Volume 20-2 *Spring 2024*

Notes from the Field

The Biannual Newsletter of the Intercollege Graduate Degree Program in Ecology

The Pennsylvania State University

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Note from the Editor: A Reflection on the Ecology Program

Dear Ecologists,

My name is Jessica Brown, the editor for this version of the Ecology newsletter. I have spent nine years as a Penn State student, the past five of which I've called the Ecology program my "home." As I tie up loose ends and make a few last memories of being a Penn State student before I graduate, I'm feeling prouder than ever to be an almost two-time alumna of this university. One of the primary reasons for that is the brilliant minds I have been surrounded by.

As I have gotten to know other ecology students and hear about their experiences (ones that are directly thesis-related *and* those that are not), it has become increasingly evident that our program is made up of people who are not merely students of ecology… rather, they are pioneers of our field.

Ecology students truly serve the land-grant mission by dedicating our focus not only to our research, but also to teaching and extension; in this way, we strive to meet all three land-grant pillars (*Fig.1*).

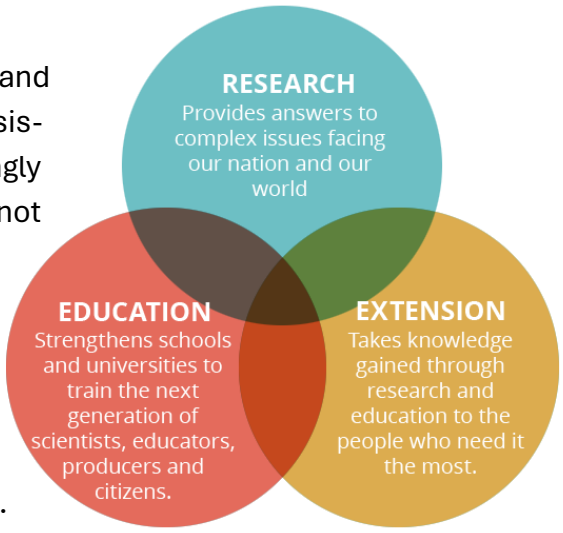

Figure 1: The three pillars of research, teaching, and extension are crucial to Penn State's land-grant mission. Source: USDA NIFA Strategic Plan.

On a personal level, one of the components of my graduate program that ultimately became the most valuable to me during my time here was being highly involved in Penn State Extension with the Vector-borne Disease Team. I taught workshops to other professionals (*Fig. 2*), worked tables at outreach events, presented webinars, and created numerous digital education products. These experiences improved my skills in public speaking, digital design, and, most importantly, translating research into digestible knowledge for public audiences. Working in extension made me a better scientist, and I'm so excited to take the skills I gained to the next step of my career.

Figure 2: Me teaching a tick dragging workshop to pest control professionals at the Vector-borne Disease Team's vector bootcamp.

I have compiled this newsletter with pieces that highlight some of the breadth of experience obtained by ecology students recently, ranging from missions to create inclusivity, to student org activities, to some really exciting fieldwork! Enjoy, and happy field season!

Building Inclusive Spaces

Maisie MacKnight

Figure 1: Me collecting data for my dissertation research on red-backed salamander

Previous experiences collecting data in the field largely contributes to my sense of belonging as an Ecologist, but I recognize this is not the case for everyone. Students from underrepresented groups may be turned away from field disciplines because they perceive to have little in common with the people who work in the field (Pickrell 2020). When people do not fit the perceived image of a traditional scientist, they are more likely to face uncomfortable or even dangerous situations (Sheffield et al. 2021). Additionally, individuals with multiple marginalized identities face increasing levels of risk in the field (Clancy et al. 2017, Demery and Pipkin 2021). Therefore, when building inclusive field teams in outdoor spaces, we need to incorporate frameworks that support diversity and intersectionality into our policies and culture. To address these problems, I created resources intended to support field teams build and maintain inclusive teams while conducting ecological field work.

