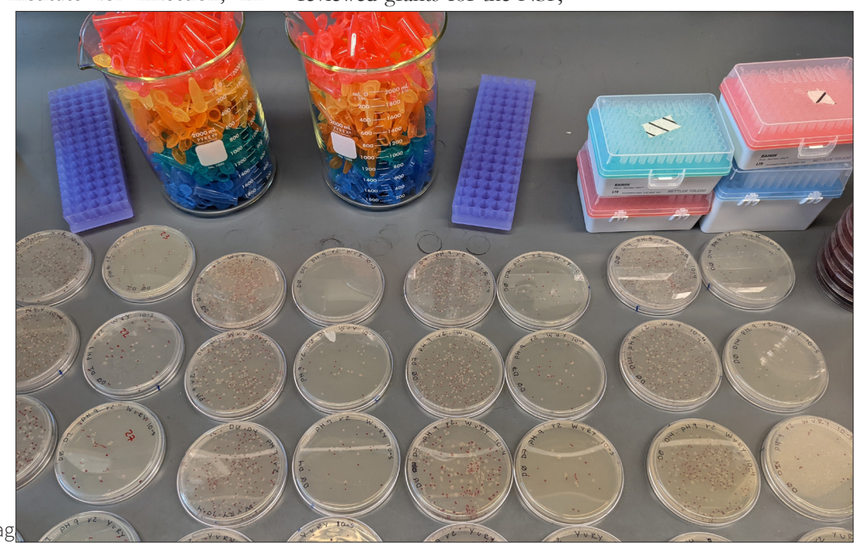
Cooperation

Behringer knows that science doesn't exist in a vacuum; along with her publications stemming from her time at ASU with advisor Mike Lynch and collaborator Ho, she has built an impressive network at Vanderbilt. In 2021, she was awarded an ESI pilot grant with Ben Bratton, an assistant professor in Pathology, Microbiology and Immunology. So far, the pilot grant has resulted in one manuscript in review and invaluable training for students in both the Behringer and Bratton labs. Additionally, Behringer worked with Carl Johnson's lab to publish a paper about daily cycles (a Johnson lab specialty) and the recovery of the guy microbiome after antibiotic treatment.

As a member of ESI, she has served on the seminar series committee and hosted our 2023 Darwin Day speaker, Richard Lenski. She also served on the faculty search committees for some of our newest evolutionary studies faculty members. As the associate director of the Vanderbilt Microbiome Initiative, she has reviewed several grant proposals and hosted the 2020 speaker, Irene Newton. Finally, Behringer is a member of the Vanderbilt Institute for Infection, Immunology, and Inflammation serving on the faculty search committee and hosting 2023 speaker, Vaughn Cooper.

Photo submitted by Dr. Megan Behringer

Serving the scientific community is also important to Behringer. She has served as a reviewer for several journals, including Evolution. She has also been a guest editor for PLoS Genetics, reviewed grants for the NSF, and served on an NIH Grant Review panel. Behringer is an exemplary member of our community and for her service to various initiatives, institutes, and the university as whole, she has been recognized with the Steven and Bunny Fayne Faculty Fellow in Biological Sciences.



A Prestigous Award

Sarah Worthan Awarded Zuckerkandl Prize

The Zuckerkandl Prize is given to the top paper published in the Journal of Molecular Evolution. The honor of the 2023 Zuckerkandl Prize belongs to a paper by first-author Sarah Worthan, a postdoctoral researcher in the Behringer lab in Biological Sciences at Vanderbilt.

Worthan was excited to talk about her new prize. "Personally, receiving this prize was a very gratifying way to kick off the new year! I feel very honored and humbled by the recognition as The Journal of Molecular Evolution is known for its commitment for publishing high quality evolutionary research. Professionally, receiving this prize is very rewarding."

She continued by describing the work, "this paper was unique in that it serves as a cautionary guide to those performing fitness assays following an adaptive laboratory evolution approach. We found that very small changes to the execution of the fitness assay led to varying results, and we were eager to share these insights with the community. The fact that our paper was chosen for this prestigious prize indicates that the editorial panel agrees that disseminating findings such as these are of great importance."

Worthan enjoys working with microbes, especially *E. coli*. She noted they have simple nutritional requirements, replicate quickly, and can easily genetically manipulated. They are also easy to design lab experiments around.

