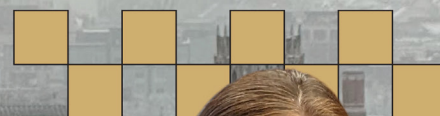


EVOLUTIONARY STUDIES



THE BEHRINGER LAB
IS CRUISING!

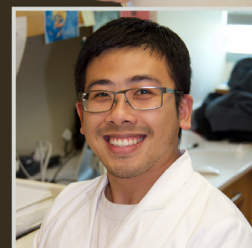


Evolution Rocks



THE BOOKS ARE BACK IN TOWN

OWEN JONES' NEW BOOK, "FORCE OF NATURE: UNDERSTANDING EVOLUTION'S DEEPEST LOGIC—AND PUTTING IT TO USE" HITS SHELVES THIS COMING JUNE!



WELCOME, WENHAN

Spring 2026

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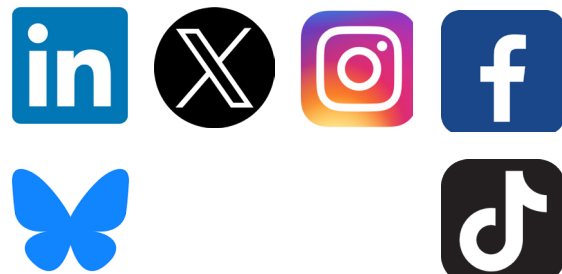
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VANDERBILT ESI

Greetings ESI Members, Alumni and Friends,

I hope this semester's magazine finds you well. As the academic year is coming to a close, I am thrilled that we are collectively reaching ever higher milestones.

As always, our faculty are setting the bar ever higher in academic scholarship. Larisa Desantis was recently awarded a Guggenheim Fellowship, which she will use to support her book-writing project on how paleontology can illuminate how organisms thrive or fail to adapt to the planet's ever-changing environments (p. 21). In this issue, you can read reviews of Ken Catania's new book "On the Art and Craft of Doing Science" (p. 29) and Owen Jones' upcoming book "Force of Nature: Understanding Evolution's Deepest Logic – and Putting It to Use" (p. 30) by Andy Flick, our scientific coordinator. This reminds me that I must get back to writing my own book as well.

Megan Behringer has been having an excellent academic year with a few exciting new papers in the pipeline and a new Hypothesis Grant. William McLaughlin, the graduate student behind some of the Behringer's lab new work, was interviewed recently and his story is in the pages below. This newly funded work looks at the role of mathematical chaos driving systems rather than confounding randomness. Check it out on pages 12-14.

A lot of our colleagues in the medical school have put out beautiful, evolution-focused research studies in the past few months. Alex Bick, Ivelin Georgiev, and Louise Rollins-Smith continue their exciting efforts toward better understanding disease. ESI also sponsored Louise's annual Amphibian Disease Conference again this year.

I also would like to take the opportunity to thank some of the folks that helped us get going when we first started seven years ago. One of those is Steve Baskauf who recently retired. We've put together a timeline of his work on pages 24-27. His commitment to systems ecology and meta-data is truly remarkable.

Finally, I would be remiss if I didn't add a comment on the ice storm we had this past January, which brought some of the ever-growing concerns associated with climate change right into our homes and backyards. Work from my own lab has shown how some of the human-infecting pathogens we deal with are predicted to change their distributions in response to the changing climate. See the piece Andy wrote about it in the center spread (pp. 18-19).

We are thrilled by the strides we've made and the bright prospects for Evolutionary Studies at Vanderbilt. In this issue, you'll discover exciting research from Medicine, Biological Sciences, Anthropology, Psychology, and Earth and Environmental Sciences. We are grateful for your unwavering support and look forward to keeping you updated on our progress. Please feel free to contact us with any questions or ideas you may have.

Sincerely,

Antonios Rokas

Antonios Rokas, Director

Evolutionary Studies Initiative

Cornelius Vanderbilt Chair in Biological Sciences

Vanderbilt University



Photo credit Olivia Riedling

Rokas at the 2026 Fungal Genomics Conference in Asilomar, CA

EVOLUTIONARY STUDIES



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Evolutionary Studies - the

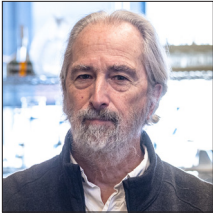
Magazine is published twice yearly for members, alumni and friends of the Evolutionary Studies Initiative.

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Evolutionary Studies Initiative

SEMINAR SERIES

Spring 2026



Michael Lynch - Darwin Day 2/18

Arizona State University, Professor and Center Director
School of Life Sciences

Drift, Mutation, and the Origin of Biological Features



Tyrone B. Hayes - J.T. Scopes Lecture 3/18

University of California, Berkeley, Professor and Judy Chandler Webb Distinguished Chair
Department of Integrative Biology

From Silent Night to Silent Spring: A Tale of Toads of Men



Greg Wilson Mantilla - Earth Day 4/15

University of Washington, Professor
Department of Biology

Earth Reset: Mass Extinction and Biotic Recovery in Hell Creek, Montana

Fall 2026



Jaap de Roode - Biodiversity Day 11/4

Emory University, Samuel C. Dobbs Professor
Department of Biology

Animal Medications Across the Tree of Life

Retreat 2026 - 12/14

Will Ratcliff

Georgia Institute of Technology
Professor
School of Biological Sciences



Beryl Jones

University of Kentucky,
Assistant Professor
Department of Entomology



Brandt Gibson

University of Tennessee, Martin
Assistant Professor
Department of Agriculture, Geoscience,
and Natural Resources



Welcome, Wenhan Zhu

Evolutionary Studies is excited to welcome Dr. Wenhan Zhu from the Department of Pathology, Microbiology and Immunology. Zhu earned his Ph.D. in Biological Sciences from Purdue University and his undergraduate degree in Biotechnology from Sun Yat-sen University in Guangzhou, China. He joined the Vanderbilt faculty in 2020 after completing his postdoctoral fellowship at UT Southwestern Medical Center in Dallas, where he worked in the lab of Sebastian Winter studying microbial metabolic interactions in the gut. His research investigates how ancient mobile genetic elements shape modern microbiomes and how those systems have been repeatedly challenged by oxygen throughout evolutionary history.

Zhu's work bridges biochemistry, genetics, and biology to investigate how the gut microbiota maintains resilience during inflammation. His lab employs a multidisciplinary approach combining next-generation sequencing, cutting-edge proteomics

and metabolomics, bacterial genetics, and mechanistic studies of bacterial physiology in living hosts. This pipeline allows his team to discover druggable targets within the microbiota and translate findings through high-throughput screening, with the ultimate goal of engineering probiotics that can better survive gut inflammation and restore balanced microbial communities.

As he noted when receiving a three-year award from the G. Harold and Leila Y. Mathers Foundation in 2023, "anaerobes were discovered as life forms over 150 years ago, however, why these organisms cannot withstand oxygen has remained unclear." By exploring the molecular pathways that make anaerobic bacteria sensitive to oxygen, his lab aims to answer this century-old mystery while simultaneously developing therapeutic interventions for inflammatory bowel disease and related conditions.

Zhu's research has already yielded important insights into how bacterial communi-

ties adapt to inflammatory environments. His post-doctoral work demonstrated that precision editing of gut bacterial populations could reduce inflammation-associated colorectal cancer in mice, published in the *Journal of Experimental Medicine*. His lab continues to investigate how beneficial gut bacteria acquire iron by "stealing" iron-chelating compounds produced by other bacteria during inflammation, and how this bacterial iron acquisition modifies host nutritional immunity.

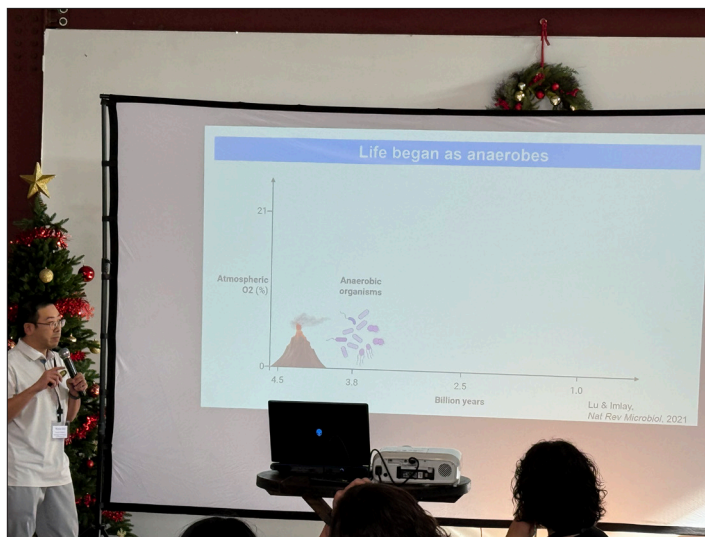
In 2023, Zhu was named a Pew Biomedical Scholar, receiving four years of funding to examine how oxygen exposure damages beneficial gut bacteria during inflammation. He also received a V Scholar Award from the V Foundation for Cancer Research in 2022. His research on the roles of bacterial toxins in promoting colorectal cancer development continues to bridge fundamental questions about microbial evolution with pressing clinical applications.

At the ESI retreat, Zhu presented his work connecting deep evolutionary history to modern gut health. He explained how gut inflammation creates conditions remarkably similar to the Great Oxidation Event when epithelial cells switch to glycolysis, oxygen diffuses into the normally anaerobic gut lumen, while the host's nutritional immunity simultaneously restricts iron avail-



Wenhan Zhu (submitted photo) ability. Some pathogens have evolved to exploit this shift, using virulence factors to trigger the metabolic switch and then capitalizing on the newly available oxygen to outcompete beneficial anaerobes. Zhu's lab investigates both sides of this dynamic: understanding how pathogens manipulate host metabolism to access oxygen, and engineering commensal anaerobes to withstand these challenges. His work with collaborators like Megan Behringer aims to develop probiotics that can resist pathogen takeover and improve outcomes for patients with inflammatory disorders.

Zhu's integration into Vanderbilt's research community reflects the university's growing strength in evolutionary biology, molecular evolution, and the intersection of genomics with health sciences. His work complements ongoing research across campus examining how evolutionary history shapes contemporary biological systems, from ancient metabolic pathways to modern disease processes.



Zhu presenting at the annual ESI retreat in December 2025. (Theo Danis)

Rollins-Smith Lab

Evolutionary Immunity in Action

While amphibian populations worldwide continue to confront the devastating effects of chytrid fungal disease, research from Louise Rollins-Smith's laboratory highlights a more nuanced story, one shaped by immune variation, evolutionary history, and the possibility of resilience.

Two recent publications underscore the lab's ongoing contributions to understanding how amphibian immune systems respond to emerging pathogens and how evolutionary diversity may influence survival.

Charting the Future of Amphibian Immunology

In April 2025, Rollins-Smith published a forward-looking review in *Developmental & Comparative Immunology* titled "The Future of Amphibian Immunology: Opportunities and Challenges." The article synthesizes decades of research on amphibian immune systems while charting the key questions that will shape the field in the years ahead.

Amphibians possess distinctive immune features, including antimicrobial peptides secreted through their skin and adaptive immune responses that differ in important ways from those of mammals. These differences take on heightened importance in the context of chytrid fungal infections, which attack amphibian skin and disrupt essential physiologi-

cal functions. Understanding these systems is not simply descriptive biology — it is central to explaining why some species collapse under pathogen pressure while others persist.

In the paper, Rollins-Smith emphasizes that variation, both genetic and functional, lies at the heart of disease outcomes. Differences in Major Histocompatibility Complex (MHC) alleles, antimicrobial peptide repertoires, and innate immune responses may shape whether individuals tolerate infection, recover, or succumb. These layers of diversity represent evolutionary history written into immune systems over millions of years.

Rather than treating disease as a static threat, the review reframes it as part of an ongoing evolutionary process — one in which host immune diversity and pathogen virulence interact dynamically over time. Recognizing that amphibian immune systems are products of deep evolutionary adaptation, Rollins-Smith argues, is essential for predicting resilience and designing conservation strategies grounded in biological reality.

Macrophage Diversity and Chytrid Defense

In January 2026, Rollins-Smith and colleagues published new mechanistic insights in the *Journal of Fungi*, examining how different macrophage subsets in *Xenopus laevis* respond to

the chytrid fungus *Batrachochytrium dendrobatidis* (Bd).

Macrophages are key components of innate immunity and among the first immune cells to encounter invading pathogens. But not all macrophages are identical. The study demonstrates that distinct macrophage subsets exhib



it different activation profiles and inflammatory responses when exposed to Bd.

