2023 Pennsylvania Botany Symposium Records

Our 6th biennial Pennsylvania Botany Symposium did it again! It brought together a diverse audience from amateur to student to academic botanists, and those interested in the natural world in general. It was a unique occasion and time to share our work and celebrate our botanical heritage.

A committee of botanists from across the state worked hard to organize this event, rich with:
• hands-on workshop opportunities
• presenters who are leaders in the field
• opportunities for students to engage with professionals

Our invited speakers were carefully selected to share their expertise. Research results were presented, but at a level appropriate for an audience of diverse backgrounds. All of our invited speakers are experts with reputations for being engaging and entertaining:

- Keynote speaker Tanisha Williams, PhD, *University of Georgia Assistant Professor, Department of Plant Biology and Director of the UGA Herbarium*
- Cheyenne Moore, *Pennsylvania Plant Conservation Alliance Coordinator PA Dept. of Conservation and Natural Resources*
- Jason Kilgore, PhD, *Professor of Biology, Washington & Jefferson College* • Anne Francis, Lead Botanist, NatureServe
- Sarah Nilson, PhD and Eric Burkhart, PhD
- Marc Abrams, PhD
- Roger Latham, PhD
- Melissa McCormick, PhD

The 2023 Symposium schedule included:
• Friday, October 20 — full and half-day workshops
• Friday evening social with exhibitors, a student poster session, and an informal presentation
• Saturday, October 21 — full day of presentations on a variety of botanical topics including taxonomy, conservation, ecology, biology, history and floristics

Join our mailing list to receive news of other upcoming PA Botany events in your mailbox. You'll find all of the latest details for what's ahead on this site and our Facebook page.

2023 Symposium Schedule

FRIDAY, OCTOBER 20
9:00 a.m. – 4:30 p.m. Full Day Workshops

Dichanthelium with Claire Ciafre *Ecologist/botanist, Pennsylvania Natural Heritage Program (PNHP) and Western Pennsylvania Conservancy*

Winter Trees and Shrubs with Norris Muth, PhD, *Professor of Biology, Juniata College*

Introduction to Mosses with Scott Schuette, PhD, *Bryologist/Botanist*
Botany Program Manager, Pennsylvania Natural Heritage Program
Western Pennsylvania Conservancy

1:30 – 4:30 p.m. Half Day Workshops

Wetland Plants with Jeff Polonoli, *Senior Project Environmental Scientist, GAI Consultants*

Invasives: Look-Alikes and Management with Brian Daggs, *Western PA Conservancy*

Paleobotany with Peter Wilf, PhD, *Professor, Department of Geosciences*
Penn State University, and His Grad Students

Friday Evening Social • 4:30 –7:30 p.m.

Appetizers (Cash Bar), Student Poster Session and Silent Auction
Documentary Movie and Discussion at 6:30 p.m.
Rooted Wisdom: Nature's Role in the Underground Railroad

SATURDAY, OCTOBER 21

9:00 – 9:10 a.m. Welcome

9:10 – 10:00 a.m. Keynote Address
Partnering to Conserve PA Native Species
Tanisha Williams, PhD, *University of Georgia Assistant Professor, Department of Plant Biology and Director of the UGA Herbarium*
View Tanisha's slide presentation here!

10:00 – 10:40 a.m.
The Plant Conservation Alliance: Changes, Progress, and Plants!
Cheyenne Moore, *Pennsylvania Plant Conservation Alliance Coordinator*
PA Dept. of Conservation and Natural Resources
View Cheyenne's slide presentation here!

10:40 – 11:10 a.m. Break and Exhibitors in Social Hall

11:10 – 11:50 a.m.
Does Herd Immunity Work for Trees? Lessons learned from selective treatment of white ash trees for emerald ash borer on the Allegheny National Forest
Jason Kilgore, PhD, *Professor of Biology, Washington & Jefferson College*
View Jason's slide presentation here!

11:50 a.m. – 12:30 p.m.
Pennsylvania's Ramps: What are they, where do they grow, and should we be concerned?
Sarah Nilson, PhD and Eric Burkhart, PhD
View Sarah and Eric's slide presentation here!

12:30 – 1:30 p.m. Lunch, Last Auction Bids and Exhibitors in Social Hall

1:30 – 2:10 p.m.
Native Americans, Smokey the Bear and the Rise and Fall of Eastern US Fire Ecosystems
Marc Abrams, PhD **View Marc's slide presentation here!**

2:10 – 2:20 p.m. Student Poster Awards

2:20 – 2:40 p.m. BREAK in Exhibitor Hall with Winning Posters and Auction Results

2:40 – 3:20 p.m. Cool Finds with Roger Latham, PhD
View Roger's Cool Finds slide presentation here!

3:20 – 4:00 p.m.
Orchids, fungi, and the surrounding plant community—the wood wide web may be even bigger than we thought
Melissa McCormick, PhD

4:00 p.m.
Adjournment

2023 Symposium Workshop Abstracts

Dichanthelium*. *Claire Ciafre, Instructor. Panicking about the panic grasses? Or are you bewitched by the witchgrasses? Either way, this workshop is for you. Participants will learn about the ~35 species of *Dichanthelium* known from Pennsylvania, including their unique reproductive strategy and where each might be found. Participants will also learn the diagnostic characters necessary for identifying these grasses to species with various dichotomous keys, and will practice keying pressed specimens. A field trip is also planned for the afternoon to observe plants in situ. Dissecting scopes and various dichotomous keys will be provided, but feel free to bring a hand lens and your favorite key if you have one! Participants may also bring specimens of their own to practice on and confirm.

Winter Trees and Shrubs. ***Norris Muth, Instructor.*** If identifying plants sometimes feels a bit like magic to your friends (or to you), then identifying woody plants in winter is pure wizardry. Odds are you know more about what to look for in winter woody ID than you think. The goal of this workshop will be to build on what we know about plant identification (although we are happy to work with all skill levels – no prior knowledge or experience necessary) and to become close observers of trees and shrubs in their winter forms. Learning how to identify wood plants in winter is a skill that not only can extend your survey-season, it also improves your growing-season ID skills, and generally makes you a better and happier person. And it makes you a wizard. While we're at it, let's give this workshop, and your future wizard-like abilities, a cool mystical name, Hibernal Dendrology.

Introduction and Identification of Bryophytes Common to Pennsylvania. ***Scott Schuette, Instructor.*** There are 560 bryophytes taxa in 244 genera across 85 families, which comprises about 14% of the Pennsylvania Flora. They are found in all types of habitats ranging from the pristine to the highly anthropogenic. This workshop is designed to introduce people to the diversity of bryophytes in Pennsylvania through classroom and in the field observations. We will explore the bryophyte lexicon to acquaint participants with the key morphological characters that are used to define families and genera. Using this information as a foundation, we will dive into the defining microscopic features for commonly encountered species. Participants must be comfortable working with microscopes and dissection tools such as razor blades and forceps. A field excursion is planned to demonstrate species in their habitats and proper collecting technique. The collected specimens will be brought back to the classroom for identification and learn the procedure for processing it into an herbarium specimen.

Wetland Plant Identification. ***Jeff Polonoli, Instructor.*** With over three thousand plant species growing within Pennsylvania, it's not surprising most novice wetland delineators struggle with 'taxonomic illiteracy'.

Proficiency in plant identification involves detailed observations, recognizing patterns, and organizing information. Organizing information when observing an unknown plant is where most fall short.

This half day workshop introduces an approach to plant identification where emphasis is placed on learning to distinguish the major plant families prior to memorizing random plant species. The workshop begins with an overview of the content and technical skills necessary to identify plants. Next, participants explore the diagnostic characteristics of plant families while examining pressed specimens of common Pennsylvania wetland plants. Participants will then apply this family first approach to plant identification by sorting and identifying specimens of Pennsylvania's rare and threatened wetland plants and their look alike species. Useful wetland plant identification resources such as technical keys, websites, and phone apps will be highlighted.

The workshop will be taught at the novice level and focus on wetland species, yet anyone interested in improving their plant identification skills while learning to identify some of Pennsylvania's common and protected wetland plant species are welcome.

Identifying Invasives Amongst Their Look-Alikes and the Implications for Management. ***Brian Daggs, Instructor.*** Invasive species remain one of the greatest challenges that conservationists and environmental professionals face today. Non-native plants encroaching on the habitats that we hope to conserve threaten to overcrowd and outcompete native flora, alter the natural disturbance regimes, interrupt critical interactions between plants and wildlife, and hybridize with closely-related native species. Proper management of invasive plants begins with accurate identification of the species that pose a significant risk to native ecosystems.

Brian Daggs has spent the last few years navigating the task of proper invasive plant identification to inform appropriate management decisions. Making the correct species identification can be the difference between quickly eliminating a pioneer population of an aggressive weed or the accidental eradication of a rare native species. In this workshop, Brian will discuss how to identify several invasive plants compared to their closest look-alikes, and how their presence may impact management decisions.

Introduction to Plant Fossils and Paleobotany. *Peter Wilf,Instructor.* Plants provide us with oxygen, food, clothing, and medicine and structure the ecosystems that we live in. Understanding the origins and evolution of our green planet is not only a scientific pursuit—it is fundamental to interpreting our existence. Dr. Peter Wilf and students from the Penn State Paleobotany Lab will introduce participants to paleobotany, fossil plant preservation, and iconic types of plant fossils found in Pennsylvania and around the world. They will then present vignettes from their research that show some of the many ways plant fossils are used to understand the evolution of land plants, landscapes, ecosystems, and biomes of the Earth. The workshop will conclude with a guided lab session wherein participants will examine a representative set of plant fossils from the Penn State teaching collections.

2018 Speaker Presentation Abstracts

Partnering to Conserve PA Native Species. *Tanisha Williams, PhD, Presenter.* Pennsylvania's unique geologic history, including substrates such as serpentinite and limestone, has given rise to impressive levels of plant diversity. Sixty percent of the native species recognized by Pennsylvania's Department of Conservation and Natural Resources are classified as rare, threatened, or endangered. These statuses are often exacerbated by urban development, invasive species, deer browsing, and climate change. To conserve

native species and combat population declines, a natural partnership emerged between Bucknell University, the Pennsylvania Natural Heritage Program, and the Western Pennsylvania Conservancy. The Natural Heritage Program and Western Pennsylvania Conservancy are the boots on the ground: collecting materials, ground-truthing sites, and working with landowners. Bucknell University is the laboratory partner: working mainly with genomics processing and data analyses. Both parties are working together to update the conservation status of rare plants and conserve unique habitats. Through this partnership, the state legislator is using scientifically-informed knowledge to revise the conservation status of this endangered species and address policies to protect its unique habitat.