She added, "there are so many cool things about working in an experimental evolution lab. First, you get to observe evolution in real time! How cool is that?! Also, not only can you utilize experimental evolution to answer questions about evolutionary processes, but you can also learn a lot about microbial genetics and physiology!"

Read more >>

Opposite top: Dr. Megan Behringer VU headshot. Opposite bottom: *E. coli* growing in petri dishes on the lab bench. This page: Behringer checking the work of Dr. Sarah Worthan at the lab computer.

Visit from Chancellor Diermeier

The Future is Bright for Evolutionary Studies

On January 17, 2024, ESI was honored to receive a visit from Chancellor Diermeier. The Chancellor's visit included an introduction to ESI's mission and the research of select members, an open-ended discussion on investing in the future of evolutionary studies at Vanderbilt, and a tour of the DREAM Lab, the paleontological lab run by Larisa DeSantis, associate professor of biological sciences and Earth and environmental sciences.

Chancellor Diermeier was impressed with the initiative and the important research efforts of its investigators, noting that "this is a great initiative, and we want to support it."

The meeting opened with Antonis Rokas, director of the Evolutionary Studies Initiative, welcoming the chancellor and providing a brief overview of the initiative's mission and growth. "The story of our initiative is emblematic of our university's Dare to Grow motto," said Rokas.

> "This is a great initiative and we want to support it."
> Chancellor Diermeier

Established in 2019, the Evolutionary Studies Initiative runs numerous highly successful research, educational, and outreach activities that unite scholars of evolution and/or its applications across our campus.

ESI members presented a brief overview of their activities and research programs, responding to probing questions from the chancellor. The discussion with the chancellor highlighted the breadth, diversity, and global reach of research from ESI faculty. Through field work across the globe and collaborations with an international network of researchers, ESI investigators' research uses evolutionary approaches to tackle major health (e.g., drug resistance, evolution of disease), societal (e.g., climate change), and economic (e.g., livestock improvement and environmental management) challenges.

The open-ended discussion focused on actions that would further increase ESI's footprint on the global stage, such as faculty retention and recruitment, the creation of an "evolution corridor" that would house the headquarters of ESI and the laboratories of several ESI investigators, and partnering with the university's Communications and Marketing team to increase the visibility of ESI work and organize high-profile events on topics related to evolution and society.

Read the full story here >>

Photo credit Harrison McClary, VU

Opposite page: From left, Allison Walker, Paul Durst, Andy Flick, Larisa DeSantis, Ken Catania, Antonis Rokas, Chancellor Diermeier, Megan Behringer, Carlos Taboada, Ann Tate, Gianni Castiglione, Lin Meng, Audrey Arner, Nicole Creanza, Owen Jones, and Jada Benn Torres pose for a group photo.

Top right: a MagicMedia AI rendition of an evolution corridor. Created and altered in Canva.

Bottom: clockwise from bottom left, Rokas, Chancellor Diermeier, DeSantis, Arner, and Meng stand around the ESI skeleton cast of the hominid (*Australopithecus afarensis*) "Lucy" in the DeSantis DREAM Lab.

Front cover: Adi Kurre ('25, pre-dental, BSCI) shows Chancellor Diermeier evidence of microwear patterns on teeth of an ancient North American mammal in the DeSantis DREAM Lab (credit Harrison McClary, VU).

Photo credit Harrison McClary, VU

Allison Walker: Faculty Fellow

Allison Walker, assistant professor in Chemistry with appointments in Biological Sciences and Pathology, Microbiology and Immunology, was named a Steve and Bunny Fayne Dean's Faculty Fellow in April.

"I am very honored to be selected as the Steve and Bunny Fayne Dean's Faculty Fellow," she said. "The award makes me feel like a valued member of the scientific community at Vanderbilt because it indicates that my department and the fellowship selection committee recognizes the promise of my research program. I am also grateful for the generous support for my research, the funding associated with the fellowship will accelerate discovery in my lab."

Her research interests include discovering secondary metabolites also known as natural products. These are generally things produced by organisms that do not directly support their living, but can help them cope with their environments.

