

2024 ESA GREAT LAKES REGIONAL CONFERENCE

"Practicing Ecology in a Changing World"

ECOLOGICAL SOCIETY OF AMERICA

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Abstracts



**FRIDAY, SATURDAY & SUNDAY,
APRIL 5-7**

Fetzer Center
Western Michigan University, Kalamazoo, MI

Amaryllis Adey, University of Notre Dame

Session: Poster I

“Invertebrate spatial biodiversity in coastal wetlands of the Laurentian Great Lakes”

Coastal wetlands of the Great Lakes are some of the most biologically diverse ecosystems in North America and can serve as an indicator of overall lake and watershed health. Despite their important hydrological and ecological functions, many of these wetland ecosystems have been degraded or destroyed over the past century. The Great Lakes watershed has undergone substantial agricultural conversion and urbanization, both of which contribute pollutants and change hydrology (e.g., industrial waste, sewage overflows, and runoff from cities and agriculture), resulting in degraded water quality. Invertebrate communities are particularly sensitive to habitat and water quality degradation and are frequently used to indicate ecosystem health. Therefore, studies of spatial and temporal change in invertebrate diversity could help understand broader changes in wetland ecosystem health across the Great Lakes. Since 2011, wetlands that are hydrologically connected to the Great Lakes have been sampled annually by the Great Lakes Coastal Wetland Monitoring Program (CWMP). CWMP has collected data pertaining to biota (macroinvertebrates, fish), habitat (vegetation), and water quality (e.g., nutrients, pH, DO, temperature, conductivity) to assess the condition of these wetlands. The overall objective of this study was to determine the spatial diversity of invertebrate communities in coastal wetlands of the Great Lakes by calculating alpha, beta, and gamma diversity. We calculated these metrics using the `vegan` and `adiv` packages in R programming and assessed the influence of wetland vegetation (i.e., zones), water quality, and land use in the surrounding watershed in determining the invertebrate diversity. Eight vegetation types comprised 94% of the zones sampled. Alpha diversity was highest for the wet meadow and *Typha* vegetation zones and lowest for *Peltandra/Sparganium/Pontedaria* and lily while gamma diversity was highest for Lake Huron and lowest for Lake Erie. Beta diversity was highest between sites with intermediate levels of disturbance and lowest between sites with high disturbance. Water quality reflected watershed land use with coincident influences on biodiversity. Overall, our results indicate that, at multiple spatial scales, invertebrate diversity is closely tied to habitat and water quality, both of which are sensitive to land use changes observed in the Great Lakes region. These findings highlight the importance of mitigating the impacts of land use on these critically important wetlands found at the interface of the landscape and the Great Lakes.

Dominic Aiello, University of Pittsburgh

Session: Poster II

“Effects of Density on Eco-evolutionary Dynamics”

Aspects of ecology and evolution reciprocally affect relationships among populations in a community. We conducted a response surface competition experiment to analyze how density affects characteristics of eco-evolutionary dynamics, such as the direction and strength of selection and intrinsic growth rate. The model system consisted of evolving populations of duckweed, specifically five clones of *Spirodela polyrhiza* (focal species) and five clones of *Lemna minor*. Single species populations and both replacement and additive communities grew at four densities (12 total treatments) for a duration of two weeks. We hypothesized that the direction and strength of selection and per capita growth rate would depend upon the density of intraspecific and interspecific competitors. Specifically, we expected that low density would favor genotypes with faster growth, while high densities would instead favor stronger competitors, and that the performance of both species would depend on the density and type of competition (interspecific vs. intraspecific). Species' abundances and the genotypic frequency of the focal species provided both ecological and evolutionary data, respectively. Our preliminary data suggest strong selection for one genotype at most density levels; however, at the highest density, selection might favor a different genotype. In both species, we observed decreased growth rate with increasing total density. The relationship between growth rate and density appears strongly linear for *Spirodela polyrhiza* and potentially non-linear for *Lemna minor*. Considering the effects of density on the ecology and evolution of populations simultaneously can contribute to our understanding of eco-evolutionary dynamics by yielding new insights into interspecific interactions (e.g., competition) in communities.

Sarah Alharbi, Eastern Illinois University

Session: Poster I

“Integrated above- and below-ground trait responses to AM inoculation in seven *Asclepias* species”

Arbuscular mycorrhizae (AM) are critical determinants of plant growth and ecosystem function, altering nutrient intake and stress tolerance. Despite the importance of AM, their role in determining integrated traits across the plant is less well-known. This study investigated the coordinated above and below-ground trait responses to AM inoculation in seven *Asclepias* species. We assessed a comprehensive suite of plant morphological traits, including whole plant (total biomass, leaf area ratio, and root mass fraction), leaf (area, dry matter content, and specific leaf area) and root (total length, dry matter content, tissue density, specific root length, and diameter) traits. *Asclepias* varied in their traits and responsiveness to AM inoculation. Importantly, we observed trait responses that were integrated across the entire plant, with AM inoculation impacting plant allocation, root and leaf traits simultaneously. Despite trait variation across *Asclepias* species, all species responded similarly to AM inoculation, shifting from resource acquisitive to conservative strategies in both above and belowground traits. Surprisingly, AM inoculation increased within-species variation in traits, representing a potentially unexplored role for AM fungi in regulating intraspecific variation. The responsiveness of *Asclepias* to AM inoculation supports the integration of above- and below-ground traits and argues for the utility of more comprehensive trait assessments in understanding the full impact of plant-microbe interactions in shaping plant responses and ecosystem dynamics.

Mikaelis Anderson, Goshen College

Session: Poster I

“Temporal variation in environmental DNA (eDNA) export at a pond-stream interface”

Sampling genetic material shed into the environment by an organism (i.e., environmental DNA, hereafter eDNA), allows us to detect populations of invasive, endangered, and/or rare aquatic species using water sampling. While eDNA is an efficient method of organismal detection compared to conventional sampling, our understanding of eDNA transport is still limited, particularly at the interfaces of aquatic systems, such as from lentic to lotic ecosystems. To explore eDNA dynamics in a small stream, we previously attempted to measure transport of ambient eDNA from fish downstream of a small pond, but unexpectedly discovered short-term variation in source eDNA concentration as it moved from pond outlet to stream. To address this, over four seasons (spring, summer, fall, and winter), we collected water samples from the outflow of Lawler Pond into a first-order stream at the Fort Custer Training Center, MI, and quantified eDNA concentrations for two fish species (Bluegill, *Lepomis macrochirus* and Largemouth Bass, *Micropterus salmoides*). During each temporal sampling, we collected 250-mL water samples every 15 min for two hours, and we found the concentrations of eDNA varied across the sampling period during all seasons. The average eDNA concentration among seasons was highest in the fall and lowest in the spring, which contradicted our expectations based on known activity patterns for Bluegill and Bass, especially as they related to environmental metrics (e.g., temperature) paired with mixing dynamics. These results suggest complex and temporally-variable dynamics of eDNA fate and transport at a pond-stream interface.

Adam Austin, The Rattlesnake Conservancy

Session: OS 8: Conservation & Restoration

“Conserving rattlesnakes and their habitats via an inclusive volunteer network”

Rattlesnakes and other venomous squamates are among the most feared, misunderstood, and persecuted taxa in North America. As a result, venomous populations have declined precipitously since the 1800s along with their associated services, while efforts to slow or reverse these declines remain grossly underfunded and understaffed. Addressing these shortcomings requires additional funding, networking, and an improved public perception of these taxa. We present the impact of a non-profit venomous safety certification program on each of these areas after nine years of continuous operation across the U.S., and call for additional professionals to expand these efforts into new states and regions.

Ellen Badger Hanson, Western Michigan University

Session: Poster II

“Using microbial distance-decay relationships to understand the influence of seed mix richness on soil microbial communities in restored prairies”

While restoring tallgrass prairies on former agricultural land can provide many benefits - such as increasing biodiversity and reducing erosion - the legacy of agricultural land use is evident in restored prairie ecosystems. Plant diversity and soil carbon storage in restored prairies often fall short of what is observed in old-growth prairies. This agricultural legacy is also evident in soil microbial communities; microbial community composition in restored prairies is often distinct from old-growth prairies. These microbial communities are important to consider in a prairie restoration context because they form interactive relationships with plants that can impact both individual plants and plant communities. Soil microbes also play key roles in soil carbon cycling and storage. By better understanding how restoration management choices affect soil microbial communities, land managers may be better able to accomplish restoration goals like increasing native plant diversity and promoting soil carbon storage. This study aims to add to that area of research by considering the effects of restoration seed mix richness on averaged and spatially explicit patterns in soil microbial communities. In 2021, we sampled six restored prairies at the Kellogg Biological Station in southwest Michigan. Each prairie is divided in half and seeded with a low-richness mix (12 species) on one side and a high-richness mix (70 species) on the other. By employing a spatially explicit sampling design in each prairie half, we were able to consider both averaged and spatial patterns in soil physiochemical parameters and microbial community metrics. We used amplicon-based sequencing of the 16S gene to assess bacterial community composition. Though we found no evidence for differences in average bacterial richness or diversity with planted seed mix richness, we did see strong evidence of differences between the two seed mixes when we considered bacterial communities through a spatial lens. Bacterial communities under the high-richness seed mix had steeper distance-decay curves at both the field and landscape scale, indicating higher community heterogeneity than observed under the low-richness seed mix. Our results suggest field-level averages may not tell the full story when comparing different prairie management choices and provide support for the use of spatially explicit analyses as a tool for evaluating restoration outcomes.

Thomas Bakoway, Siena Heights University

Session: Poster I

“Drone-Based Assessment of Invasive Shrubs in Ramsdell Park, Lenawee County, Michigan”

Satellite and aerial photography have been recognized as useful for effectively mapping out different shrub species. However, there have been few attempts to utilize Unmanned Aerial Vehicles (UAV) to identify specific invasive species in a given area. The present study looks into the effectiveness, precision, and accuracy of drone imaging to test the viability of such methods on invasive shrubs in Ramsdell Park, Lenawee County, Michigan, including Honeysuckle (*Lonicera spec.*) and Autumn Olive (*Elaeagnus umbellata*). We also quantified how much of Ramsdell Park was covered by invasive shrubs. The assessment was carried out using a DJI Phantom 4 Pro drone utilizing Pix4Dcapture Pro for mapping. Individual invasive and non-invasive species were identified using on-ground positioning by a Garmin Etrek 10 GPS device and ground photography to compare to UAV-acquired results. Out of a 40-sample size, an overall accuracy rate of 92.5% was achieved in distinguishing invasive and native shrubs in the maps based on UAV visible-light photography. Our maps show that invasive shrubs cover a large percentage of the park and that urgent management is needed to impact these prairie ecosystems' health positively. We will continue to quantify the coverage of invasive shrubs of different age classes to suggest age-specific restoration techniques.

Claudia Bartlick, Michigan Technological University

Session: OS 4: Conservation & Restoration

“MICEDAR - Restoring Northern White-Cedar Swamps in the Upper Great Lakes Region”

Northern white-cedar (*Thuja occidentalis* L.) swamps are vital ecosystems in the upper Great Lakes region, sequestering significant amounts of carbon and supporting a diverse fauna and flora, including many rare and endangered species. However, these habitats face substantial challenges due to regeneration and recruitment failure, resulting in a notable decline in age-class diversity with few young cedars establishing. Moreover, many sites historically dominated by cedar have transitioned to other vegetation types following timber harvest. The MICEDAR project, a collaboration between Michigan Technological University, the USDA Forest Service, and the Michigan Department of Natural Resources, aims to address these challenges by identifying and evaluating restorative silviculture treatments in Northern Michigan.

Among the conditions targeted by MICEDAR, two current focusses include: (1) In cedar-dominated swamps without recent harvest history lacking age-class diversity, we aim to enhance stand structure and age-class diversity by establishing new cedar cohorts while maintaining canopy connectivity. The proposed treatments for this condition include a gap irregular shelterwood system, a strip irregular shelterwood system, and strip cutting. Treatments will focus on the removal of non-cedar species and poorly vigorous cedar. (2) In formerly cedar-dominated sites that converted to balsam fir (*Abies balsamea* (L.) Mill.) following timber harvest, our goal is to reduce the proportion of non-cedar species and improve light conditions for cedar establishment using mastication treatments. Additionally, we will complement natural regeneration with enrichment planting in all treatments and implement single-tree browse protectors to assess deer browse impact.

Our objective is to address immediate challenges in cedar swamps while gaining insights into sustainable forest management practices. By evaluating the effectiveness of various treatments in enhancing cedar regeneration and age-class diversity, our research contributes to the development of evidence-based strategies for conserving and restoring critical habitats. Our presentation will offer an overview of the initial project stages, including data collection and pilot studies, as well as selection of treatment sites, and provide an outlook on the next project phase.

Katilyn Beidler, University of Minnesota/Peter Kennedy

Session: OS 3: Population & Community

“Alterations to grassland soil nutrient supply have a stronger effect on fungal necromass decay than manipulations of soil food web composition”

In grasslands, half of all soil carbon (C) is derived from dead microorganisms, particularly fungal mycelia (fungal necromass). Despite a developing understanding of the controls on fungal necromass decay in forests, grassland soils, which act as resilient C sinks, have received less study. Currently, human activities are impacting grassland C cycling by increasing the availability of growth limiting nutrients, which can enhance both plant C inputs and litter decomposition. It is unclear how shifting resource availability might alter microbial decomposition of fast cycling C inputs like fungal necromass. To assess how fungal necromass decomposition in grasslands is influenced by both nutrient supply and food web composition, we leveraged a long-term manipulative field experiment at the Cedar Creek Ecosystem Science Reserve, Minnesota, USA that combines nutrient amendment and plant consumer removal treatments.

Lab generated fungal biomass was used as a common substrate to measure necromass decay and decomposer communities across grassland prairie plots treated with a factorial combination of fungicide (both soil and foliar fungicide) and nutrients (nitrogen, phosphorus and potassium, or NPK). The combined application of foliar fungicide and fertilizer has been shown to increase the supply of plant C entering the soil food web in this experiment. Thus, we included the foliar fungicide treatment to explore decay processes in the context of altered plant C inputs. We measured necromass loss and microbial community composition in mesh bags after 7, 14, 30 and 60-days. We found that fungal removal either from fungicide treatments had no effect on fungal necromass loss through time, but that NPK fertilizer additions increased necromass decay by decreasing the fraction of slowly decaying necromass. Necromass decomposer and soil microbial community analyses are in progress, and we hypothesize shifts in microbial community composition either due to nutrient or fungicide additions, with necromass decomposer communities having greater relative abundances of fast-growing copiotrophic taxa in fertilized plots. Our findings highlight the potential for nutrient additions to reduce fungal necromass contributions to soil C storage in Midwest grasslands.

Kristen Bellisario, Purdue University

Session: OS 8: Conservation & Restoration

“Quantifying the response of biodiversity in core and edge habitats in midwest USA across temporal and spatial scales due to barriers”

Wildlife corridors provide the opportunity for movement between suitable habitat patches but are often located near roads, dense populations, or agricultural fields. Land use change is a major driver in regional extirpation of many large mammals and disconnected populations. In particular, the midwest USA is highly fragmented and lacks federally protected lands that could be utilized to develop wildlife corridors. This region incurs pressures of large mammal presence at state borders without access to corridors to new territory. We aim to find a least cost path for an intra- and interstate wildlife corridor solution through partnerships with Land Trusts and conservation easements with private land owners.

In this continuing study of a multi-county midwestern USA region, we consider how the acoustic community diversity and camera trap occupancy changes across space and time from core to edge habitats with a focus on mesocarnivore presence and top predator bobcat (*Lynx rufus*). To do this, we deployed acoustic and camera-trap sensors at sites along a river basin in Indiana. We used open source AI methods for species detection to assess acoustic and computer vision occupancy and performed vegetation and canopy density surveys to establish habitat quality and relationship to satellite-based leaf indices.