These differences may affect how disease progresses. Some macrophages seem better at controlling fungal growth, while others may drive harmful inflammation. This suggests that small differences in how immune cells behave and communicate can influence whether an infection is tolerated, cleared, or becomes deadly.

From an evolutionary perspective, this work highlights how immune diversity operates not only at the level of genes, but at the level of cell populations and functional responses. Variation in macrophage subsets may represent another axis along which natural selection can act, influencing survival under pathogen pressure.

By linking cellular immunology to species-level vulnerability, the study bridges laboratory experimentation with real-world conservation challenges. It underscores that resilience is not random; it is rooted in biological variation shaped by evolutionary processes.

From Cells to Conservation

The questions raised in these studies extend well beyond the laboratory. If immune variation shapes survival at the level of genes and cells, how does that knowledge inform conservation on the ground? How can evolutionary insights guide real-world responses to one of the most devastating wildlife diseases of our time?

Those questions brought researchers from across the country — and beyond —

to Vanderbilt in November 2025. The Amphibian Disease Conference, supported by the Evolutionary Studies Initiative, provided a forum to connect mechanistic immunology with field observations, population genetics, and conservation strategy. What follows are reflections from Rollins-Smith on the meeting and the emerging signs of resilience discussed there.

With the support of the Evolutionary Studies Initiative, Vanderbilt hosted an Amphibian Disease Conference November 15-16, 2025. Approximately 40 students, post-docs, and faculty members from 19 institutions attended in person or presented virtually.

Although amphibians continue to experience population declines due to a chytrid

fungus, we learned of the potential recovery of a rocket frog population in Panama. Pratt's Rocket Frog (*Colosethus pratti*) was found with sufficient numbers to translocate them to a suitable habitat where they had previously disappeared.

As a hopeful sign, acoustic devices recorded the males continuing to call and one female guarding eggs. The western boreal toad (*Anaxyrus boreas boreas* formerly *Bufo boreas*) had also declined but continues to persist in some areas of Wyoming. These tolerant populations appear to have greater Major Histocompatibility Complex (MHC) heterozygosity and two newly recognized “supertypes” of alleles that may contribute to resilience.



Opposite top: Laura Reinert (left) and Rollins-Smith showing off their research organisms (Anne Raynor). Opposite bottom: an image of *Anaxyrus boreas* from Wikimedia Commons (Walter Siegmund). This page: photo from the November 2025 Amphibian Disease conference (photo submitted by Rollins-Smith).

Bick Lab

Study identifies potential target for blood cancer treatment, prevention

By: Bill Snyder, VUMC science writer

A multi-institutional research team that included genomic scientists from Vanderbilt Health has identified a potential target for blood cancer prevention and treatment.

Their report, published Jan. 1 in the journal *Science*, could lead to new treatments for blood cancers, which kill an estimated 23,540 people in the United States every year.

The research team, led by scientists from Boston Children's Hospital, Dana-Farber Cancer Institute, the Broad Institute of MIT and Harvard, and Memorial Sloan Kettering Cancer Center, found that the protein Musashi-2 (MSI2) is essential for the function of blood-forming stem cells.

High levels of MSI2 can support the unchecked growth of abnormal stem cells, a precancerous condition known as clonal hematopoiesis of indeterminate potential, or CHIP.

The researchers used a genome-wide association study (GWAS) meta-analysis to identify a haplotype, or inherited grouping of genomic variants, which reduces MSI2 expression, thereby protecting against CHIP.

To validate these findings

in humans, Alexander Bick, MD, PhD, Yash Pershad, and colleagues leveraged Vanderbilt Health's DNA biobank, BioVU, the world's largest repository of genetic

**"resilience to cancer can arise through inherited genetic variation"
-Agarwal et al.**

material linked to de-identified electronic health records based at a single academic center.

By analyzing a unique longitudinal cohort of 3,000 patients with genetic sequencing performed approximately six years apart, the Vanderbilt Health team tested whether a variant which reduced the expression of MSI2 protected against the expansion of precancerous mutations.

Patients who carried the protective variant had precancerous clones that grew significantly more slowly than those without the variant. In many of these patients, the abnormal cells were transient; that is, they disappeared entirely over the study period rather than expanding into cancer.

"Most genetic studies only provide information from a snapshot in time, but the longitudinal samples in BioVU allowed us to study the mutations over six years," noted

Pershad, an MD/PhD student in the Bick lab, who with Bick is among the paper's co-authors.

"We could clearly see that in people with the protective variant, precancerous clones behaved fundamentally differently than we expected — they shrunk or disappeared rather than expanding and becoming cancer," Pershad said.

While CHIP results from somatic (acquired) blood stem cell mutations, this protection against it is inherited. This human genetic evidence suggests a potential way to prevent blood cancer by targeting MSI2 through small molecule inhibition or genome editing.

"More broadly," the researchers concluded, "we provide an example of how resilience to cancer can arise through inherited genetic variation, motivating the search for other natural pathways that could be leveraged to prevent or treat malignancy."

[Read more >>](#)



Above: Nancy Cox and Alexander Bick pose for 2024 announcement of Bick as new head of Genetic Medicine (Donn Jones). Below: Faculty headshot of Bick from Bick Lab website.



Georgiev Lab

AI can speed antibody design to thwart novel viruses: study

By: Bill Snyder, VUMC science writer

Artificial intelligence (AI) and “protein language” models can speed the design of monoclonal antibodies that prevent or reduce the severity of potentially life-threatening viral infections, according to a multi-institutional study led by researchers at Vanderbilt University Medical Center.

While their report, published Nov. 4 in the journal *Cell*, focused on development of antibody therapeutics against existing and emerging viral threats, including RSV (respiratory syncytial virus) and avian influenza viruses, the implications of the research are much broader, said the paper’s corresponding author, Ivelin Georgiev, PhD.

“This study is an important early milestone toward

our ultimate goal — using computers to efficiently and effectively design novel biologics from scratch and translate them into the clinic,” said Georgiev, professor of Pathology, Microbiology and Immunology, and director of the Vanderbilt Program in Computational Microbiology and Immunology.

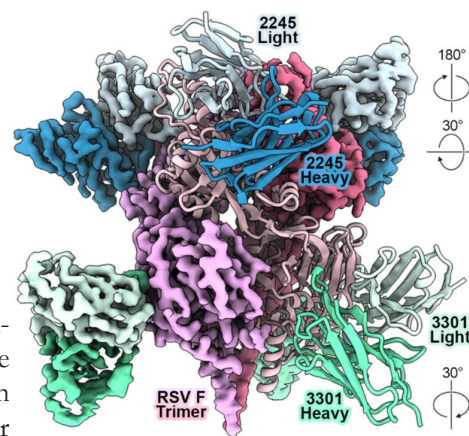
“Such approaches will have significant positive impact on public health and can be applied to a broad range of diseases, including cancer, autoimmunity, neurological diseases, and many others,” he said.

Georgiev is a leader in the use of computational approaches to advance disease treatment and prevention. He is the principal investigator

of an up to \$30 million award from the Advanced Research Projects Agency for Health (ARPA-H) to support the application of AI technology that can develop novel antibodies with therapeutic potential.

Perry Wasdin, PhD, a data scientist in the Georgiev lab, was involved in all aspects of the study and is first author of the paper.

The research team, which included scientists from around the country, Australia and Sweden, showed that a protein language model could design functional human antibodies that recognized the unique antigen sequences (surface proteins) of specific viruses, without requiring



part of the antibody sequence as a starting template.

Protein language models are a type of large language model (LLM), which is trained on huge amounts of text to enable language processing and generation. LLMs provide the core capabilities of chatbots such as ChatGPT.

By training their protein language model MAGE (Monoclonal Antibody Generator) on previously characterized antibodies against a known strain of the H5N1 influenza (bird flu) virus, the researchers were able to generate antibodies against a related, but unseen, influenza strain.

These findings suggest that MAGE “could be used to generate antibodies against an emerging health threat more rapidly than traditional antibody discovery methods,” which require blood samples from infected individuals or antigen protein from the novel virus, the researchers concluded.

[Read more >>](#)



Top: Cryogenic electron microscopy (cryo-EM) resolution of the structure of a respiratory syncytial virus fusion protein (shades of pink) bound to fragments of two antibodies (dark/light and blue/green) designed by the researchers’ protein language model, MAGE. Bottom: Members of the Georgiev Lab at Vanderbilt University Medical Center from the Georgiev Lab website.

Benn Torres Lab

Human Variation, Evolution, and Women's Health

In a December 2025 article in the *Journal of Anthropological Research*, Jada Benn Torres confronts a recurring methodological problem in biomedical research: the habit of treating race as if it were a biological explanation. In *Pathologizing Race and the Utility of Racial Experience for Addressing Women's Health Disparities*, Benn Torres reorients the conversation by showing how evolutionary clarity, which distinguishes genetic ancestry from social categories, produces better science and fairer health inference.

From an evolutionary standpoint, human variation is shaped by migration, admixture, demographic history, and local adaptation. These processes produce gradual, clinal patterns of genetic variation across geography rather than discrete biological “races.” Modern population genetics consistently demonstrates that most genetic diversity is found within populations, not neatly partitioned between socially defined groups. When clinicians and researchers use race as a shorthand for biology, they risk masking the real drivers of health outcomes: population history, environmental exposures, structural inequality, chronic stress, and gene–environment interactions.

Benn Torres argues for precision. Genetic ancestry is a measurable feature of evolu-

tionary history — it can be quantified from genomic data and linked to allele frequencies shaped by drift, selection, and migration. Race, by contrast, is a social and historical construct that shifts over time and place. Conflating the two obscures scientific inference and can misdirect both research and policy. A condition such as uterine fibroids, which shows higher prevalence in some populations, is not usefully explained by invoking “Black race” as a causal factor. Instead, Benn Torres urges researchers to parse ancestry, environment, and lived experience into discrete, testable components.

A central contribution of the paper is the concept of racial experience as an environmental axis rather than a biological category. Experiences of discrimination, differential access to care, occupational and residential exposures, and chronic psychosocial stressors shape physiology and interact with genetic background. From an evolutionary perspective, these social conditions function as powerful environmental pressures that influence health over the lifecourse. Recognizing that social environment and evolutionary history operate together, rather than as alternatives, allows researchers to ask sharper questions about mechanisms and causation.

Practically, Benn Torres lays out a research roadmap: measure ancestry directly

where relevant; model environmental and social variables explicitly; and design studies that can separate population-history signals from non-genetic sources of variation. This approach improves the interpretability of genomic associations and reduces the risk of attributing causality to socially defined categories. It also opens better paths to intervention: **if environmental exposures or structural inequalities drive disparities, those are precise policy levers**; if particular ancestry-linked alleles contribute to risk, that points to biological mechanisms and targeted biomedical strategies.

Why this matters to evolutionary studies is simple: evolutionary theory gives us the language and tools to describe how human populations change over time and space. Applying that framework to contemporary health questions prevents conceptual shortcuts that muddy inference. Benn Torres's paper is not a political tract; it is methodological correction grounded in population genetics and anthropological insight. By making those distinctions, evolutionary anthropology can help move biomedical research from blunt categorization toward nuanced, actionable science.



Benn Torres headshot (Steve Green).

Johnson Lab

Evolutionary Logic of Biological Clocks

In a 2026 paper published in *Current Biology*, a team led by postdoctoral fellow Chitrang Dani in Carl Johnson's Lab addressed a foundational evolutionary question: why do organisms possess internal circadian clocks that continue to oscillate even in constant conditions?

Circadian rhythms are found across life, from cyanobacteria to mammals. These self-sustained oscillators persist even in the absence of external light cues. While the molecular mechanisms of these clocks are well understood, their evolutionary origins have remained less clear. Why would natural selection favor internal oscillators instead of simple, stimulus-driven responses to environmental light and temperature?

Dani and colleagues pro-

pose that the answer lies not only in daily cycles but in seasonal variation in day length. Using computational evolutionary modeling, the study demonstrates that exposure to realistic annual photoperiod changes creates strong selective pressure for organisms to evolve internal, self-sustained oscillators. Seasonal shifts in day length introduce a predictable but gradually changing environmental structure. Under these conditions, organisms that rely solely on direct environmental cues are less robust than those that maintain internal rhythmic stability while entraining to external cycles.

"In simpler terms, the challenge of keeping time accurately in the face of changing seasons may be a reason why self-sustained circadian clocks in bacteria were evo-

lutionarily favored," Dani explained. "That's an exciting development for the field of chronobiology."

The models show that key features of biological clocks like persistence, entrainability, and phase stability emerge as adaptive responses to compound temporal pressures operating across both daily and annual timescales. In other words, circadian systems appear to have evolved not simply to track the day-night cycle, but to coordinate internal processes in environments where seasonal shifts continually reshape light availability.