"Natural products have complex structures and are generally produced by multiple enzymes," she noted. "Understanding the co-evolutionary constraints on these enzymes can help us engineer them to produce novel natural product-like compounds. In addition, many natural products have antimicrobial activity and are therefore useful as antibiotics that can treat disease. The bacteria that produce compounds with antibacterial activity must also maintain resistance to the product in order to survive. I hope that knowledge of how antibiotic producing enzymes co-evolved with antibiotic resistance can eventually be used to anticipate how resistance will evolve to newly discovered antibiotics."

"I am most excited about identifying previously undiscovered natural products that could be used to treat human disease," she said. "I believe that new machine learning and bioinformatic methods will make it possible to identify biosynthetic gene clusters that are mostly likely to produce novel and active compounds and help avoid the persistent problem of natural product rediscovery."

Photo credit Dr. Hao Yin

As a junior faculty member, she still holds dear those first moments of starting up her own lab. She said that her favorite memory of starting at Vanderbilt was walking into the lab and seeing her very own space for the first time. It felt like a true sense of accomplishment to finally open up the Walker Lab.

Photo credit Harrison McClary, VU

Top: Dr. Allison Walker at Nashville Earth Day 2024. Bottom: Dr. Walker teaching a computational methods course

Jada Benn Torres: AAAS Fellow

Jada Benn Torres, associate professor of anthropology, has had an exciting spring semester! In April, it was announced that she had been elected as a fellow to the American Association for the Advancement of Science. She noted being both humbled and pleased with the election.

"The AAAS is a phenomenal organization," she said, "and being part of it really facilitates interacting with scientists inside and outside of your field. These types of interactions encourage you to learn within and beyond your discipline- this then helps to keep the creative spark alive as well as remain motivated about the importance of communicating well with different audiences."

Her graduate students sang her praise as well.

According to Rosseirys De La Rosa, "Dr. Benn is a constant source of encouragement, consistently motivating others to excel and providing the necessary tools and mentorship to succeed. And yet she's more than just a mentor; she's an individual who's always there to offer guidance and wisdom as folks navigate their journey in anthropology, helping them develop as a researcher and academic."

Benn Torres spoke to the importance of the mentorship she has received, especially during her post-doctoral experience.

She said, "I've had the very good fortune of having a post-doctoral mentor, Dr. Rick Kittles, whose scholarship always involved communication of his work to both academic and lay audiences. I watched how he prepared lectures for students and peers and how he reached out to various community centers to speak about health and well-being. Since my post-doc days, I try to emulate as best I can what I saw in the Kittles' lab for my own trainees. For me, it remains important to make sure I find the time to be responsive to community members and to do all I can to make my research accessible. I have made purposeful efforts to learn how to use a few types of social media and other forms of public engagement so that interested community members can find me and engage with my work."

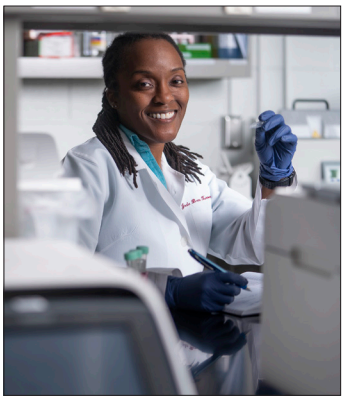


Photo credit Harrison McClary, VU

This commitment to mentoring has already been paying dividends as her senior graduate student Taiye Winful was awarded a National Science Foundation Research Fellowship in 2023. Another graduate student in her lab, Katie McCormack, was just awarded a Vanderbilt Dissertation Enhancement Grant for work investigating tuberculosis that was supported with an ES Pilot Grant.

Photo submitted by Dr. Jada Benn Torres

Top: Dr. Jada Benn Torres working at the lab bench. Bottom: Dr. Benn Torres sitting in front of a Puerto Rican flag

Student Writers

Neomi Chen

Photo submitted by Neomi Chen

Chen is a dynamic individual whose academic journey at Vanderbilt University has been shaped by her diverse interests and commitment to excellence. She is a junior from Long Island, New York, majoring in English with a concentration in Literary Studies and minoring in Communication of Science and Technology. Chen is in the pre-dentistry program and serves as secretary for the Pre-Dental Society. After her time at Vanderbilt, she plans on going to dental school.

As the Co-Director of Copy Editing for the Vanderbilt Undergraduate Research Journal, she oversees a team of 17 copy editors, managing the workflow from manuscript submission to final publication. Her role not only involves technical expertise but also mentorship and coordination to ensure a high standard of academic publication.