In preliminary findings, we found bobcat (*Lynx rufus*) in lower canopy density close to river water resources. We found presence of bobcat at sites with acoustic detections of low engine noise and higher biodiversity (Acciptriformes, Anura, Charadriiformes, Coraciiformes, Gryllidae, Orthoptera, Passeriformes, and Piciformes) as compared to sites with more frequent engine noise and lower biodiversity (predominant Piciformes, Passeriformes, and Rodentia). We found higher incident of mesocarnivore presence with small mammals ($r=0.99$) as compared to presence of deer with mesocarnivores ($r=-0.312$) and presence of bird with mesocarnivores (rare sightings at $r=0.078$). Deer have a negative correlation with presence of mesocarnivores while small mammals have a higher correlation with presence of mesocarnivores. We did not find a correlation between satellite-based leaf indices and canopy density.

These findings are relevant to midwestern regions to find suitable zones of habitat that support mesocarnivore movement between edge and core habitats. Our ultimate aim is to predict sites between state boundaries that could support the development of a wildlife corridor.

Ty Belville, Denison University

Session: Poster II

“Effects of artificial lighting on Red-back Salamanders (*Plethodon cinereus*) and forest floor communities.”

Urbanization and suburbanization can affect native wildlife in a variety of ways. One potential impact is night time artificial lighting (NTAL). In particular, nocturnal species in natural areas located in urban or suburban areas would likely be vulnerable to effects of NTAL. We used a field experiment to examine the effects of NTAL on forest floor communities, with a focus on the Eastern Red-backed Salamander (*Plethodon cinereus*). We hypothesized that artificial lighting would attract salamanders, since the lighting may attract their invertebrate prey. We established five sites, each with paired coverboard arrays in a deciduous forest on the Denison University Biological Reserve in central Ohio. At each site, one coverboard array experienced constant LED lighting, whereas the other experienced only ambient lighting. Salamander abundance was higher under coverboards in the light treatment than the no light treatment. Salamanders in the light treatment were larger than those in the no light treatment. Invertebrate abundance was higher in the light treatment than the no light treatment. Our results suggest that artificial lighting in natural areas has the potential to alter the behavior and distribution of some terrestrial salamanders. It is unclear what such changes might mean for salamander populations and forest floor communities.

Michael Benson, University of Illinois, Urbana-Champaign

Session: OS 6: Climate Change & Phenology

“Tree growth sensitivity is a poor indicator of mortality following severe drought in midwestern United States forests”

The oak-hickory forests of the midwestern United States are widely considered drought-tolerant, due to their propensity to sustain carbon uptake and growth during hydrologic stress. Across the region, management activities and environmental changes are inhibiting oak-hickory regeneration, paving the way for the establishment of more water-intensive "mesophytic" trees. This ongoing demographic shift has raised concerns that midwestern US forest productivity will become increasingly sensitive to increased hydroclimate variability with warming. However, productivity depends not only on carbon uptake and growth but also tree mortality, and the extent to which these two drought-tolerance metrics are functionally linked is unclear.

To better understand the consequences of oak-hickory decline, we evaluated growth and mortality dynamics following the severe 2012 midwestern drought for a wide range of oaks, hickories, and mesophytes. We developed a novel approach to analyze continuous forest inventory databases that minimized confounded covariances associated with site-to-site environmental variance. Our results confirmed prior expectations that oak-hickory species are resilient to drought in terms of growth. However, they experienced similar stem loss rates as mesophytes, such that growth sensitivity was a poor indicator of mortality risk. Importantly, total stem loss following this exceptional drought event was low (~2% on average). Consequently, the carbon uptake of midwestern US forests during severe drought is more likely to be diminished by limited growth, as opposed to drought-driven mortality.

Wesley Bickford, USGS - Great lakes Science Center

Session: OS 5: Invasive Species

“A decision support and prioritization framework for invasive plant management under fluctuating Great Lakes water levels”

Great Lakes water-level patterns are changing in unprecedented ways, with both historically low- and high-water levels occurring in the last decade. Expectations are that larger and more frequent water-level fluctuations will occur in response to climate change. This increased variability of lake levels will provide managers with both challenges and opportunities. Plants that invade Great Lakes coastal wetlands may be particularly responsive to greater lake-level variation during periods of low water that expose bottom lands and offer expansion opportunities. For example, the invasive *Phragmites australis* (common reed) expanded into lower elevations and thrived during the most recent period of low lake levels, particularly in shallow water low-slope bays. Non-native *Phragmites australis* is a prominent invasive grass identified as a high management priority by Federal, Tribal, State, and other management agencies. The plant has a unique physiology, including tall, persistent stems and abundant belowground carbon reserves that allow it to persist in deep water. While low-water levels provide opportunities for expansion, periods of high lake levels could create further management opportunities in *Phragmites* stands that can be cut below the waterline and "drowned", a promising strategy that is the subject of ongoing USGS research. Identifying the most effective time and place to invest limited resources is a challenge for managers, so our team is developing a decision support and prioritization tool that combines publicly available data to predict invasion corridors during low water and identify management opportunities. This effort strives to both safeguard existing management gains and identify future restoration opportunities.

To understand management opportunities and priorities, we updated a published habitat suitability index for *Phragmites* and incorporated water level data to understand how lake levels will influence stress and expansion potential in current *Phragmites* populations. We are working with partners across the Great Lakes basin to create a customizable online tool for decision support and prioritization of *Phragmites* management that will allow users to visualize how lake levels impact management decisions in the region. The initial development of this tool will focus on *Phragmites*, but the products will be deliberately transferable to other species of management or habitat restoration interest.

Colin Brooks, Michigan Technological University - Michigan Tech Research Institute (MTRI)

Session: OS 12: Invasive Species

“Multispectral drone sensing for Eurasian watermilfoil treatment monitoring”

Monitoring the effectiveness of different treatment methods of invasive aquatic can be challenging with only field survey methods. We demonstrate how multispectral drone sensing can help identify *Myriophyllum spicatum* (Eurasian watermilfoil or EWM), in invasive submerged aquatic vegetation species, in nearshore areas of Lake Huron and Lake Superior. Two multispectral camera systems were deployed in 2016-2018 to help identify EWM. During these periods, we captured imagery from before and after vegetation management programs implemented by local groups, with one example each of mechanical harvesting, diver-assisted suction harvesting (DASH), and treatment with a native fungus. Reductions of between 47% to 89% could be documented due to these treatments. DASH treatment effects were quantified over a week, mechanical harvesting over a summer with significant fragmentation issues, and fungal treatment effects over a year. Our results indicate that drone-enabled multispectral mapping of EWM extent can be used to provide quantitative data for programs monitoring the effectiveness of invasive aquatic vegetation treatments.

Abigail Cahill, Albion College

Session: OS 9: Population & Community

“Macroinvertebrate community composition and diversity in wild rice beds”

Wild rice (*Zizania palustris*) is an annual aquatic plant found in rivers and lakes in Michigan, forming emergent beds that are home to a diversity of macroinvertebrates. These animals are key components of aquatic food webs and indicators of river quality. We studied macroinvertebrate community composition and diversity in a short (ca. 200 m) stretch of the Kalamazoo River in Albion, Michigan, USA to see if there was a difference in these factors inside and outside of the rice beds. We used collectors deployed in the river for two weeks, which were colonized by invertebrates. The animals were identified using morphology, and we calculated taxon diversity and richness. This process was repeated in three seasons (fall, spring, summer). We found that seasonal patterns in diversity and richness were stronger than differences between habitat with and without wild rice: after the growing season, wild rice sites had higher richness than sites without it. However, during the growing season, differences in diversity and composition did not clearly relate to the presence of wild rice. We also suspect that other, unmeasured factors such as nutrient availability are important in driving invertebrate diversity in this system.

Ember Carrera, Oberlin College

Session: Poster II

“Surface activity of the burrowing crayfish *Creaserinus fodiens* in northern Ohio.”

The crayfish *Creaserinus fodiens* is a primary burrower found in wooded wetlands and old fields widely distributed north-south from Canada down to the Gulf coast and east-west from the Atlantic coast to the midwest. Primary burrowing crayfish are cryptic animals, spending much of their time in underground burrows, often distant from surface waters (rivers, streams, ponds) but located in seasonally mesic habitats. As detritivores, these animals are integral to nutrient turnover, increasing nutrient availability and aerating the soil. Burrows may provide a source of reliable moisture, safety, and food or food storage. Like surface-water crayfishes, burrowing crayfishes use gills, requiring available water; thus, when the surface conditions are dry, such as in summer, these animals spend their time belowground, presumably below the water table. However, in their preferred habitats the surface is seasonally flooded and it is during these wet periods that the crayfish emerge. To study the behavior of the burrowing crayfish *Creaserinus fodiens* at the surface in 2022-23, we placed trail cameras up to once per week to record surface activity around burrows for a 24-hour span, recording a still image every 2-30 seconds. We surveyed each time-lapse video to observe crayfish emergence and categorize any activity (e.g., foraging, perching, excavating) as well as the time at which it occurred. We find that crayfish are most active and for longer periods after dark, with activity levels peaking after 8pm. Additionally, crayfish activity and duration of activity peaks in April-May, with Sep-Oct representing a second period of high activity. Perching, peeking, and retreating are most commonly observed while hunting and capping are relatively uncommon.

Olivia Carson, University of Pittsburgh

Session: OS 12: Invasive Species

“Increases in genetic, species, and trophic diversity affect the invasibility of experimental duckweed communities invaded by *Salvinia* sp.”

The biotic resistance hypothesis proposes that greater biodiversity within an ecosystem's native communities leads to lower invasibility, or greater resistance against biological invasions. However, biodiversity encompasses many aspects, such as genetic, ecological, and trophic diversity. These different aspects are often studied independently, but may interact within a community to determine its invasibility. Studying the effects of multiple aspects of biodiversity and their interactions on invasibility could provide insight into the factors that shape community responses to invasions. Using a factorial design, we created model communities of aquatic duckweed plants and aphids (insect herbivores), varying levels of genetic, species, and trophic diversity between communities. We invaded the communities with *Salvinia* sp., an invasive aquatic fern, and measured the change in *Salvinia* growth over the course of two weeks to determine which community composition posed the most resistance to the invader. Preliminary results show that increasing genetic and species diversity among the duckweed communities resulted in a decrease in invader growth, while increasing trophic diversity with the addition of aphids resulted in an increase in invader growth. These results indicate that multiple aspects of biodiversity are responsible for shaping a community's response to invasions, and that understanding the interactions between different aspects of biodiversity is critical to identifying the characteristics that promote effective community resistance to invasive species.

Kadisyn Ceplina, St. Norbert College

Session: Poster II

“Intraspecific variation in body shape between three alewife (*Alosa pseudoharengus*) populations: anadromous, East Coast USA landlocked, and Laurentian Great Lakes.”

Intraspecific variation across populations is increasingly being recognized for its importance in driving ecological and evolutionary processes. The alewife, *Alosa pseudoharengus*, exhibits great intraspecific variation in various morphological and life history traits across two well studied eco-types; the ancestral anadromous alewife, and landlocked alewife found in small Connecticut lakes. New research on alewife gill rakers suggests that alewife in the Laurentian Great Lakes region may represent a third ecotype. We used geometric morphometric analysis to study body shape morphology between anadromous alewife, Connecticut landlocked alewife, and alewife from the Laurentian Great Lakes to determine variation between the three eco-types. We found that alewife from Lake Michigan resembled landlocked alewife from small Connecticut lakes, both of which show significant differences from anadromous alewife. This finding is evidence that there are only two alewife ecotypes: landlocked alewife, which includes the Laurentian Great Lakes, and anadromous alewife.

Evan Chalmers, University of Wisconsin La Crosse

Session: OS 6: Climate Change & Phenology

“The Phenology of *Microstegium vimineum*”

Invasive species present a severe and worsening threat to native ecosystems. The economic loss is staggering, estimated at \$120 billion per year in damages and losses to agriculture, tourism, and property value. The cost for native ecosystems is incalculable. Understanding the phenology of invasive plants is foundational to timing management efforts. One such invader, *Microstegium vimineum* (Trin.) A. Camus, has been identified for the first time in Wisconsin at the Coulee Experimental State Forest in La Crosse County. *M. vimineum* is an aggressive invader and potentially devastating to local plant diversity. While concerning, this infestation also presents an opportunity to study its phenology in a new area. Soil and air temperature data were collected at two infestation sites over the course of two growing seasons. These data were used to calculate growing degree dates for *M. vimineum*'s different phenophases. The effects of light intensity on these phenological changes were also assessed. Lastly, soil samples were taken and analyzed to quantify the presence and spread of *M. vimineum* in the seed bank. These data can be used by Wisconsin land managers to time conservation efforts in case of further spread.

Xiaoyong Chen, College of Arts and Sciences, Governors State University, University Park, Illinois 60484

Session: Poster I

“Characteristics of earthworms in selective forest types in Michigan-Illinois region”

Both invasive exotic and native earthworms have undesirable ecological effects on the structure, function, and biodiversity of forest ecosystems in the Great Lakes area. Understanding the biological parameters and distribution patterns of these earthworms is crucial for their life cycle and their impacts on ecological processes such as nutrient biogeochemistry cycling and carbon sequestration in forests, as well as for informing forest management practices. In this study, abundance, distribution, and mass-length relation of earthworms were investigated in selective typical forest types along a Michigan-Illinois latitudinal gradient. These forest types include Hemlock-White pine-Maple (HWM) forests in Huron Mountains of Michigan, White Pine-Hemlock-Oak forests (WHO) in Sylvania Wilderness of Michigan, and Shagbark hickory-Oak-Black Cherry (SOB) forests in Governors State University Field Station of northeast Illinois. Earthworms were captured from established sampling quadrats in these selected forest types using a mustard solution extraction method. The results showed that the abundance was significantly reduced from HWM forests (13 individuals/m²) to WHO forests (28 individuals/m²) and SOB forests (90 individuals/m²). Earthworm exhibited the largest body dimensions in SOB forests, with a mean length and mass of 74 mm and 0.203 g, respectively. In contrast, HWM forests had the smallest earthworm body size, with average values of 31.6 mm and 0.038 g for length and mass, respectively. The body dimensions of earthworms in the WHO forests fell between those of the SOB and HWM forests. The regression equations describing the length-mass relations of the earthworms were: $Mass = 7E-06L^{2.258}$, $Mass = 1E-06L^{2.7255}$, and $Mass = 2E-05L^{2.0792}$ in HWM, WHO, and SOB forests. The results suggested that variations in species compositions, food availability, soil nutrients, and micro-environments in the selected forest types may account for these differences in earthworm abundance and its body features. Our study provides scientific reference to further understanding of earthworm structure and function in northern forest ecosystems.

Quinn Collins, Kalamazoo College

Session: Poster I

“Interplay of Avian Predation and Parasitism in Goldenrod Gall Communities in SW Michigan”

Goldenrod galls, induced by the larvae of the goldenrod gall fly, provide a unique system where plant-insect interactions intertwine with predator-prey dynamics. These galls serve as both food and shelter for the developing fly larvae, attracting an array of predators including parasitic wasps, downy woodpeckers, and black-capped chickadees. Using goldenrod galls collected from a large field and a smaller field at the Lillian Anderson Arboretum, Kalamazoo County, Michigan, we investigated the rates of avian predation, insect parasitism, and successful emergence of gall flies. Our findings indicate that downy woodpeckers and black-capped chickadees preyed on goldenrod galls from the larger field more frequently than those from the smaller field, which is opposite from what we would expect if these birds stayed close to forest edges for cover. Bird predators also showed a preference for larger galls. On the other hand, parasitism by wasps and beetles showed no site or size effect despite previous studies that find parasites preferring smaller galls. In galls that were not preyed on or parasitized, there were no effects of site or size of the gall. Our results contribute to our understanding of predator-prey dynamics in prairie ecosystems and highlight the importance of considering spatial variation in predator foraging behavior.