The study also reflects the strength of the Johnson lab's training pipeline. Maria Luísa Jabbur, a recent PhD graduate of the lab, is a co-author on the paper, underscoring the collaborative and multi-generational nature of the research program.

Johnson's group has long been at the forefront of chronobiology, linking molecular clock mechanisms to ecological and evolutionary theory.

This new work extends that legacy by offering a formal evolutionary explanation for why self-sustained circadian oscillators exist at all.

From an evolutionary perspective, the findings suggest that biological clocks are solutions to layered temporal challenges. Organisms evolved internal timing systems not merely to respond to daily light cues, but to anticipate and remain robust under the shifting rhythms of the seasons. By grounding molecular chronobiology in evolutionary modeling, the team provides a unified framework for understanding one of biology's most fundamental regulatory systems: the clock that keeps time across life on Earth.

Find the full paper here >>



Dani's photo from the Vanderbilt International Research Alliance webpage.



Brazilian lake with cyanobacteria *Anabaenopsis elenkinii* (Kleber Renan de Souza Santos)

Behringer Lab

Exploring the science of chaos with graduate student William McLaughlin

By: Mary-Lou Watkinson, Arts & Science writer

William McLaughlin starts his day at 7 a.m. with a cup of coffee.

A Ph.D. candidate in biological sciences, he likes to keep his mornings slow and predictable before driving to campus to work in Assistant Professor of Biological Sciences Megan Behringer's lab.

In the lab, McLaughlin is studying how chaotic dynamics arise in microbial populations, which are localized groups of tiny organisms like bacteria, fungi, or viruses inhabiting a specific environ-

ment. He is examining what ecological factors drive microbial populations from predictable, stable states to more complex, chaotic dynamics. This has potential implications for both the medical and agricultural fields, as it could help provide predictability in soil conditions or assist with treatments for the skin and gut.

"I love my job," McLaughlin said. "It is amazing that you can take very simple mathematics that ignore selection and the detailed ecology of

these environments, and you can get outputs that are highly accurate. What makes me excited is that yes, I am getting to perform complicated molecular biology and work with different cultured strains, but it is in such a controlled system that we are able to prove the math using biology, when normally it is the other way around. Coming in every day, I get to pull out a plate and see what the strain diversity is of a given experiment and then see if that aligns with the math, and I love it."

Recent funding from the Hypothesis Fund has allowed Behringer and McLaughlin to expand this research, exploring the limits of chaos in ecological systems and its evolutionary consequences.

McLaughlin has always had an interest in science; however, his current career path wasn't presented as an option until later in life. Growing up, he said his dad always encouraged him to spend time outside, which gave him an appreciation for some of the same ecological systems he is



studying now.

“I grew up on the Tennessee River,” McLaughlin said. “I fished a lot and was outside a ton, and you do get an appreciation of how the ecosystem functions, and for how many parts need to work together to keep things stable. I toured the HudsonAlpha Institute for Biotechnology my junior year of high school, and I was like, ‘I could do this. This seems like a really neat job.’”

He went on to obtain his bachelor’s degree in microbial, cellular, and molecular biology from Auburn University, where he started on the pre-med track. After spending time working on plant development as the only undergraduate in a lab during COVID, McLaughlin’s interest in the ecology of agricultural systems blossomed.

“With plant biology, you get very specific very fast, so in graduate school I wanted to pivot and study ecology and evolution more broadly,” he said. “Vanderbilt has a great set of faculty, and I grew up two and a half hours from here. I could

stay close to my family and, in my eyes, get a world-class education and train with some really amazing faculty. I applied, got accepted, and have been thrilled ever since.”

McLaughlin worked in three different labs before meeting Behringer, who earned the same undergraduate degree from Auburn. He said he enjoys having the freedom to try new

things in Behringer’s lab, while also having the proper supports not to fail.

“Vanderbilt has a lot of resources, and having access to all the tools and equipment needed is great,” he said. “Megan is also great in that if there is something you want to dive deep into, she is very encouraging about trying it, and if it doesn’t work, she will help you reassess. At Vanderbilt, it feels

like you are fortunate enough to have a certain level of academic freedom that you can try different things. You are also rubbing elbows with a lot of very smart people from very diverse skillsets, and because of that, it almost feels like I’m getting a liberal arts education through my Ph.D. in STEM.”

Thinking of the future, McLaughlin said he would like to keep studying plant developmental genetics, utilizing the skills and background he is gaining in ecology and evolution.

“Simple environmental cues can either ravage or greatly support the health of plant ecosystems,” he said. “I’d like to try to integrate what we understand from a basic-science level about ecology and microbial evolution and apply that to agricultural systems at large. I’d like to take the skills I’ve gained here performing applied microbiology and apply that to work in the future thinking about how we can design, analyze, and monitor plant associated microbial communities, which can have a great impact on the health of soil and crops.”



Some Anaerobic Bacteria Have Surprisingly High Mutation Rates

Ask any biologist what causes DNA mutations, and oxygen will likely make the shortlist. It is reactive, super-abundant, and has been fingered as a major culprit in genetic damage for decades. So, here is a head-scratcher: if oxygen is such a DNA troublemaker, bacteria that avoid it entirely should have lower mutation rates, right?

New research led by graduate student Owen Hale in the Behringer Lab reveals that one order of anaerobic bacteria does not exhibit lower mutation rates and these findings challenge long-held assumptions about what actually drives mutation in microbes.

The new paper, “Elevated rates and biased spectra of mutations in anaerobically cultured lactic acid bacteria,” was published in the journal *mBio*. Hale tracked three species of lactic acid bacteria (*Lactobacillus acidophilus*, *Lactobacillus crispatus*, and *Lactococcus lactis*) through more than 1,000 generations in strictly oxygen-free conditions. The experiment revealed exceptionally high mutation rates compared to oxygen-using bacteria.

The mutations were not random, either. They were strongly biased toward a specific type of change called transitions, which result from spontaneous deamination of DNA bases. The bias in mutations is shared by aerobic bacteria highlighting that even without oxygen around to create damaging free radicals, DNA remains inherently

fragile and prone to certain types of errors.

According to Hale, the findings point to population demographics rather than environmental oxygen levels as the primary driver of mutation rates in these bacteria. While oxygen does cause DNA damage, the re-

ful mutations in DNA repair genes. But in smaller populations, random chance (genetic drift) dominates, and these repair genes can be lost simply by bad luck. The bacteria in this study have relatively small effective population sizes, which means their high mutation rates are consistent with

Hale Explains Mutation Bias

“The DNA code is made up of four letters: A, C, T, and G. We looked at single nucleotide mutations (SNMs), a kind of ‘typo’ where one letter changes into another. What we found is that the rate at which C’s turn into T’s is generally much higher than the rate of C’s turning into A’s or any other type of ‘typo’. This difference in the rates of specific SNMs is what we mean by bias. The one exception to the trend was the high rates of T to C mutations in *L. acidophilus*, which is likely due to the loss of a key DNA repair gene. Mutation bias is important for evolution because mutations are the source of evolutionary novelty that other evolutionary forces like natural selection work on, and the bias controls which mutations will come to be.”

sults suggest that mutation rates are shaped more by a species’ population size over time than by whether oxygen is present.

Most of these mutations have little to no effect on the organism, so there is no need to worry about the “mutant bacteria” lurking in that morning yogurt.

The reason population size matters comes down to a balance between natural selection and random genetic drift. “If your population size is really large, then you should be able to maintain lower mutation rates,” Hale explained.

In large populations, natural selection can efficiently weed out even slightly harm-

curiosities, they are industrial heavyweights used in probiotics, pharmaceuticals, and dairy fermentation.

The industrial workhorse *Lactobacillus acidophilus* provided a particularly striking example. This commercial strain has been domesticated for dairy fermentation, and Behringer noted that “the diversity within the commercial strains is all but gone...these commercial strains haven’t been domesticated in this way for that long.”

The team found that *L. acidophilus* has lost some DNA repair proteins while possibly adding others, suggesting the mutation rate itself may be evolving in real time. Because domestication dramatically reduced the population size of these commercial strains, the bacteria can no longer maintain all their repair machinery as efficiently.

Read more >>



what evolutionary theory predicts when drift overpowers selection.

The three bacterial species in this study are more than lab



Hale working at the fume hood (submitted photo).

Creanza Lab

Snyder Uncovers How Boundaries and Bonds Build Bird Song

Female song is far more widespread in songbirds than many people realize, occurring in about two thirds of songbird species, and new research is reshaping how scientists understand its evolution. Using large-scale species-level datasets collected on songbird behaviors, Associate Professor of Biological Sciences Nicole Creanza and her lab are discovering new insights into the social factors that underlie the evolution of birdsong, especially in female birds.

Female song remains one of the most understudied and misunderstood aspects of songbird biology, and the team argues that its role may be far more complex than previously appreciated. There are nearly 5,000 songbird species, each shaped by distinct environments and social contexts. The functions of female song seem to differ across these species, and too few species-level studies exist to draw broad

generalizations, though limited field evidence supports female song serving roles in territory defense, conflict mediation, pair communication, and social recognition.

Birdsong is often studied through the lens of competition among males, since many use their songs to defend a territory or compete for mates. The research team for this work, led by postdoctoral researcher Dr. Kate Snyder, used data collected from more than 1,000 songbird species to uncover the role of a less common social behavior, cooperative breeding, on the evolution of singing behaviors.

Cooperative breeding, where individuals help raise offspring that are not their own, occurs in roughly 10 to 15 percent of songbird species, likely driven by factors such as harsh environments, limited breeding resources, and the fitness benefits helpers

can gain through experience, group safety, and even future reciprocal assistance.

The team investigated how territoriality interacted with this association. Creanza and Snyder note that about 28 percent of songbird species defend territories year-round, and about 72 percent actively defend territories for at least part of the year, underscoring how variable territorial behavior is across the songbird family tree. Territoriality affects both singing and breeding behaviors, so the team effectively asked “does territoriality explain the association between cooperative breeding and female song?”

They found that, while cooperative breeding and female song commonly co-occur in strongly territorial species, their association is especially pronounced in weakly territorial species, meaning those



that are tolerant of intruders or have flexible territory boundaries, where the two behaviors appear together far more often than chance would predict. This pattern suggests that there may be at least two evolutionary pathways to female song: in strongly territorial species, females may sing to help defend the territory, while in weakly territorial species, female song may serve a role in promoting social cohesion within cooperative groups.

Read more >>



Top: Superb starling perched. Bottom left, Snyder left and Creanza. Bottom right: a mourning dove and a European starling during Nashville's ice storm (submitted photos).

Novick Lab

Evolutionary Perspectives on Visual Cognition

Professor emerita Laura Novick's longstanding interest in how the human mind interprets evolutionary information dates back at least to her 2022 work on intentionally designed figures, in which she and graduate student Jingyi Liu demonstrated that carefully structured visuals can reduce intuitive but misleading interpretations of phylogenetic trees. That study showed how perceptual grouping and diagram design influence reasoning revealing that misconceptions about evolution are often rooted not in ignorance, but in predictable cognitive tendencies.

Now, the pair are back at

it. In their recent paper, published in the *Quarterly Journal of Experimental Psychology*, Liu and Novick shift from visual design to language, asking how the words we use shape how people think about evolution.

The study focuses on how certain kinds of wording can nudge people toward seeing evolution as goal-driven. In everyday language, we often say things like organisms “adapt to survive” or traits “develop to meet needs.” These phrases can subtly imply intention, making it seem as though evolution works through purpose or conscious effort rather than nat-

ural processes.

To test this, the researchers used experimental tasks across multiple languages, varying how evolutionary scenarios were described. They found that certain word choices reliably increased the chances that people would give goal-based explanations even among those with formal training in evolutionary biology. Importantly, this wasn't just an English-language effect: similar patterns showed up across languages, although the strength and details of the effect differed.

Rather than treating these responses as simple misunderstandings, Liu and Novick argue that they reflect how human cognition is built. People are naturally tuned to look for intention and agency, a tendency that helps us navigate social and environmen-

tal situations. But those same instincts can get misapplied when we try to reason about processes like evolution, which don't involve goals or conscious direction. Language plays a key role here by triggering these intuitive ways of thinking in contexts where they don't fit.

By bringing together insights from psychology, linguistics, and evolutionary theory, Liu and Novick offer a clearer explanation for why evolution is often hard to reason about and how teaching it might improve. Their work highlights a core idea from cognitive science: understanding evolution isn't just about learning the concepts, but also about recognizing how language and mental habits shape the way we interpret them.