Beyond her academic pursuits and leadership roles, Neomi is an enthusiast of outdoor activities such as rowing, which she actively participates in as a member of the Vanderbilt Rowing Team.

Nick McCoy

Photo submitted by Nick McCoy

McCoy is a third-year student at Vanderbilt University, pursuing a Bachelor of Science degrees in Elementary Education and Child Studies, with minors in American Studies and Anthropology.

With a focus on practical experience, McCoy has excelled in various roles within educational settings. His tenure as a teaching assistant, program coordinator, and paraprofessional has honed his collaboration skills and instructional acumen. Notably, his leadership roles within Phi Delta Theta Fraternity demonstrate his ability to organize, lead, and foster a sense of community among peers.

McCoy's involvement in anthropological research, historical studies, and archaeological projects makes him a great asset for the Evolutionary Studies community.

His capstone project culminating in a TEDxVanderbilt speaking engagement highlights his proficiency in communicating complex ideas effectively.

Sarah Ward

Ward has contributed several articles as the Evolutionary Studies graduate communications assistant over the past academic year. In this edition, she's written three wonderful pieces about paleontology with Neil Kelley and Kat Turk and insect immunity with Julián Hillyer and Lindsay Martin.

In April, she was named an American Association for the Advancement of Science Mass Media Fellow. She will spend the summer working with the folks at the MIT Technology Review honing her science communication skills and learning about science journalism.

"Right now, a career in science communication is just a dream," she said. "I'm hopeful the mass media fellowship will help me see how I could turn this dream into reality. That is, I'm interested in learning what it's actually like to work in a news-room and if this career is feasible for someone with my background."

She said that the last couple of years at Vanderbilt truly helped show her how to pursue her passion for science communication.

"I've loved reading and writing since I was young. In graduate school, I felt like my writing skills were under-utilized," she started. "Of course, you have to write technical articles. You have to present your work to your colleagues. But there was a different kind of writing, writing for a broader audience, that I missed. Taking CSET 5100 (Science Communication Tools and Techniques) last Fall with Stephen Ornes reminded me that I didn't have to give that part of myself up. I could combine my love of science with my love of writing and construct a career path that was better suited to my skills and interests."

Photo submitted by Sarah Ward

Evolutionary Studies is excited about Ward's bright future as a scientist and communicator.

Earth Day

On April 20th, we hosted a table at the annual Nashville Earth Day event at Centennial Park.

We were able to meet with hundreds of local community members to talk about saber-tooth tigers, the hominid Lucy, and all about the exciting research going on in our labs. Our big draw was having families pose with the saber-tooth tiger skeleton cast we brought along; people also enjoyed posing with Lucy. We also gave out Evolutionary Studies branded coasters made from recycled tires. It was a great event and we can't wait to go again!

Participating ES folks included faculty members Antonis Rokas, Allison Walker, and Larisa DeSantis; postdoctoral researchers Hao Yin, Allyson Ray, Thomas Sauters, Juan Carvajal Garcia, and Karin Steffen; graduate students Katharine Walls, Brynn Wooten, Theo Danis, Nadir Dbouk, and Ro De La Rosa, and staff Adi Gumilang and Andy Flick. Others present for the festivities were Carlos Taboada, Nicole Creanza, Houra Merrikh, Kyle David, Dana Lin, Sam Schaffner, and Toby McCabe.

Spotlight on a Student: Ashley Rogers

Ashley Rogers, an undergraduate student in Ecology, Evolution, and Organismal Biology with a minor in African American and Diaspora Studies, recently hosted an ESI journal club session to speak about Alexander Winchell. Winchell was a well renowned geologist of the 19th century working at Syracuse University, the University of Michigan, and a three-year stint at Vanderbilt as co-chair of Natural Sciences and Geology.

According to Rogers, he was highly sought after by Bishop Holland McTyeire, founder and first president of Vanderbilt University. Winchell believed in evolution, but with pretty major variations to Darwinism. She explained that some scientists of the day believed in evolution with varying modifications to reconcile their religious beliefs. Southern Methodists of the time, though, were strict bible interpreters and strictly opposed theories of evolution.