The Plant Conservation Alliance: Changes, Progress, and Plants! ***Cheyenne Moore, Presenter.*** The Pennsylvania Plant Conservation Alliance started several years ago as a part of the PA Natural Heritage Program. After a brief hiatus, in 2022 the program was restarted with a focus on rare plant conservation, particularly Pennsylvania's globally rare, threatened, and endangered species (G1-G3). This presentation will give an update on species with ongoing work including propagation, population genetics, intensive monitoring, and other research. We'll review some case studies to learn about the PPCA's approach to plant conservation and see some of the progress made. All of this work is done in collaboration with botanic gardens, universities, research institutions, and other partners in conservation. We'll discuss examples of this work and goals for future PPCA work.

Does Herd Immunity Work for Trees? Lessons learned from selective treatment of white ash trees for emerald ash borer on the Allegheny National Forest. ***Jason Kilgore, PhD, Presenter.*** The non-native and invasive emerald ash borer (EAB, *Agrilus planipennis*) has decimated ash (*Fraxinus* spp.) across eastern hardwood forests of North America in two decades, and ash are rapidly approaching functional extirpation throughout the range of EAB invasion. Loss of ash can change the composition and structure of some forests and could lead to a trophic cascade of population crashes by insects dependent on ash. Systemic pesticides can save individual trees; this approach is utilized in urban/suburban areas. These treatments require recurring, costly applications making their use in forest landscapes cost-prohibitive. Infectious disease dynamics, however, point to an alternative wherein selective treatment ("inoculation") of a portion of the ash population may provide a level of herd immunity against EAB to ash trees throughout the landscape. Results thus far from our ongoing study on the Allegheny National Forest suggest that treatment of several hundred white ash trees can preserve most of the genetic diversity and lead to associational protection of untreated ash trees. The long-term effects of *in situ* conservation of ash through judicious application of insecticide, including prevention of ash extinction and conservation of associated insects and functional resource dynamics, are still unfolding.

Pennsylvania's Ramps: What are they, where do they grow, and should we be concerned?
Sarah Nilson, PhD and Eric Burkhart, PhD, Presenters. Ramps (*Allium* spp.) are non-timber forest species traditionally harvested and consumed as a wild food in Pennsylvania. Conservation concerns for ramps have been raised recently due to the growing popularity of ramp foraging and consumption. Previous studies have shown ramp populations recover slowly from extensive harvesting and this has led to bans on ramp digging in some areas. Over the past few years, we have been studying the status of ramp populations across Pennsylvania and have confirmed that at least two ramp species are present in the state, *Allium tricoccum* and *Allium burdickii*. We will discuss key differences in the traits, biology, ranges, habitats, and genetics of these two species. Additionally, we will discuss trends in ramp harvesting and consumption, conservation concerns, and best practices for sustainable ramp harvests.

Native Americans, Smokey the Bear and the rise and fall of eastern US fire ecosystems.
Marc Abrams, PhD, Presenter. A diverse array of fire-adapted plant communities once covered the eastern United States largely due to millennia o Native American active fire management. European settlement

greatly altered fire regimes, often increasing fire occurrence (e.g., in northern hardwoods) or substantially decreasing it (e.g., in tallgrass prairies). Notwithstanding these changes, fire suppression policies, beginning around the 1920s, greatly reduced fire throughout the East, with profound ecological consequences. Fire-maintained open lands converted to closed-canopy forests. As a result of shading, shade-tolerant, fire-sensitive plants began to replace heliophytic (sun-loving), fire-tolerant plants. A positive feedback cycle—which "mesophication"—ensued, whereby microenvironmental conditions (cool, damp, and shaded conditions; less flammable fuel beds) continually improve for shade-tolerant mesophytic species and deteriorate for shade-intolerant, fire-adapted species. Plant communities are undergoing rapid compositional and structural changes, some with no ecological antecedent. Stand-level species richness is declining, and will decline further, as numerous fire-adapted plants are replaced by a limited set of shade-tolerant, fire-sensitive species. As this process continues, the effort and cost required to restore fire-adapted ecosystems escalate rapidly.

Cool Finds Slide Show. ***Curated & Narrated by Roger Latham, PhD*.** Every year plant devotees make fascinating (and occasionally alarming) botanical discoveries in the hills and valleys, forests and grasslands, wetlands and barrens, lakes and rivers, mountaintops and beaches, and even urban environments across the Keystone State. It's a Pennsylvania Botany Symposium tradition to invite all to submit photos and descriptions of "Cool Finds" anywhere in the Commonwealth, mainly within the preceding two years. This presentation will review the latest reports and describe each within the ecological, biogeographical, historical, geological, or cultural context that makes it noteworthy.

Orchids, Fungi, and the Surrounding Plant Community—the wood wide web may be even bigger than we thought. ***Melissa McCormick, PhD.*** Orchids include some of our most prized native plants. All naturally occurring orchids rely on associations with particular mycorrhizal fungi to grow from seeds and for nutrition throughout their lives. This requirement means that orchids can only grow where the specific fungi they need are abundant and available, and it may make them very sensitive to disturbance and environmental change. Knowing what those fungi need to grow is a major key to orchid conservation. We conducted a study of fourteen orchid species in Tioga County, PA in summer 2022. Our aim was to determine whether surrounding plants might be supporting the orchid mycorrhizal fungi that these orchids needed as root endophytes. We used DNA metabarcoding to determine what fungi were present in orchid roots and surrounding plant roots. We found that for over half of the orchids we sampled, their orchid mycorrhizal fungi were also present in the roots of surrounding plants. This suggests a previously unsuspected role for the surrounding plant community in supporting orchids.

2023 Symposium Friday Instructor Bios

Claire Ciafre, is an ecologist with the Pennsylvania Natural Heritage Program at the Western Pennsylvania Conservancy. She has worked as a field botanist since 2013 doing primarily vegetative plant identification for monitoring plots, but she now spends her time on a much wider variety of projects. She earned her MS in biology in 2019 from Austin Peay State University (Clarksville, TN), studying the plant community ecology of isolated wetlands harboring grassland remnants. She has published a variety of works, including the description of a new species of *Rhynchospora*, ecology of rare *Dichanthelium* species, patterns observed in wetland plant community assemblage, and a host list for spotted lanternfly.

Norris Muth, PhD is a Professor of Biology at Juniata College where he teaches courses in Winter Dendrology, Invasive Species, Plant Diversity and Ecology, and Evolutionary Biology.

Scott Schuette, PhD is the Botany Program Manager with the Pennsylvania Natural Heritage Program at the Western Pennsylvania Conservancy. He earned his PhD in plant biology from Southern Illinois University, Carbondale focusing on the evolutionary biology of bryophytes. He is a bryologist, botanist, ecologist, and evolutionary biologist with a passion for conservation of native plant diversity. He has authored several manuscripts in botanical topics ranging from new bryophyte species accounts and regional checklists to the use of social media to document globally imperiled plants in Pennsylvania. His current projects include, rare plant surveys and assessments, reviewing bryophyte species records in Pennsylvania to determine conservation ranks, and plant conservation genetics for three globally rare species endemic to the Appalachian Mountains.

Jeff Polonoli has over 30 years' experience identifying plants in the field. He developed his identification skills while working as an herbarium technician, field botanist for The Nature Conservancy, and acting curator of collections for Phipps Conservatory and Botanical Gardens. He specializes in vegetation monitoring, floristic inventories, and plant mitigation. Having a strong background in education, Jeff served as an Ecology Coordinator for a professional development program instructing teachers on implementing inquiry-based science in the classroom. Currently, Jeff works for an environmental consulting company conducting environmental surveys, wetland delineations, rare plant surveys, and mentoring junior staff.

Brian Daggs grew up in Dillsburg, PA, spending his youth catching insects around his yard and exploring the nearby woodlands. He attended the University of Pittsburgh, earning a double major B.Sc. degree in biological sciences and environmental science. During this time, he worked as a research assistant in the Carson Lab, studying the impacts of invasive species on understory plant communities and habitat succession. After graduating, Brian continued to work on invasive plants as a seasonal ecologist at the Western Pennsylvania Conservancy, which transitioned to a full-time position as the invasive species ecologist within the Pennsylvania Natural Heritage Program.

Peter Wilf, PhD, professor of geosciences at Penn State, is a paleobotanist who uses fossil plants to investigate ancient ecosystems, past environmental change, biogeography, and the evolution and extinction of plants and plant-insect associations. His research emphasizes questions of relevance for modern climate change, biodiversity, biogeography, and conservation. Field work with his students includes Argentina, Vietnam, Indonesia, Brunei, the Western US, and Pennsylvania. Dr. Wilf is a Fellow of the American Association for the Advancement of Science, the Paleontological Society, and the Geological Society of America and a recipient of the Atherton Award for Excellence in Teaching from Penn State.

2023 Symposium Presenter Bios

Tanisha Williams, PhD, presenting *Partnering to Conserve PA Native Species*. Tanisha is an assistant professor in the Department of Plant Biology and Director of the UGA Herbarium. Her research examines the impacts of climate change and uses genomics methods to update the conservation status of rare plants. Prior to joining UGA, Williams was the Richard E. and Yvonne Smith Postdoctoral Fellow at Bucknell University. She earned her doctorate degree in Ecology and Evolutionary Biology from the University of Connecticut. She is the founder of Black Botanists Week, a campaign to amplify diverse voices in botany. She is also the recipient of the 2023 Bicentenary Medal from The Linnean Society. Originally from Washington, DC, Williams enjoys hiking and traveling.

Cheyenne Moore, presenting *The Plant Conservation Alliance: Changes, Progress, and Plants!* After earning a B.S. in Biology from Dickinson College, Cheyenne received her M.S. in Biology from Bucknell University where she worked on conservation and genetics of Pennsylvania's threatened, rare, and endangered plant

taxa. She is now the Pennsylvania Plant Conservation Alliance Coordinator for the PA Dept. of Conservation and Natural Resources and the PA Natural Heritage Program. In this role she facilitates the conservation of Pennsylvania's globally rare, threatened, and endangered plants.