Allison Collins, Denison University

Session: OS 3: Population & Community

“Testing growth-defense tradeoffs in 20 populations of Common Milkweed, *Asclepias syriaca*”

Plant success against herbivory in different environments can be mediated via growth-defense tradeoffs and synergistic defense traits. For plants, defense traits are costly investments that hinder resource allocation to growth. In *Asclepias syriaca*, cardenolide production is negatively correlated with growth. In environments with more intense herbivory levels and poor growing conditions, plants might invest more in defense traits. In environments with better conditions, plants can invest more in growth and tolerate herbivory. Plants can maximize their defense by investing in grouped defense traits that work better together.

In this experiment, we measured the growth and defense traits of 20 populations of common milkweed, *A. syriaca*. Traits of common milkweed have been studied since 2000 so there is directly comparable temporal data on *A. syriaca*. From the results of past studies, we expected 1) an inverse relationship between latex and trichomes, 2) positively correlated relationships between SLA (surface area to leaf mass ratio), latex and trichomes, and 3) negatively correlated relationships between defense traits and growth traits.

To test our hypotheses, we set up three common gardens in three different areas which contained roughly 180 genotypes from 20 populations of common milkweed originating across the Northeast United States. Over two years we measured the defense traits (trichome density, latex mass, and SLA) and growth traits (growth rate, height, and leaf number).

From our analyses of our data from both years and across all common garden sites so far, we found medium-strength positive correlations between trichomes and all growth traits. Interestingly, within the common garden located at St Olaf, positioned as the northernmost common garden of the three along the latitudinal gradient, we found negative medium-strength correlations for SLA against height and growth rate respectively. St Olaf's garden has strongly negatively correlated relationships between SLA and trichomes, and SLA and latex mass. There is also a highly positive correlation between trichomes density and latex mass at this common garden as well.

Water-use efficiency traits have been found to vary widely between *Asclepias* species. For *A. syriaca* it is possible that the correlations with SLA at our northern most common garden, the area with the least annual precipitation, reflect increased effort in plant water conservation. Our results open doors to investigate more questions surrounding the resilience and phenotypic plasticity of common milkweed populations to differences in their environment.

Harrison Copeland, Denison University

Session: Poster II

“Effects of Color, Pattern, and Distance from a Pond on Predator Attack Rates on Clay Model Frogs in Central Ohio”

Defensive coloration is a predator avoidance strategy used across many taxa and includes crypsis and aposematism. We used clay frog models to examine the effects of color (dark green vs. yellow), pattern (no pattern vs. black spots), and distance from a pond (near or far) on predator attack rates in central Ohio. We placed 20 clay frog models of each color and pattern combination at either near (< 1 m) or far (~ 4-6 m) from the pond edge (total number of models = 160). We examined the frog models weekly for evidence of predation for four weeks. Yellow frog models were less likely to be attacked than the green models. There was no difference in predator attack rates between frogs with and without spots. Frog models that were closer to the pond experienced a higher predator attack rate than those farther away. There was no interaction between color and pattern or between color and distance for predator attack rates. Our results suggest that local predators may avoid the novel yellow frog models and attack the dark green frog models that more closely resemble local frogs and that we thought would be more cryptic, possibly suggesting avoidance of an aposematic color even though no aposematic frogs are found in the area (although some salamanders are). Avoidance of yellow frogs may also reflect neophobia. Spots did not appear to affect predator attack rates, but different or more realistic patterns might. Frog models closer to the pond experienced higher predator attack rates, probably because they were in a more open habitat than the far models. In conclusion, color and location around a pond can influence predator attack rates in frogs.

Greg Corace, Alpena-Montmorency Conservation District

Session: OS 1: Management

“Ecological Forestry and Private Lands: Promoting Complexity for Biodiversity and Climate Change Adaptation”

Many approaches to forest and wildlife management were developed in the early 20th century when the global human population was a quarter of what it is today. Now, in the 21st century, biodiversity loss, climate change, and other stressors on forest ecosystems have necessitated a new working model for forest management. This presentation will illustrate how some published research in Michigan has helped guide the development of the four principles of ecological forestry: 1) context: the importance of planning and management at larger (landscape) spatial scales; 2) continuity: the maintenance of forest structure, function, and biota between pre- and postharvest ecosystems; 3) complexity: the need to create and maintain structural and compositional complexity and biological diversity, including spatial heterogeneity at multiple spatial scales; and 4) timing: the importance of applying silvicultural treatments at ecologically appropriate time intervals. This presentation will also outline opportunities and limitations to the future application of ecological forestry, with special emphasis on non-industrial, private lands.

Michael Cramer, University of Notre Dame

Session: OS 11: Behavior & Defensive Traits

“Utilizing trapping data to understand how movement determines mating systems in *Peromyscus*”

Mating systems are essential to improve our understanding of reproductive behavior in wild populations. Two species ubiquitous in North America are *Peromyscus maniculatus* and *P. leucopus*, both of which are thought to exhibit polygynandry, in which males and females have several different mates. In addition, mating in these species is believed to be spatially determined, with males having larger home ranges than females and these males defending territories to gain access to multiple females. The role of the females is less well understood, although genetic evidence suggests that they obtain extra-pair matings as well. My goal was to use trapping data collected from wild populations to determine how female movement behavior varies between reproductively active and inactive individuals and to document potential differences between these species for their use of space in the context of reproduction. To quantify movement, I used the mean squared distance (MSD) from the center of activity, calculated by using trapping data for mice who were captured three times in a trapping session. The trapping data was collected in June, August, and September of 2020-2023. Results indicate that for both species, males increase their movement distance when they are reproductively active, consistent with our understanding of male reproductive behavior. Also, mice that are not reproductively active have similar movement behavior regardless of sex for both species. When both sexes are reproductively active, males have a higher MSD compared to active females, most strikingly for *P. maniculatus*. The same trend was observed for *P. leucopus*, but it was not statistically significant. Further analysis of how reproductive status affected movement behavior for females revealed another difference between the species: *P. maniculatus* females moved more when they were lactating compared to those who were active but not lactating (presumably searching for mates) but *P. leucopus* females did not demonstrate this difference in movement. It is possible that females classified as lactating (due to the condition of their mammae) may have weaned their litter and started searching for additional mates for *P. maniculatus* but not *P. leucopus*. This difference in reproduction between the *Peromyscus* species may have important ramifications for small mammal community structure, as *P. leucopus* is thought to be extending their range northward with changes in climate. These results indicate the need for additional data on small-scale movement behavior and better indicators of reproductive condition, especially for females.

Kelvin Crone-Willis, Albion College

Session: Poster I

“The effects of wild rice on macroinvertebrate communities within the North branch of the Kalamazoo River in Michigan”

Wild Rice (Mnomen in Anishinaabemowin, the language of the Indigenous Anishinaabe people) is a culturally and ecologically significant plant native to the Great Lakes region. As part of an ongoing relationship between Albion College and the Nottawaseppi Huron Band of Potawatomi, we worked to measure the impact this plant has on the aquatic ecosystems by assessing the diversity of macroinvertebrate communities throughout the Kalamazoo River. Specialized macroinvertebrate collectors made out of 3D-printed wood, birchbark, and artificial sinew were designed, printed, and assembled. These collectors were filled with dead leaves and deployed in the north branch of the Kalamazoo River both within and outside of wild rice beds. The collectors stayed in the river for two weeks while macroinvertebrates moved into them. The samples were then returned to the lab where richness and biodiversity were calculated to establish the diversity of the samples. We also used biotic indices to measure pollution based on pre-established tolerances of the macroinvertebrates. Initial statistical analysis of the macroinvertebrates within the river showed little difference in diversity, richness, or biotic index of the sample sites with wild rice and those without rice due to high within-site variation. Biotic indices showed that the water quality in the river was consistently fair across sites. Further research must be done to establish the larger effects of wild rice on the whole river ecosystem.

Erik Curtis, University of Notre Dame

Session: OS 10: Decomposition & Nutrients

“Leaf Litter Inputs and Their Biofilms Influence Size-Specific eDNA Removal Rates in Streams”

Seasonal dynamics in streams, such as allochthonous organic matter inputs during autumn leaf fall, result in physical and biological changes that may influence eDNA removal from the water column. We explored the impact of the experimental addition of leaf litter using short-term releases of Common Carp (*Cyprinus carpio*) and Steelhead Trout (*Oncorhynchus mykiss*) eDNA using recirculating mesocosms and outdoor experimental streams to quantify eDNA removal rates. We conducted replicate releases over time and quantified eDNA removal for different particle sizes using sequential filtration. For both mesocosms and streams, Carp and Steelhead eDNA were removed at similar rates (TukeyHSD, ANOVA; $p > 0.05$). Using experimental streams, larger ($> 1.2 \mu\text{m}$) eDNA particles were removed 10x faster than smaller ($0.4 \mu\text{m} - 1.2 \mu\text{m}$; ANOVA, TukeyHSD; $p < 0.001$), and this effect was more pronounced in treatments when leaves had biofilms. In the experimental streams, physical removal via benthic substrate preferentially trapped larger eDNA particles, whereas in mesocosms, which lacked benthic substrate, longer water column residence times achieved via recirculation increased the relative contribution of leaf biofilms to eDNA removal. These contrasting results demonstrate that environmental context (substrate composition, temperature, and microbial activity) can mediate the effect of leaf litter on size-specific eDNA removal in streams.

Emma Dawson-Glass, University of Michigan

Session: Poster II

“Effects of warming on plant investment into a plant defense mutualism”

Mutualisms are essential to the survival and reproduction of many plants, but climate warming is altering how plants and mutualists interact. The relationship between plants and foliar mites is an important but understudied plant-defense mutualism, in which fungivorous mites provide plants with defense by consuming potentially harmful fungi. In exchange, plants provide protection for mites within leaf structures called domatia. Because mites and fungus are both sensitive to temperature, warming could alter the abundance of each community. Warming could also alter plant investment in domatia, which directly correlates with the number of mites present on a leaf. Here, we explored warming's effect on domatia size, mite abundance, and fungal abundance on *Prunus serotina* seedlings. There were no relationships between warming and domatia size, mite abundance, and fungal abundance. Mite abundance was positively correlated with domatia size, but only on plants in the warmed treatment. Fungal abundance was positively correlated with mite abundance in both treatments. These findings indicate warming may alter plant investment into the mite-plant mutualism, with implications for the function of this defense mutualism.

Lang DeLancey, University of Minnesota

Session: OS 7: Decomposition & Nutrients

“Prime time for pine decomposition: Ectomycorrhizal fungi enhance litter decay in a temperate red pine forest”

The suppression of organic matter decomposition by ectomycorrhizal fungi (EMF), a.k.a. the "Gadgil effect", is often linked to variation in leaf litter chemistry, especially as it relates to nitrogen (N) and carbon (C) chemistry. To date, however, the litters of a limited number of plant species have been tested, hindering our ability to predict EMF effects on C cycling at the ecosystem scale. Here, we compared needle decomposition of both a novel (red pine; *Pinus resinosa*) and previously tested (white pine; *P. strobus*) species for 12 months in control plots and plots where EMF were suppressed via trenching in a red pine stand in Central Minnesota, USA. In addition to tracking mass loss, we analyzed litter bags for C- and N-acquisition enzyme expression and changes to chemistry (FTIR, %C, and %N). We hypothesized that EMF would suppress leaf litter decomposition and that this suppression would be more pronounced in the relatively recalcitrant and N-poor red pine litter. We also expected this decrease in decomposition to be associated with changes in the activities of N acquisition enzyme expression. Contrary to our hypotheses, leaf litter decomposed 13% more over one year in the presence of EMF and roots, an effect that was more pronounced for red pine litter. These decomposition changes were associated with increased N-acquisition and decreased litter %N and proteins. These results suggest that while litter N content may influence EMF-saprotroph interactions, EMF suppression of decomposition does not necessarily follow in low-N, recalcitrant litter types, even in temperate pine forests.

Tom Denbow, Biohabitats - Great Lakes Bioregion Office

Session: OS 8: Conservation & Restoration

“Sandusky Bay Restoration Initiative: Landscape Scale Integrated Project to Restore Lost Coastal Wetland Functions”

The Sandusky Bay Restoration Initiative (Lake Erie), launched by the ODNR Office of Coastal Management, was established to implement much-needed landscape-scale restoration to enhance nutrient assimilation benefits of restored and created wetlands in the 64 mi sq. Bay. Most of the existing wetlands in the Bay are associated with diked wetlands that attract waterfowl and support hunting. While some diked wetlands provide water quality benefits, ecological functions are restricted due to the lack of connection to the Bay's open waters. Also, dikes and shoreline protection have created a hardened shoreline, increasing nearshore wave energy dynamics. The alterations and nutrient loadings have created conditions where virtually no SAV exists in the Bay due to high turbidity levels and loss of resilient SAV community. Also, the Bay has been plagued in the past by Planktothrix (HAB) blooms caused by the high nutrient loadings and sediment resuspension, which threaten public health and the regional economy. In response, opportunities for restoring wetlands require innovative approaches to re-establish wetland functions. As a result of funding provided by the H2Ohio program, a series of projects have been designed to reduce the Bay's problems using a combination of nature-based shoreline, riparian floodplain, and in-bay barrier wetlands restoration projects. Design development required understanding existing Bay conditions caused by years of nutrient loadings from the Sandusky River and other tributaries and comprehensive modeling (physical and water quality) to understand baseline conditions including fetch, bottom shear stresses, water-level changes (short and long term cycles) and the effectiveness of different restoration strategies and designs. Also geotechnical, sediment quality testing, and cultural resource investigations were required. Using an ecological functions design-based approach, 13 integrated projects were designed to reduce sediment resuspension, enhance nutrient assimilation, and provide much-needed habitat improvements for this important Lake Erie lacustrine. One project has been construction, a second nature-based shoreline project is under contract, and two additional projects are in permitting. The program is the largest landscape-scale restoration project ever undertaken in the State of Ohio.

Kaylynn Dennis, Grand Valley State University

Session: Poster I

“Exploring carbon cycling trends in a Great Lakes Estuary and Area of Concern”

Inland waters are hotspots of carbon cycling. They are also warming faster than both the ocean and atmosphere and can serve as an early warning system for climate and environmental changes. As climate change accelerates, the role of these inland lakes and the ability to quantify their contributions to the carbon budget becomes increasingly important. Muskegon Lake, Michigan is a highly productive Great Lakes Estuary and Area of Concern that drains the second largest watershed in Michigan into Lake Michigan, making it an active study site for carbon dynamics. Previous metabolic studies have concluded that Muskegon Lake, Michigan is a carbon sink on an annual basis, but no multi-year or high-frequency, seasonal time-series measurements of oxygen dynamics or analyses of carbon flux exist. To better understand and catalog the carbon flux in inland waters like Muskegon Lake, we experimentally measured rates of photosynthesis and respiration and made direct measurements of dissolved oxygen dynamics. Seasonal measurements of ecosystem metabolism (3 times per year) have been conducted on the lake since 2004, and an observatory (www.gvsu.edu/buoy/) has made nearly continuous dissolved oxygen measurements since 2011. In addition to seasonal metabolism measurements, we made more frequent, monthly discrete measurements of photosynthesis and respiration during 2023. Here we present higher frequency, discrete estimates of carbon production and respiration from 2023 to compare with past seasonal trends since 2004. We also analyze corresponding high frequency dissolved oxygen data via modelling carbon metabolism for more intense inter and intra-annual comparisons. Both analyses will help quantify carbon flux in this Great Lakes estuary and contribute to the assessment of the role of temperate lakes in the changing global carbon cycle. Gaining a better understanding of the carbon cycle within this lake can aid in addressing ongoing issues of eutrophication, HABs, and hypoxia.