Winchell was fired from the university in 1878, just three years after starting. Rogers pointed out that the biggest reason that Winchell was fired from the university was not that he believed in evolution per se but that he believed black people evolved before white people. This was in direct conflict with the Southern Methodist interpretation that a white Adam walked the Earth first.

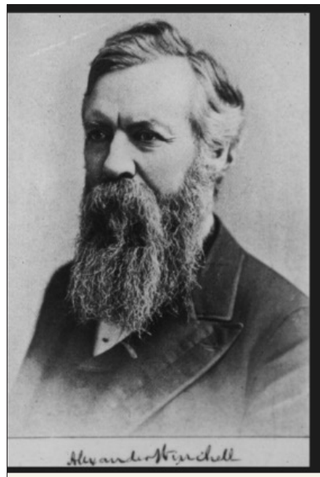
After her talk, a great discussion with the community followed. When asked by a faculty member how we might combat some of the triggering practices of today, like rooms named after racists or sexists, Rogers brought up the importance of education.

"Not a lot of people necessarily know the history," she said. "Unless you're very intentional about going to the library and sitting for hours to look through material, you won't know the history. So, the best thing to do is put it in people's faces in whatever way you can, for example, on a lecture slide in your classes."

Rogers recently received the Undergraduate Diversity at Evolution award to fund her trip to the Evolution Conference in Montreal this summer. The award will cover her travel costs, hotel stay, food, and registration fees as well as a professional development event. She will speak about scientific racism and her work researching Winchell.

Her work in Larisa DeSantis' DREAM Lab studying dental microwear patterns of marine mammals has left her well prepared for graduate school. Her current plan is to pursue a Master's degree in the lab of Vivienne Foroughirad, assistant professor of marine biology at Texas A&M at Galveston.

Rogers learned about Winchell through working with the librarians, specifically Kathy Smith and Teresa Gray. She spent hours digging through board of trust minutes, newspaper articles, and personal letters to and from Winchell. This project was supported by a Sesquicentennial Grant from VU.



The Legacy of Alexander Winchell: Paleontology, Evolution, and Scientific Racism

Ashley Rogers

EEOB, AADS Major
Class of 2024

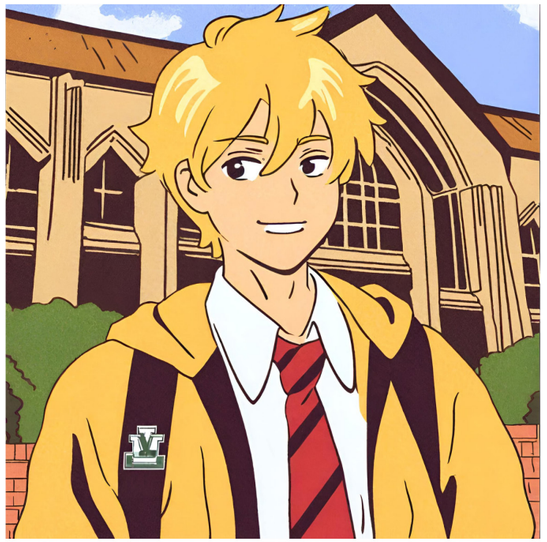
MRBIII 1220
March 22, 2024
3:30 PM - 4:30 PM

V150

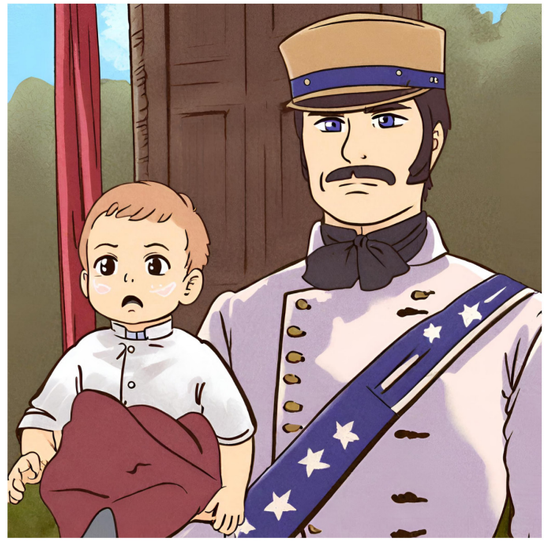
Opposite page: Ashley Rogers presents her research into Alexander Winchell at Evolutionary Studies journal club. Above: Flyer for Ashley Rogers' journal club presentation.