Jason Kilgore, PhD, presenting *Does Herd Immunity Work for Trees? Lessons learned from selective treatment of white ash trees for emerald ash borer on the Allegheny National Forest.* Jason is Professor of Biology and Curator of the Campus Arboretum at Washington & Jefferson College. His research focuses on plant community responses to environmental change, including novel species and other disturbances. Jason collaborates with scientists from the Northern Research Station (USDA Forest Service) and Ecological Research as Education Network (EREN). Jason teaches courses in field biology, forest ecology, water resources, biostatistics, and immigration issues. In addition to experience as a natural resource consultant, Jason earned degrees from Michigan State University in Environmental Science (BS), Conservation & Environmental Management (BS), Dendroecology (MS), and Biogeography & Ecophysiology of Ponderosae (PhD).

Sarah Nilson, PhD and Eric Burkhart, PhD, presenting *Pennsylvania's Ramps: What are they, where do they grow, and should we be concerned?*
Dr. Sarah Nilson is an Assistant Professor of Biology at Penn State Beaver. She is a plant biologist who studies interdisciplinary research questions relating to wild plant conservation and agroforestry. Her work spans population genetics, plant physiology, taxonomy, and ethnobotany. Her current research addresses conservation and agroforestry of culturally and economically significant non-timber forest species and other wild plants including American ginseng (*Panax quinquefolium*), goldenseal (*Hydrastis canadensis*), ramps/wild leek (*Allium tricoccum*), and wild bleeding heart (*Dicentra eximia*).
Dr. Eric Burkhart is the Director of Appalachian Botany and Ethnobotany at Shaver's Creek Environmental Center and an Associate Teaching Professor in the Department of Ecosystem Science and Management at Penn State. His group conducts research on questions relating to Appalachian Forest botany, ethnobotany, ecology, phytochemistry, horticulture, agroforestry, and invasive forest plants. Burkhart's research to date has focused on four culturally and economically important eastern North American forest plants: American ginseng (*Panax quinquefolius*), goldenseal (*Hydrastis canadensis*), ramps/wild leek (*Allium tricoccum*), and ghost-pipe (*Monotropa uniflora*).

Marc Abrams, PhD, presenting *Native Americans, Smokey the Bear and the rise and fall of eastern US fire ecosystems.* Marc recently retired from Penn State University's Department of Ecosystem Science and Management where he taught courses in Forest Ecology and Tree Physiology, advised more than two dozen graduate students and served as Editor for multiple ecological and forestry journals. His current research is focused on global change ecology and the impacts of indigenous people. He is widely known for his studies in disturbance ecology, old-growth forests, tree physiology and vegetation classification.

Roger Latham, PhD, Cool Finds Slide Show Curator & Narrator. Roger has worked as a research ecologist, conservation biologist, and environmental planner since the year the Endangered Species Act was passed (1973). After earning a Ph.D. in biology at the University of Pennsylvania, he served as Pennsylvania Director of Science and Stewardship for The Nature Conservancy, post-doctoral researcher in biogeochemistry and fire ecology in Penn's Department of Geology, and faculty member in the Department of Biology at Swarthmore College. For the last 23 years he has been a full-time consultant, conducting applied research and planning for agencies and organizations involved in wildlands stewardship and endangered species recovery.

Melissa McCormick, PhD, presenting *Orchids, Fungi, and the Surrounding Plant Community—the wood wide web may be even bigger than we thought.* Dr. Melissa McCormick is an Ecologist at the Smithsonian

Environmental Research Center, where she has studied orchids and other plants since 1999. She uses a combination of field and DNA-based techniques to study orchid-fungus interactions, orchid conservation, and plant invasions. Her main research focus is on how mycorrhizal fungi affect orchid rarity and distribution. She is also one of the founding members of the North American Orchid Conservation Center (NAOCC), a pioneering initiative to link botanic gardens, land managers, and researchers to conserve all the native orchids of North America.

2023 UNDERGRADUATE STUDENT RESEARCH POSTER ABSTRACTS

Title: Tree Distributions and Responses in Relation to Soil Characteristic and Topographic Differences in a Premontane Rainforest
Presenter: Jenna Baljunas, Chatham University
Coauthors: A.T. Cahill, Texas A&M University, Department of Civil & Environmental Engineering; A. Dunnebacke, Michigan State University, Department of Forestry; G. Moore, Georgia Southern University, Department of Biology; K. Brumbelow, Texas A&M University, Department of Multidisciplinary Engineering; A. P. Smith, Texas A&M University, Department of Soil & Crop Sciences
Abstract: Future climate changes may have a significant impact on ecosystem composition in montane tropical rain forests. Because of the relationship between elevation and microclimate, potential future impacts can be investigated through the present effects of elevation and topographic gradients on landscape characteristics such as vegetation and physical soil properties. While there is a general understanding of species migration in response to microclimate changes, site-specific analyses are still required, especially given underlying geologic differences. With knowledge that topography influences hydrologic processes and patterns as well as species distributions and traits, this study used geostatistical analysis to discover current elevational impacts on soil and vegetation in an undisturbed premontane tropical rainforest in Costa Rica. A land surface elevation model was generated using azimuth, horizontal distances, and vertical distances between grid points of a 30 x 30-meter gridded plot measured by a clinometer. We performed 25 soil moisture, bulk density, and texture analyses, along with the determination of diameter at breast height (DBH) and locations of previously tagged trees. Soil properties and tree locations were then mapped. Empirical variograms for the soil textural properties were calculated and used to develop a kriging model for the soil characteristics field. Although the spatial intermittency of large trees at the site led to sampling issues, results show associations between the soil field and the vegetation field. Kriging models suggest interactions between trees and soil moisture and bulk density and reveal the influence of moisture on the distribution patterns of *Carapa guianensis*. Overall size distribution suggests an uneven-aged stand which can relate to the topographical changes, such as slope, observed. Some potential implications of the results on future changes in landscape are also discussed, as well as limitations of the modeling approach.

Title: Weather-induced Flower Closure in Spring Ephemeral Forest Wildflowers and its effect on Pollen Viability
Presenter: Megan Gauger, University of Pittsburgh, Carnegie Museum of Natural History
Coauthors: Mason Heberling, Carnegie Museum of Natural History
Abstract: This project seeks to understand how temperature, light, rain, and time of day affect day-to-day petal movement in three spring ephemeral wildflower species common across Eastern Deciduous Forests of North America; (*Claytonia virginica* (Montiaceae; spring beauty), *Sanguinaria canadensis* (Papaveraceae; bloodroot), and *Erythronium americanum* (Lilliaceae; yellow trout lily)). Additionally, this project experimentally tests the functional effects of flower opening and closure on fruiting success. Two hypotheses were tested: 1) Species will close their petals at night and reopen only at a certain threshold (temperature, wetness, and/or light levels) in order to protect pollen, and 2) Weather-induced flower petal opening/closing increases pollen viability, therefore improving fruiting success.

At a wildflower-rich field site outside of Pittsburgh, we monitored mature flowers using field cameras programmed to capture images every 30 minutes. Footage was analyzed to determine how each petal opened, which was paired with local atmospheric and abiotic data.

We also experimentally manipulated flower petals to test the effect of permanent petal opening on pollen viability. Multiple organisms of *Sanguinaria canadensis* (Papaveraceae; bloodroot) and *Erythronium americanum* (Lilliaceae; yellow trout lily) were organized into four groups; one group of total petal removal, another of petal cutting, a total control where the flowers were not modified, and a secondary control where petals were lightly crushed to account for the effect of general petal damage.

We found that flowers were at peak openness between noon and 2pm and were never fully open before noon. Flowers never opened when the local temperature was below 9°C or when leaf wetness was greater than 4%. Flowers were fully open at atmospheric temperatures above 13°C, with most fully open around 20°C. From these preliminary results, we can conclude that both moisture levels and atmospheric temperature play a role in the opening and closing cycles of spring ephemerals.

Title: An anatomical analysis of vessel element size and density in shrub willow (*Salix* spp.) stems in response to nitrogen treatments
Presenter: Sara Hallameyer, Alvernia University
Coauthors: Michelle Serapiglia, Alvernia University
Abstract: As technology advances and the human population grows, renewable energy sources and sustainability have become more important to keep the world running and habitable. Plants are one of the largest sources of biomass in the world and the majority of its biomass comes from the cell wall. Cell wall development is a complex process in providing a plant structural integrity and protection against abiotic and biotic stressors. Trees and woody plants, like shrub willow, have the potential to reduce our dependence on fossil fuels by conversion to renewable forms of energy and natural products. Plant biomass consists of manly cellulose and lignin, two of the vital components in the cell wall that respond to changes in the environment. Nitrogen is a critical nutrient to plants and is found in many fertilizers to assist in plant growth. The goal of this project was to examine changes in cell wall development in willow in response to various nitrogen treatments. Cell wall changes were observed using fluorescent microscopy of thin sections of plant stem tissue. Various staining methods were used in order to visualize structural changes in the cell wall. Tissue samples were also analyzed via electron microscopy. Vessel element size and density were analyzed across the treatments. Images, along with these data, will be presented.

Title: Plant and fungi inhibitors of autoinducing peptides in methicillin-resistant *Staphylococcus aureus* (MRSA)
Presenter: Amelia Hanson, The Pennsylvania State University
Coauthors: Teal Jordan, The Pennsylvania State University; Joshua J Kellogg, The Pennsylvania State University
Abstract: Due to the widespread use of antibiotics to treat bacterial infections, pathogenic bacteria like methicillin-resistant *Staphylococcus aureus* (MRSA) are well known to develop resistance to current antibiotic therapies, which poses a serious threat to public health. The peptide signaling system of MRSA, *Staphylococcus aureus* accessory gene regulator (agr), secretes many destructive virulent agents and is activated by cyclic peptides known as autoinducing peptides or AIPs. An anti-virulence approach to bacterial treatment has been proposed that limits toxin production through inhibition of AIP with the goal of lowering the severity of bacterial infections while allowing the body to rid itself of infection without the development of resistance. Natural resources, especially plants, hold possible small molecules capable of combating antibiotic resistance and thus contribute to the development of new classes of antibiotics. In this study we tested 39 plants and fungi, some North American native plants and some widely used plants and fungi of

commerce, for their antibacterial and AIP inhibitory activity via a rapid, quantitative liquid chromatography-mass spectrometry (LC-MS) method. Several of the plants surveyed have shown reduction in quorum sensing peptides; two of the most noteworthy being *Inonotus obliquus* at 62.41% AIP inhibition and *Typha* species at 63.19%.