Sara Diller, Western Michigan University

Session: OS 4: Conservation & Restoration

“Riparian Vegetation and Arthropod Responses to Dam Removal along the Kalamazoo River”

Riparian ecosystems serve as critical corridors between riverine and terrestrial habitats and support a diverse assemblage of organisms, many of which are adapted to periods of inundation. When a dam is constructed and natural flood pulses are reduced, riparian vegetation communities are susceptible to replacement by terrestrial species, which in turn can alter the wildlife present. Dam removal is a popular river restoration strategy that has often proven successful for macroinvertebrate and fish communities; however, it isn't until recently that riparian zone responses to dam removal have garnered attention. The Kalamazoo River in western Michigan provides a unique opportunity to study these responses because there are several reaches in different stages of dam removal. Moreover, these reaches lie within a US EPA Area of Concern (AOC), so there is special interest in how their ecosystems are responding to restoration efforts. The goal of this study was to compare riparian vegetation and arthropod community structure along the Kalamazoo River in reaches with an intact dam to those where a dam has been removed. Specifically, we assessed taxonomic composition, Floristic Quality Index (FQI) scores, diversity, and relative frequency of key functional groups. We observed greater relative frequency of obligate and facultative wetland plant species in reaches where the dam has been removed compared to reaches where the dam is intact, suggesting a return to normal flood regimes after dam removal. We also observed a significant positive relationship between FQI scores and relative abundance of detritivorous riparian arthropods. Overall, our results suggest that dam removal can be a successful strategy for improving riparian function, namely through restoration of riparian vegetation communities and additional arthropod functional groups.

Zhijun (Mavis) Ding, Denison University

Session: Poster II

“Exploring local adaptation in common milkweed through a common garden design: insights from herbivore dynamics over three years”

The monarch butterfly (*Danaus plexippus*), particularly its migratory subspecies, plays a significant educational, conservational, and cultural role in North America, undertaking an annual journey from southern Canada and the northern and central United States to overwinter in central Mexico. This subspecies is now classified as Endangered on the IUCN Red List, with its population experiencing a steep decline over the last two decades due to factors such as habitat degradation, adverse weather conditions, pesticide use, and the loss of milkweed (*Asclepias* spp.) host plants, which are crucial for their survival and reproduction.

In response to the monarch's population decline and the pivotal role of milkweed in their lifecycle, our study investigates the concept of local adaptation in common milkweed (*Asclepias syriaca*) by conducting a three-year long (2021-2023) common garden experiments across Minnesota, Ohio, and Virginia, using 20 common milkweed populations from 7 different ecoregions in the northeastern United States. Given the monarch's dependence on milkweed, we examine whether local milkweed populations exhibit less herbivory damage than non-local ones, which could inform conservation efforts by recommending the planting of local milkweed varieties to support monarch populations more effectively.

We found some interesting results by examining the herbivory dynamics over three years (2021-2023) within the Ohio common garden experiment. The overall herbivory leaf damage for all populations increased significantly each year from 2021 to 2023. More notably, the difference in herbivory leaf damage across different ecoregion-based populations became increasingly pronounced. While the first two years showed no significant differences in damage scores among these groups, by 2023, milkweed populations from the Virginia ecoregion area exhibited significantly higher average leaf damage compared to those from or near the Ohio ecoregion. Although this pattern does not conclusively provide strong evidence of local adaptation, it aligns with the notion that plants may develop adaptive differences at later stages of their life history.

We also found that the overall herbivore presence count was much higher in 2023 compared to the first two years, with red milkweed beetle, snail/slug, and weevil as the most abundant ones. Based on the 2023 data, leaf number had a significant effect on the likelihood of having red milkweed beetles and weevils on the plant. Stem height had a significant effect on the likelihood of having snails/slugs, red milkweed beetles, and weevils on the plant.

We are currently extending our analysis to compare the herbivore presence data across ecoregion-based populations and to investigate if certain insects are significantly correlated with herbivory leaf damage. These steps can further inform our understanding of local adaptation in common milkweed populations based on herbivory dynamics.

Matthew Dougherty, Saint Norbert College

Session: OS 11: Behavior & Defensive Traits

“Predation and ecosystem size interact to regulate prey heterogeneity”

Environmental heterogeneity is important for ecological and evolutionary processes, and it can be shaped by both abiotic and biotic drivers. The importance of fundamental ecosystem properties, like ecosystem size, in determining which factors have greatest influence is poorly understood. We measured the heterogeneity of the zooplankton community properties to test how ecosystem size mediates the role of abiotic and biotic drivers of environmental heterogeneity in lakes. We collected zooplankton in 30 lakes across a lake size gradient of 9.4 to 8,200,000 hectares throughout the Northeast and Midwest of the United States. We investigated water depth and lake volume as abiotic drivers of zooplankton heterogeneity, and the alewife, a keystone zooplanktivore, as a biotic driver of zooplankton heterogeneity. We found that alewife impact zooplankton heterogeneity across a wide range of lake volumes, but that impact weakens as lake volume increases. Our results suggest that biotic drivers of environmental heterogeneity are likely strongest in small, spatially compressed ecosystems. Our results also provide additional evidence of the importance of spatial scale for ecological processes, in this case an understudied component of heterogeneity.

Lillian Dun, University of Pittsburgh

Session: Poster I

“Duckweed populations (*Lemna minor* and *Spirodela polyrhiza*) evolve different traits in the presence or absence of different invasive *Salvinia* species”

Invasive species can negatively impact species native to a specific community. When measuring the impact of invasive species, researchers often only consider ecological factors such as changes in biodiversity or relative abundance. However, the evolutionary impact of invasive species on native communities is often overlooked. We investigated if native populations would evolve phenotypically in the presence of non-native species. To test this, we conducted an experiment evolving populations of the native aquatic plant species *Lemna minor* and *Spirodela polyrhiza* in the presence or absence of non-native *Salvinia natans*, *Salvinia minima*, or a combination of both non-native species. After six weeks of evolution, populations of *L. minor* and *S. polyrhiza* were placed in common garden environments for one week before measuring changes in traits such as surface area and biomass of individuals. In populations containing any of the other species, *Lemna minor* evolved decreases in per capita surface area and biomass whereas *Spirodela polyrhiza* evolved increases in these traits. Through evolution, *Lemna minor* decreased similarity to introduced *Salvinia* spp while *Spirodela polyrhiza* increased similarity to *Salvinia* spp. The opposing directional evolutionary trends found in the *L. minor* and *S. polyrhiza* populations can offer insight into the diverse ways native community populations might evolve in response to invader species. In the future, we will investigate the specific mechanisms of evolution contributing to phenotypic diversification and whether evolution might alter the way these native populations compete with their introduced counterparts.

Keely Dunham, Grand Valley State University, Annis Water Resources Institute

Session: Poster II

“Using airborne eDNA to investigate the impacts of hemlock woolly adelgid on community diversity”

Anthropogenic impacts on landscapes create opportunities for invasive species to spread, causing biodiversity changes. Large-scale biodiversity alterations contribute to the degradation of ecosystem functions and services, creating a need to better understand invasive species' impacts on systems. Hemlock woolly adelgid (HWA) is an invasive forest pest threatening Michigan's 176 million eastern hemlocks. Eastern hemlocks are a foundation tree species found in sensitive coastal dunes and riparian zones. Once infested, HWA feeds on hemlocks, resulting in hemlock mortality within 4 - 10 years. Since HWA infestations ultimately lead to the decline and death of this foundation species, we expect to see landscape-level changes in biodiversity as infestations progress. For this study, we are using airborne environmental DNA (eDNA) as a tool to investigate HWA impacts on plant community composition in west Michigan hemlock-dominant forests. We deployed 87 airborne eDNA traps across 16 sites in the spring and summer of 2023 to sample plant taxa. Our sites included hemlock stands with no known HWA infestation and stands with varying infestation levels. Using an amplicon sequencing approach, we targeted the ITS2 region and identified plant taxa at the genus level. The traps detected 461 unique sequences, representing at least 32 plant families and 55 genera. We found a significant difference in the diversity of observed plant genera between sites ($F = 2.03$; $p < 0.001$); but there were no significant differences in diversity estimates between infested and non-infested sites ($F = 1.33$; $p = 0.13$). Many of our infested sites are still in the earlier stages of HWA infestation and the eastern hemlocks have not yet experienced substantial health declines, which is likely causing a lack of significant differences between infested and non-infested sites. However, as hemlock health continues to decline, we expect plant taxa diversity to shift, and using eDNA approaches will be a powerful research tool to monitor these changes. eDNA gives us insight into how these systems are changing, allowing managers to predict, and then mitigate the impacts this loss will have on these critical forests.

Lekeah Durden, Central Michigan University

Session: OS 9: Population & Community

“Being Neighborly: Can morning glory endosymbiosis impact co-occurring neighbor?”

Plant species can have ecological impacts on co-occurring species by altering their resistance to natural enemies. Associational resistance occurs when one species reduces enemy damage to neighboring species, whereas associational susceptibility increases enemy damage to neighboring species. In a previous study, *Ipomoea tricolor* "Pearly Gates" plants, endosymbiotic with alkaloid-producing *Periglandula* fungi developed fewer nematode galls and produced less biomass than non-endosymbiotic plants. To explore whether endosymbiont-mediated resistance could extend to neighboring species, we grew endosymbiotic or non-endosymbiotic *I. tricolor* with corn (*Zea mays*) in soil inoculated with Southern root-knot nematodes (*Meloidogyne incognita*) or no inoculation controls. Both nematode and endosymbiont treatments reduced total plant biomass per pot, but corn produced significantly more biomass in the nematode addition treatment when morning glory was endosymbiotic, consistent with associational resistance. These results suggest that the *Periglandula* endosymbiont of *I. tricolor* can enhance the growth of co-occurring plants in the presence of natural enemies.

Kaylin Engerman, Holden Forests & Gardens

Session: Poster I

“Newly introduced garlic mustard aphid (*Lipaphis alliariae*) reduces growth and reproduction of invasive garlic mustard (*Alliaria petiolata*)”

The success of many invasive species is due, in part, to a lack of natural predators in their introduced ranges. Garlic mustard (*Alliaria petiolata*), a highly invasive biennial herb found in forests across North America, reduces species diversity by displacing native understory plants. Originally native to Europe, garlic mustard is now experiencing herbivory pressure from garlic mustard aphid (*Lipaphis alliariae*). The garlic mustard aphid was discovered for the first time in North America in 2021, in Lake County, OH. To determine if the newly introduced garlic mustard aphid might effectively reduce garlic mustard in its North American range, we assessed naturally occurring garlic mustard plants found with or without the aphids in forests at the Holden Arboretum, quantifying the impact of aphids on garlic mustard growth and reproduction. While there were no differences in stem number, leaf number or seed viability between plants found with and without garlic mustard aphids, plants found with aphids were shorter and had lower aboveground biomass. In addition, plants with aphids produced fewer and smaller seeds. Given that garlic mustard plants tend to be less robust when infested by the newly arrived garlic mustard aphids, it is important to continue to monitor the potential detrimental impacts of the garlic mustard aphid on garlic mustard.

Daniel Etcheberrigaray, Oberlin College

Session: Poster I

“Genetic and morphological effects of hybridization during a species invasion”

Rusty crayfish (*Faxonius rusticus*) are invaders of native Sanborn crayfish (*Faxonius sanbornii*) in Ohio. Previous work in the Roles lab has established that hybridization between these two species is occurring in the Huron R. Morphologically intermediate individuals have also been observed in the Kokosing R. We sampled multiple sites along each invaded river as well as for several allopatric (native) rivers for each species; at least 14 crayfish were sampled per site. Here, we report patterns of morphological and genetic variation along the length of invaded rivers. We describe the pattern of genetic mixing that may be occurring along the length of invaded rivers and correlate it with the morphological patterns. Morphological variation was measured via a suite of standard measurements for crayfish and then analyzed via discriminant analysis. For genetic analysis, DNA was isolated from each crayfish and libraries were prepared for double digest RAD-seq to generate genetic markers. Raw genetic data were processed with ipyrad to extract genotypes for SNP loci; 81,503 loci were identified from the entire dataset. Patterns of genetic variation were assessed using STRUCTURE and DAPC on subsets of the complete dataset. Morphological characters show that downstream sites are more similar to the invasive *F. rusticus* while upstream sites are more similar to the native *F. sanbornii*, with a gradient along the river's length. Preliminary results from ddRAD-seq suggest a similar pattern is occurring for the genetic data such that downstream sites resemble the invader while upstream sites resemble the native species.

Stive Flores Gomez, University of Santa Cruz do Sul

Session: Poster II

“Phytoplankton community in lake water quality assessment: a review of scientific literature based on bibliometric and network techniques”

The health of the world's lakes is affected by human activities; there are several methods to assess their water quality, and this article, recognizes the functional importance of phytoplankton for the aquatic ecosystem. In this research, bibliometric and network techniques were used to analyze the inclusion of the phytoplankton community in assessing lake water quality. PRISMA criteria were adopted to produce reliable results. Scopus and Web of Science were consulted. The number of publications, citations, co-citations, and bibliographic coupling were techniques used to identify relevant journals, countries, authors, and articles. The conceptual evolution was analyzed by keywords co-occurrence and thematic trend. Based on 219 documents of the annual period 1986-2022, the annual growth index was 12.2%. Maria Moustaka-Gouni denoted as the top influential author, China leded in publications. Hydrobiologia was the top journal. In the analysis of co-authorship networks, Y. Zhang had a prominent relationship. Top influential articles content theme related to phytoplankton community as an indicator of water quality in lakes and functional groups in the phytoplankton community. The conceptual structure analysis showed that lake, phytoplankton, eutrophication, phosphorus, water quality, and cyanobacteria were the most relevant themes. Furthermore, the trending topics were mainly toxicity, dynamic, functional groups, and restoration.

Priya Gahir, University of Michigan

Session: OS 5: Invasive Species

“Phragmites management in high water: how adventitious roots may save plants from drowning.”

The increase in the prevalence of invasive *Phragmites australis* (Common Reed), has threatened biodiversity and displaced native plant species throughout North America. The surge in *Phragmites*, particularly the Laurentian Great Lakes Basin, coincides with Great Lakes water levels fluctuating in the late 1990s and early 2000s. The prolonged period of low water exposed vast stretches of shoreline and lake bottom, facilitating the expansion of *Phragmites*.

Phragmites survives in high water by growing above the water surface and transporting oxygen from above to below water. *Phragmites* plants may also develop adventitious roots as a stress response to high water environments which could aid in uptake of nutrients or even dissolved oxygen. Cut-to-drown management is a control strategy whereby *Phragmites* stems are cut below the water line and drowned. This strategy can be effective, however adventitious roots could help the plants withstand cut-to-drown by making its impact less severe by providing an additional oxygen source to the plants after they have been cut under water. It is necessary to know the role these adventitious roots play in the survival of *Phragmites* for management strategies to be broadly effective in the Great Lakes. To examine the function of adventitious roots on *Phragmites*, we incorporated cut-to-drown treatments (full/partial/no cuts) in conjunction with manipulation of dissolved oxygen and adventitious root removal. We conducted a controlled greenhouse that tested the effects of submergence, dissolved oxygen and presence of adventitious roots on *Phragmites* growth and viability post treatment. We measured belowground, aboveground and new rhizome biomass, as well as rhizome non-structural carbohydrate content as measures of *Phragmites* growth and viability.

Results showed that plants receiving full cuts (all the way to the soil surface) and partial cuts (cut below the water but above the sediment) produced significantly less belowground biomass and rhizosphere carbohydrates than controls. Additionally, plants receiving partial cuts sprouted significantly more stems over time than full cuts or controls. New sprouts were more common when those partial cuts had adventitious roots and/or added dissolved oxygen. This implies that adventitious roots may be providing increased oxygen to the plants allowing them to respire and produce new shoots following cuts. The cut treatments, dissolved oxygen and adventitious root removal together played a significant role in new rhizome biomass. Together, our results suggest that full cuts are most effective in controlling *Phragmites* populations due in part to the removal of adventitious roots. This information could be incredibly valuable to land managers, increasing effectiveness of cut-to-drown treatments and decreasing the need for retreatment.