HOW LANGUAGE SHAPES EVOLUTION REASONING

INTUITIVE / TELEOLOGICAL FRAMING

“Giraffes developed long necks so they could reach higher branches.”

“Birds evolved wings in order to fly.”

“Plants adapted to survive drought.”



EVOLUTIONARY / SELECTION FRAMING

“Giraffes with slightly longer necks had greater feeding success and left more offspring.”

“Variants with wing structures that enabled flight were more likely to reproduce.”

“Plants with drought-tolerant traits survived and reproduced more successfully.”

Jorge Lab

Tropical Mammals Show Resilience with Activity Shifts

As global temperatures climb, animals are rewriting the rules of daily life in real time. Work from associate professor of Earth and Environmental Sciences Malu Jorge documents one of the clearest examples yet of a tropical mammal fundamentally restructuring its behavior in response to heat, and raises urgent questions about what that means for ecosystems across the warming tropics.

White-lipped peccaries in Brazil's Pantanal wetlands, once creatures of daylight, are increasingly waiting for darkness to forage. The pig-like mammals, which travel in herds of 50 to 300 individuals and play a critical role in seed dispersal across Neotropical forests, are shifting their activity so dramatically that the afternoon hours have gone from peak activity to near silence. The findings, published in the journal *Biotropica*, come from research conducted by

recent Vanderbilt PhD graduate Michaela Peterson and her advisor Jorge.

Peterson spent more than a year monitoring peccary activity using camera traps and microclimate data loggers across the Pantanal. As daily maximum temperatures climbed, nocturnal activity increased in kind. The afternoon period, once the busiest window for peccary movement, became quieter.

"We have very few examples of tropical species being affected by climate change," said Jorge. "White-lipped peccaries are just a first attempt to show that mobile organisms, who can choose where to go and find food everywhere, can still be affected by changes in temperature, even if in subtle ways. It tells us that there is much more going on than the very clear effects that we see."

One particularly striking finding was that the peccaries

showed no evidence of seeking out cooler microclimates within their habitat during hot periods. Jorge suggested the explanation is rooted in the scale of the environment itself.

"I think the variation in microclimate is not large enough to affect microhabitat choices," Jorge explained. "I think that their habitat choices are mostly driven by food presence at small-scale and short-term. The daily and seasonal temperature range is much more effective than the small-spatial scale temperature differences."

Because white-lipped peccaries are keystone species whose movement patterns shape forest regeneration



across vast territories, their behavioral shifts carry consequences well beyond the individual animal. Jorge is candid that the research does not predict imminent collapse, but that the subtlety of these effects is itself the warning.

[Read more >>](#)



Peccaries caught on the trail camera by Jorge's research group in Brazil (Jorge).

Nashville's Winter for the Ages

A Perspective from Andy Flick, ESI Scientific Coordinator

On January 24th and 25th, 2026, a devastating ice storm descended on Nashville, knocking out power for more than 200,000 residents and claiming at least 25 lives across the state (WKRN). More than 70,000 people remained without electricity five days later. The damage was driven by an accumulation of ice followed by sustained below-freezing temperatures, a one-two punch that snapped trees, downed power lines, and tested the resilience of a city unaccustomed to prolonged winter emergencies. On January 29th, Vanderbilt opened its recreational facilities to the broader community as a warming center.

While extreme winter weather may be a relatively new phenomenon in Tennessee, the effects of climate change driving it have been documented for well over a century. In July 1912, an Australian newspaper called the Braidwood Dispatch and Mining Journal published a short item noting that burning coal was loading the atmosphere with carbon dioxide and that the effect on global temperatures “may be considerable in a few centuries.” That prediction was not wrong. What do we have to show for more than a century of warnings? A planet where, in the last three decades, more than three-quarters of all the world’s land has become drier than in the previous 30 years (Columbia Climate School/UN), hurricane seasons that shatter records with the combined costs of Harvey,

Irma, and Maria alone reaching \$339.2 billion (NOAA), and polar ice caps shrinking at a rate of roughly 77,000 square kilometers, the size of Austria, every single year (NASA/NSIDC).

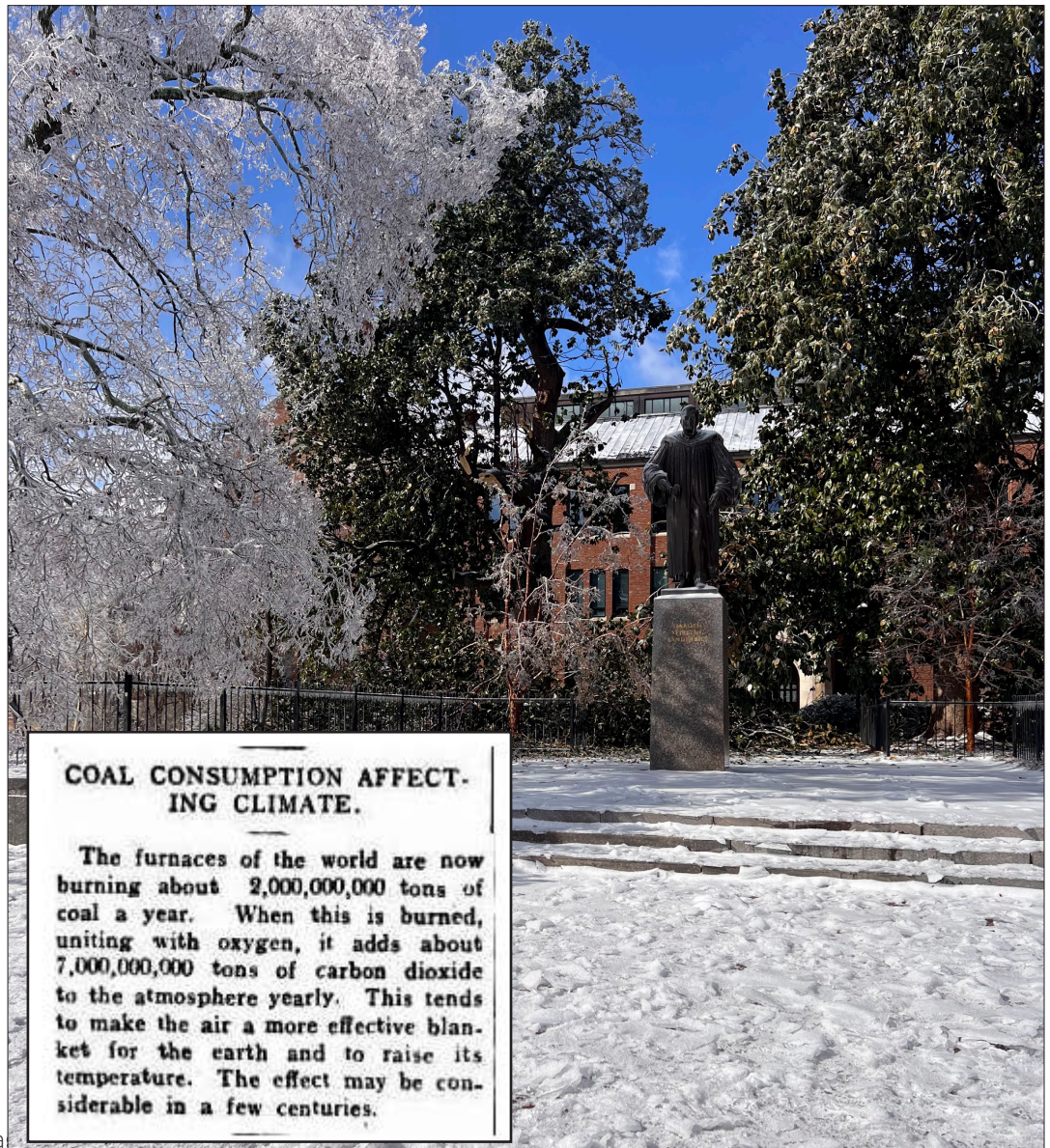
This was not Nashville’s first brush with extreme weather, and it will not be its last. The spring of 2024 brought an onslaught of severe storms and tornadoes to Middle Tennessee, with 13 twisters touching down across the state in April and May alone. An EF-3 tornado

with winds of 140 miles per hour carved a path through Maury County in May, killing one person and injuring twelve more. Nationally, 2024 was the second most active tornado year since 1950, with 1,796 confirmed tornadoes (NOAA Storm Prediction Center). Scientists are clear that extreme weather events of this caliber, which are more intense, more frequent, and less predictable, are a signature of a changing climate. ESI researchers are on the front lines of understanding

how.

Climate Change and Disease

Some of the most direct consequences of warming temperatures play out in the bodies of the smallest creatures. Research from the lab of Professor Julián Hillyer has shown that rising temperatures accelerate aging in mosquitoes and weaken their ability to fight infection. A 2024 study led by graduate student Jordyn Barr found that warming and aging together lower mosquito lifes-



COAL CONSUMPTION AFFECTING CLIMATE.

The furnaces of the world are now burning about 2,000,000,000 tons of coal a year. When this is burned, uniting with oxygen, it adds about 7,000,000,000 tons of carbon dioxide to the atmosphere yearly. This tends to make the air a more effective blanket for the earth and to raise its temperature. The effect may be considerable in a few centuries.

pans and worsen bacterial infection outcomes, with serious implications for how mosquito-borne diseases spread in a warming world. A related study, published in *PLOS Pathogens*, found that higher temperatures also compromise mosquito immune response.

Fungi present a parallel concern. ESI alumna Annie Hatmaker spent the better part of a decade studying the pathogenic fungus *Aspergillus*, whose soil habitat makes it directly susceptible to climate-driven temperature change. Her research shows that *Aspergillus* species produce more infection-associated molecules under elevated temperatures, with implications as global warming reshapes the environments of these pathogens.

Climate Change and Our World

The effects of a warming

planet are intensifying and extending well beyond disease. In a recent *Nature Portfolio* paper, Earth and Environmental Sciences professor Lin Meng and collaborators showed that extreme “hot droughts” in the Amazon already mirror the conditions projected for later this century, increasing tree mortality and raising the risk of large-scale forest die-back (p. 18). At the same time, Meng has shown that artificial light at night is now outpacing temperature as a driver of extended urban growing seasons, with city lights reshaping carbon cycling, frost risk, and allergy seasons.

Meanwhile, ESI member Malu Jorge has documented how tropical mammals are shifting their activity to nighttime hours as daytime heat becomes less tolerable, a behavioral adaptation with ripple effects through entire ecosystems (p. 17).

Adaptation, Then and Now

The question of how living things adapt to dramatic environmental change stretches back millions of years. Vanderbilt professor Neil Kelley has explored how Triassic-era mammals responded to upheaval bracketed by two mass extinction events, finding that even closely related species can carve out strikingly different evolutionary paths under the same pressures.

More recently, an international team led in part by ESI member Amanda Lea examined the genomes of the Turkana people of northwestern Kenya. Published in *Science*, the study found that over the past 5,000 to 8,000 years, natural selection shaped remarkable genetic adaptations allowing the Turkana to thrive in extreme desert conditions. It also carries a sobering modern parallel: as more Turkana

migrate to cities, those same adaptations may predispose them to chronic disease in a radically different environment.

ESI and Vanderbilt's Commitment to Climate Science

ESI's engagement with climate change is no accident. Founding members Larisa DeSantis and Betsey Robinson serve on the governing faculty of Vanderbilt's Program in Climate and Environmental Studies, established in 2022. The breadth of ESI research, spanning mosquitoes, fungi, mammals, plants, and human populations across continents, reflects a conviction that understanding climate change requires an interdisciplinary, evolutionary perspective. The ice on Nashville's streets this January was a reminder that this work is not abstract. It is happening here.



Nashville's Vanderbilt campus and skyline blanketed by the January 2026 ice storm (Adiyantara Gumilang - opposite page; Thodoris Danis - above).

Front cover: Photos from around Nashville during the winter storm, contributed by trainees Danis, Gumilang, Olivia Riedling and Brynn Wooten.

Back cover: View from the Rokas Lab in the aftermath of the ice storm (Danis).

QUICK

Lin Meng: Climate Extremes and Artificial Light Reshape Ecosystems

In 2025, Lin Meng contributed to two high-profile studies that examine how human-driven environmental change is altering ecosystems in both tropical forests and urban landscapes.

In a recent *Nature Portfolio* paper led by Jeff Chambers, Meng and collaborators analyzed “hot droughts” in the Amazon, combining long-term forest plot data, field measurements, and climate model projections. The study demonstrates that recent extreme drought events already mirror the hyper-tropical cli-

mate conditions projected for later this century. These combined heat and drought stresses increase tree mortality and elevate the risk of forest dieback, with implications for global carbon storage and climate feedbacks. The work positions contemporary extremes not as anomalies, but as previews of future baseline conditions.