Title: Multi-method sampling of ground and canopy-dwelling insects in temperate deciduous trees
Presenter: Brianna A. Hoffman, Washington & Jefferson College
Coauthors: Jason S. Kilgore, Washington & Jefferson College
Abstract: Individual trees provide a range of niche habitats from the ground into the canopy. Research conducted in temperate forest canopies suggests that biodiverse insect communities exist but remain understudied, especially when compared to tropical regions. We are investigating the change in insect community from the ground to the canopy in temperate deciduous trees.

As part of a developing collaboration called ARBOREAL between primarily undergraduate institutions (PUIs) dedicated to temperate forest canopy research, we developed and piloted protocols to survey canopy- and ground-dwelling insect biodiversity in deciduous trees. In Fall 2022, we used a large pin oak (*Quercus palustris*) on a college campus to practice stationary-rope climbing, to perform diurnal sweep net surveys, and to conduct nocturnal surveys using a suspended blacklight bucket trap. We also selected a large northern red oak (*Q. rubra*) in a mesophytic forest in southwestern Pennsylvania to survey ground-dwelling insect communities using a modified NEON pitfall trap protocol. In Fall 2023, we placed insect flight interception traps, game cameras, and temperature data loggers in the lower, middle, and upper canopy of this tree as part of a one-year ARBOREAL pilot study.

All insects collected in Fall 2022 were identified to the lowest possible taxonomy. Pitfall trap collections consisted of members belonging to the families Carabidae, Gryllinae, and Formicidae, while nocturnal blacklight traps captured insects belonging to the orders Lepidoptera, Orthoptera, and Coleoptera; due to cold weather, no insects were captured during the diurnal sweep net survey. Pitfall traps were the most consistent collection method. Diurnal sweep net surveys require training and supervision in tree climbing; however, lower branches and smaller trees could be more accessible using modified collection methods such as a telescoping net. This Fall, we continue to collect data from the insect flight interception traps, game cameras, and temperature loggers within the three canopy strata.

Title: Using Herbaria to Track Phenology Changes in *E. americanum*
Presenter: Peter Kaires, East Stroudsburg University
Coauthors: Emily Rollinson, East Stroudsburg University
Abstract: Climate change is altering environmental conditions for many organisms and ecological communities, potentially leading to changes in the natural history of many species. Many phenological shifts have been documented in response to changing seasonal patterns, including shifts to earlier flowering time in many plant species. Spring ephemeral plant species such as the yellow trout lily are of particular interest in studying flowering time phenology as they are some of the first plants to arise in the spring and their entire life cycle is completed not long after flowering. We assess phenological change in yellow trout lilies by examining herbarium specimens from 1890 to present from the ESU Buser Herbarium and 26 additional herbaria, accessed via The Global Biodiversity Information Facility (GBIF). To explain current-day variation in flowering time among yellow trout lilies in eastern Pennsylvania, we also examined the relationship between flowering time and local temperatures, using iNaturalist observations and PRISM climate models.

Title: Is the widely-cultivated katsura-tree (*Cercidiphyllum japonicum*, Cercidiphyllaceae) an invasion threat in Pennsylvania?
Presenter: Kayleigh Long, Bucknell University

Coauthors: Melody Sain, Bucknell University; Christopher Martine, Bucknell University
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Title: Zinc tolerance of fernleaf bleeding heart (*Dicentra eximia*), a Pennsylvania endangered plant.
Presenter: Shaniah Miller, The Pennsylvania State University – Beaver
Coauthors: Sarah Nilson, The Pennsylvania State University – Beaver
Abstract: Fernleaf bleeding heart (*Dicentra eximia*) is a perennial plant native to the Appalachian Mountains, ranging from Pennsylvania to Georgia. In Pennsylvania, the species is listed as critically imperiled (S1), but two counties have multiple, thriving populations of 10,000+ individuals: Beaver County in western PA (out-of-range) and Carbon County in eastern PA. These counties share a history of industrial zinc smelting, heavy metal emissions, and heavy metal soil pollution. To determine whether *Dicentra eximia* displays tolerance to high levels of soil zinc, we measured soil zinc, foliar zinc, and took photosystem II stress measurements at three sites in Beaver County. Our results indicate that *Dicentra eximia* is capable of thriving in soils with extremely high levels of zinc, up to 2,000 ppm, as well as accumulating zinc in their shoots, up to 1,000 mg/kg dry shoot mass with minimal impact on plant stress. Due to its apparent zinc tolerance, *Dicentra eximia* may be a species of interest for bioremediation efforts throughout Appalachia at zinc contaminated sites.

Title: Determining the Effects of a Changing Climate on Phenology of a Dioecious Shrub
Presenter: Chris Perrone, University of Pittsburgh
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Abstract: While plant phenology has been an increasing area of study in the context of plant responses to climate change, potential differences between plant sexes are often ignored for dioecious species, plants which have male and female reproductive parts on separate individuals. If males and females respond differently to warmer springs, the period of overlap for pollination, and therefore successful reproduction, may decrease. Here, we combined field observations and herbarium specimen data of common spicebush (*Lindera benzoin*), a common forest shrub found across Pennsylvania. We asked whether males and females respond differently in flowering times in response to changes in mean annual spring temperature. We scored over 500 herbarium specimens from 5 different herbaria. We found males and females seem to have similar phenological responsiveness to increases in temperature. Despite similar responses with spring temperatures, males seem to generally flower earlier than females. We surprisingly found strong sex biases in the herbarium record, with the majority of individuals collected in flower being male. The extent of the sex bias seen in the herbarium varied between herbaria. However, we surveyed local populations in a southwestern PA forest and found most populations exhibited 1:1 sex ratios. Further studies are needed to understand whether the strong sex bias we found in herbarium record is representative of natural populations

or reflect bias by plant collectors. Future phenological studies involving dioecious species should consider the possibility of different responses to climate change between male and female individuals.

Title: The Effect of Fire on Northern Red Oak Regeneration
Presenter: Abigail Powell, Duquesne University
Coauthors: Natalie Cleavitt, Cornell University
Abstract: This research project investigates the impact of fire on soil biota and Northern Red Oak regeneration. Oak regeneration is widely recognized to be difficult to execute for numerous reasons, including the presence of soil-fungal pathogens. Previous research has found a decrease in fungal pathogens following fire. This suggests that prescribed forest fire may be a useful tool in regenerating oak though little research has been done previously to fully support this hypothesis. An ex-situ experimental design was used to eliminate the influence that abiotic features of fire (charcoal presence, decreased leaf litter) may have on oak seedling development. Ten acorns were planted in pots containing soil from a burn site, ten acorns were planted in pots containing unburned soil, and five acorns were planted in a potting mix control. All seedlings received equal water and light. A qualitative measurement taken after the first month of development showed that seedlings in the burned soil developed faster than seedlings in the unburned and control soils. Measurements taken after the second and third months show that the seedlings in burned soil developed thicker stems as well. The growth difference between the seedlings in burned soil and the seedlings in unburned soil may be explained by a difference in soil pathogens. Fire may act as a natural sterilization process, eliminating harmful biota from soil. Thus, oaks growing in fire-influenced soil will have more energy to put towards growth than the seedlings in other soils. These findings suggest that fire can be a valuable tool when planning to incorporate oak into forests.

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Title: Tiny Forest Carbon Sequestration
Presenter: Catherine Segada, Mercyhurst University
Coauthors: Christopher Dolanc, Mercyhurst University
Abstract: Urban Nature can be defined as green space, either formal or informal, that is held within an urban setting. These spaces are not only vital to the quality of life of urban residents but also to the greater

biosphere. Due to the recent worldwide scientific interest in Urban Nature, more specifically, Miyawaki Forests (Tiny Forests), it is important to determine how much carbon they can sequester. The Mercyhurst University Tiny Forest, planted in the Winter of 2021, is 20 x 11 m and originally hosted 640 trees. We asked, how much carbon can the Tiny Forest sequester in comparison to the amount of carbon emitted from Mercyhurst University? In June-August of 2023, tree diameter and heights were measured on all 580 living trees at the Tiny Forest. We used i-Tree Planting software to calculate carbon (C) sequestered using current dbh and projected future C sequestered at 50, 75, and 99 years using predicted dbh. A comparison between the amount of C sequestered in the Tiny Forest and the amount of C emitted through campus buildings was carried out. From the time it was planted through July of 2023, the Mercyhurst Tiny Forest sequestered 10,987.1 kg of carbon at 3 years, and is projected to sequester 2,204,932.6 kg of carbon at 50 years, 2,658,987.6 kg of carbon at 75 years, and 2,008,632.8 kg of carbon at 99 years. In comparison, Mercyhurst's largest dorm, Warde Hall, emits 300,000 kg of CO^2e annually. It would take 8 years for Warde Hall to emit the same amount of carbon that it will take the Tiny Forest 50 years to sequester. If carbon neutrality is the goal, our findings highlight the importance of increasing tree mass and carbon sequestration efforts on college campuses.

Title: The chemical cue of a parasite accelerates the chemical defense of tall goldenrod (*Solidago altissima* L.)
Presenter: Lily Sudol, The Pennsylvania State University
Coauthors: Robert Witkowski, The Pennsylvania State University; Eric Yip, The Pennsylvania State University;
John Tooker, The Pennsylvania State University; Tanya Renner, The Pennsylvania State University
Abstract: Plants rely on environmental information to detect threats. Chemical cues associated with certain herbivores trigger plant chemical defenses in preparation for a later challenge, a phenomenon known as priming. Induced phytohormones including jasmonic acid (JA) and salicylic acid (SA) coordinate defense responses after priming. The relationship between the Pennsylvania native wildflower tall goldenrod, *Solidago altissima* L. (Asteraceae: Astereae), and the parasitic goldenrod gall fly, *Eurosta solidaginis* Fitch (Diptera: Tephritidae), is an example of an interaction mediated by chemical signals. Before mating, male *E. solidaginis* emit an airborne sex pheromone that primes *S. altissima*, alerting the plant that a parasitic gall attack is imminent. Studies have shown that specialist herbivory and gall formation rate decreases on primed *S. altissima*. However, the primed state of *S. altissima* is not well described. The reaction of primed *S. altissima* plants to generalist herbivory is not known, especially their defense hormone induction over time. We hypothesized that primed plants will rapidly induce JA-mediated chemical defense following insect herbivory and that JA levels will remain higher and last longer during herbivory than in an unexposed plant. We conducted a 48 h generalist herbivory feeding assay on *S. altissima* plants exposed to the pheromone of *E. solidaginis*. From damaged leaf tissue we quantified the defense hormones JA, SA, and abscisic acid (ABA) from with vapor phase extraction and subsequent gas chromatography-coupled mass spectrometry (GC-MS). Primed plant JA levels peaked 24 h before plants that were not exposed to the priming cue. SA levels were not significantly different across either time points and treatments, nor were ABA levels. Primed plants appeared to have an accelerated defense response to a chewing generalist insect. Interestingly, this indicates that a parasitic specialist's cue influences plant defense against unrelated herbivores. Our results illuminate the complexities of environmental signaling across trophic levels.