Paul M. Jones: The First Giant of Biology at Vanderbilt

His uncle, Willam J. Vaughn, was a professor of Mathematics at Vanderbilt and no doubt played a large role in the young Paul's life. At 18, Paul started his academic journey at Vanderbilt University as an undergraduate student.

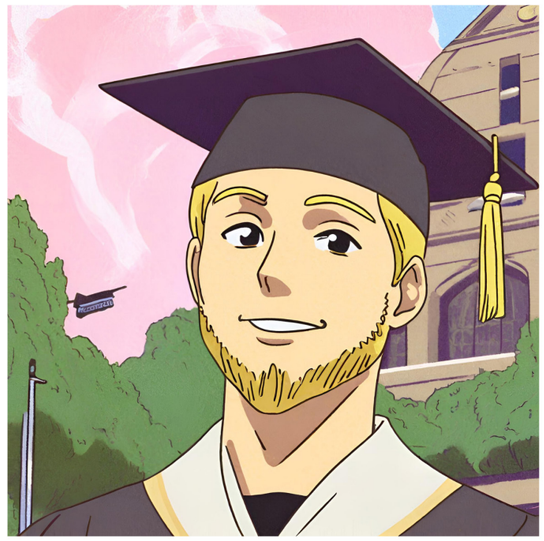


Paul M. Jones was born on November 8th, 1867, in Alabama. He was the son of Mary and John, a confederate colonel turned superintendent of public instruction. He moved to Nashville at the age of 16 to live with his aunt and uncle.



During his time as an undergraduate student, Jones studied English, modern languages, history, political science, math, philosophy, German, chemistry, physics, and natural history and geology. Along with being on the honor role, he was an active athlete.

He set records in field sports like the horizontal bar and rope and ladder climbing. He was a member of the Phi Delta Theta fraternity and earned his Bachelor of Science degree in 1889. He then took one year to help the USGS with a survey of Tennessee geology.

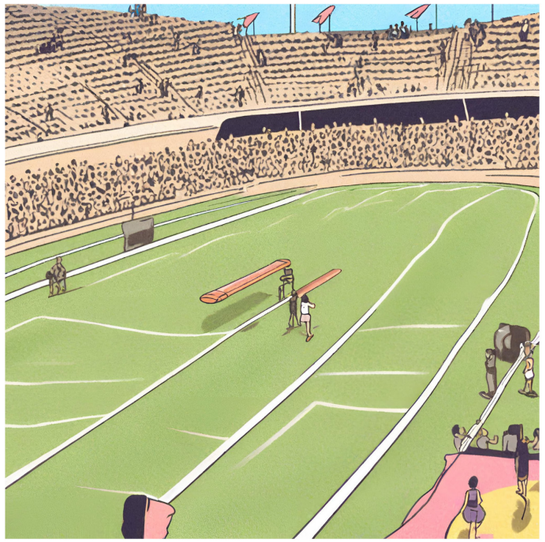


He then continued teaching and earned his Doctor of Science in 1892 publishing his dissertation, *The Geology of Nashville and immediate vicinity with map; a thesis*. He made $300 per year as a teaching assistant and lived on campus.

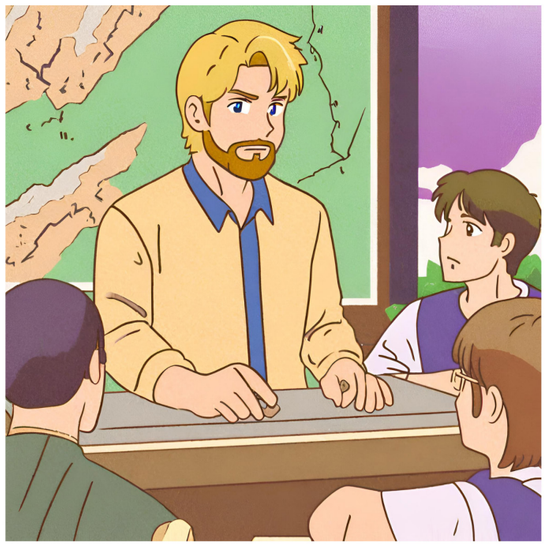
From there, he started working for the university as a teaching assistant for James M. Safford while working toward a Master of Science degree and identifying coral in the museum. While a teaching assistant in Natural History and Geology, he graduated with his MS in 1891.