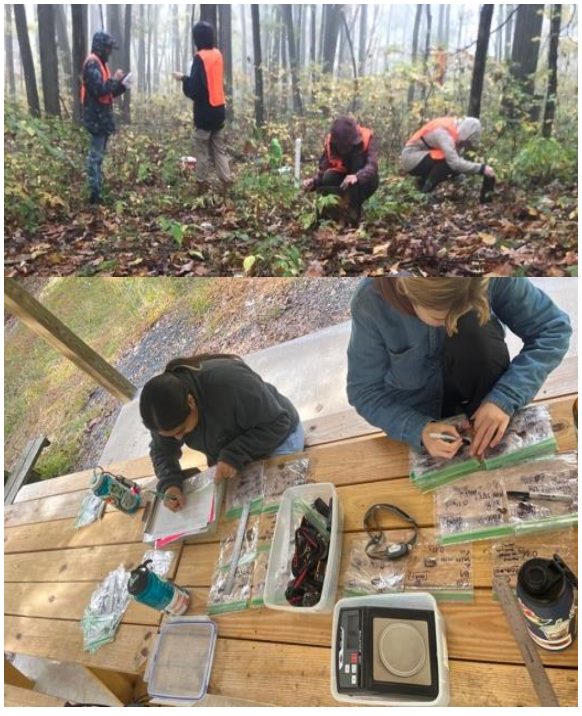

Figure 2: My undergraduate students and field technicians collecting (above) and processing (below) red-backed salamanders using SPARCnet protocols.

Based on my experience and those of my fellow Ecology graduate students, field and lab safety are an important part of building community, especially in the context of diversity, equity, and inclusion (DEI) initiatives. The consequences of ignoring field safety are great, and they disproportionately affect those that are already underrepresented in outdoor spaces. Supervisors and institutions have a responsibility to provide safe learning environments for all students, but to do this, they need to acknowledge how individual identity and prior experiences shape unique challenges for individual team members. This framing is reflected in the National Science Foundation's 2022 requirement for Safe and Inclusive (SAI) Plans for off-site and off-campus field work. Despite the impetus from increased dialogue and

policy changes, there are few resources to support field teams as they apply these best practices within their spaces.

There are many resources for physical safety such as those released by Penn State's Office of Environmental Health and Safety. However, these resources ignore the reality that individual team members face different amounts of risk that shape their perceived and actual safety in outdoor spaces. With the momentum from civil rights initiatives such as the #MeToo and Black Lives Matter movements, there is an increased call for cultural changes within our disciplines. Additionally, there are often higher, pre-existing institutional or university policies addressing more egregious offenses, such as sexual harassment and assault, that departments and groups must operate within. However, there remains a paucity of resources that offer guidance for building culture that goes beyond physical safety and prevents incidence of harassment and assault-- features that are necessary for maintaining truly inclusive environments (Marshall and Thatcher 2019). Beyond the prevalence of harassment in ecological sciences and academia (Rosenthal et al. 2016), some people with marginalized identities leave the field as a result of many, smaller offenses (Duncombe 2019). Most previous work focuses on preventing harassment, while leaving routes for intermediate cultural change ambiguous (Witze 2018, Copenheaver et al. 2021) Therefore, we present a constellation of resources that shed light on how to build upon pre-existing resources through guiding action items that empower students in the field.

To address these issues, I present a collection of resources when I call the Right to Know (RTK) communication tool box. Taken from the legal concept, participants have a right to know the risks they encounter when participating in field work. However, this is not intended to serve as a legal document and cannot possibly provide a complete list of risks that could be encountered while doing fieldwork. Still, this document has two main goals: 1) to inform technicians of expectations regarding risks and codes of conduct so that technicians can provide informed consent prior to starting work and 2) to provide guidance as supervisors and technicians use this tool to maintain communication between all field members. Although I focus on outdoor spaces, the crux of the issue lies in broad cultural change (Witze 2018) and tools from the RTK can be applied in wet labs, and classrooms to build inclusive culture (Schell et al. 2020, Bratman and DeLince 2022).