In a second 2025 paper published in *PNAS Nexus*, Meng and colleagues turned to urban environments, showing that artificial light at night (ALAN) extends pollen

seasons and increases allergen exposure. Using 12 years of pollen observations across the Northeastern United States, combined with satellite-based ALAN and climate data, the team found that nighttime lighting is linked to earlier season onset, delayed season end, and longer overall pollen duration. The effect on delaying the end of pollen season was particularly strong, leading to more days and greater severity of allergenic exposure.

Together, these studies underscore a shared theme



Submitted Photo

in Meng’s research: environmental signals that organisms evolved to rely upon like temperature, moisture, and photoperiod are being rapidly altered by climate change and urban infrastructure. Whether in the Amazon rainforest or American cities, these shifts reshape biological timing, stress thresholds, and ecosystem resilience in ways that carry profound ecological and public health consequences.

Owen Jones: Linking Cognitive Biases Through Evolutionary Theory

In a 2025 article published in the *Journal of Risk and Uncertainty*, Owen D. Jones advances a test case demonstrating how evolutionary theory can unify and predict patterns in human cognitive biases.

Titled “Linking Cognitive Biases: The Successes of a Test Case That Predicted Variations in Endowment Effect Magnitudes,” the paper examines whether cognitive biases which are often treated as irrational quirks may instead reflect decision-making tendencies shaped by natural selection.

Rather than simply cata-

loging behavioral anomalies, Jones argues that evolutionary biology provides a theoretical framework capable of linking biases through shared underlying psychological processes. The paper focuses on the “endowment effect,” a well-documented bias in which individuals value items more highly simply because they own them.

Drawing on two decades of research, Jones demonstrates that evolutionary analysis can generate testable predictions about when, how, and why the endowment effect varies in magnitude. His test case

successfully predicted a large portion of the variance in endowment effect magnitudes across a new dataset of items — something not previously accomplished in behavioral research.

More broadly, the work suggests that many cognitive biases may be interconnected products of decision systems that were adaptive in ancestral environments but can produce predictable mismatches in modern contexts. By situating behavioral economics within an evolutionary

framework, Jones offers a model for moving beyond description toward explanation and prediction.

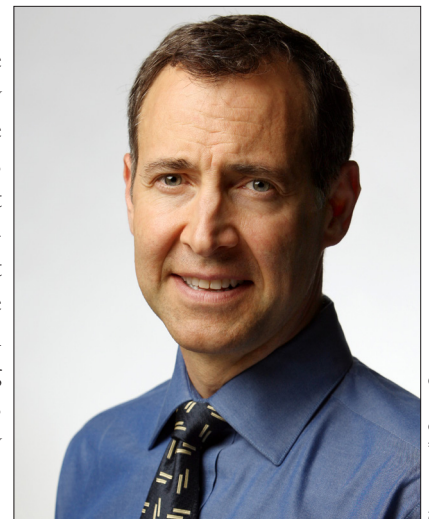


Photo credit Steve Green

HITS

Larisa DeSantis: 2025 Guggenheim Fellow

Larisa DeSantis, associate professor of biological sciences, was named a 2025 Guggenheim Fellow, one of the nation's most prestigious awards for scholarly achievement. The fellowship recognizes DeSantis's innovative research in paleobiology, including her work reconstructing ancient ecosystems and understanding how mammals responded to past climate change. This honor supports her ongoing efforts to use the fossil record to illuminate how species adapt or fail to adapt to environmental change over deep time.

DeSantis's research harnesses evolutionary theory to bridge past and present: by studying how ancient mammal communities shifted through periods of warming, cooling, and changing precipitation patterns, her work reveals ecological and evolutionary patterns that can inform forecasts of biodiversity responses to modern climate change. Her findings have implications for conservation biology, demonstrating that some physiological and morphological traits shaped by millions of years of evolution may determine which

lineages persist in the face of rapid anthropogenic change.

The Guggenheim Fellowship will fund the development of a new popular science book about paleoecology and evolution. DeSantis's work exemplifies how deep time perspectives enrich our understanding of modern biodiversity crises, anchoring urgent ecological questions within an evolutionary framework.



Photo credit Harrison McClary

Eric Skaar: National Academy of Sciences Award & Infection Biology



Submitted Photo

Professor Eric P. Skaar was awarded the 2025 National Academy of Sciences Award in Molecular Biology, a high-profile honor recognizing his contributions to understanding host-pathogen interactions. This award highlights Skaar's leadership in unraveling how bacteria access nutrients like metals in the host environment, and how hosts in turn restrict nutrient availability to defend against infection.

Skaar's lab investi-

gates the molecular "tug-of-war" between pathogens and hosts, exploring evolutionary strategies that microbes use to persist and evade immunity. For example, pathogenic bacteria often evolve specialized metal uptake systems that help them thrive in nutrient-limited host tissues — adaptations that reveal evolutionary trade-offs between virulence and survival. The evolutionary lens clarifies why certain virulence factors are conserved across bacterial species and how hosts counteradapt with nutritional immunity strat-

egies.

Beyond fundamental infection biology, Skaar's research has biomedical implications: insights into nutrient-pathogen dynamics could inform the design of new antimicrobial therapies that target evolutionarily conserved bacterial processes, offering alternatives in an age of rising antibiotic resistance. The NAS award not only recognizes scientific achievement but underscores the broader relevance of evolutionary thinking in tackling urgent public health challenges.

New Museum Studies Course

In spring 2026, Evolutionary Studies member Neil Kelley and History of Art and Architecture senior lecturer Susan Dine began teaching a new Museum Practice course. The course offers a focused, immersive, case- and project-based intro to museum practices and is in the new Minor in Museum Studies.

The course emerged through an unexpected but natural collaboration. Kelley was connected to Dine by a student who had taken classes with both faculty members and recognized their shared interests. What followed has been, in Kelley's words, "a wonderful partnership," strengthened by support from Special Collections and the Vanderbilt University Museum of Art (VUMA), including registrar and collections manager Rachelle Wilson.

Students in the inaugural class were tasked with an ambitious goal: bringing order to thousands of fossil specimens that had fallen into disarray. Despite coming from a wide range of backgrounds including Earth and Environmental Sciences, Anthropology, Biology, Art History, and Museum Studies and with varying levels of experience in paleontology or collections work, they rose to the challenge.

"We have been really impressed with our students," Kelley said. "They stepped into a class that had never been taught at Vanderbilt before, led by two instructors who had never worked together. They have met that challenge with insight, dedication, and curiosity."

The course also connects students to museum professionals beyond campus, including guest speakers from the Natural History Museum of Utah and the Smithsonian's National Museum of Natural History. For some students,

"At a time when the pursuit of knowledge is under attack and the information that we are being served is regulated, curated and micromanaged by corporations and propagandists, it is more important than ever to forge bonds across disciplines united by our shared curiosity, enthusiasm, and willingness to listen and learn from those with different lived experiences. Museums and universities, with all of their historic and modern faults and complications, remain powerful places where we can spark curiosity and cultivate connections. I hope that our course can contribute to that in a tiny way."

-Neil Kelley

the class provides data for graduate research; for others, exposure to new career paths and interdisciplinary conversations. All gain hands-on experience alongside broader theoretical frameworks that bridge scientific and humanistic inquiry.

Kelley and Dine believe the persistent narrative of "Arts vs. Science" is both false and limiting. They hope this course demonstrates that the two not only can coexist but are stronger together.



Students prepping the plesiosaur for 3D scanning (photo credit Neil Kelley)

evolution

IN THE COMMUNITY

Find us:

April 11 - Nashville Predators Family Night

April 18 - Nashville Earth Day

November 5 - Biodiversity Day at
Adventure Science Center



Steve Baskauf: From Corn Borers to Global Knowledge Graphs

Steve Baskauf's path to scientific research was unconventional. After earning his BA in chemistry and biology from Bluffton College, he spent more than a decade teaching high school science in Ohio, Swaziland, and Tennessee, earning Teacher of the Year honors at Harpeth High School and for Cheatham County. This classroom experience gave him insights into how students learn science, knowledge he would later bring to Vanderbilt.

Early Research Career: Field Ecology and Insect Population Dynamics

Baskauf's scientific journey began in the cornfields of America's heartland, where he pursued one of ecology's fundamental questions: what determines where species can live? His doctoral research at Vanderbilt under the late Dave McCauley focused on the southwestern corn borer (*Diatraea grandiosella*), a pest causing millions of dollars in annual agricultural losses across the southern plains states.

Through extensive field work with cooperators from Arizona to Indiana, Baskauf investigated the complex factors limiting this insect's northward expansion. His dissertation asked a deceptively simple question: if cold winter temperatures are not limiting the borer's range (as conventional wisdom suggested), what is?

His findings, published in *Environmental Entomology*, revealed a nuanced story. Rather than simple cold

tolerance, a constellation of factors—adult dispersal mortality, predation by northern flickers, and larval cannibalism—combined to regulate populations across geographic gradients. The work demonstrated how seemingly minor predators could exert density-dependent control, while cannibalism acted as a population ceiling in western populations.

The Digital Naturalist: Documenting Biodiversity

Even as Baskauf transitioned into university teaching, he maintained his naturalist's eye. Beginning around 2000, he created **Bioimages** (bioimages.vanderbilt.edu), an extensive photographic database documenting the plants and ecosystems of Tennessee and the southeastern United States. What started as a personal project became a major educational



resource, with images appearing in more than 25 books including the National Wildlife Federation Field Guide to Trees of North America.

The Bioimages collection embodied best practices in biodiversity documentation.

Each image was carefully georeferenced, taxonomically verified, and released under Creative Commons licenses. It was digital scholarship before the term became fashionable, and it would prove pivotal to his career trajectory.



“I got involved in the **Biodiversity Information Standards (TDWG)** organization when I was trying to figure out the best practices for exposing metadata about images of live organisms while working on my Bioimages project,” Baskauf explained.

That quest for proper metadata standards would lead him deep into the world of biodiversity informatics.

The Standards Builder: Darwin Core and Semantic Web

Baskauf discovered his true calling at the intersection of biodiversity science, information technology, and global data standards, becoming deeply involved with TDWG.

His breakthrough came with the **Darwin Core RDF Guide**, which he led as principal author. Working with collaborators, Baskauf solved the technical challenges of expressing biodiversity data in RDF (Resource Description Framework) for the Semantic Web. By creating pathways for biodiversity data to participate in the broader Linked Data ecosystem, this work positioned natural history collections to integrate with other knowledge domains.

Baskauf served on the TDWG Executive Committee and chaired the Technical

Architecture Group, developing technical infrastructure for maintaining vocabularies through GitHub-based workflows. His contributions extended to the Audubon Core for biodiversity multimedia and vocabularies for camera trap data.

The Knowledge Engineer: Wikidata and VanderBot

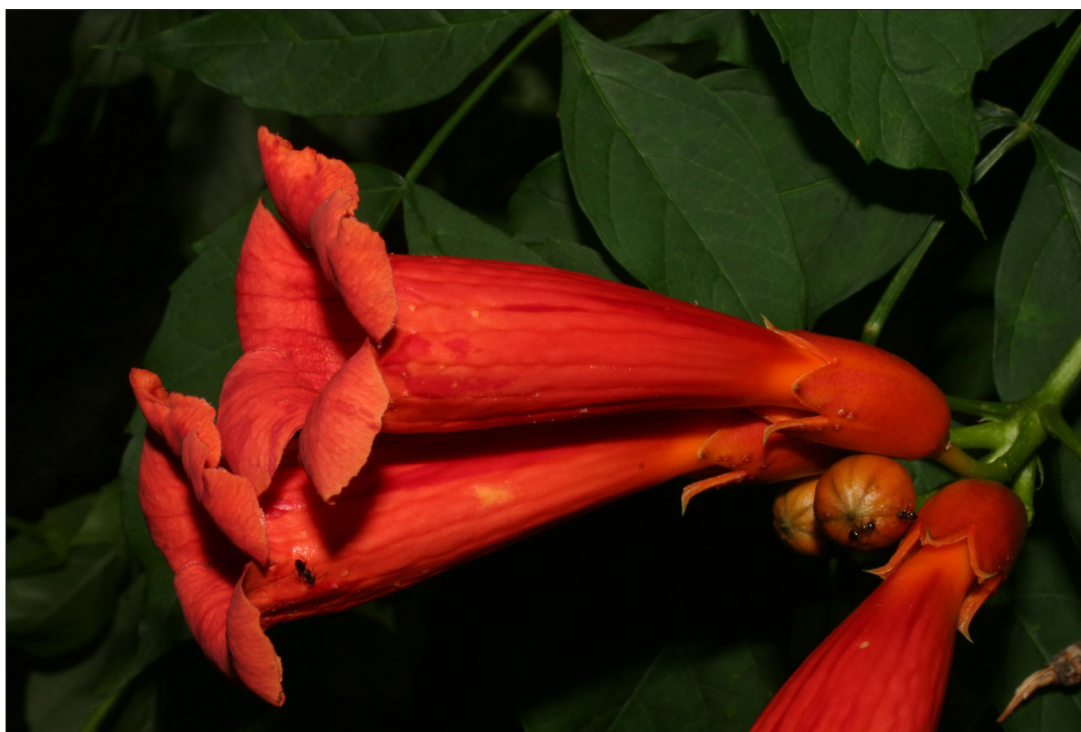
Starting in 2019, Baskauf developed **VanderBot**, a Python application for bulk uploading structured data to Wikidata. By July 2020, he had created or enhanced Wikidata items for more than 4,500 Vanderbilt researchers and documented nearly 7,000 artworks from the Vanderbilt Fine Arts Gallery.