During his time as a graduate student, Jones also began working for the Vanderbilt Alumni Association. He began as treasurer in 1891 and was also a member of the executive committee starting in 1892. Jones represented VU in the Southern Intercollegiate Athletic Association.

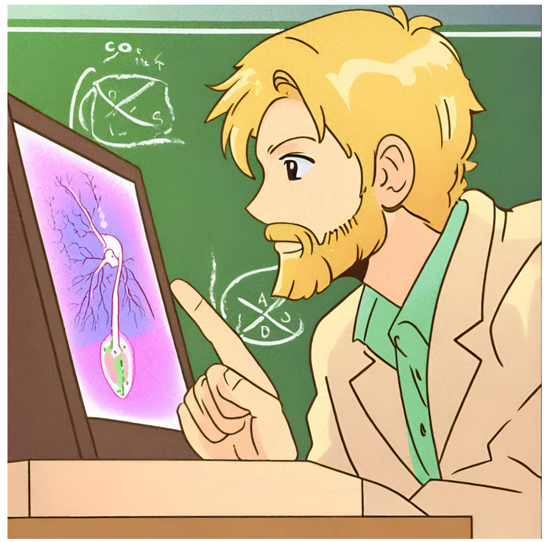
He helped the SIAA hold its first annual field day in 1896 and even refereed an event. He served on the games committee and met with other members in Atlanta. He was the secretary, treasurer, and on the executive committee of the VU Athletic Association.



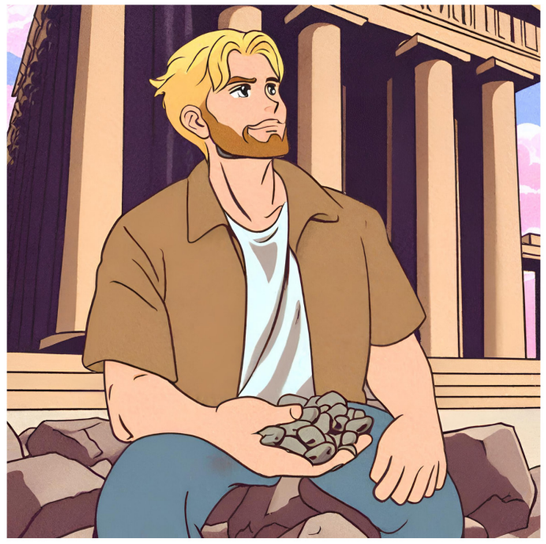
The textbooks used in his zoology courses had sections on Darwinism and the theories of the origins of life. According to Paul Conkin's Gone with the Ivy, "almost alone, as a nominal subordinate of Safford, [Jones] had built what amounted to a new school of biology."



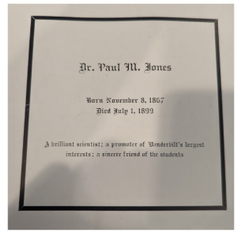
Jones taught courses like botany, zoology, mineralogy, general geology, and applied geology in the Natural History and Geology program. He was also a lecturer of embryology in the medical department with courses cross-listed in Pharmacy and Engineering.



In 1897, Jones helped Safford showcase the minerals and fossils of Tennessee at the Centennial Exposition, a six-month long celebration meant to attract folks from around the country to Nashville. Even then-president McKinley made a trip!



Jones spent many summers assisting the programs at the Marine Biological Lab in Woods Hole, MA. Unfortunately, while exploring the coast in 1899, Jones drowned. The loss was devastating to the Vanderbilt community, though his legacy lives on.



Photos clockwise from top-left:

- Annual yearbook notice
- Home of his uncle, Dr. Vaughn
- Portraits of Paul M. Jones circa 1885
- His on-campus housing

Story written and researched by Dr. Andy Flick. Special thanks to the special collections staff at the VU Jean and Alexander Heard Libraries. Special thanks to Teresa Gray, Molly Dohrman, and Kathy Smith. This work was funded by a Vanderbilt University Sesquicentennial Grant.

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Cartoons throughout were created in Magic Media AI through a Canva subscription.

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