Based on best practices from the literature and the outcomes from facilitated discussions among members of my home department of Ecosystem Science and Management, I propose best practices for building inclusive field teams and demonstrate their applications with examples from data collection for my dissertation research. In the RTK, I present examples from my own dissertation research within the Salamander

Population Adaptation Research Collaborative Network (SPARCnet) to demonstrate the different components of the communication tool. The RTK and its supplementary materials are designed support supervisors as they build communication tools for their teams. I include a general template for building lab safety plans, protocols, and communication guides, and I urge PIs and others acting in supervisor positions to use this as a guide their individual projects. I also include additional support for supervisors as they use their RTK to navigate federal grant requirements such as NSF's SAI plan.

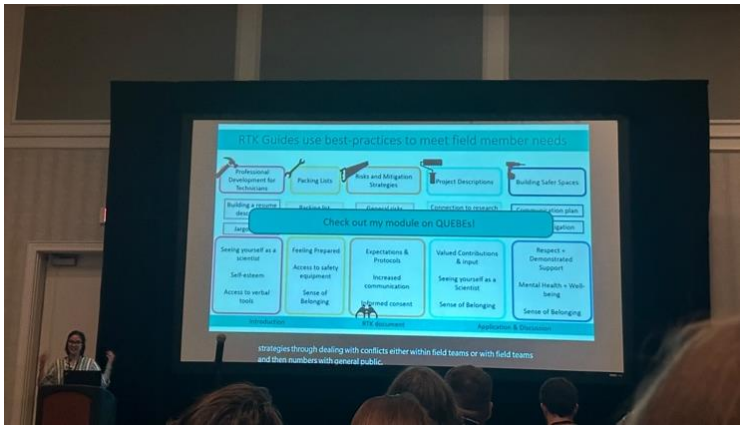

Figure 3: Me presenting my Right to Know resources at the Joint Meeting of Ichthyologists and Herpetologists last summer.

I presented this work within Penn State during the Fall 2022 and 2023 Advances in Ecology course, in several workshops, and as an invited speaker for the 2024 Ecology spring seminar series. This work has been shared more broadly at professional conferences, professional society-sponsored workshops, and at other institutions. For more information about these resources, please visit my QUBEs site: https://qubeshub.org/publications/4460/2

RESOURCES

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Macrobes for Microbes student organization to construct a large Winogradsky column to communicate concepts of microbial evolution in real time; a "living laboratory" on display

Sarah Richards

Evolution, often portrayed as a gradual force spanning thousands of years, is less frequently discussed in the context of observable changes that can happen within a human lifetime. Microbes, especially bacteria with their rapid life cycles, provide a unique and accessible platform for studying evolution in real time and communicating these concepts to a broad audience. This rapid evolution, observable within weeks, allows for a tangible understanding of fundamental evolutionary principles, such as adaptation, natural selection, and drivers of biodiversity.

The Macrobes for Microbes student organization is a club open to all graduate and undergraduate students who are enthusiastic to engage their community around all things microbiology! Currently, club members are working to establish a permanent Winogradsky column exhibit at Penn State's Pasto Agricultural Museum. This initiative focuses on revealing the often-overlooked microbial biodiversity in soil and emphasizes the pivotal role microorganisms play in nutrient cycling and their early evolutionary significance. The proposed exhibit involves constructing a large 12" X 36" Winogradsky column with three panels, each featuring soils from distinct environments: 1) unmanaged forests, 2) agricultural fields, and 3) acid mine drainage sites, which will enable a visual representation of different evolutionary trajectories stemming from each panel. For instance, the acid mine drainage starter soil, housing extremophilic microorganisms reminiscent of early Earth, has been shown in similar efforts to result in a column with distinct orange and black layers, showcasing iron oxidizers and sulfide producers. Rooted in community engagement, the project took shape with input from last year's Ag Progress Days event (with an estimated 44,000 attendees), where visitors were polled on their preferences for soil sources in this exhibit. Based on this feedback, the top three most popular soil sources were selected, ensuring alignment with community interests.