VanderBot became internationally recognized, with Baskauf leading training sessions for library professionals across North America and Europe. The work represented his conviction that knowledge should be open, interoperable, and globally accessible.

- continued on next page



Except for Baskauf's headshot (Vanderbilt VandyVision photo gallery), the photos on these two pages are from Baskauf's uploads to Bioimages. Opposite bottom, a western corn borer (*Diatraea grandiosella*), (<http://bioimages.vanderbilt.edu/baskauf/94002>). Top right, Tennessee coneflower (*Echinacea tenesseeensis*), an endemic species once federally listed as endangered and the subject of Baskauf's wife Carol's doctoral research. Bottom right, trumpet creeper (*Campsis radicans*), (<http://bioimages.vanderbilt.edu/baskauf/52498>). All images CC BY 4.0.



The Educator: Full Circle

During this time of technical achievement, Baskauf never abandoned teaching. At Vanderbilt, he developed an inquiry-based curriculum where students designed their own experiments and had the freedom to fail.

In a VU news story about Baskauf's teaching, Derek Bruff from the VU Center for teaching said, "this type of inquiry-based course is what everyone is looking for."

One project particularly stands out for Baskauf.

"I think that one of the most satisfying things I did was taking undergraduate students in the field to Warner Parks to remove and survey invasive bush honeysuckle," Baskauf recalled. "Many of the students had not spent much time in a native forest and the removals really impressed upon them what a serious problem invasive species are."

What began as a service-learning project developed into a five-year experiment demonstrating that invasive honeysuckle significantly suppressed native plant growth. Baskauf's teaching excellence was recognized with the Harriet S. Gilliam Award for excellence in teaching by a senior lecturer.

The Latest Chapter: Humboldt Extension

Baskauf's newest contribution brings his career full circle, connecting field ecology with data infrastructure. The Humboldt Extension to Darwin Core, published in *Ecography* in January 2025, addresses a critical gap in biodiversity data sharing—one that has hampered ecological research

for years.

While Darwin Core excels at describing individual specimen records, ecological survey data requires capturing crucial context: sampling protocols, effort, taxonomic scope, temporal coverage, and hierarchical relationships between survey components. This context is essential for

interpreting species absence data, estimating abundance, understanding sampling bias, and enabling data reuse for modeling and conservation decisions. Without it, valuable survey data remains difficult to discover, integrate, and properly interpret.

The Humboldt Extension adds 55 new terms to Darwin

Core to capture this critical information. Baskauf's role drew on decades of experience navigating the complex world of standards development.

"My primary role in the task group that developed the Humboldt Extension was to provide guidance on how to move the group's work



through the standards development process,” he noted. As a former review manager for Audiovisual Core and convener of several other standards task groups, he was well acquainted with the procedural steps and documentation requirements for vocabulary development in TDWG. “That background and my general experience as an ecologist allowed me to provide guidance to the group.”

The paper demonstrates the Extension’s value through detailed case studies from Antarctic fish surveys to eBird checklists, showing how enriched metadata enables more sophisticated ecological analyses. It represents the culmination of community collaboration spanning 2018–2024, moving from initial concept through task group refinement to formal ratification as a TDWG standard in February 2024.

For Baskauf, it is a fitting achievement. The field ecol-

ogist who once documented corn borer populations is now building infrastructure to help the global community better document and understand biodiversity change.

“THIS TYPE OF INQUIRY-BASED COURSE IS WHAT EVERYONE IS LOOKING FOR.”
- DEREK BRUFF

The Humboldt Extension makes survey data as findable and interoperable as museum specimens and unlocks decades of ecological field work for new research and conservation applications.

Looking Back, Looking Forward
Baskauf retired from Vanderbilt in 2024, but his legacy is built into the infrastructure of biodiversity informatics. Every time a researcher uses Darwin Core in RDF, uploads ecological survey data with Humboldt Extension terms,

or discovers a Vanderbilt artwork through Wikidata, they are using tools Baskauf helped create.

Asked who should be using Darwin Core, Baskauf noted

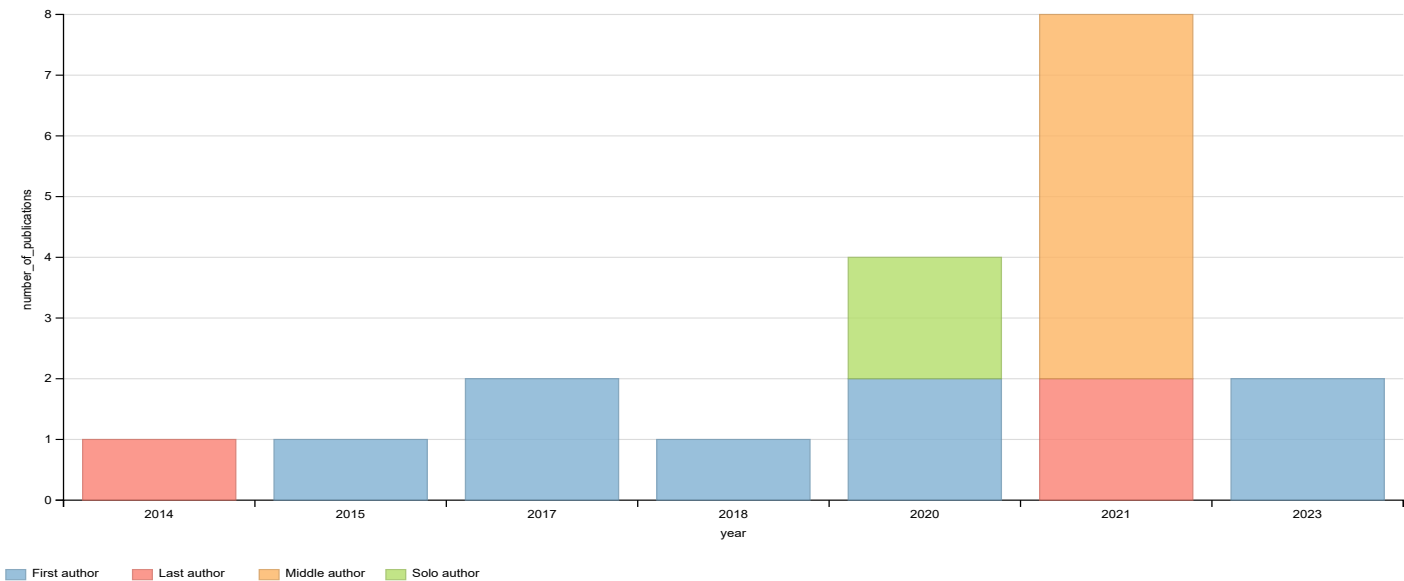
that, “most people who use Darwin Core probably don’t actually know that they are using it. It’s the behind-the-scenes standard that makes it possible to publish biodiversity data in a way that allows it to be aggregated with similar data published by others.”

Data from popular apps like eBird and iNaturalist flow to the Global Biodiversity Information Facility using Darwin Core, where Baskauf explained they are analyzed by scientists and used by policy-makers to make sci-

ence-based decisions. The southwestern corn borer research asked what limits a species’ range. The Humboldt Extension asks how we can better share what we learn when we look. Both questions are fundamentally about understanding pattern and process in nature—just at different scales and with different tools.

His standards work continues to enable new research. In fact, ESI investigators are building a Tennessee natural history fossil collections digitization workflow around Darwin Core standards. This project helps demonstrate how his infrastructure enables interoperability across institutions.

Whether photographing wildflowers in Tennessee, defining controlled vocabularies, or writing Python scripts, Baskauf has always been in the business of documenting life and helping others do the same.



Opposite: *Quercus macrocarpa* (bur oak) north of the Molecular Biology Building, Vanderbilt University. Photographed August 26, 2014. Baskauf, Bioimages (<http://bioimages.vanderbilt.edu/baskauf/90661>), CC BY 4.0

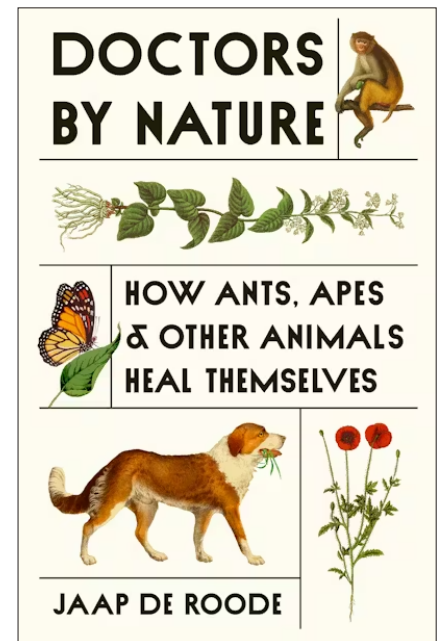
This page: Baskauf’s publication timeline visualized through Scholia using Wikidata. Baskauf’s VanderBot tool created more than 4,500 researcher profiles in Wikidata, contributing to the knowledge graph infrastructure that powers visualizations like this. Generated via Wikidata Query Service.

What We're Reading

Doctors by Nature by Dr. Jaap de Roode offers a fascinating exploration of how animals utilize natural flora and fauna to medicate and treat symptoms of a plethora of infectious diseases. Drawing on his own research with monarch butterflies and milkweeds, he seamlessly connects these and many other examples to broader concepts of ecology and evolution of infectious disease and host-pathogen interactions. The book provides historical context, citing early scientific studies with chimpanzees in Africa and indigenous populations who have learned healing practices from animal observations for hundreds of years. de Roode emphasizes the importance of natural animal behaviors throughout the book, especially

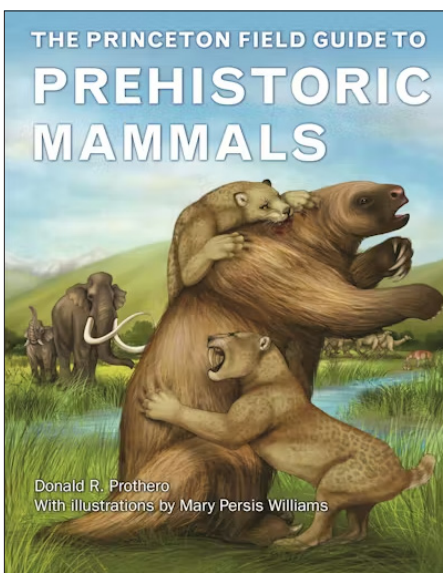
as industrialization diminishes access to many natural resources for animals to thrive and self-medicate from. This shift has significant long-term consequences such as increased reliance on pharmaceuticals which can lead to antibiotic resistance and negatively impact agriculture and public health. *Doctors by Nature* is a well-researched and enjoyable read that highlights many scientists across the world that have contributed to the field. I highly recommend it for anyone interested in ecology and evolution of infectious diseases or those interested in becoming more knowledgeable about how nature can serve as a blueprint for future healthcare approaches.

- Rayshaun Pettit



Rayshaun Pettit is a graduate student in the Tate Lab. He has received national recognition via the NSF GRFP. He holds a bachelor's degree from the University of Maryland and has research experience examining how cardenolide mixtures affect monarch butterfly resistance to the parasite *O. elektroscirrha*.

Brynn Wooten is a graduate student in the DeSantis Lab, where she studies paleontology. She has received regional and national recognition for her work, including an NSF GRFP, a pilot grant and outreach excellence award from ESI, and the President's Student Research Award from the Paleontological Society.