Sylvain Giroud, Northern Michigan University

Session: OS 6: Climate Change & Phenology

“Trade-Offs in Seasonal Dormancy Phenology in Endotherms and Ectotherms”

Seasonal animal dormancy (hibernation, diapause) is a physiological response to survive energy challenges during the harshest periods of the year. Beyond this aspect, it also reduces the risk of predation and competition (the "life history" hypothesis). According to this hypothesis, the phenology of dormancy is influenced by a trade-off between the reproductive benefits of being active and the survival benefits of being dormant. Thus, species can emerge from dormancy when reproductive advantages appear, irrespective of environmental conditions for obtaining energy. They can also enter dormancy when these environmental conditions would allow activity to continue, if there were advantages linked to reduced predation or competition. Within the same species, males and females do not invest the same amount of time and energy in reproduction. Thus, the trade-off between reproduction and survival may be reflected in sex differences in dormancy phenology. To date, there are no comparative tests between animal species to verify this.

Using a phylogenetic comparative method applied to over 20 species of hibernating mammals, we therefore predicted that sex differences in hibernation phenology should be associated with differences in reproductive investment, independent of energetic status. In line with the life-history hypothesis, the sex that spent least time in activities directly (testicular maturation, gestation) or indirectly associated with reproduction (recovery from reproductive stress) spent more time hibernating. This would not be expected if hibernation phenology were solely influenced by energetic constraints. Moreover, animals can enter hibernation even if the environment allows a positive energy balance to be maintained. Finally, our results suggest that the life-history hypothesis would explain the dormancy phenology of ectotherms (invertebrates and reptiles). Thus, dormancy during non-life-threatening periods that are unfavorable for reproduction may be more widespread than previously appreciated.

Ryan Graham, University of Windsor

Session: OS 1: Management

“The use of cellphone-based applications complements but doesn't replace local expert knowledge for species-level plant identification”

The development of plant identification cellphone-based applications (apps) has increased the ability for individuals to identify unknown plant and animal species. Increasingly, citizens and novice biologists have been using these tools to explore the natural world around them however the accuracy of these apps range in quality when it comes to prompt, accurate identifications. With growing species at risk of extinction in human settled and working landscapes, there are fewer experts and resources available in key regions including southwestern Ontario, Canada. While apps have the potential to offer support and validation for the purposes of scientific research, accuracy is a major concern to ensure research-grade data. Here we present findings from a study on vegetational communities in agricultural drains and wetlands in Essex County, Ontario, Canada. We employed two apps: Seek from iNaturalist, and, PictureThis alongside quantitative quadrat-level data assessing vegetational biodiversity. Apps were employed to assist with two different field studies in 2022 which involved initial plant identification combined with field photos were taken of every individual species. To confirm plant identification, we undertook an expert elicitation process involving over 250 photos of unique plant individuals requiring species-level identification (or its closest level). We engaged five well-known local regional biodiversity experts and sought their recommendations for identification to the lowest possible level. In the agricultural drain study, 131 species were sent to expert groups and 85% of identifications had at least 2 expert groups submitting identifications. 121 species were confirmed and a total of 10 plants were removed because of lack of confidence after expert consultation. Only 14 of the expert identifications had conflicting identifications across expert groups, 12 of which were only species changes and only 2 had both genus and species differ. Additionally, conflicts between identification were primarily grass species. Overall, 5 genus and 19 species identification were changed after completing the expert consultation. This expert elicitation methodology will be discussed with the aim of formalizing a hybrid approach that combines all available knowledge to help implement and accelerate local vegetational communities and their management and conservation.

Timothy Gsell, Governors State University

Session: Poster II

“Influence of Invasive Earthworms to Microbial Abundance and Carbon Usage in Three Unique Forest Type Soils in the Upper Peninsula of Michigan”

Invasive earthworms have been shown to affect the amount and distribution of organic matter and to increase the rates of organic matter decomposition in soils. They are responsible for transport of large quantities of carbon from the surface of the soil to the lower horizons and influence microbial abundance diversity and metabolic activity. The purpose was to determine the diversity, abundance, and distribution of invasive exotic earthworms and their effects on soil microbes in different forest types in the Huron Mountain region of the Upper Peninsula of Michigan. The specific objectives were: (1) to examine the abundance, distribution, diversity, density and biomass of the invasive earthworms in the three main forest types; hemlock-white pine, aspen-maple and birch-maple, (2) to define relationships between the characteristics of invasive earthworms and the microbial population abundances (aerobic bacterial, actinomycete and fungal viable counts) and carbon usage patterns from surface soils and at 40 cm depths in the forest type. Three forest types were sampled using quadrants and the mustard water technique to collect earthworms. Soils were collected from the surface and 40 cm depths aseptically, diluted and counted on aerobic bacterial, actinomycete agar plates and yeast mold petrifilms. BiOLOG ecoplates were analyzed to assess carbon use of 31 commonly metabolized carbon sources. The highest aerobic counts were found in the maple-aspen and hemlock-pine sites (106 bacteria/g) from all three surface soil types and dropped between one to two orders of magnitude at 40cm depths for all three forest types. Actinomyces were highest in the hemlock-pine site, and lowest in the birch-maple site, but ratios to aerobic were similar in all sites. Fungi were similar at all sites at the surface and 40cm. Ecoplates indicated that hemlock-pine and birch maple plots had the lowest utilized carbons at 18/31 and 17/31 at the surface and increased to 27/31 with depth. The aspen maple carbon use pattern was higher at the surface than deeper in the horizon. All sites contained exclusively invasive earthworms with hemlock-pine site having the highest density, mass, and size. The microbial data tended to be inversely correlated to these earthworm parameters. Results from this study provide the guidance for further molecular studies assessing the potential influence of the invasive earthworm on structure, function, and ecosystem level microbial activities such as nitrogen cycling and carbon sequestration patterns.

Christiana Guthrie, Northern Illinois University

Session: Poster II

“The Proof is in the Plant Traits: A comparison of intraspecific plant trait data collected from both a natural and experimental prairie restoration”

One of the major criticisms of biodiversity-ecosystem functioning (BEF) experiments is that the synthetic assemblages used in these experiments are not realistic when compared to real-world ecological communities. To address the issue of realism, the BEF experiment titled "Community Assembly and Prairie Ecosystem Restoration," (CAPER; Dekalb, IL, U.S.A) was designed to be based off natural plant communities found at Nachusa Grasslands (Franklin Grove, IL, U.S.A.), a natural restored prairie site ca. 35 miles from CAPER. However, the CAPER research team has observed that some of the plant species were growing in a way that didn't match their growth forms in a real-world setting. Specifically, the CAPER plants seemed to be growing taller and bushier than their species' counterparts found at Nachusa Grasslands. This study explored the functional trait differences between plants found at the experimental prairie restoration and the natural prairie restoration. Traits collected included plant height, stem density, specific leaf area (SLA), and leaf dry matter content (LDMC) for four common native forbs found at both sites. We selected two species we expected to have similar functional trait values and two species we expected to have different functional trait values between the two sites based on anecdotal observations. We found that all four species had significantly differing values for all functional traits that were measured except for LDMC for all species and SLA for one species. Overall, we found the average magnitude of difference between the experimental and real-world setting traits to be 44%. We expect these differences may be the result of differences in competitive dynamics due to the experiment using plant plugs while the real-world restoration used seeds. The differences may even out in the future, as experimental communities mature under ongoing competition pressure. Without proper acknowledgement of the unrealistic aspects of BEF experiments, there is a level of uncertainty for how applicable the BEF findings are for the real world. We hope that by understanding the magnitude of difference between experimental and natural plant communities, we will be more confident in drawing conclusions from BEF experiments that are realistic for natural restorations.

Jacob Hansel, University Wisconsin of La Crosse

Session: Poster I

“Factors affecting ectomycorrhizal community ecology in the Kickapoo Valley Wisconsin USA.”

The Kickapoo Valley in southwest Wisconsin, U.S.A. is a unique ecosystem comprised of old growth and early successional forests that rely on symbioses with the ectomycorrhizal (ECM) community to thrive. To understand how the ECM symbiosis affects the health and stability of this ecosystem, tree, soil bacterial, and ECM community composition was surveyed in 23 plots in the Kickapoo Valley; soil characteristics were also examined. The surveys identified 6 distinct tree communities, which varied along a north to south gradient, with significant differences observed among slope aspects. Soil texture varied among loam, sandy loam, and silt loam. Carbon utilization metabolic assays of the soil bacterial communities showed high functional diversity amongst the surveyed plots. The greatest range of carbon substrate utilization was found in tree communities with significant understory debris. Ongoing analysis is determining how soil chemistry affects tree community composition. Future analyses include identifying ECM fungi isolated from tree roots in the soil samples to determine ECM fungal community composition on the levels of individual trees, individual soil cores, and entire plots. Tree, fungal, and soil bacterial communities will be identified using Illumina sequencing. Results of these analyses will provide an overview of the factors that affect the interactions of ECM trees, fungi, and soil bacteria of the forested ecosystems within the Kickapoo Valley that can be applied to other temperate forested ecosystems worldwide.

Allison Harnish, Albion College

Session: Poster II

“Wigwasmkek: Braiding Indigenous Ecological Knowledge and Western Research Methods in the Study of Mnomen (Wild Rice) Ecosystems”

An extraordinary partnership between the Nottawaseppi Huron Band of the Potawatomi (NHBP) and Albion College in southern Michigan has produced an innovative tool for studying the health of mnomen (wild rice) ecosystems. This biodegradable macroinvertebrate collector creatively combines natural materials and Indigenous ecological knowledge with field and laboratory methods of western biology. The wigwasmkek (birchbark container) is being used to study water quality as part of a broader effort to research and restore mnomen, a native aquatic grain that is ecologically, culturally, and spiritually significant for Indigenous peoples of the North American Great Lakes. Results from test deployments of the wigwasmkek in the Kalamazoo River and Nottawa Creek indicate that it functions well as an alternative to a plastic macroinvertebrate collector (leaf pack). The wigwasmkek can withstand two weeks of submersion and its parts can be reused at least two times. With this poster we share how Albion College students, staff and faculty designed, assembled, deployed, and analyzed the wigwasmkek with guidance from the NHBP's Environment Department and Tribal Historic Preservation Office. We note how our work strives to honor the Anishinaabe Seven Grandfather Teachings while providing community-engaged and experiential learning opportunities for undergraduate students. We also describe our next research steps.

F. Collin Hobbs, Huntington University

Session: Poster I

“Recovery of native shrub layer following removal of invasive bush honeysuckle (*Lonicera* spp.) in a Midwestern forest”

Invasive species may cause long-term damage to ecosystems that can persist even after eradication. Non-native bush honeysuckles (*Lonicera* spp.) are highly invasive, allelopathic shrubs that have become common in Midwestern forests. While many studies have established the negative impact of non-native bush honeysuckles on native understory plants, few have studied the long-term residual effects of bush honeysuckle after its removal. Here we assess the recovery of native woody shrubs and tree saplings following the removal of bush honeysuckle in a forest understory. Our study site was a portion of Huntington University's campus woods that had been heavily invaded by bush honeysuckle. Honeysuckle had been actively removed from approximately half of the study area for nine years (treated) while the other half was left unmanaged (untreated). In November 2022 we sampled 24 1m² plots, twelve in treated and twelve in untreated portions of the woods. Every woody-stemmed plant larger than 1mm in diameter was identified, recorded, and its stem diameter measured. We then calculated the species richness, Shannon diversity, stem density, and basal area for each plot. The stem density of native species was 2.6 times greater in treated plots ($P=0.04$) and basal area was 8.1 times greater ($P=0.003$). Invasive species had a similar stem density between treated and untreated plots ($P=0.97$), however their basal area decreased by a factor of 9.1 in treated plots ($P=0.02$). Shannon diversity was also higher in treated plots (2.41) compared to untreated plots (1.44). Our results indicate that native woody shrubs and trees can quickly recover following the removal of a dominant invasive species.

Katie Hong, Purdue University

Session: Poster II

“How does mammal species diversity in a gradient of habitat features predict bobcat presence in the Central Till plains?”

Bobcats (*Lynx rufus*) are nocturnal and cryptic animals that are rarely seen by humans. Previous research has not produced a standardized, straightforward method for estimating bobcat populations in a given area, relying on a combination of sightings, environmental DNA data, mortality reports, and tracks. We aim to develop a predictive model that utilizes prey species presence and habitat quality from known sightings of bobcat in Central Till Plains area of Indiana. To do this, we deployed remote sensing equipment (camera traps) at 8 sites near water source (ie., river, creek) in Tippecanoe county, Indiana that reflected a gradient of habitat features (water source, canopy density, and vegetation classification) in open woodlands, ravines, and prairie habitats from December 10, 2023 - March 24, 2024. The camera traps were deployed at knee height and attached to a tree with an attractant applied to a resting log approximately 20 meters in front of the camera to trigger captures using motion and infrared sensor at a 20-meter distance. We designated vegetation type classification as predominantly leaf litter or grassy (decaying) which are typical in open woodlands, ravines, and prairie habitats by using a 1m quadrat in a 15m transect from the camera-trap sensor at each cardinal direction. We calculated distance to resources and habitat type using Google Earth Engine (World Map Land Cover version 2). Then, we assessed correlation between habitat type and prey or mesocarnivore presence. We found bobcat had positive correlation of presence in sites with small mammals and deer. Furthermore, we found that that leaf litter with some grassy area could be an indicator of bobcat suitable habitat (Adj R² = 0.8639, F(2,6)=26.4, p=0.001) and deer (Adj R²=0.37, F(1,7)=5.688, p=0.049). The correlation between deer and small mammal species presence as observed through camera trap data, as well as a habitat feature of leaf litter with grassy area could be indicators of locations that are suitable for bobcat populations. This information will be useful for selecting new sites and properties that could be beneficial to large mammal wildlife corridors.

Mia Howard, University of Michigan

Session: OS 7: Decomposition & Nutrients

“Three decades of experimental nitrogen addition provides empirical evidence for resource-driven plant defense evolution”

Resources, such as nitrogen, are widely hypothesized to underlie the expression and evolution of plant defenses to herbivory. Most notably, the Resource Availability Hypothesis posits that resource availability drives plants' investment in defense, such that plants evolve increased defenses in low resource environments where herbivory is most costly. While this influential hypothesis is well-supported through macroevolutionary comparisons and has some support at the microevolutionary level from retrospective population comparisons, these correlative studies do not directly link resource availability to the evolution of plant defense traits. We leveraged a three-decade-long nitrogen fertilization field experiment at Kellogg Biological Station to test how nitrogen availability affects the evolution of an architectural plant defense trait: stem nodding. Stem nodding is a genetic polymorphism that allows plants to evade apex-galling herbivores. By comparing the frequency of defensive nodding versus erect morphs in experimentally fertilized or unfertilized *Solidago altissima* populations, we assessed how nitrogen addition affects the evolution of this defense trait. We found that the defensive nodding morph was 3-4 times more common in populations that evolved under nitrogen fertilization compared to those that evolved in unfertilized control plots. Our work provides empirical evidence for resource availability driving plant defense evolution and demonstrates that this evolution can occur on time-scales conducive to study at many long-term nutrient fertilization experiments.

Sierra Hunnicutt, Purdue University

Session: Poster II

“How does proximity to moving water impact biodiversity of a Central Indiana habitat, using AI and geo-informational technology?”