In a recent development, club President Jamie Spychalla and member Sarah Richards recently secured a grant through the Society for the Study of Evolution, with support from Seth Bordenstien, Director of the One Health Microbiology Center, via partial matching funds for the project. The grant will fund essential components like custom-cut glassware and framing the Winogradsky columns, ensuring safe construction and guaranteeing the exhibit's longevity at the museum.

This initiative is an exciting opportunity to bridge the gap between the perceived slowness of evolution and the rapid changes that occur in soil microbial communities, as well as how those natural processes can be influenced by human activities like agriculture or mining. By offering a visually striking, educational experience to the public, the project aims to make evolutionary concepts more relatable and inspire a deeper appreciation for the dynamic, ever-changing nature of life on earth.

Organisms Influencing Landscapes

Janniry Cabrera Belen

Ecogeomorphology (i.e. also known as biogeomorphology) is a field that investigates how living organisms influence land configuration and its geomorphic processes. The great Charles Darwin even pondered these ideas in his book "*The Formation of Vegetable Mould through the Action of Worms*" as he observed an earthworm tunnel through soil and wondered how they could influence the landscape around them (Darwin, 1881). Since then, national agencies like NASA have utilized these same principals to investigate what clues could be left behind by living organisms on other planets. The fascinating ideas present in the field today and the many unknowns led to my own research question about how plant diversity may influence soil erosion along our waterways: How do plant species diversity, species interactions, and resulting root traits influence rates of erosion in stream systems? To address this question, I am conducting both an observational study in Pennsylvanian streams and an experimental greenhouse study this summer.

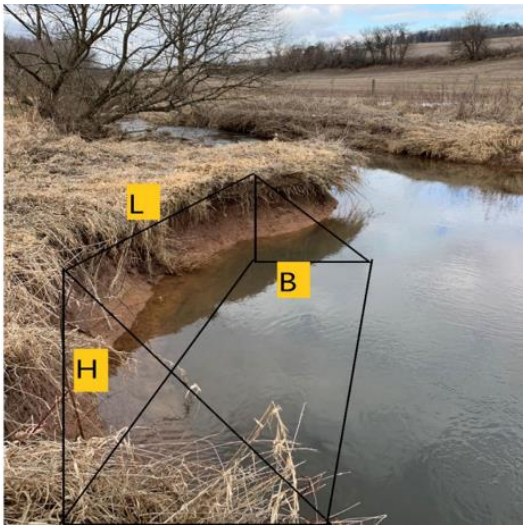

Figure 1a: Before bank reinforcement (source: PA F&BC)

Soil erosion, a routine geologic process that weathers soil and sediment, has become a significant environmental issue because of its potential to degrade agricultural land and increase sediment pollution in waterways (Montgomery, 2007, Mack et al, 2024). Deforestation and unsustainable agricultural practices (i.e. overtilling of land) have increased the severity and frequency of erosion processes, accelerating the geologic rate of erosion to 11 to 38 times faster than past geologic records (Montgomery, 2007). To address this detrimental issue, not only in terrestrial systems but also in aquatic systems, I have been working with the PA Fish and Boat Commission's (PA F&BC) Stream Habitat team to find stream sites experiencing active erosion. This PA F&BC team reinforces the banks of hundreds of streams each year by implementing typical restoration techniques (i.e. incorporating logs and other materials to


Figure 1b: After bank reinforcement (source: PA F&BC)

structurally support and protect the bank) (Figure 1a and 1b). In building this connection and establishing active erosion sites, I can test my hypotheses in real time to accurately evaluate how plant diversity and rooting structures present in the soil can deter erosion. This knowledge will inform management organizations regarding incorporating plant-related techniques that can anchor and reinforce stream banks.