The Princeton Field Guide to Prehistoric Mammals by Donald Prothero is a thorough and comprehensive guide book on extinct mammals. The information about prehistoric mammals is detailed, yet easy to understand and accompanied with many helpful images, figures, and illustrations. The chapters of the book and the mammals it covers are broken down phylogenetically to provide a sense of evolutionary relationships between these lesser-known mammals. While being phylogenetically driven, the book still opens with the basics of paleontological research and the evolution and rise of mammals. My favorite aspects of the book are: 1) the

section on entelodonts (as I love seeing representation of my focal research taxon), 2) the section of the book that focused on entire taxonomic orders that are completely extinct, and 3) the section detailing mammalian evolution and extinction. Lastly, the book closes out by discussing mass extinctions and the future of mammals, both of which are majorly important in the modern era. Overall, this is a great, easy to consume book for anyone interested in prehistoric mammals, phylogenetic relationships, and mammalian evolution.

- Brynn Wooten

Ken Catania: The Art, Craft, and Mess of Science

Ken Catania is, by any measure, a remarkable scientist. The Stevenson Professor of Biological Sciences at Vanderbilt, MacArthur Fellow, and Guggenheim Fellow has spent his career studying some of nature's most spectacular oddities: star-nosed moles, electric eels, zombie-making wasps. His new book, **On the Art and Craft of Doing Science**, is not about those animals. It is about the person who studies them, and about all of us who have ever fumbled toward a discovery we could not quite yet name. The book's central argument is that science is not the orderly, logical process we present in publications. It is messy, creative, and deeply human. Catania makes this case compellingly, drawing on his own research alongside historical examples from figures as varied as Thomas

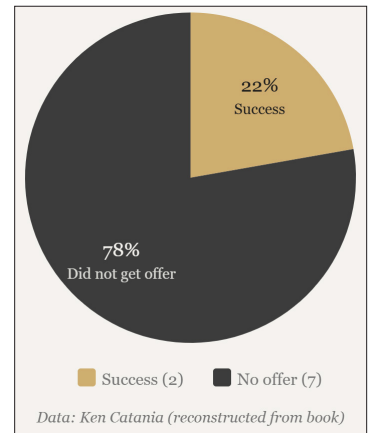
Kuhn and Stephen King. The effect is legitimizing rather than self-aggrandizing. He is not describing his genius process; he is describing how science actually works and providing receipts.

The first three chapters are the book's strongest and most universal. Catania writes with genuine warmth about curiosity, observation, and experimental iteration. His description of how a single observation evolves through successive experiments, each success breeding a better version and each potential failure threatening to end the line entirely, reads as an elegant argument for natural selection applied to ideas. It is the kind of passage that makes you want to dust off your camera and go find something worth looking at.

Chapter 2 in particular offers a welcome glimpse of the

nerd, rather than the celebrated neuroscientist. That distinction matters. His frequent quotation of other scientists throughout serves a quiet but important purpose: reminding readers that the hidden, chaotic interior of doing science is not a personal failing but a universal condition we simply do not discuss enough.

The middle chapters offer ambitious frameworks for how scientists should structure and tell their stories, and the advice is genuinely inspiring. Catania writes from a position of hard-won expertise: decades of intimate knowledge of his systems, high-resolution equipment, and the career security to take creative risks most scientists cannot yet afford. He acknowledges this briefly, noting that a junior scientist might think twice before giving a paper a silly title. Readers who are

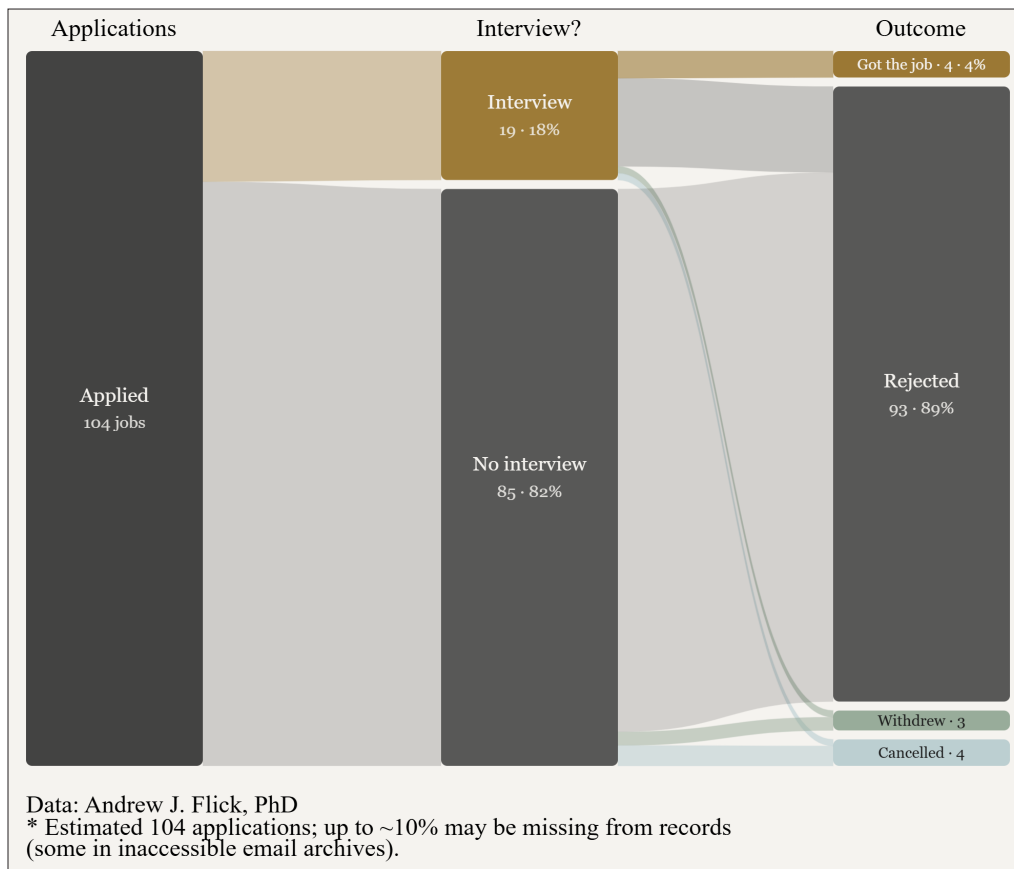


pre-tenure or on the job market may want to hold some of the grander prescriptions loosely. The advice is aspirational by design, and there is value in that, even when the summit feels far off.

The failure chapter is the book's most valuable for early-career readers. The advice to let go of bad ideas and resist massaging data to fit a beloved hypothesis is both important and underserved in scientific training. Catania includes graphs of his own failures alongside his successes, job applications and grant rejections, that are candid and worth sitting with, even if his numbers will look foreign to scientists navigating today's far more brutal academic market - see my figure at the bottom vs his at the top.

Catania is at his best when he steps back from prescription and simply reflects. For graduate students and early-career researchers, the first half is essential reading. For established scientists, the whole book rewards attention. For anyone who has ever wondered whether the messy reality of their scientific life is normal: it is, and Catania makes a convincing case that the mess is not a bug.

The book is available now from Princeton University Press.



Owen Jones: Force of Nature

I was pleased to receive early access to this book in order to write this review.

Owen Jones' *Force of Nature: Understanding Evolution's Deepest Logic—and Putting it to Use* sets out to demonstrate how evolutionary thinking can improve our everyday lives. Jones, who holds the Glenn M. Weaver, M.D. and Mary Ellen Weaver Chair in Law, Brain, and Behavior at Vanderbilt and serves on the founding advisory board of the Evolutionary Studies Initiative, brings an interdisciplinary perspective that bridges law, biology, and behavior. The result is an accessible overview aimed at college-educated readers and curious generalists. It would also

work well as a text for a graduate seminar in evolution.

The introduction does an

excellent job of setting up

making complex evolutionary concepts understandable

without oversimplifying. This would make a good book for a long bus ride or a couple of flights, and will work well as an audiobook when released.

For readers curious about Jones' approach before committing to the full book, his talk from the 2025 Scopes Trial Centennial Symposium at Vanderbilt serves as an excellent precursor. That presentation is available on the ESI YouTube channel at <https://www.youtube.com/watch?v=mc5dvTw-Rzk> - or by following the QR code at the end of this story.

Where the book truly shines is in Jones' use of examples. The evolutionary medicine chapter stands out as a particular highlight, showing how

"OWEN JONES, PROFESSOR OF BOTH LAW AND BIOLOGY, MAKES THE CASE FOR HOW [NATURAL SELECTION] POWERS EXTEND FAR BEYOND BIRD BEAKS AND BEETLES TO OUR BRAINS AND BEHAVIORS, WITH MYRIAD IMPLICATIONS FOR MEDICINE, PSYCHOLOGY, TECHNOLOGY, AND THE LAW. EVEN DARWIN WOULD BE SURPRISED."

-SEAN B. CARROLL



evolutionary perspectives can reshape our understanding of health and disease. Chapter 5's exploration of bio-design in engineering is equally impressive, presenting a remarkable depth of case studies that demonstrate how engineers draw inspiration from evolutionary solutions. The breadth and specificity of these examples reflect serious research and genuine enthusiasm for the subject.

Jones' talent for finding compelling illustrations continues throughout. The discussion of step-parent dynamics in Chapter 9, for instance, offers stirring examples that ground abstract evolutionary psychology concepts in recognizable human experiences. The section on crops, farming, and fishing

provides thought-provoking insights into how evolutionary pressures shape agricultural systems and resource management. These concrete examples are top notch.

The middle chapters explore concepts in considerable depth. Chapter 6 is particularly thorough, which may reflect an intention to emphasize certain ideas as major takeaways. Chapter 7 takes an interesting approach to its stated focus on risk, examining the gap between statistical reasoning and human evolutionary psychology.

The book's scope occasionally works against it as well. Chapter 8's deep dive into the endowment effect is well-executed and understandably detailed given Jones' own research in this area, but

feels narrow for a chapter titled "Primal Preferences." A broader survey of evolutionary influences on human preferences might have better served the book's overarching goals.

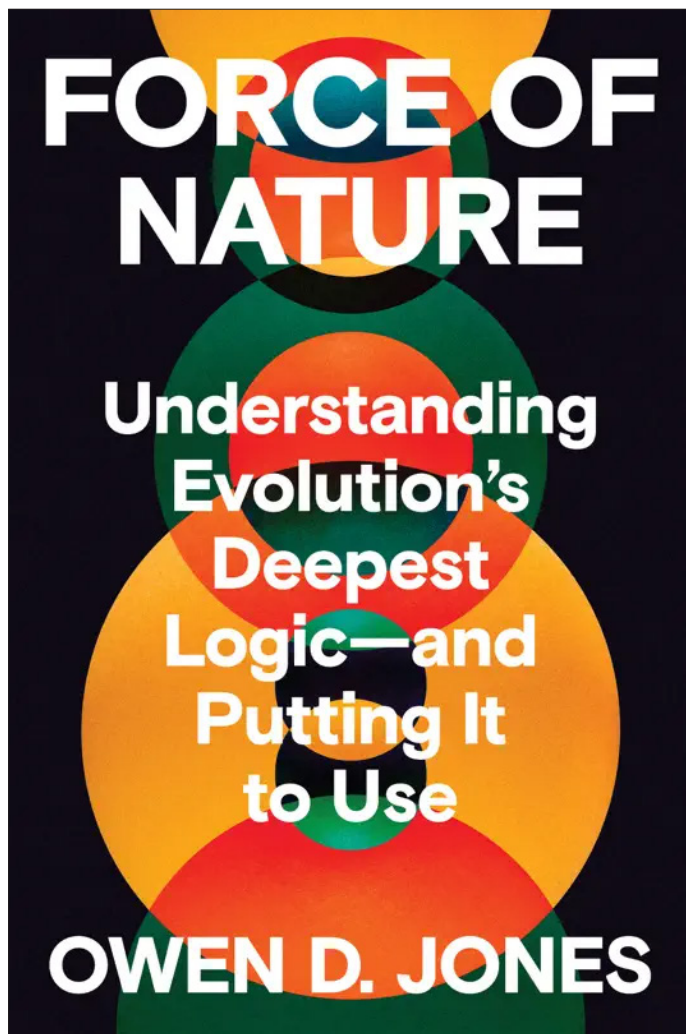
Stylistically, the writing occasionally adopts an impersonal tone that creates distance between author and reader. This is not necessarily a drawback, and some readers may find this formality refreshing compared to the more intimate, conversational style many science writers favor. Others might wish for more of Jones' personality to come through on the page. Again, this is particularly true in the second half of the book.

The conclusion wraps things up satisfyingly and

brings Jones' arguments to a clean finish.

Force of Nature offers a comprehensive look at evolution's practical applications across medicine, engineering, psychology, and policy. Jones' talent for finding compelling examples and his interdisciplinary expertise make this a valuable addition to popular evolution literature. The book will find its audience among educated general readers curious about evolution's relevance to contemporary challenges, as well as graduate students seeking a broad introduction to evolutionary thinking across disciplines.