Title: Delimiting Varieties in *Cerastium velutinum*
Presenter: Juliana Sweeney, Delaware Technical Community College
Coauthors: Chris Hoess, Delaware Technical Community College
Abstract: Large field mouse-ear chickweed (*Cerastium velutinum*) is a member of the *C. arvense* species complex endemic to the Appalachian floristic province. Goat Hill chickweed (*C. velutinum* var. *villosissimum*) has been described from a mid-Atlantic serpentine barrens, but is difficult to cleanly delineate from the typical variety. A population in northern New Jersey has also been ascribed to this variety, but is clearly

distinct in habitat and possibly in morphology. Morphologically and ecologically diverse collections have been made to form the basis of an initial molecular phylogeny using existing nuclear markers. Introns from *Cerastium* RNA polymerase paralogs have been amplified by PCR and cloned for sequencing to determine placement in existing phylogenies of the genus. This will allow us to analyze the likely origins of these populations and help determine an appropriate conservation status.

Title: Factors limiting reproduction in the Pennsylvania endangered dwarf iris, *Iris verna*
Presenter: Leslie Taylor, Shippensburg University
Coauthors: Heather Sahli, Shippensburg University
Abstract: The conservation of local biodiversity has gained importance in recent years as threats from climate change increase. Multiple factors including pollinator decline, inbreeding due to isolated and small populations, irregular and unnatural fire regimes, and more, are potential reasons for why some plant species are decreasing in abundance and quality across the world. *Iris verna*, a state endangered wildflower at the northernmost tip of its range, has been located and studied in Michaux State Forest, Pennsylvania. Since very little is known about the species, research on the factors limiting reproduction was conducted during the spring and summer months of 2023. Hand pollination using pollen from different origins was conducted, as well as pollen viability tests. Additionally, one site had experienced a controlled burn earlier in the year, so that population's fruit and seed production was compared to the fruit and seed production of the other two populations which were not burned. The likelihood of individuals setting fruits only significantly differed between populations ($\chi^2 = 9$, df = 2, P = 0.01), suggesting possible resource inequality. Pollen crosses from the same and different populations overall increased the amount of fruit and seed production, but the origin of the pollen produced no difference, suggesting that bi-parental inbreeding depression likely is not causing low seed production. Effects of the controlled burn were not observed, suggesting fire does not increase fruit and seed production, at least right away. The viability of *I. verna* pollen from numerous individuals varied greatly, but there was no significant difference between the populations ($\chi^2 = 0.97$, df = 2, P = 0.62), leaving a concern for the viability of some individuals. This research improved knowledge and understanding of *I. verna* factors limiting reproduction (pollinator limitations and nutrient and light limitations) and has implications for how best to conserve the species.

Title: Weather-induced Flower Closure in Spring Ephemeral Forest Wildflowers and its effect on Pollen Viability
Presenter: Megan Gauger, University of Pittsburg, Carnegie Museum of Natural History
Coauthors: Mason Heberling, Carnegie Museum of Natural History
Abstract: This project seeks to understand how temperature, light, rain, and time of day affect day-to-day petal movement in three spring ephemeral wildflower species common across Eastern Deciduous Forests of North America; (*Claytonia virginica* (Montiaceae; spring beauty), *Sanguinaria canadensis* (Papaveraceae; bloodroot), and *Erythronium americanum* (Lilliaceae; yellow trout lily)). Additionally, this project experimentally tests the functional effects of flower opening and closure on fruiting success. Two hypotheses were tested: 1) Species will close their petals at night and reopen only at a certain threshold (temperature, wetness, and/or light levels) in order to protect pollen, and 2) Weather-induced flower petal opening/closing increases pollen viability, therefore improving fruiting success.

At a wildflower-rich field site outside of Pittsburgh, we monitored mature flowers using field cameras programmed to capture images every 30 minutes. Footage was analyzed to determine how each petal opened, which was paired with local atmospheric and abiotic data.

We also experimentally manipulated flower petals to test the effect of permanent petal opening on pollen viability. Multiple organisms of *Sanguinaria canadensis* (Papaveraceae; bloodroot) and *Erythronium americanum* (Lilliaceae; yellow trout lily) were organized into four groups; one group of total petal removal,

another of petal cutting, a total control where the flowers were not modified, and a secondary control where petals were lightly crushed to account for the effect of general petal damage.

We found that flowers were at peak openness between noon and 2pm and were never fully open before noon. Flowers never opened when the local temperature was below 9°C or when leaf wetness was greater than 4%. Flowers were fully open at atmospheric temperatures above 13°C, with most fully open around 20°C. From these preliminary results, we can conclude that both moisture levels and atmospheric temperature play a role in the opening and closing cycles of spring ephemerals.

Title: An anatomical analysis of vessel element size and density in shrub willow (*Salix* spp.) stems in response to nitrogen treatments
Presenter: Sara Hallameyer, Alvernia University
Coauthors: Michelle Serapiglia, Alvernia University
Abstract: As technology advances and the human population grows, renewable energy sources and sustainability have become more important to keep the world running and habitable. Plants are one of the largest sources of biomass in the world and the majority of its biomass comes from the cell wall. Cell wall development is a complex process in providing a plant structural integrity and protection against abiotic and biotic stressors. Trees and woody plants, like shrub willow, have the potential to reduce our dependence on fossil fuels by conversion to renewable forms of energy and natural products. Plant biomass consists of manly cellulose and lignin, two of the vital components in the cell wall that respond to changes in the environment. Nitrogen is a critical nutrient to plants and is found in many fertilizers to assist in plant growth. The goal of this project was to examine changes in cell wall development in willow in response to various nitrogen treatments. Cell wall changes were observed using fluorescent microscopy of thin sections of plant stem tissue. Various staining methods were used in order to visualize structural changes in the cell wall. Tissue samples were also analyzed via electron microscopy. Vessel element size and density were analyzed across the treatments. Images, along with these data, will be presented.

Title: Plant and fungi inhibitors of autoinducing peptides in methicillin-resistant *Staphylococcus aureus* (MRSA)
Presenter: Amelia Hanson, The Pennsylvania State University
Coauthors: Teal Jordan, The Pennsylvania State University; Joshua J Kellogg, The Pennsylvania State University
Abstract: Due to the widespread use of antibiotics to treat bacterial infections, pathogenic bacteria like methicillin-resistant *Staphylococcus aureus* (MRSA) are well known to develop resistance to current antibiotic therapies, which poses a serious threat to public health. The peptide signaling system of MRSA, *Staphylococcus aureus* accessory gene regulator (agr), secretes many destructive virulent agents and is activated by cyclic peptides known as autoinducing peptides or AIPs. An anti-virulence approach to bacterial treatment has been proposed that limits toxin production through inhibition of AIP with the goal of lowering the severity of bacterial infections while allowing the body to rid itself of infection without the development of resistance. Natural resources, especially plants, hold possible small molecules capable of combating antibiotic resistance and thus contribute to the development of new classes of antibiotics. In this study we tested 39 plants and fungi, some North American native plants and some widely used plants and fungi of commerce, for their antibacterial and AIP inhibitory activity via a rapid, quantitative liquid chromatography-mass spectrometry (LC-MS) method. Several of the plants surveyed have shown reduction in quorum sensing peptides; two of the most noteworthy being *Inonotus obliquus* at 62.41% AIP inhibition and *Typha* species at 63.19%.

Title: Multi-method sampling of ground and canopy-dwelling insects in temperate deciduous trees
Presenter: Brianna A. Hoffman, Washington & Jefferson College

Coauthors: Jason S. Kilgore, Washington & Jefferson College
Abstract: Individual trees provide a range of niche habitats from the ground into the canopy. Research conducted in temperate forest canopies suggests that biodiverse insect communities exist but remain understudied, especially when compared to tropical regions. We are investigating the change in insect community from the ground to the canopy in temperate deciduous trees.

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Coauthors: Christopher Dolanc, Mercyhurst University
Abstract: Urban Nature can be defined as green space, either formal or informal, that is held within an urban setting. These spaces are not only vital to the quality of life of urban residents but also to the greater biosphere. Due to the recent worldwide scientific interest in Urban Nature, more specifically, Miyawaki Forests (Tiny Forests), it is important to determine how much carbon they can sequester. The Mercyhurst University Tiny Forest, planted in the Winter of 2021, is 20 x 11 m and originally hosted 640 trees. We asked, how much carbon can the Tiny Forest sequester in comparison to the amount of carbon emitted from Mercyhurst University? In June-August of 2023, tree diameter and heights were measured on all 580 living trees at the Tiny Forest. We used i-Tree Planting software to calculate carbon (C) sequestered using current dbh and projected future C sequestered at 50, 75, and 99 years using predicted dbh. A comparison between

the amount of C sequestered in the Tiny Forest and the amount of C emitted through campus buildings was carried out. From the time it was planted through July of 2023, the Mercyhurst Tiny Forest sequestered 10,987.1 kg of carbon at 3 years, and is projected to sequester 2,204,932.6 kg of carbon at 50 years, 2,658,987.6 kg of carbon at 75 years, and 2,008,632.8 kg of carbon at 99 years. In comparison, Mercyhurst's largest dorm, Warde Hall, emits 300,000 kg of CO^2e annually. It would take 8 years for Warde Hall to emit the same amount of carbon that it will take the Tiny Forest 50 years to sequester. If carbon neutrality is the goal, our findings highlight the importance of increasing tree mass and carbon sequestration efforts on college campuses.