For my observational study, I will measure the plant species richness present on the banks, take soil cores to evaluate the length and volume of the roots present, and measure fluvial erosion (i.e. the sediment coming from the bank) and geotechnical erosion (i.e. the strength of the bank). With these variables, I will be able to run a generalized linear model in R and evaluate if the length and volume of the rooting structures are influencing fluvial and geotechnical erosion. I can also indirectly see if the diversity of the plants present is counteracting sediment being removed from the bank. It's possible that differing above ground plant structures (i.e. characteristics of leaves and stalks) can remove or displace the force exerted on the bank from the water's velocity. Additionally, belowground structures can bind together the soil and reduce the amount of soil removed from the bank, and longer roots are thought to anchor the bank and reduce landslides from occurring when whole portions of a stream bank plummet into the stream. Investigating this is incredibly important in Pennsylvania given that there is an estimated 86,000 miles of streams and a recent assessment by the Pennsylvania Department of Environmental Protection states that over 28,000 miles of streams are impaired due to pollution from agricultural runoff, with urbanized streams being the most affected due to incision (Figure 2) (PA DEP, 2022).

Figure 2: Incised stream (source: NY Times)

For my greenhouse experiment, I am growing approximately 1,600 native plants that will be transferred to artificial stream banks. These artificial stream banks will be constructed in containers and will allow us to observe the interactions occurring between native plants in differing plant species richness treatments (i.e. from monocultures to six species polycultures). The container itself is transparent and will allows us to observe


Figure 3: Janniry and her 1,600 pots (source: JCB)

the rooting structures as the plants grow into the stream banks. In September, when the plants have grown into the stream for approximately 5 months, I will perform an erosion test in a flume (i.e. an engineered device used to emulate the flow and characteristics of streams and rivers) to measure how much sediment is removed from each artificial stream bank depending on the plant diversity, root traits, and species interactions present.

As of now, I am growing my plant species for four weeks so that I can transfer them to the artificial stream banks in May. I am doing this instead of directly seeding the artificial stream banks so that I can control the plant density and species present across all the banks. Long story short, this is going to be a busy summer for me, but I am extremely excited to collect data and find some new insights on a topic that is still yet to be thoroughly explored.

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A photo collection from Brazil

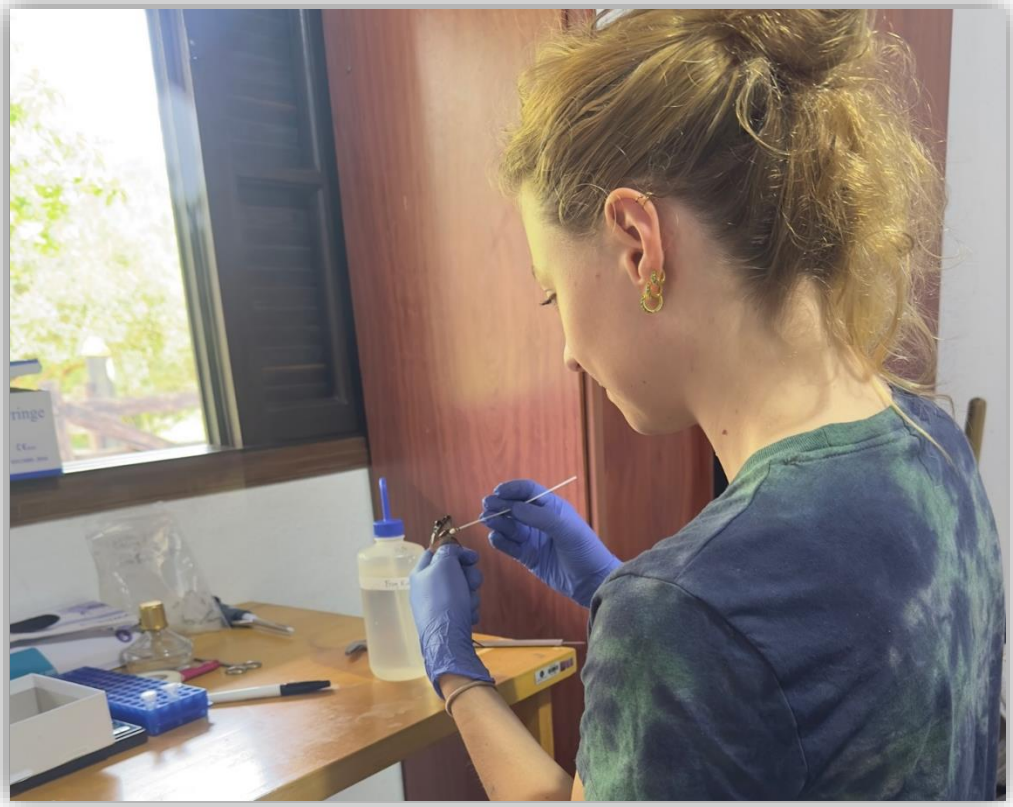
Shannon Buttimer

The beautiful Núcleo Santa Virginia field station on a (rare) sunny day.