The book releases June 9, 2026, and is available for pre-order now.



Owen Jones

Force of Nature: Applications of Natural Selection to Other Fields



NCSE National Center for Science Education



Watch Jones' Scopes "Monkey" Trial Centennial Symposium lecture at this QR code



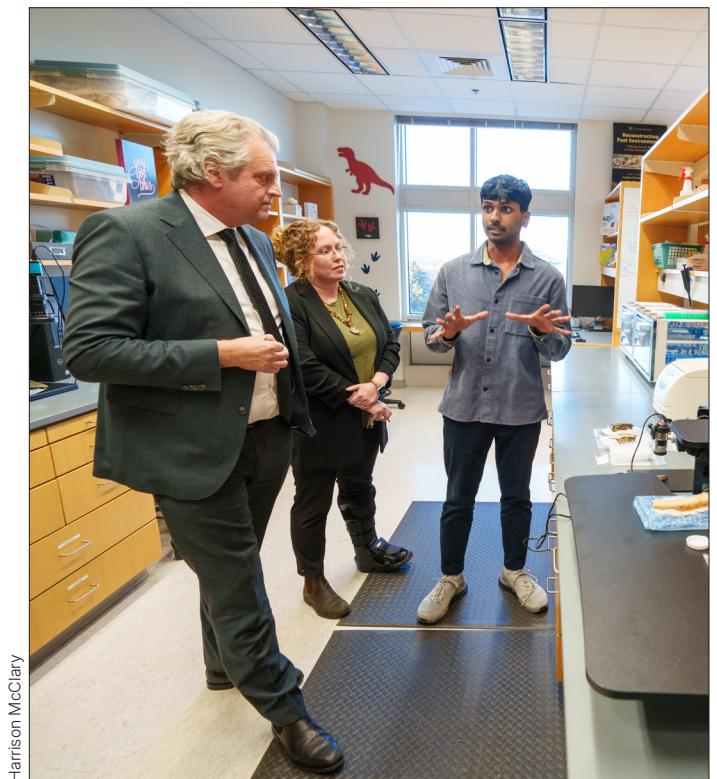
Undergraduates

Fall 2024

- Neomi Chen - Bachelor of Arts in English

Spring 2025

- Lawrence Ryan Ashley - Bachelor of Arts in Ecology, Evolution & Organismal Biology
- **Charu Balamurugan** - Bachelor of Arts in Medicine, Health & Society and Molecular & Cellular Biology (*magna cum laude*, highest honors)
- Isabella Zoe Binici - Bachelor of Arts in Ecology, Evolution & Organismal Biology (*magna cum laude*)
- Lauren Taylor Bishop - Bachelor of Arts in Ecology, Evolution & Organismal Biology
- Claire Anne Downing - Bachelor of Science in Cognitive Studies and Ecology, Evolution & Organismal Biology
- Namju Kim - Bachelor of Arts in Molecular & Cellular Biology (*cum laude*)
- **Aditya Reddy Kurre** - Bachelor of Arts in Molecular & Cellular Biology (*cum laude*, honors)
- Leon Li - Bachelor of Arts in Molecular & Cellular Biology (*magna cum laude*, honors)
- Nicholas Thompson McCoy - Bachelor of Science in Early Childhood or Elementary Education and Child Studies (honors)
- Karen Yuxin Nie - Bachelor of Arts in Molecular & Cellular Biology (*summa cum laude*, honors)
- Kaitlyn Michelle Russell - Bachelor of Arts in Biological Sciences and Psychology
- Lauren Elizabeth Solecki - Bachelor of Arts in Anthropology and Medicine, Health & Society
- Melumo Sophie Tagashi - Bachelor of Arts in Medicine, Health & Society
- Selina Sinan Wang - Bachelor of Arts in Biological Sciences (*magna cum laude*)
- Corey Robert Wiseman - Bachelor of Arts in Biochemistry & Chemical Biology (honors)
- Seokin Yang - Bachelor of Arts in Ecology, Evolution & Organismal Biology (*cum laude*, honors)



Graduates

Summer 2024

Master's Degrees

- **Rosseirys De La Rosa** (MA - Anthropology)
- Md Sadequr Rahman (MS - Biological Sciences)

Doctor of Philosophy Degrees

- James Paul Held (Biological Sciences)
Dissertation: Elucidating the Role of RNase Z in Mitochondrial Quality Control in *Caenorhabditis elegans*
- Jingyi Liu (Psychological Sciences)
Dissertation: The Effects of Spatial Alignment on Making Inferences with Multiple-view Visualizations
- Grace Helen Morales (Microbe-Host Interactions)
Dissertation: Leveraging Strain Diversity to Predict Host-Uropathogen Dynamics
- Olawunmi Winful (Anthropology)
Dissertation: The Etiology of Inflammatory Responses: Exploring Biocultural Influences on Salivary C-Reactive in African Diasporic Communities

Fall 2024

Doctor of Philosophy Degrees

- Cole Jared Meier (Biological Sciences)
Dissertation: Photosensitive Insecticides for Mosquito Control
- Katherine Atonia Turk (Earth and Environmental Sciences)
Dissertation: Engineering the Rise of Animals

Spring 2025

Master's Degrees

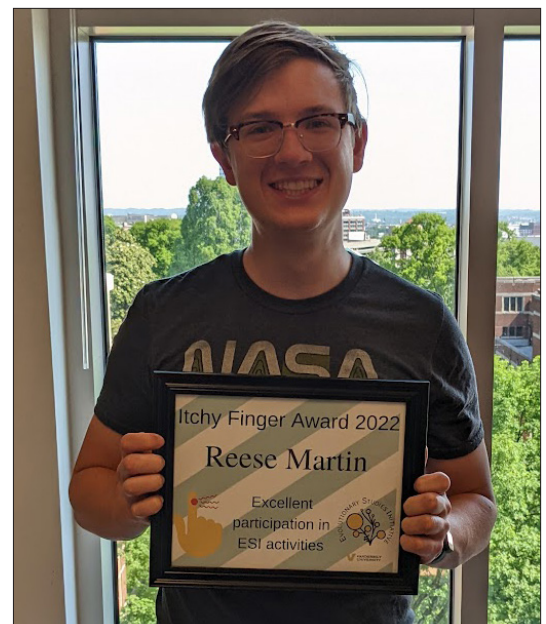
- Brandt Kolson Geist (MS - Earth and Environmental Science)
- Val Zachary Jackson-Hundley (MS - Microbiology and Immunology)

Doctor of Philosophy Degrees

- Jordyn Sanner Barr (Biological Sciences)
Dissertation: Warmer Temperature and Aging Interact to Shape How Mosquitoes Survive and Respond to Infection
- **Reese Alexander Martin** (Biological Sciences)
Dissertation: Immune Pleiotropy, its Costs, Benefits, and Evolutionarily Favorable Conditions



Submitted photo



RECRUITING NOW

Brian O. Bachmann (Biochem)

Biosynthesis, Secondary Metabolites, Directed Evolution, Drug Discovery

Megan Behringer (BSCI)

Population genetics, genomics, microbiology, *E. coli*

Rachel Bonami (PMI)

B cell evolution, *T* cell, autoimmunity, type 1 diabetes, arthritis, microbiome

Benjamin Bratton (PMI)

Bacterial evolution, microscopy, cell shape, quantitative biology

Gianni Castiglione (BSCI)

Molecular evolution, vision, oxidative stress, evolutionary medicine

Larisa DeSantis (BSCI)

Vertebrate paleontology, paleoecology, paleoclimates

Ivelin Georgiev (PMI)

Immunology, virology, vaccines, antibodies, computational, disease

Monica Keith (Anthro)

Biological anthropology, data science, Bayesian modeling, maternal health disparities

Amanda Lea (BSCI)

Gene regulation, biological anthropology, genotype x environment interactions, early life effects

Lin Meng (EES)

Climate change, plant ecology, remote sensing, light pollution

Antonis Rokas (BSCI)

Evolutionary genomics, molecular evolution, phylogenomics, fungi, mammals, fungal diversity

Eric Skaar (PMI)

Bacteria, host-pathogen interactions, biochemistry, molecular biology, cell biology

Ann Tate (BSCI)

Immune system, virulence, systems biology, coinfection, host-parasite coevolution, life history evolution

UNIVERSITY POSITIONS

Professor of the Practice:

Climate and Environmental Policy

Environmental Engineering

Senior Lecturer:

Anatomy and Physiology

Biological Sciences

Chemical Biology

Neuroscience

Psychology

Assistant Professor:

Biomedical Engineering

Cell & Developmental Biology

Computational Systems Biology

Medical Anthropology



Current Job Postings



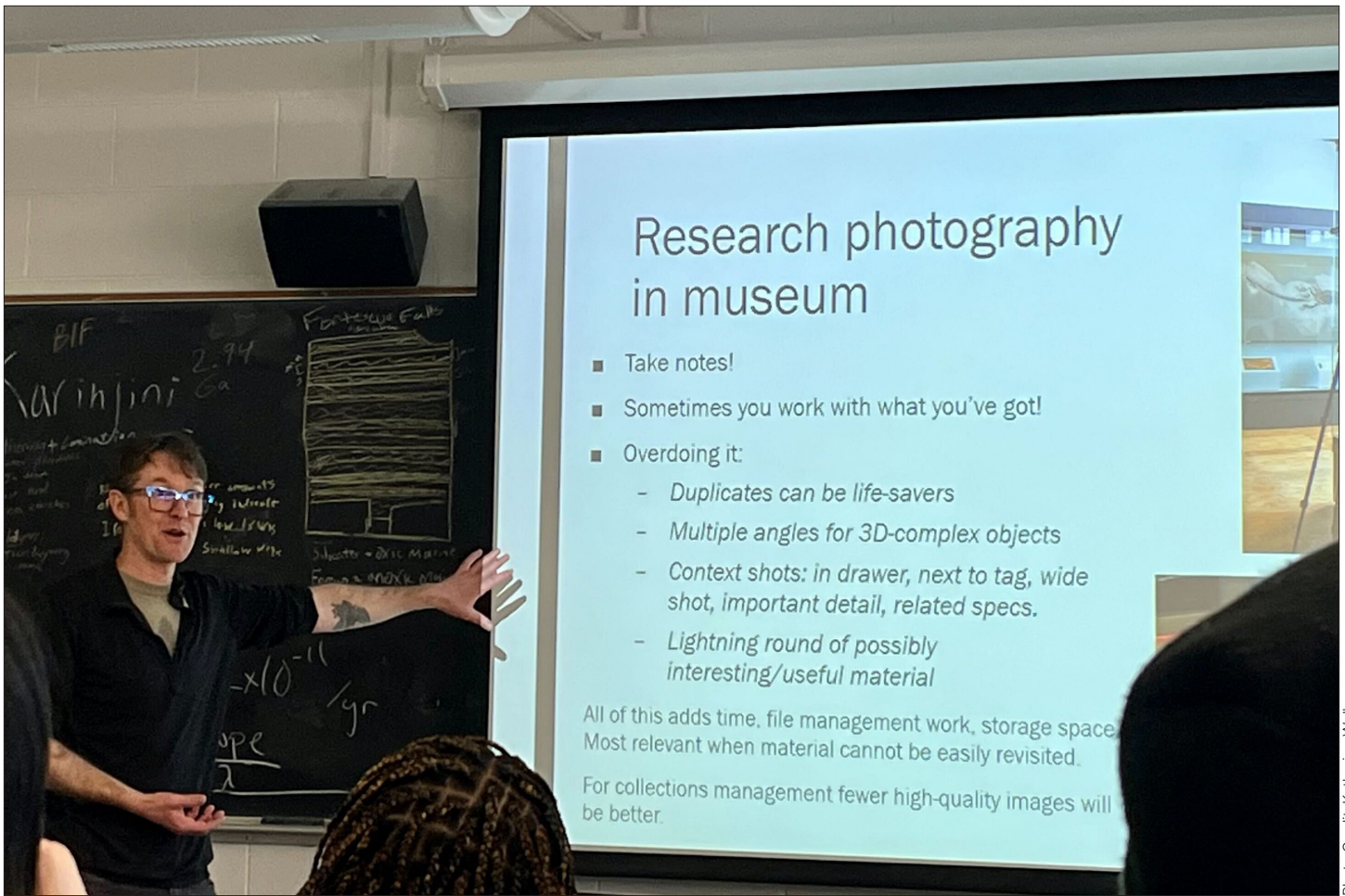


Photo Credit: Katharine Walls

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VU Special Collections, Bobby Moore, March 7, 1954