Urbanization has resulted in increased habitat fragmentation, which negatively impacts wildlife. A popular solution to this problem is known as wildlife corridors—natural paths of land that various species will take to reach a new destination in dispersal or migration. Several previous studies from across the country have found rivers and creeks to be preferential areas for movement, specifically in mesocarnivores. Bobcats (*Lynx rufus*) have historically held a crucial position in the Indiana ecosystem as prominent predators that feed on rabbits, rodents, and birds. This study looked at how proximity to moving water in proposed bobcat corridor land may impact the biodiversity of birds and mammals in the area and thus resource availability. We used camera trap images (n=18,483) and acoustic recording unit recordings (n=30,559) in several study sites (n=13) from September 25, 2023 to March 6, 2024 in protected areas (ie., nature preserves, conservation easements, Tippecanoe County park, DNR Indiana State park) near Wabash River. We established a bird alpha diversity from the acoustic recordings using an open source neural net (BirdNet) and then labeled mammal presence (largely without presence in the acoustic community) from camera trap recordings into the groups mesocarnivore, bird/groundbirds, small mammals, deer, and bobcat. Then we calculated proximity of site to the nearest water using the World Cover Map v. 2.0 on Google Earth Engine at a 10 meter resolution. We hypothesized that sites in closer proximity to water would have a larger number of bird species present. To test this, we ran a linear model to see if bird species richness is impacted by distance to nearest water, $F(1,13)=8.027$, $Adj R^2=0.334$, $p=0.014$, which was significant with low explanatory value. All other linear models (mesocarnivores, bird/ground bird observations, small mammals, deer, and bobcat) did not have a significant result in relationship to distance to nearest water. While our results indicate a positive correlation between proximity to water and the number of bird species present, no significant results were found when comparing water proximity to larger species like deer and mesocarnivores. From the results of this large-scale study, the intent is to determine viable land for conversion into wildlife corridors that would specifically encourage bobcat population movement back into northern Indiana. This could indicate that proximity to water may not impact large mammal movement as habitat features are selected for wildlife corridor consideration.

Luca Iacobucci, Purdue University

Session: Poster I

“Can Least Cost Path Analysis be effective for plotting a potential wildlife corridor for bobcats in northern Indiana?”

Many species rely on forest interior habitat to thrive, reproduce, and disperse. Wildlife corridors are a way to encourage the dispersal of species into previously unavailable habitat. Corridors have become a necessity for certain species because of urbanization. The bobcat (*Lynx rufus*) is one of these species. With the historic overexploitation of bobcats by European settlers in the Midwest, the species has yet to return to areas like northern Indiana. By using remote acoustic monitors, AI-CNN technology, and camera traps, we aim to locate dispersing bobcats in Tippecanoe County. We deployed camera traps (n = 14 sites) as well as acoustic monitors (n = 9 sites) in locations on the southern and northern sides of the Wabash River to gather data on potential barriers to dispersal for bobcats. By labeling observations of mesocarnivore, bird/ground bird, small mammal and rodents, deer, and bobcat from camera trap captures, we have defined predicted movement. To analyze and predict movement of mesocarnivores using bobcat dispersal, we used Least Cost Path Analysis (LCPA). LCPA is a way to plot potential wildlife corridors that use multiple inputs and weigh them all differently as necessary. We used our southernmost site with recorded bobcat presence as a starting point for a Least Cost Path Analysis (a geospatial tool that calculates the optimal path from point A to point B), and included known bobcat presence (from this study's data), with an endpoint on the northern border of Indiana/Michigan border to represent complete distance required for one intrastate wildlife corridor. Then, we combined two different “costs” of elevation and land use. We compiled a transitional and elevation raster to generate path regions with cost as low human settlement or high cost as high elevation or steep slope. To allow for visualization, we used landmarks, known protected areas, waterways, to draw a predicted corridor path. In future work, we will optimize the path using additional barrier and attraction inputs. The aim will be to help decision makers preserve, acquire, or protect these regions along one or more of the predicted paths.

Asma Jamil, University of Michigan-Dearborn

Session: Poster II

“Patterns of seed maturation and packaging and their effects on dispersal potential in the multi-seeded fruits of eastern redbud (*Cercis canadensis*)”

Seed dispersal has an essential role in structuring plant populations. Most studies of the effects of variation of wind-dispersed diaspore characteristics on dispersal capacity have focused on single-seeded fruits. However, the effects of seed number and position on dispersal capacity of multi-seeded fruit diaspores have rarely been explored. We assessed the relationships between seed number and fruit and seed packaging characteristics in multi-seeded fruits of *Cercis canadensis* and how these influence their dispersal potential. Indoor dispersal experiments with fruits in still air were conducted to determine how the variability in seed number affects their rates of descent and dispersal distances. For each fruit, fruit mass, surface area, wing loading, and the position and developmental fate of each ovule (undeveloped ovule, aborted seed, or mature seed) and individual seed mass were determined. Patterns of seed maturation in redbud fruits were nonrandom and depended significantly on ovule position and the number of seeds per fruit. The frequency of seed maturation was lower at the bases than at the tips of fruits, and was much higher in many-seeded fruits versus few-seeded fruits. Few-seeded fruits had significantly higher rates of descent and dispersed significantly shorter distances in comparison to many-seeded fruits despite the former having lower wing loading values. We determined that redbud fruits could be grouped into two aerodynamic types, with few-seeded fruits behaving as autogyros and many-seeded fruits behaving as rolling autogyros. Our findings suggest that differences in seed number and position, and, hence, internal seed weight distribution within redbud fruits have variable effects on diaspore flight behavior. Future studies of wind dispersal of multi-seeded diaspores will need to account for within-fruit variation in the locations, sizes, and numbers of seeds.

David Jenkins, Holden Forests & Gardens

Session: Poster I

“Increasing spring temperatures result in earlier onset of forest canopy closure and ephemeral wildflower emergence”

As mean annual temperatures continue to increase under climate change, understanding how ecosystems will adapt is critical to both predicting impacts of future changes, and mitigating harm caused by them. In eastern deciduous forests, spring ephemeral species present a unique opportunity to study these responses, as the phenological shifts within their lifecycle all occur in a relatively short time span and depend heavily on environmental cues such as temperature. Furthermore, the life cycles of these species are intrinsically tied to canopy tree phenology, which also has strong responses to the same cues and thus high potential for phenological mismatch. Since 2018, we have been monitoring 5 plots in an old growth forest in northeast Ohio to observe the timings of spring wildflower phenophases, along with canopy tree closure and spring temperatures. Over the course of the experiment, we have observed consistently warmer springs over time, with the warmest spring being approximately 5° C warmer than 2018 and corresponding with earlier onset of both spring ephemeral emergence and forest canopy closure. The warmest springs had a closed canopy 15-20 days sooner than the coldest. Magnitude of response in spring wildflowers varied by species, but all species showed significant advance in emergence with warmer spring temperatures. These short-term responses to warming can provide insight into how these species will continue to respond as mean spring temperatures rise.

Ariel Johnson, Virginia Commonwealth University

Session: Poster II

“Moderate severity disturbances from insects can increase temperate forest diversity and minimally impact net primary production”

In numerous forests worldwide, there is a growing prevalence of insect disturbances that impact the composition of plant communities and the overall structure of forests. Despite this, the degree to which these alterations in community composition and structure affect the annual storage of carbon in plant biomass, also known as net primary production (NPP), remains poorly understood. Our study investigates whether changes in plant community composition, structural adjustments, and NPP exhibit similar responses to increasing severity of disturbances and two specific disturbance orientations that selectively impact large (top-down) and small (bottom-up) diameter trees.

Understanding these responses is crucial for effective management and modeling, particularly when making inferences about how forested ecosystems structurally and functionally respond to varying levels of disturbance caused by insects. The Forest Resilience Threshold Experiment (FoRTE) is a replicated study focused on disturbance orientation and severity, using stem-girdling to induce four levels of gross defoliation ranging from 0% (control) to 85%. Through the analysis of five years of data on leaf litter, seedlings and canopy composition, and portable canopy LiDAR, we explored the relationships between community composition, structure, and NPP across different levels of disturbance severity.

Our findings, observed five years after the initiation of the girdling disturbance, indicate that mid-successional *Fagus* and *Acer* species consistently dominate the composition of seedlings and saplings, regardless of disturbance severity. In contrast, the canopy is predominantly occupied by *Acer* and *Populus* species, surpassing *Quercus* and *Fagus*. Despite expectations that high canopy mortality would create conditions favorable to early successional species, their anticipated dominance did not manifest in any of the plots.

Surprisingly, NPP demonstrated significant resistance to disturbance across the gradient of severity, irrespective of compositional changes and the level of tree mortality for mid-successional species, but not for early successional species. This suggests a decoupling between composition and production following altered functional responses to disturbance for early successional species. Our analysis implies that, as we strive to manage forests for greater stability in the face of increasing disturbance and intensifying climate change, stability in carbon cycling may be achievable even in the presence of substantial changes in community composition.

Jewel Johnson, Ball State University

Session: Poster I

“Doing what your neighbours do: Finding evidence of social interaction within an egg clutch using network-based diffusion models.”

Social interactions are omnipresent in group-living animals, and they serve various roles in animal communication. Although conspecific social interactions have mostly been studied in the juvenile and adult phases of animals, growing evidence suggests that individuals may also communicate with others during the embryo or the egg stage. Studies in birds, insects, reptiles, fish and crustaceans have shown that embryos interact with sibling embryos and/or parents for diverse functions, including synchronized hatching, hatching assistance, and alerting to the presence of a predator. However, although evidence of embryonic communication is commonly observed, the sensory mechanisms that facilitate the transfer of information and understanding how that information flows across a clutch are often unknown. In this study, we are using simulated predator attacks on clutches of fathead minnow (*Pimephales promelas*) embryos and network-based diffusion modelling to investigate whether disturbance to one embryo influences behaviour patterns in adjacent embryos and the extent to which that information is socially propagated through the egg clutch. Our pilot data suggest that a localized disturbance to a single focal egg (e.g., a predatory attack) may be transmitted through at least three eggs in physical contact with the focal embryo, and suggests a role for mechanosensory mechanisms of information transfer. This study also illustrates the various adaptive mechanisms favoured by embryos, given that the embryo stage is one of the most vulnerable stages of an animal's life.

Zachary Kassuba, Lake Superior State University

Session: Poster II

“Restoration of Fire to the Litter and Duff Layers in a Pine-Oak Dominated Forest Stand”

Prescribed burn techniques are ecologically and biologically important to many regions in the United States. These techniques are applied and managed because they play a critical role in the breakdown of plant litter and duff layers (the top two layers above the mineral soil) and help facilitate the return of nutrients into the soil. Additionally, prescribed burn techniques seek to emulate natural disturbances in locations that may historically had natural seasonal fires. One proposed hypothesis suggests that the application of fire to a site within a pine-oak forest stand could result in mitigated litter and duff layers (removal of layers due to burning), compared to sites in the forest where there is no fire application. However, location, canopy coverage, and basal tree area may all play a role in layer depth and substance profile. To address some of these knowledge gaps, we collected and analyzed litter and duff layers at twenty-four plots, consisting of fifteen burned plots and nine unburned plots, from Sea Pines Forest Preserve in Hilton Head Island, South Carolina, USA in March 2023. Our objectives were to determine if differences exist between mean litter and duff layer depths in burned versus unburned plots, and if relationships exist between mean layer depth and basal area via tree type (coniferous or deciduous). We found a difference in mean layer depth with and without prescribed burn applications. The unburned layers mean depths were about two times deeper than burned layers. However, the mean litter and duff layer depths in burned and unburned plots categorized by tree type (coniferous or deciduous) were not different. Our results provide insight for identifying how prescribed burns modify litter and duff layers, which has applications across forest ecosystems.

Kenny Larsen, Michigan Technological University

Session: OS 1: Management

“Estimating the Historical Environmental Impacts of Beavers in the Great Lakes Region using a Monte Carlo Simulation”

The North American beaver (*Castor canadensis*) is a keystone species and ecosystem engineer that significantly alters the environment through dam building. Historically, beavers occupied North America from Northern Mexico to the Arctic Tundra, excluding only the arid southwest and the Florida Peninsula. However, beaver populations precipitously declined in the 17th century and were extirpated from most of North America in the following centuries. Recent conservation and reintroduction programs have increased the population to an estimated 8-15 million individuals. However, our understanding of the continental impact of beavers on hydrology, limnology, and nutrient cycles is limited. The study of nutrient cycles on the larger landscape has occurred after the large-scale removal of beavers and the subsequent disappearance of their dams from North American streams. Beavers have reoccupied much of their original range, but only at ~10% of their previous population density. Statistical simulations estimate a historical mean of approximately 12.3 million beaver dams in the contiguous 48 US states, covering a cumulative area of approximately 45,000 km² and potentially retaining 37.9 km³ of sediment. Beaver dams have historically had a measurable impact on the large-scale landscape in creating wetland habitat, retaining sediment, and altering biogeochemical processes. Beaver ponds dynamically modify stream ecosystems, altering nitrogen, phosphorus, and carbon cycles. The historical loss of beavers from the landscape transformed streams and ecological functions across the US.

John Lawrence, Grand Valley State University Annis Water Resources Institute

Session: Poster II

“Assessing Littoral Dissolved Oxygen Trends in Muskegon Lake”

We assessed spatial and temporal dissolved oxygen trends within littoral habitats of Muskegon Lake. Littoral habitats are highly productive and support diverse ecological communities, and coincidentally are often the focal point of human interaction. We quantified the magnitude of diel oxygen fluxes during May, July, and September at four littoral sites in Muskegon during 2022-2023. Dissolved oxygen and temperature loggers collected time-series data for one day-night cycle. Additional readings of dissolved oxygen and temperature were taken with a sonde on the set and pull day of each logger. Percentage of SAV cover was visually estimated at each sampling site. Diel oxygen fluxes were the least extreme at sites with the lowest SAV cover. Dissolved oxygen never reached concentrations below 4 mg/L (i.e., threshold for mild hypoxia). However, oxygen supersaturation in excess of 20 mg/L was noticed during summer, which may be a proxy for eutrophication. This is likely due to external nutrient loading from the greater watershed, and the complex interactions between plant respiration and microbial decomposition of detritus. In Muskegon Lake SAV likely influences diel fluxes in dissolved oxygen and hypoxia was not present at littoral sites, though we suspect littoral hypoxia is more likely under different conditions.

Mitchell Liddick, University of Notre Dame

Session: OS 7: Decomposition & Nutrients

“The effects of leaf litter availability and decomposition on antimicrobial resistance gene (ARG) transport in streams”

The prolific utilization of antibiotics in animal husbandry and subsequent manure application on agricultural lands contributes to the persistence of antimicrobial resistance genes (ARGs) in adjacent waterways. To explore the effects of leaf litter decomposition and biofilm colonization on ARG fate and transport, we conducted five short-term, steady-state additions of cow manure over a 21-day period (Fall 2023) in four experimental streams ($Q=2\text{L s}^{-1}$, mean width= $67\text{cm} \pm 0.2\text{ SE}$, and mean depth= $5.2\text{cm} \pm 0.1\text{ SE}$). We compared water column removal rates ($k\text{ m}^{-1}$) of two clinically significant ARGs (tetracycline-resistant tetQ and tetW) between control and treatment streams containing 0 and 150g DM m^{-2} sugar maple (*Acer saccharum*) leaves, respectively. We placed bag-free leaf packs in treatment streams on day 0, quantifying leaf litter decomposition as mass loss over time ($k=0.01\text{ d}^{-1}$). The mean ARG water column removal rates were 56% and 62% faster in treatment streams for tetQ (control= 0.010 m^{-1} ; treatment= 0.016m^{-1}) and tetW (control= 0.012 m^{-1} ; treatment= 0.019m^{-1}), respectively, with no discernable temporal trend in removal over the 21-day colonization period. Furthermore, there was no significant difference in removal between tetQ and tetW (t-test; $p=0.48$). Notably, the influence of leaves was most pronounced on ARG removal for both tetQ and tetW prior to day 7, suggesting that physical complexity and increased surface area, rather than leaf biofilm, drives removal. This work improves our ability to predict the transport of ARGs in streams, ultimately informing strategies to mitigate the dissemination of antimicrobial resistance.