Title: The chemical cue of a parasite accelerates the chemical defense of tall goldenrod (*Solidago altissima* L.)
Presenter: Lily Sudol, The Pennsylvania State University
Coauthors: Robert Witkowski, The Pennsylvania State University; Eric Yip, The Pennsylvania State University; John Tooker, The Pennsylvania State University; Tanya Renner, The Pennsylvania State University
Abstract: Plants rely on environmental information to detect threats. Chemical cues associated with certain herbivores trigger plant chemical defenses in preparation for a later challenge, a phenomenon known as priming. Induced phytohormones including jasmonic acid (JA) and salicylic acid (SA) coordinate defense responses after priming. The relationship between the Pennsylvania native wildflower tall goldenrod, *Solidago altissima* L. (Asteraceae: Astereae), and the parasitic goldenrod gall fly, *Eurosta solidaginis* Fitch (Diptera: Tephritidae), is an example of an interaction mediated by chemical signals. Before mating, male *E. solidaginis* emit an airborne sex pheromone that primes *S. altissima*, alerting the plant that a parasitic gall attack is imminent. Studies have shown that specialist herbivory and gall formation rate decreases on primed *S. altissima*. However, the primed state of *S. altissima* is not well described. The reaction of primed *S. altissima* plants to generalist herbivory is not known, especially their defense hormone induction over time. We hypothesized that primed plants will rapidly induce JA-mediated chemical defense following insect herbivory and that JA levels will remain higher and last longer during herbivory than in an unexposed plant. We conducted a 48 h generalist herbivory feeding assay on *S. altissima* plants exposed to the pheromone of *E. solidaginis*. From damaged leaf tissue we quantified the defense hormones JA, SA, and abscisic acid (ABA) from with vapor phase extraction and subsequent gas chromatography-coupled mass spectrometry (GC-MS). Primed plant JA levels peaked 24 h before plants that were not exposed to the priming cue. SA levels were not significantly different across either time points and treatments, nor were ABA levels. Primed plants appeared to have an accelerated defense response to a chewing generalist insect. Interestingly, this indicates that a parasitic specialist's cue influences plant defense against unrelated herbivores. Our results illuminate the complexities of environmental signaling across trophic levels.

Title: Delimiting Varieties in *Cerastium velutinum*
Presenter: Juliana Sweeney, Delaware Technical Community College
Coauthors: Chris Hoess, Delaware Technical Community College
Abstract: Large field mouse-ear chickweed (*Cerastium velutinum*) is a member of the *C. arvense* species complex endemic to the Appalachian floristic province. Goat Hill chickweed (*C. velutinum* var. *villosissimum*) has been described from a mid-Atlantic serpentine barrens, but is difficult to cleanly delineate from the typical variety. A population in northern New Jersey has also been ascribed to this variety, but is clearly distinct in habitat and possibly in morphology. Morphologically and ecologically diverse collections have been made to form the basis of an initial molecular phylogeny using existing nuclear markers. Introns from *Cerastium* RNA polymerase paralogs have been amplified by PCR and cloned for sequencing to determine placement in existing phylogenies of the genus. This will allow us to analyze the likely origins of these populations and help determine an appropriate conservation status.

Title: Factors limiting reproduction in the Pennsylvania endangered dwarf iris, *Iris verna*
Presenter: Leslie Taylor, Shippensburg University

Coauthors: Heather Sahli, Shippensburg University
Abstract: The conservation of local biodiversity has gained importance in recent years as threats from climate change increase. Multiple factors including pollinator decline, inbreeding due to isolated and small populations, irregular and unnatural fire regimes, and more, are potential reasons for why some plant species are decreasing in abundance and quality across the world. *Iris verna*, a state endangered wildflower at the northernmost tip of its range, has been located and studied in Michaux State Forest, Pennsylvania. Since very little is known about the species, research on the factors limiting reproduction was conducted during the spring and summer months of 2023. Hand pollination using pollen from different origins was conducted, as well as pollen viability tests. Additionally, one site had experienced a controlled burn earlier in the year, so that population's fruit and seed production was compared to the fruit and seed production of the other two populations which were not burned. The likelihood of individuals setting fruits only significantly differed between populations ($\chi^2 = 9$, df = 2, P = 0.01), suggesting possible resource inequality. Pollen crosses from the same and different populations overall increased the amount of fruit and seed production, but the origin of the pollen produced no difference, suggesting that bi-parental inbreeding depression likely is not causing low seed production. Effects of the controlled burn were not observed, suggesting fire does not increase fruit and seed production, at least right away. The viability of *I. verna* pollen from numerous individuals varied greatly, but there was no significant difference between the populations ($\chi^2 = 0.97$, df = 2, P = 0.62), leaving a concern for the viability of some individuals. This research improved knowledge and understanding of *I. verna* factors limiting reproduction (pollinator limitations and nutrient and light limitations) and has implications for how best to conserve the species.

2023 GRADUATE STUDENT RESEARCH POSTER ABSTRACTS

Title: Phytochemical and Ethnobotanical Investigations of Ghost Pipe (*Monotropa uniflora*), a North American Medicinal Plant
Presenter: Savannah Anez, The Pennsylvania State University
Coauthors: Joshua J. Kellogg, The Pennsylvania State University; Eric P. Burkhart, The Pennsylvania State University
Abstract: Ghost-pipe (*Monotropa uniflora*, Ericaceae) is a widely distributed North American plant that is used in contemporary folk herbalism in the United States. The species also has a rich ethnobotanical history, and has been used as an analgesic, to treat inflammation, and to allay symptoms of emotional distress. Despite this history of use, little is known about phytochemistry, and it is unclear whether it possesses compounds of medicinal or toxicological activity. Additionally, ghost-pipe is parasitic to mycorrhizal fungi. Thus, its secondary metabolite profile, and therefore medicinal properties, may be more affected by changes in local environment and/or host compared to autotrophic plants. I am pairing untargeted metabolomics approaches with a survey and key informant interviews to characterize this plant's phytochemistry in relation to its ethnobotany. Survey responses indicate pain relief as the most common use of this plant, while other historic uses of this plant have been less commonly reported. Responses also report a tincture of fresh plant material as the most common mode of preparation. Preliminary sampling at three different central PA sites was done last summer, and these samples were extracted and chemically analyzed with UPLC-MS. Principal component analysis (PCA) was unable to differentiate between the chemical profiles of these samples based on their location. However, significant differences in antioxidant activity were observed between extracts from different sample sites. Furthermore, purified fractions of ghost pipe extracts displayed a stronger antioxidant activity than crude extracts, as well as stronger binding capability to certain human serotonin, dopamine, and norepinephrine transport receptors. The results from the survey and preliminary sampling have been used to guide more extensive sampling from multiple states this summer, and these samples will be chemically and bioactively analyzed. Results will collectively be used to better understand therapeutic potential of this plant using ethnobotanical knowledge as a guide.

Title: *Paxistima canbyi* A. Gray (Celestraceae), a rare plant species of the Central Appalachian region of the United States: Preliminary assessment of threats using population genomics
Presenter: Isaac Buabeng, Bucknell University
Coauthors: Christopher T. Martine, Bucknell University; Tanisha Williams, University of Georgia; Rachel Goad, Western Pennsylvania Conservancy; Scott Schuette; Western Pennsylvania Conservancy
Abstract: Understanding the migratory patterns of genes in the clustered metapopulations of *Paxistima canbyi* across its entire range is important for conserving this species. This project, which is born out of a collaboration between scientists and experts from the Pennsylvania Natural Heritage Program and Bucknell University will assess the genetic diversity and phylogeography of two major disjunct *Paxistima canbyi* (Canby's mountain lover or Cliff green, Celastraceae) populations – occupying the limestone-rich interior low plateaus of central Kentucky, Northern Tennessee, and southern Ohio, and the similarly limestone-rich central Appalachian mountains of Southern Pennsylvania, West Virginia, Maryland, and Virginia – using a reduced-representation sequencing method i.e. Genotype-By-Sequencing (GBS). Data acquired through the Genotype-By-Sequencing (GBS) approach will be used to generate genomic libraries for assessing gene flow, genetic diversity, and migration patterns between other subpopulations and the phylogenetic relationships and historical introgression of populations within and between the two major disjunct *Paxistima canbyi* metapopulations. The results of my project will directly influence the conservation of *Paxistima canbyi* in the United States and contribute to the growing body of knowledge on the genetic structure, health, and phylogeography of *Paxistima canbyi* populations across its range.

Title: Pollinator interactions between native flowers and their ornamental counterparts on Shippensburg University's campus
Presenter: Christopher Duff, Shippensburg University
Coauthors: Heather Sahli, Shippensburg University
Abstract: There has been a mixed message about whether pollinators find exotic flowers as adequate substitutions for native flowers in urban and suburban environments. Because the replacement of native plants for exotic, ornamental flowers in suburbs has been shown to negatively impact caterpillars and insectivorous birds, this substitution may also harm pollinators. To address this knowledge gap, we compared pollinator preference for PA native flowers to their exotic, ornamental counterparts in the urban habitat of Shippensburg University's campus.

We set up 12 pairs of pots across Shippensburg University's campus containing four PA native flowers in one pot, and four of their corresponding, exotic hybrids or cultivars in the other. We conducted pollinator visitation observations for each plant on a rotating basis throughout the Summer of 2023. Furthermore, we quantified the pollen rewards presented by each plant species.

Rudbeckia was the only genus to have a significant difference between total number visitors and total visitations per flower, with the exotic hybrid receiving more visitors and visitations per flower. For pollen rewards, *Verbena* was the only genus with a significant difference between native and exotic species, with the native, *V. stricta*, producing more pollen. These findings demonstrate a relationship between pollinators and flowers in an urban environment that is more complicated than assuming native flowers are always better. Also, although this study shows exotic plants may serve as a resource for urban pollinators, the pollen reward analysis shows exotic plants may not always be as nutritious as their native counterparts. Therefore, even though exotic plants can be as or more attractive to pollinators, native plants may serve as more nutritious options for pollinators in some cases. Nevertheless, there is also a chance exotic, ornamental flowers in urban habitats are providing beneficial services for pollinators in urban habitats.

Title: Determining survival, competition ability, and photosynthetic capacity of hybridized, blight-resistant American Chestnut Trees (*Castanea dentata*).