This is the field-microbiology lab we set up to culture and count bacteria to use in our field experiments. We converted one of the bathrooms into a "clean room."

A family of capybaras grazing right behind the dorms.

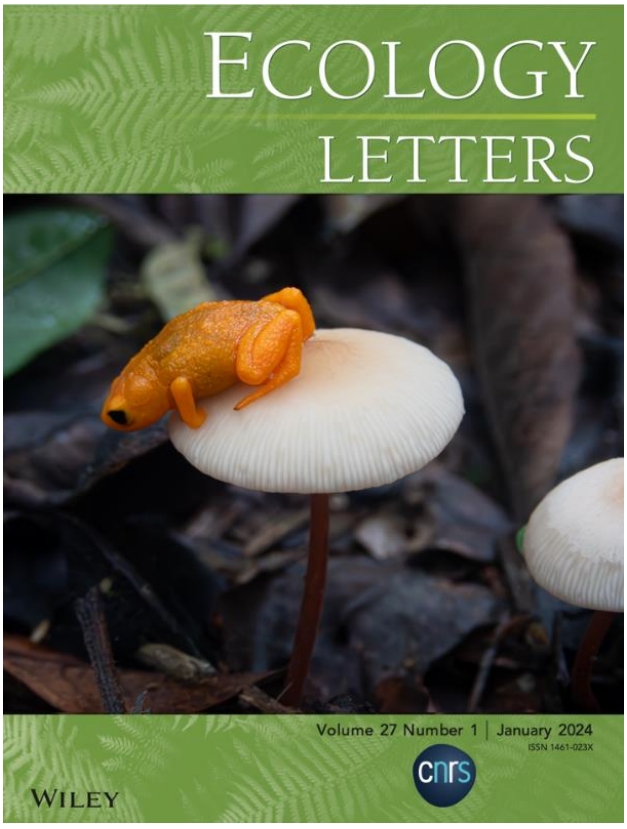
Our experimental mesocosms from the outside. Half of them were covered with transparent tarps to exclude rainfall.



Me swabbing a frog to test it for the amphibian chytrid fungus and to sample its skin microbiome. We wear gloves to protect the frogs and to make sure our skin bacteria aren't contaminating the samples!

Gui, Jack, and I processing frog antimicrobial peptide samples so that our collaborators can test their ability to inhibit the chytrid fungus. From start to finish, the collection and processing takes about an hour per frog, and we like big sample sizes!

Pumpkin toadlets inside one of the enclosures.



A copy of our cover photo of Brachycephalus rotenbergae featured in Ecology Letters.

Recent Ecology Student Awards

Shannon Buttimer: Travel Grant, World Congress of Herpetology

Sarah Richards: Graduate Student International Research Award, The Graduate School at Penn State

Jessica Brown: Evans Family Award for Graduate Student Extension Achievement, Penn State College of Agricultural Sciences

Marissa Kopp: Paul Hand Award for Graduate Student Teaching Achievement, Penn State College of Agricultural Sciences

Emma Rice: Katherine Mabis McKenna Award, Penn State College of Agricultural Sciences

Recent Publications from Ecology Students

Allen, D. C., J. Larson, C. A. Murphy, E. A. Garcia, K. E. Anderson, M. H. Busch, A. Argerich, A. M. Belskis, **K. T. Higgins**, B. E. Penaluna, V. Saenz, J. Jones, and M. R. Whiles. 2024. Global patterns of allochthony in stream–riparian meta-ecosystems. Ecology Letters 27:1–13.

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Ecology students and faculty denoted in bold

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