Kaira Liggett, USGS - Great lakes Science Center

Session: OS 5: Invasive Species

“Invasive species management in a changing environment: Using Great Lakes high water levels to control invasive common reed (*Phragmites australis*)”

Phragmites australis (ssp. *australis*) is an invasive perennial grass prevalent throughout North America and is especially problematic in the Great Lakes basin. It is a proficient invader due in part to its vast underground rhizome network that provides stability, stores energy, and aids in oxygen transport among stems and into the rhizosphere. The "cut-to-drown" method has emerged as a promising management strategy for *Phragmites* populations occurring in standing water. This is especially so along the Great Lakes shoreline, where water levels have undergone significant fluctuation over the past decade. Cutting *Phragmites* below the water line effectively drowns the plant, impeding its ability to photosynthesize and respire. Underground storage reserves are then depleted as stems regrow. We established a multi-year experiment to understand optimal cut timing, cut frequency, and the impact of cutting on rhizome viability at field sites where water levels could be actively controlled. We also sought to understand how partially flooded stands would fair under this treatment and whether maintaining connection to unflooded stems would affect success of the cut-to-drown method on the stand as a whole. After two years, the cut-to-drown significantly reduced all *Phragmites* health metrics collected. On average, aboveground stem regrowth and belowground sugar reserves were reduced by 98.6 and 66.0 percent, respectively, when averaged across cut frequency treatments and sites. Rhizome viability was reduced by 50 to 100 percent, dependent on cut frequency treatment. Connection to unflooded stems increased rhizome viability of partially submerged *Phragmites* stands when compared to stands that were isolated and totally flooded. These results serve as proof-of-concept for the cut-to-drown technique as an effective management strategy for invasive *Phragmites* populations in or at the shoreline of bodies of water. In locales where water level control is feasible and as fluctuations in Great Lakes water levels become more frequent in the future, this technique serves as another effective tool for land managers working to control this pervasive invasive species.

Azim Mallik, Lakehead University

Session: OS 6: Climate Change & Phenology

“Shade effect on phenology, fruit yield, and phenolic content of two wild blueberry species of NW Ontario, Canada”

We studied the effect of shade on phenology, growth, berry yield and chemical content of two common blueberry species (*Vaccinium myrtilloides* and *V. angustifolium*) of NW Ontario. We hypothesized that high shade would delay vegetative and reproductive phenology, decrease berry yield by increased resource allocation to vegetative vs reproductive growth and moderate shade will increase berry phenolic content and antioxidant capacity. We subjected transplanted blueberry plants to a controlled shade treatment and evaluated plant phenological events, vegetative and reproductive growth, and berry phenolics and antioxidant capacity. High shade caused earlier leaf maturation in *V. myrtilloides*, delayed flowering in *V. angustifolium*, and prolonged fruit maturation in both. Berry yield of both species decreased with increasing shade. High shade reduced berry phenolic content and antioxidant capacity, especially in *V. myrtilloides*. We conclude that shade shifts species-specific vegetative and reproductive phenology leading to difference in resource acquisition causing lower berry yield and antioxidant activity.

James Marshall, Rockford University

Session: OS 12: Invasive Species

“The role of migrant versus resident birds in the spread of an invasive bush honeysuckle”

Amur honeysuckle (*Lonicera maackii*) is one of several invasive bird-dispersed honeysuckle species fundamentally changing the structure of deciduous forests in the eastern United States. *Lonicera* fruit, however, is a nutritionally suboptimal choice for many birds. Fall migrant birds have higher energy demands than resident birds, and are more frequently in unfamiliar habitat with incentives to find food quickly. As a result, we predicted that migrant birds would be more likely than resident birds to consume *Lonicera* berries. North American birds are also not the co-evolved native avian dispersers of invasive *Lonicera* species. We collected seeds from birds and from *Lonicera* and grew both to evaluate the ability of native birds to disperse viable *Lonicera* seeds. We caught birds in fall migration between 2014 and 2023, collecting fecal samples to identify birds dispersing *Lonicera* seeds. We also collected berries from *Lonicera* bushes. We soaked seeds in water for six weeks, and then planted them in the Rockford University greenhouse to determine which would germinate. Over the course of the study, we collected data from 6096 migrants, 1099 residents, and 204 cedar waxwings (*Bombycilla cedrorum*). When leaving out waxwings or counting them as migrants, migrants were significantly more likely than residents to consume *Lonicera* ($p < 0.001$). If we consider waxwings to be residents, then residents were more likely to consume *Lonicera* ($p = 0.019$). We planted seeds from three years (2017, 2018, & 2022). Overall, seeds consumed by thrush species germinated at rates similar to berries collected directly from plants. Seeds consumed by cedar waxwings germinated more successfully than those consumed by other birds or seeds collected from plants. Unlike most birds, cedar waxwings have the enzymes to process carbohydrates, making *Lonicera* a nutritious food source. For birds that are best suited to digesting lipids, the results were as predicted: migrants were more likely to consume *Lonicera*. The results suggest that removing *Lonicera* early in the year would be the most effective way to limit further spread.

Osmary Medina-Báez, Case Western Reserve University

Session: OS 2: Climate Change & Physiology

“Assessing vulnerability of butterflies to climate change in Ohio using their physiological tolerances”

Habitats are getting warmer and drier in many parts of the world, leading to species responses like phenological and geographic range shifts, population decline and extinction. Predicting which organisms are more susceptible to climate change is critical for their conservation. In Ohio, butterfly abundance has declined 33% in the last few decades, with most species showing declines, even species classified as common and of least concern. Why some species are more vulnerable than others is still unclear. One way to determine species' vulnerability to climate change is by understanding their physiological tolerances to abiotic variables such as temperature and humidity. The critical thermal limits – the maximum and minimum temperatures that organisms can tolerate before they lose motor functions – and the desiccation tolerance – mass loss per unit of time under low relative humidity – are commonly studied physiological tolerance traits. Organisms living in habitats with climates that could exceed their physiological limits might be at higher risk. Understanding which species are less tolerant to these environmental pressures, and how such tolerances predict population declines, will help us better inform conservation practices. Here, we collected butterflies across Northeast Ohio to determine thermal tolerances (CT_{max} and CT_{min}) and desiccation tolerance. We found a significant association between higher CT_{max} and population abundance decline. Desiccation tolerance and CT_{min} were not predictive of butterfly abundance trends. The association between higher CT_{max} and population decline is unexpected in a warming world, and may be explained by correlations between CT_{max} and other traits. For example, if higher thermal tolerance allows butterflies to have a greater dispersal ability, allowing them to travel long distances, high temperature tolerant butterflies might be declining in Ohio but moving elsewhere to more advantageous spaces. More work on butterfly movement and future habitat suitability is needed to fully understand species vulnerability to climate change.

Hannah Menosky, Denison University

Session: Poster I

“Habitat Use and Distribution of The Common Garter Snake *Thamnophis sirtalis* in a Restored Prairie/ Wetland Complex”

As restored habitats are established to reclaim agricultural land, understanding how the restored habitats are used by native vertebrates may provide an indication of restoration success. We examined how various habitat factors; including vegetation type, distance to nearest water, distance to nearest mowed path, and number of trees within a 10m radius; affect the distribution of the Common Garter Snake, *Thamnophis sirtalis*, on the Granville Schools Land Lab (GSL), a restored prairie/ wetland complex in central Ohio, established in 2014. Using cover boards located at 29 grid points throughout the GSL we monitored *T. sirtalis* abundance and habitat use from spring 2022 to fall 2023. Generally, *T. sirtalis* used habitats with more trees with mostly grass and forb vegetation, and that were located at intermediate distances from water and paths. The habitat preferences of *T. sirtalis* were generally consistent in the two years of the study, however fewer total snakes were found during 2023 than in 2022. In 2023, we found significant relationships between snake size (snout-vent length) and most of the measured habitat factors, but not in 2022. Our results suggest that the mosaic of habitat types on the GSL provides the necessary habitat to support a population of *T. sirtalis*.

Geoffrey Miller, University of Minnesota

Session: OS 9: Population & Community

“Who's the top dog? Movement analyses suggest humans facilitate spatial partitioning in competing urban canids”

Urban landscapes present novel scenarios for wildlife to navigate, with much of the novelty arising from both the alteration of landscapes to serve human use cases and direct use of natural areas for recreation. To examine how human activity in urban landscapes affects the movement behaviors of multiple carnivores in an urban system, we GPS-collared 17 coyotes (*Canis latrans*) and 16 red foxes (*Vulpes vulpes*) in the Twin Cities Metropolitan Area (TCMA) of Minnesota between 2019 and 2024. To assess habitat selection patterns of individual animals, we fit resource selection functions with various covariates to determine second-order habitat selection (i.e., selection of territories), and step-selection functions to assess third-order habitat selection within home ranges. Across all seasons, coyotes established home ranges in areas of relatively low development (i.e., with lower relative road density), while red foxes were found to inhabit home ranges with more residential zoning and higher road density. However, within their home ranges, both species showed selection for areas of the landscape associated with relatively lower human use. Increases in the most urban-dwelling coyotes' selection for non-residential areas and wetlands in the spring highlight the importance of urban wetlands for mitigating risk of human-wildlife conflict during the pup-rearing season. While coyotes occupied mainly larger greenspaces or networks of greenspaces, red foxes often selected areas with smaller green spaces within residential areas. Differences in where coyotes and red foxes choose to establish home ranges and what parts of those home ranges they display highest selection for suggests that minimizing the likelihood of encountering coyotes may be a primary driver of habitat suitability for red foxes. Furthermore, availability of residential areas is likely one of the most important factors allowing for the coexistence of coyotes and red foxes in the TCMA.

Ashlynn Moretti, University of Pittsburgh

Session: OS 12: Invasive Species

“Genetic and species richness interact to influence invasibility within experimental aquatic plant communities”

Understanding the aspects of native communities that reduce their susceptibility to invasion (or invasibility) could help us create more resilient communities. Many researchers have focused on how ecological factors influence communities’ invasibility (i.e., resident species identity and diversity), while few have integrated genetic factors. Genetic factors, such as resident genotypic identity and genetic diversity, could be important for determining invasibility. Specific genotypes may deter invasions better than others or genotypes may interact in non-additive ways to competitively exclude invasions. In a series of replicated experimental invasions, we tested how ecological and genetic factors of native floating aquatic plant communities (*Lemna minor* and *Spirodela polyrhiza*) interact to impact their invasibility when experimentally invaded by a non-native aquatic fern, *Salvinia* sp. By varying the number of genotypes and species of invaded communities, we found that single-species residents decrease in invasibility with increasing genetic diversity, while multi-species communities increase in invasibility with increasing genetic diversity. This implies that there could be antagonistic interactions between ecological and genetic factors that should not be overlooked when considering experimental tests of invasibility and conservation strategies.

Maria Nachivula, Albion College

Session: Poster I

“Do yellow warblers modify the frequency and temporal traits of their songs in response to intermittent noise?”

An important outcome of the conversion of natural ecosystems to human-dominated landscapes is the increasing prevalence of anthropogenic noise. Noise may be chronic or sudden, degrading natural acoustic environments and disrupting communication in animals that vocalize to defend territories and attract mates. To maintain communication in noise, male songbirds may adjust their songs by singing at higher frequencies, increasing song amplitude, and altering temporal traits such as song rate, duration, and number of notes. Chronic noise alters habitat occupancy and species-specific singing behavior, but the effect of intense and highly variable noise on bird communication is poorly understood. Thus, the objective of our study was to explore how male yellow warblers modify temporal and spectral song traits to reduce noise interference during intermittent noise exposure. We broadcast randomized, intermittent noise in yellow warbler habitat on a military base, and used passive acoustic recorders (n=30) to capture singing before noise, during noise exposure, and within silent gaps between successive noise bouts. The number of notes per song varied across all periods, with males producing songs with the fewest notes before noise introductions, intermediate numbers of notes during gaps, and the greatest number of notes during noise exposure. We found no differences in song duration or frequency characteristics across periods. Our study is an important step in understanding behavioral responses to unpredictable noise sources of species that depend on vocal communication to achieve fitness.

Kylee Nissen, Eastern Illinois University

Session: Poster II

“Seeding Strategies Influence Pollinator Community Composition within an Electric Right-of-Way”

Pollinator populations are in decline globally due to anthropogenic changes, particularly in areas affected by agricultural expansion and urbanization. Utility lands - managed to prevent tall vegetation encroachment - represent an opportunity to establish native grasslands and support pollinator communities. This study investigates how different seeding strategies used by utility companies influence pollinator community composition within a 15-acre electric right-of-way (ROW) outside St. Louis, Illinois. Despite the logical benefits of native seeding to pollinators, utility companies are often hesitant to do this, often favoring seeding to turf. Seeded in late 2021, the site incorporates randomized plots with turfgrass seeding (no restoration), native seeding (active restoration), and unseeded areas (passive restoration). Insect sampling was conducted via flower netting within standardized optimal pollinator conditions. We collected a total of 396 insects between June, July, and August of 2023, the second year of the planting. We identified 98 species spanning 30 different families. Our analyses revealed significant effects of both seeding strategy and survey months on pollinator composition, with a strong correlation between pollinator and flower composition. Native-seeded plots exhibited sustained high diversity and abundance, underlining their significance for pollinator habitats. In contrast, turf and unseeded plots had low pollinator abundance and diversity, illustrating their poor ability to support pollinators. These results advocate for strategies that promote native vegetation and their flowering to conserve vital insect populations and the ecosystem services they provide.

Sandra Okoye, Eastern Illinois University

Session: Poster I

“A Study on the Sewage Microbiome Dynamics in Different Serving Neighborhoods of Charleston, Illinois.”

The complex microbial ecosystem within sewage systems holds significant implications for environmental and public health. Unlike studies on wastewater treatment plant microbiomes, upstream sewage systems have not been studied widely. This research investigated the dynamic sewage microbiome across diverse serving neighborhoods in Charleston, Illinois, encompassing residential, hospital, industrial, and university areas. Drawing upon recent advancements in microbiome research, the study aimed to unravel the spatial and temporal variations in microbial structures. Three times between June to December 2023 sewage samples were collected from manholes in the areas mentioned above. Community DNA was extracted and sequenced for the V4-V5 region of the 16S rRNA gene (515F-926R) using the Illumina MiSeq platform. We found distinct microbial compositions across serving communities, with hospital and industrial zones exhibiting higher pollution levels and specialized microbial communities, contrasting with the higher diversity observed in residential and university areas. Moreover, the type of sewer employed significantly may have influenced microbial populations, highlighting the relationship between community types. Environmental factors like temperature and pH played essential roles in shaping microbial communities over time. Initial observations from time-series sampling hint at potential seasonal fluctuations, with the expectation that microbial diversity and abundance might exhibit trends of peaking during warmer seasons. Tailored wastewater management strategies, informed by neighborhood-specific characteristics and supported by multivariate statistical techniques, emerge as crucial for mitigating potential risks associated with sewage microbiomes and safeguarding public health. Overall, this research advances our understanding of sewage microbiome dynamics, offering invaluable insights for addressing contemporary challenges in environmental and public health management.

Emily Parker, Michigan State University

Session: Poster I

“How the overlap of abiotic and biotic stressors impact tall goldenrod (*Solidago altissima*) fitness”

As extreme shifts in climate become more prevalent, it is increasingly important to understand how different plant species will fare in predicted future conditions. While numerous studies have investigated these abiotic stress effects, the intersection of abiotic and biotic stressors has not been thoroughly explored. The combination of abiotic and biotic stress may have a synergistic negative effect, leading to lower fitness than predicted by either stressor alone. We used tall goldenrod (*Solidago altissima*), a common native plant species, and one of its gallmakers - the goldenrod bunch gall midge (*Rhopalomyia solidaginis*) - as the focus of our study. Utilizing the Rain Exclusion eXperiment (REX) at the Kellogg Biological Station Long-Term Ecological Research site (KBS LTER), we conducted a full factorial experiment with galled and non-galled plants in warming and drought conditions over a two year period. At the end of each growing season, we measured plant size (height and stem biomass) and reproductive indicators of fitness (seed mass). Warming resulted in heavier, taller plants that produced more seeds. Galling increased stem biomass, and lowered seed production in some climate treatments. Overall, climate (particularly warming) had a larger effect on plant fitness than galling. Understanding how individuals respond to both abiotic and biotic pressures will help better predict future fitness of the species, and can lead to better models of future community dynamics under new climate regimes.