Presenter: Peyton Eckard, Indiana University of Pennsylvania
Coauthors: Michael Tyree, Indiana University of Pennsylvania; Brenda Wasler, National Park Service
Abstract: The American chestnut (*Castanea dentata*) was one of the most culturally significant trees in the eastern United States, but when the chestnut blight (*Cryphonectria parasitica*) was introduced, it took A. chestnuts to near extinction. American chestnut has since been hybridized with Chinese chestnuts (*C. mollissima*) to produce blight resistant hybrids that are actively being reintroduced back into their native habitat. Oaks (*Quercus* spp.) benefitted from the absence of A. chestnuts and adopted the available niches as the dominant hard-mast producing species. This research addresses if bight-resistant A. chestnuts can compete with oaks to reestablish themselves back into their historic habitats. Specifically, our objectives are to determine: i.) if differences occur in photosynthetic capacity (A_{Max}) among the three species studied, ii.) any differences in lighting requirements among the species, and iii.) if there are interactions among species and light availability. We used a randomized complete block design with species and light treatments set up as a 3×3 full factorial. We applied three different shade treatments (high, medium, and low light) across six-year-old, blight-resistant A. chestnut hybrid, white oak (*Q. alba*), and red oak (*Q. rubra*) trees planted at Flight 93 National Memorial, which is a reclaimed surface mine. We used the LiCOR 6400XT to measure photosynthetic capacity of each tree to determine difference between available light levels and species. The American chestnut hybrids were 15% lower than the oak species ($p=0.05$), however, no difference in A_{Max} was detected among available light treatments as either its own effect or an interaction. This could indicate that leaf morphology plays a significant role in carbon assimilation.

Title: Habitat Suitability Modeling of Goldenseal (*Hydrastis canadensis*) in Pennsylvania
Presenter: Ezra Houston, Penn State University
Coauthors: Grady Zuiderveen, U.S. Forest Service; Eric Burkhart, Penn State University; Xin Chen, Florida State University
Abstract: Goldenseal (*Hydrastis canadensis* L.) is a well-known perennial forest herb indigenous to eastern North America. In Pennsylvania, conservation concerns including wild harvesting for medicinal markets, habitat loss and degradation, and a patchy distribution present both a need for in-situ conservation efforts and an income opportunity for landowners. In support of these efforts, measurements of site-level habitat conditions observed in the field were combined with statewide GIS-based habitat suitability modeling to provide guidance for in-situ conservation and forest farming site selection. Field based methods included measurements of soil characteristics and topographic position, as well as indicator species analysis (ISA) to determine common floristic associates with goldenseal. Site-level soil testing identified loam soils as the most common textural class, with an average pH of 6.2 and high variation in macronutrients. Topographic measurements pointed to goldenseal's preference for moist, lower slope woodland sites. Indicator species analysis identified tulip-poplar (*Liriodendron tulipifera*) and sugar maple (*Acer saccharum*) as the most prevalent overstory associates. Spicebush (*Lindera benzoin*), Virginia creeper (*Parthenocissus quinquefolia*), Jack-in-the-pulpit (*Arisaema triphyllum*), mayapple (*Podophyllum peltatum*), wood fern (*Drypoteris marginalis*), and rattlesnake fern (*Botrypus virginianus*) were the most common understory associates. Maxent modeling confirmed observations of site-level characteristics, identifying lower slope positions with high levels of organic matter and wet to mesic soil as most suitable for goldenseal. While such sites are widespread in Pennsylvania, Maxent modeling suggests the present distribution is restricted by cold winter temperatures in the north of the state and at high elevations. Additionally, bedrock types derived from acidic sandstone or with land use legacies of row crop agriculture were unsuitable for goldenseal. This research can guide decision making at multiple scales by first narrowing the breadth of potential sites for surveying, and then informing site-level selection using specific habitat cues.

Title: Vitamin Content of Two Species of "Ramps", or "Wild Leeks", *Allium tricoccum* and *A. burdickii*.
Presenter: Kirk Lawson, Penn State University
Coauthors: Eric P. Burkhart, Penn State University; Joshua D. Lambert, Penn State University

Abstract: Two species of wild *Allium* are harvested for their leaves and bulbs each spring across the northern U.S and southern Canada, *A. tricoccum* and *A. burdickii*. These are collectively known as "ramps" or "wild leeks". Their nutritional values are analyzed and compared in this study.

Despite the widespread consumption of these species, only one study has been conducted examining nutrient content; and it used a small sample size and only one species (*A. tricoccum*). Given that these are widely consumed wild plants, it is important to know their nutritional value.

Samples of both species were collected from 19 forest sites in Pennsylvania (11 *A. tricoccum* and 8 *A. burdickii* sites). Standard calibration curves were used to quantify vitamins: C, B2, B3, B6, and B9, on a high-pressure liquid chromatography instrument with diode array detector. Approximately 200 samples were analyzed (20 per site). Leaves and bulbs were analyzed separately. Additionally, *A. tricoccum* contains red- and green-stemmed color morphs and these are also being compared.

Preliminary results will be shared at the symposium. Differences have been observed in the vitamin content, but it is unclear whether these are statistically significant at this time.

Ramps are a very popular culinary item and are being suggested as a forest-farmed agroforestry non-timber forest product. It will be beneficial to learn how their nutritional content varies between species and phenotypes to benefit quality control and species selection.

This is the first time the two ramp species have had nutrient content compared, and the first known nutritional analysis of *A. burdickii*.

Title: Eastern hemlock (*Tsuga canadensis*) physiological responses to elongate hemlock scale (*Fiorinia externa*) infestation.
Presenter: Robert T. Michalow, Indiana University of Pennsylvania
Coauthors: Michael C. Tyree, Indiana University of Pennsylvania; Sarah Johnson, Pennsylvania Department of Conservation and Natural Resources; Tim Tomon, USDA Forest Service – Morgantown Field Office; Will Oldland, USDA Forest Service – Morgantown Field Office
Abstract: Eastern hemlock (*Tsuga canadensis*), a major component of forests in eastern North America, is appreciated ecologically as a foundation species where local biota thrive in hemlock-dominate ecosystems. With increased globalization, hemlock woolly adelgid (*Adelges tsugae*) consequently arrived in North America and has since threatened eastern hemlock, where widespread decline has been reported throughout much of its native range. Furthermore, elongate hemlock scale (*Fiorinia externa*) is another invasive insect pest that is seeing significant population growth on native hemlocks, but much debate still exists on whether it is a cause of concern for current hemlock management programs. This project investigates if hemlock stress-induced responses are occurring at an individual branch level on treated trees absent of hemlock woolly adelgid but populated with elongate hemlock scale. To enumerate, objectives of this project are *i.)* determine if elongate hemlock scale infestation causes stress-induced responses of eastern hemlock at an individual branch level by measuring tree physiological properties, *ii.)* observe this interaction with respect to seasonality to determine if stress-induced responses are arising during a certain elongate hemlock scale developmental stage, and *iii.)* prove a workable window exists after branch detachment to validate methodology. Twenty eastern hemlock trees that met strict criteria located in Tuscarora State Forest were selected as the sample population. Using a LiCOR 6400XT portable photosynthesis system, two branches classified as elongate hemlock scale present and absent were selected from each tree and subsequently analyzed to determine if any physiological differences existed. Sampled branches classified as elongate hemlock scale present and absent had no differences in net photosynthesis (P_{net}) or daytime dark respiration (R_{dark}) physiological variables in each sampling campaign. Having no observable difference

between elongate hemlock scale present and absent branches may indicate that the densities observed in this study are not high enough to elicit hemlock stress-induced responses.

Title: How "wild" is American wild ginseng? Investigating the role of human cultivation in shaping morphological and genetic diversity of a valuable non-timber forest resource
Presenter: Rachel Palkovitz, Department of Anthropology, Penn State University
Coauthors: Rachel Palkovitz, Penn State University; Eric Burkhart, Penn State University; Sarah Nilson, Penn State Beaver
Abstract: Unconscious selection refers to genetic changes that rapidly accrue over generations when plants are placed in a novel environment and reproduce at a faster rate than in the wild. In this study, we investigate the research topic of unconscious selection from human cultivation in shaping genetic and morphological diversity in American ginseng (*Panax quinquefolius* L.) The main problem we address is that seeds from commercial ginseng farms are planted in Appalachian forests to supplement natural reproduction, but the effect that this has on ginseng genetic and phenotypic diversity is unknown. Has the practice of human cultivation resulted in non-native lineages being introduced to Appalachian forests, and do these lineages show any major differences in morphological traits? Utilizing a combination of genetic and morphometric methods, we are analyzing a comparative sample of commercially cultivated and wild ginseng specimens from 37 populations ranging from the Midwest to eastern Pennsylvania that we collected from 2021- 2023 (N=567) using 14 microsatellite genetic markers paired with 5 morphometric trait measurements. We will also conduct key informant interviews with ginseng growers in artificial shade and forest farm settings, using grounded theory analysis to characterize if and how growers source and select ginseng stock. Major points of discussion include the role of ginseng growers in influencing ginseng diversity through their knowledge of stock origins, selection, and distribution, as well as the possible conservation challenges posed by genetic admixture between cultivated and wild ginseng populations. While data collection is still ongoing, preliminary results indicate that above-ground morphological diversity exceeds what is currently represented in the taxonomic key, and one trait, peduncle to petiole ratio, is not a reliable marker of lineage membership. Pilot interviews with commercial growers indicate that ginseng growers identify above-ground morphological characteristics they associate with specific ginseng lineages (e.g., Canadian, Menominee Native American).

Title: Classifying understory plant communities in the Susquehannock State Forest, PA
Presenter: Nicole Palmer, The Pennsylvania State University
Coauthors: Autumn Sabo, Penn State Beaver; Marc McDill, The Pennsylvania State University
Abstract: We aimed to classify unique understory plant communities in the Susquehannock State Forest, PA. The goal of this analysis was to identify clear differences between species assemblages that can be used by foresters and wildlife managers to support management decisions. We sought to address the following questions:

1. Are there natural assemblages that occur among understory communities in a northern hardwood ecosystem?

2. Which species characterize the understory community types?

We collected 10 years of data from permanent plots located in the Susquehannock State Forest of northcentral Pennsylvania recording the composition and abundance of understory vegetation.

We analyzed the community composition at each site sampled in 2014 and 2015 based on the cover of non-tree vegetation and tree seedling counts. Our communities were constructed based on a cluster analysis of 329 subplots. We found evidence to support the distinction between several different understory community

types among a relatively homogenous hardwood overstory. In the resulting clusters, between 1-5 taxa emerged as characteristic of the different assemblages.

Following this initial analysis of community assemblages, we plan to analyze the abiotic environment covariates that contribute to community uniqueness. The differences among understory community types may also lead to different outcomes for seedling regeneration, which will be explored through an additional cluster analysis with our 2021 and 2022 datasets to monitor for changes over time. The understory communities we identified here are compositionally distinguishable from one another, which may lead to benefits for forest management.

Title: Effect of Prescribed Burning and Deer Exclusion Fencing on Wild Lupine (*Lupinus perennis* L.)
Presenter: Isabella Petitta, The Pennsylvania State University
Coauthors: Autumn E. Sabo, The Pennsylvania State University; Margarita M. López-Uribe, The Pennsylvania State University
Abstract: Wild lupine (*Lupinus perennis* L.) is a perennial plant distributed from Minnesota to the east and along the Atlantic coast in the United States and southern Canada. Habitat loss and the alteration of historic disturbance regimes have contributed to population declines throughout its range. Conservation status rank varies between states and provinces but in Pennsylvania it is ranked as Pennsylvania Rare. To best conserve existing populations, land managers are in need of recommended management regimes. Here we test the hypothesis that prescribed fire and deer exclusion fencing alter wild lupine growth. We tested this hypothesis with a factorial field experiment in which we manipulated low-intensity fire (burned/unburned) and deer browsing (fenced/unfenced). Floral traits were assessed in the spring before and after treatments were applied. Preliminary analysis shows there was no significant effect of any treatment on the number of individuals or flowering stems across 5 wild lupine populations. This suggests that prescribed fire and deer exclusion fencing do not significantly affect wild lupine growth one year after treatments are applied. Treatment effects on habitat and surrounding plant communities are an important consideration for conservation of this species. These effects have been measured but not yet quantified. Management recommendations should consider the use of fire and fencing in wild lupine populations although this should be further investigated.

Title: Are exclosures really doing any good? Exploring native plant abundance in a severely invaded suburban fringe forest plagued by white-tailed deer and non-native plant invaders
Presenter: Gillian Revenis, Chatham University
Coauthors: Ryan Utz, Chatham University; Walter P. Carson, University of Pittsburgh
Abstract: Two pervasive threats facing Eastern Deciduous Forests are overabundance of white-tailed deer (*Odocoileus virginianus*) and the rapid spread of non-native invasive plants. Chronic overbrowsing of native plants has often locally extirpated palatable species and enabled invasives to flourish, leading to a greater regeneration failure. Such dynamics, lead to depauperate and recalcitrant understories of invasive shrubs that render forests vulnerable to disturbances. We evaluated the combined impact that overabundant deer and non-native invasive plants have on native plant communities. In 2018, 2.2 m tall fences were erected and paired with adjacent control plots. We removed all invasive plant species from a randomly selected half of each exclosure and control in May 2019. We tested the hypotheses that 1) species richness and diversity will be higher within portions of the exclosures in which invasives were removed, 2) native species abundance will be highest amongst fence and removal areas, and 3) invasive removals will have no impact on species diversity, richness, or abundance of nonnative plants. We found that species richness and diversity were higher within fenced and removal areas in comparison to plots that were unfenced and had no removals. Additionally, native abundance was higher in fenced areas with removals, however, removals of invasive plants had little to no impact on richness, diversity, and abundance. We found *Fraxinus* spp. to be the most found tree sampling inside fences, indicating a potential regeneration debt in this forest, since these saplings

are unlikely to become mature trees due to the emerald ash borer. Extensive single-occasion invasive removals are unlikely to prove enough to limit impact on native plants, suggesting that in the absence of herbivores, invasive plant regeneration increases.

Title: Historical climate change shifts flower shape and production of a common annual plant, Orange Jewelweed (*Impatiens capensis*)
Presenter: Amber Stanley, University of Pittsburgh
Coauthors: Tia-Lynn Ashman, University of Pittsburgh
Abstract: Climate change is a major-human mediated stressor that alters temperature and precipitation patterns across the globe. In the Eastern United States, projections show that annual temperatures will increase 3-5 degrees Celsius and precipitation will increase 20% by 2100. Such changes in the environment have the potential to disrupt key species interactions. For example, nearly 90% of all flowering plants rely on insect pollinators to transfer pollen between individuals. Higher temperatures cause many plant species to flower up to 3-4 weeks earlier in the year, but pollinator activity has not shifted with the same magnitude, meaning that flowers are produced when fewer pollinators are active. Flower size can be limited by increasing temperatures, which makes it harder for larger pollinators to transfer pollen. Some plant species can produce self-pollinating flowers to mitigate disruptions in pollination, however this can decrease genetic diversity. Here, I ask How have temperature and precipitation increases due to climate change influenced floral traits of a common focal species? To investigate this question, I used a focal plant species, Orange Jewelweed (*Impatiens capensis*). This well-characterized annual plant is common in wetlands and floodplain forests of the Eastern United States. It primarily relies on bumblebees to transfer pollen between individuals, but can also produce selfing flowers. Using digitized herbarium collections, I measured the timing of flowering, flower size and production on herbarium specimens of 650+ collected in Pennsylvania between 1900-2020. I used CRU-TS climate projections to extract temperature and precipitation for each specimen. I hypothesize increasing temperatures are highly correlated with H1) earlier flowering time and H2) increased production of flowers, and increasing precipitation is correlated with H3) increasing flower size. Such changes in floral traits due to increasing temperatures may alter the pollination interaction and could increase extinction risk.

Title: You've Been Warned: Tall goldenrod (*Solidago altissima* L.) changes its gene expression after detecting the nearby emission of a gall-inducing herbivore
Presenter: Robert Witkowski, The Pennsylvania State University
Coauthors: Lily Sudol, The Pennsylvania State University; Eric Yip, The Pennsylvania State University; John Tooker, The Pennsylvania State University; Tanya Renner, The Pennsylvania State University
Abstract: Plant-insect interactions are heavily influenced by chemical cues in the environment. When plants perceive a chemical associated with a specific herbivore, they induce chemical defenses in preparation for a possible challenge from that herbivore. This phenomenon, called "priming", enables a rapid defense response to later herbivory. Priming mediates interactions of tall goldenrod (*Solidago altissima* L., Asteraceae) and the goldenrod gall fly (*Eurosta solidaginis* Fitch, Diptera: Tephritidae), a classic, multi-trophic model ecology system that is commonly observable across Pennsylvania. While perching on goldenrod, male gall flies emit a volatile pheromone to attract mates. This airborne pheromone primes nearby *S. altissima* plants. Although costly in resources, priming in *S. altissima* appears to confer resistance to galling and feeding by some co-occurring specialist herbivore species. However, it is not known how *S. altissima* alters its gene expression in the primed state, if at all. Our experiment, the first to use transcriptomic tools in this system, addressed two questions: does *S. altissima* priming against *E. solidaginis* confer any resistance to unrelated generalist herbivores, and how do defensive gene expression patterns differ between primed plants and plants that are naive to the priming cue? We exposed *S. altissima* plants to *E. solidaginis* pheromone and added a generalist caterpillar to feed for 48 hours. We harvested damaged plant tissue at five time points during that period for Illumina RNAseq and performed differential gene expression (DGE) analysis using the Trinity pipeline. Our DGE results indicate that primed plants induce a suite of gene pathways like wounding response and

jasmonic acid induction earlier than naive plants. Additionally, the timing and relative expression of defense-related genes appears to change in the primed state, indicating that priming entails wide-scale transcriptomic changes. This study identifies molecular signatures of priming and characterizes strategies plants use to defend themselves in their environment.

Title: Ecoculture Market Analysis and Business Best Practices
Presenter: Andrew Wraith, University of Pennsylvania
Coauthors: Sally Willig, University of Pennsylvania
Abstract: Ecoculture is the ancient practice of cultivating food, medicine, and other useful products in the context of natural ecosystems (Thayer, 2017). At its heart ecoculture is the process of restoring and cultivating healthy robust ecosystems in which humans are integral to the ecology. Despite this being an ancient practice across the globe, few examples persist in our modern economy. These include maple syrup forests and blueberry barrens. There has been little research published on the topic of running a successful ecoculture business. A literature review and interviews will be conducted to consolidate available information on current and past ecoculture practices. A market analysis will be conducted to gather primary data regarding the financial feasibility of running an ecoculture practice. Finally, a book on running a successful ecoculture business will be created with the potential to provide a powerful tool for ecoculture practitioners to start their own business. Given the blending of goals and outcomes in an ecoculture framework, a mixed non-profit and for-profit business model may be the best fit. If ecoculture entered the mainstream as a method for food production, nature preservation, and engaging our human communities in a reciprocal relationship with nature, this could have positive impacts on the resilience in our global food supplies, biodiversity, food sovereignty, and public health.

Title: Mushroom Hunting in the Mid Atlantic
Presenter: Amy Wrobleski, Penn State University
Coauthors: Eric Burkhart, Penn State University
Abstract: Mushroom hunting has long been an important part of identity for Pennsylvanians. It is the centerpiece of clubs, forays, and festivals around the state. However, very little is actually known about who mushroom hunts in Pennsylvania and, more broadly, the Mid Atlantic. To better understand who hunts for mushrooms in this region and why, we developed a survey instrument that was distributed through a convenience sampling method to self-identified mushroom hunters in the Mid Atlantic. The survey was distributed at mushroom club forays and festivals, through workshops and classes, and through social media. A total of 904 people from the Mid Atlantic completed the survey. The results indicate that mushroom hunting has grown substantially as a pastime in recent years, with the greatest growth in 2020. Additionally, while a majority of mushroom hunters forage mushrooms to eat, many of them also forage mushrooms for other purposes such as: medicinal use, community science projects, art, and photography. Despite these varied uses, the mushrooms of greatest interest are either edible or medicinal (or both). Understanding who hunts for mushrooms in this region and why will allow for conservation efforts, public policy, and educational materials to better align with the interests and needs of the mushroom hunters. Many community members are already participating in community science projects through mushroom clubs, mycological associations, and platforms such as iNaturalist. Allowing for greater understanding and collaboration between the mushroom hunters, land managers, and scientists will allow for a richer understanding of the ecology and mycology of Pennsylvania and the Mid-Atlantic region.

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