Mackenzie Persinger, Ball State University

Session: Poster I

“Don't eat plastic, kids: Evaluation of the effects of microplastics and its potential as a vector for 17 alpha-ethinylestradiol on early life stage behaviors in *Pimephales promelas*”

Anthropogenic disturbances in nature, particularly those involving pollution, have been shown to negatively impact aquatic organisms. One such pollutant, microplastics (MP), can act as a vector for other aquatic pollutants due to its unique surface properties. Although studies have documented synergistic effects of microplastics and pollutants on the physiology and behavior of affected organisms, few studies have evaluated the potential for transgenerational or multigenerational effects of microplastics on aquatic organisms during critical early life stages, either alone or as a vector for locally co-occurring contaminants. In this study, we evaluated the effects of microplastics alone, and in combination with the common endocrine disrupting chemical, 17 alpha-ethinylestradiol (EE2), on both embryonic and larval life stage behaviors in the fathead minnow, *Pimephales promelas*. We exposed adult minnows (F0 generation) to microplastics alone (MP Virgin), in association with either a low (MP EE2 10; 10 ng/L) or high (MP EE2 50; 50 ng/L) concentration of EE2, or to a clean water control, for 30 days and then collected fertilized eggs (F1 generation). Embryonic locomotor activity was assessed at 5 dpf (days post fertilization). After hatching, half of the larvae from each treatment underwent continued exposure until 21 dph (days post hatching), and half were maintained in control water. Larval swimming performance was assessed at 14 and 21 dph using open-field swimming trials. Trends towards hyperactivity were observed in both embryos and larvae associated with MP exposure, but we did not observe consistent dose-dependent trends associated with EE2 concentration. In addition, F1 offspring of exposed F0 parents that did and did not receive continued exposure showed similar MP-associated changes in behavior, suggesting that the transgenerational effects of exposure may be significant. The results of this study will improve our knowledge of the effects of MPs and long-term consequences on populations affected by MP exposure.

Silas Pickhardt, Northern Michigan University

Session: OS 8: Conservation & Restoration

“Using LANDFIRE data to assess current vegetation, late-succession habitat and wildfire exposure risk in the central Upper Peninsula of MI”

Landscape stewardship requires an understanding of current ecosystem conditions, historic disturbance patterns and their effects, and future threats such as wildfire that may be exacerbated by land use demands and climate change. Using data and historical ecosystem models from the LANDFIRE program, ArcGIS pro, and R, we compared historical to current vegetation, mapped current late-succession habitat and wildfire exposure risk in the Central Upper Peninsula of Michigan. Further, to aid government planning agencies, the general public and streamline our delivery method, we built a web report hosted on GitHub. A few notable patterns emerged which include: 1) a relatively small amount of the area has experienced conversion to human-focused land use, or changes in broad ecosystem type, 2) there have been increases in late-succession habitat compared to historical for some ecosystems (mostly in fire-dependent ecosystems which have missed multiple fire cycles), but a major decline in late-successional habitat for the northern hardwoods ecosystem and 3) roughly 20% of the area was classified in the highest wildfire exposure risk category. The entirety of the project took ~100 hours, including development and deployment of the web report which includes a variety of layouts displaying the current vegetative state and fire risk of the Central Upper Peninsula.

Katherine Porrás Brenes, John Carroll University

Session: Poster II

“Loads in leafcutter ants may impede sensing the foraging trails”

In social insects communication is crucial in foraging, and individual decisions can impact the fitness of the entire colony. To navigate from the nest to the plant source and back leafcutter ants form and follow well-defined pheromone foraging trails, which they smell tapping the ground with the antennae. It is common that workers carry loads smaller than what they could lift. Relatively larger loads cause them to walk more slowly, but the mechanisms behind this are not yet understood. We tested the hypothesis that carrying an oversized load interferes with the ability to smell the foraging trail by limiting the number of antennae taps on the ground before taking a step. We therefore related the antennae taps per step with the load presence, and with the load shape and area. In addition, we calculated the allometric relation between the antennae length and worker size. We found that unladen workers perform more antennae taps per step than laden workers. Hence, carrying a load might be sensorially more difficult. Among laden workers, we found an interaction between load size and worker head width: larger ants, but not smaller ants, performed fewer antennae taps per step when carrying oversized loads. Antennae length showed negative allometry with worker size, hence larger ants had proportionally shorter antennae. Our results indicate that larger laden ants may have more sensorial impediments than smaller ants when carrying oversized loads, which could explain why they slow down and suggest they may be using other cues. Workers carrying oversized loads are uncommon with high traffic because it slows down the foraging trail, and the cost in pheromone detection may be causing this delay. Further research on ant orientation will provide more understanding on the evolution of individual decisions that impact a superorganism.

Abagael Pruitt, University of Notre Dame

Session: OS 4: Conservation & Restoration

“Land use and stream size impact spatial patterns of water chemistry signatures across four midwestern river basins”

Water chemistry signatures of streams are influenced by a combination of land use, stream size, and other environmental drivers. To understand how water chemistry signatures vary within and among watersheds, we used a synoptic sampling approach to sample N=105 tributary and mainstem sites across four Midwestern river basins spanning a gradient in agricultural land use (as % cover). The basins included the Manistee R. (MAN; 8%), Muskegon R. (MUSK; 20%), St. Joseph R. (JOE; 56%), and the Tippecanoe R. (TIP; 78%). Watersheds with >50% agriculture had the highest nitrate-N (0.2-1.3 mgN/L) and ammonium-N concentrations (18-54 gN/L; Kruskal-Wallis, $p < 0.001$), whereas soluble reactive phosphorus (SRP) was more similar among basins (15-28 g/L). Among watersheds, nitrate-N concentrations were an order of magnitude higher than for SRP or ammonium (Friedman, $p < 0.05$), but we will use estimated discharge to further explore the relationship between size and nutrient loads. Principal component analysis showed significant grouping by land use, where >50% agriculture was distinct from <50% agriculture along PC1, which was primarily explained by dissolved nutrients, conductivity, and temperature. We plan to use membrane inlet mass spectrometry (MIMS) to analyze dissolved N gasses, and the SSN2 R package to summarize spatial stream networks among basins to make predictions at unobserved locations. Our data will refine our understanding of how land use impacts water quality and nutrient loading to downstream ecosystems.

Biana Qiu, Denison University

Session: Poster I

“Effectiveness of light color and conspecific presence in promoting tadpole capture via funnel trapping”

American bullfrogs (*Lithobates catesbeianus*) are a prominent invasive species outside of the eastern United States and pose a threat to native amphibian species as competitors and disease carriers. We examined the use of funnel traps for capturing bullfrog tadpoles as a control measure, specifically examining if the presence of conspecifics or glow sticks would increase trap yields. We deployed traps in a local fishless pond in central Ohio from May 25-June 5, 2023, either pre-stocking a set of traps with 0, 1, or 3 conspecifics, or in a separate experiment baiting traps with green, yellow, red, or blue glow sticks. We hypothesized that pre-stocking funnel traps with conspecifics would increase the final tadpole capture, and likewise traps with specific glow stick colors might alter capture numbers. While conspecific presence did not influence capture in tadpoles, we found that tadpoles were attracted to all glow stick colors other than red. We also observed that trapping date affected the number of tadpoles caught, likely due to developmental cycles of the tadpoles. Our funnel trapping results suggest that if trapping is used for population control purposes, trapping success may be enhanced if traps are baited with glow sticks.

Therese Reisch, University of Notre Dame

Session: Poster II

“Complex effects of perfluorooctane sulfonic acid (PFOS) on stream ecosystem function”

Anthropogenic stressors have the ability to alter ecosystem functions that are important for nutrient cycling and overall ecosystem health. PFAS or "forever chemicals" are a class of fluorinated chemicals that are now diverse and ubiquitous in the environment. A recent field study suggested that increased levels of PFAS including the compound PFOS (perfluorooctane sulfonic acid) in a stream ecosystem emanating from a point source reduced leaf litter decomposition rates and ecosystem respiration. However, other studies of PFAS effects on terrestrial decomposition and microbial respiration have shown varying results, in some cases enhancing, and in others suppressing decomposition. We conducted a laboratory experiment to further examine the relationship between PFOS and organic matter decomposition by dosing aquatic mesocosms with three different levels of PFOS – 0, 10, and 100 ppb – within a randomized block design (n=6 per treatment). Three 2-g packs of sugar maple (*Acer saccharum*) leaves were placed into each mesocosm. One leaf pack was removed from each mesocosm after 7, 14, and 28 days and measured for community respiration and decomposition. No differences in respiration were measured on day 7 or day 14. On day 28, respiration was significantly higher on leaf discs from the 100 ppb treatment than from the control, but not different from the 10 ppb treatment. Additionally, no significant differences were observed in decomposition rate among treatments, with k-values of -0.873, -0.840, and -0.769 for control (0 ppb), low (10 ppb), and high (100 ppb) levels of PFOS, respectively. Interestingly, these results contrast with those from the field study despite controlled laboratory conditions. Because the complexity of natural systems cannot be replicated in the laboratory, nor the full suite of PFAS found in the environment, our laboratory experiment likely lacked field realism. Next steps include analysis of PFOS levels in water and leaves to confirm treatment doses and determine PFOS movement between environmental compartments.

Hannah Reyes, Purdue University

Session: Poster I

“How does acoustic community profiles in a prairie habitat in the midwest provide biodiversity metrics that identify bobcat presence?”

Wildlife corridors are stretches of core habitat that connect separate wildlife populations and have been a pivotal strategy in federal lands to support connectivity between these habitats, such as prairies. Prairies have grasses, forbs, and native flowering plants that provide seeds and resources for animals. Research indicates that both mesocarnivores, bobcat (*Lynx rufus*) and gray fox (*Urocyon cinereoargenteus*), prefer grassland cover to forest cover. In our pilot study, we had one grassy site that did show evidence of gray fox presence. However, due to the height of the grass, it is difficult to assess population presence using a camera trap. To assess mesocarnivore presence in prairies, we deployed a passive acoustic monitoring (PAM) protocol to assess the presence of prey species (i.e., Wild turkey (*Meleagris*), Hairy woodpecker (*Leuconotopicus villosus*), Canada goose (*Branta canadensis*) known to be preferential to bobcats. We placed acoustic recording units in prairie (n=4), open woodlands (n=4), ravine (n=4), and known bobcat sightings (n=4, but one sensor did not record). To test our research question about bobcat preference in prairies, we created an acoustic profile of each habitat group using acoustic indices (ACI, ADI, BI, BGN, NDSI) and smoothing algorithm (loess). In comparison, we find the acoustic profile to be distinct for prairie and more constant for bobcat sighting locations. To confirm differences in our habitat groups, we performed a Kruskal-Wallis (test of normality) and found the groups to be significantly different, $H(3)=781.82$, $P<0.05$ confirmed by the the Levene's Test (homogeneity of variance), $F(3,186.8)$, $p<0.05$ and by an ANOVA which found that the main effect of group is statistically significant and small ($F(3, 27195) =560.88$, $p < .001$; $\text{Eta}^2 = 0.06$, 95% CI [0.05, 1.00]). We assessed prey species richness by running the acoustic data into a convolutional neural net (BirdNet) and compiled species presence. We had predicted prairie as a desirable habitat for bobcats and in line with historical literature, especially as they seek to expand their territory from previously extirpated areas. Based on camera trap data and acoustic profiles for habitat types, open woodlands and ravine areas have similar acoustic profiles with less prey. This study contributes to a model for conservation efforts emphasizing the importance of considering habitat preference and the innovative use of acoustic technology in wildlife conservation.

Molly Russell, John Carroll University

Session: Poster I

“Variation in microhabitat availability and selection across a landscape disturbance gradient in the neotropics”

Microhabitats provide refuge and decrease vulnerabilities posed by warming associated with both deforestation and climate change. Such microhabitats are especially important for ectothermic species, such as amphibians and reptiles, who rely on heat from the surrounding environment to regulate body temperature and maintain performance. Little is known regarding how the availability of microhabitats is changing due to deforestation and climate change, in addition to how herpetofaunal species disproportionately select such microhabitats relative to their availability. We measured the abundance of microhabitats commonly used by amphibians and reptiles (canopy cover, vegetation, leaf litter, burrows, and water) across a disturbance gradient in the tropical lowlands of Colombia. We sampled locations in highly disturbed agricultural pastures, regenerating forests, and relatively untouched, dense rainforest landscapes to understand how deforestation and habitat restoration influence the availability and use of microhabitats. We found that areas of high and intermediate vegetation densities had very different microhabitat composition compared to the most disturbed localities ($F_{2,69} = 51.302$, $p < 0.001$). Some microhabitats were used disproportionately more than their availability in the environment: Woody understory, leaf litter, and grass, for example, were less abundant microhabitats in intermediately vegetated areas, yet species were observed to heavily rely on their limited presence for refuge. Although previous studies have highlighted differences in microhabitat availability between old secondary and primary forest, our results illustrate broad similarity in microhabitat composition, although somewhat variable use, in a lowland rainforest landscape. Thus, our research highlights how both active restoration and passive regeneration can help maintain biodiversity in disturbed landscapes.

Jillian Salmon, Denison University

Session: Poster II

“Initial Movement Orientation of Two Pond-Breeding Amphibians”

It is well established that amphibians are one of the most imperiled taxa and face a wide variety of threats. These threats are particularly diverse in pond-breeding amphibians such as the Spotted Salamander (*Ambystoma maculatum*) and Wood Frog (*Lithobates sylvaticus*) due to their dependence on two distinct habitats throughout different phases of their life histories. In order to better understand their vulnerabilities, I examined the factors that influence these amphibians' position and orientation as larvae within their natal pond; specifically, inter- and intraspecific interactions with other organisms that may serve as predator or prey. Then, I attempted to determine whether their position as larvae influences their dispersal orientation as new metamorphs with the ambition to better understand their susceptibility to ecological traps. I found that the positions of both species of amphibian as larvae were nonrandom both alone and relative to each other. Although initial dispersal direction of *L. sylvaticus* was nonrandom, no correlation was found between larval position and metamorph dispersal direction. Dispersal patterns of *A. maculatum* as metamorphs could not be analyzed because the pond being studied dried before they could metamorphose. It is clear that the factors influencing this behavior are complex and multifaceted; however, it appears that predator avoidance may play some role in facilitating movement of larval amphibians within the pond.

Madeleine Schouman, University of Michigan

Session: Poster I

“Comparing Strategies for Reducing Contamination in Plant-Microbiome Experiments”

Our expanding appreciation of the plant microbiome creates a growing need to experimentally manipulate plant-microbe interactions. However, microbial contamination is a major challenge of conducting plant-microbe experiments, especially with the large numbers of experimental units typically needed to ask ecological and evolutionary questions. One particularly tricky group of microbes are rhizobia, bacteria that form mutualistic relationships with legume species by fixing atmospheric nitrogen and converting it to ammonia – a form the plants can use. In return, the plant provides the rhizobia with carbohydrates and shelter within the nodules. However, this bacteria's ability to spread via water, soil, and air can lead to rampant contamination within microbe experiments. Previous studies have found that clovers (*Trifolium* spp.) experienced 175-200% higher rhizobium contamination rates than 17 other legume species grown in the same conditions. This proclivity to form symbioses with rhizobia makes the clover-rhizobium system a convenient model to evaluate the methods of microbial containment. Scientists have employed the use of a variety of methods to prevent microbial contamination in plant-microbe experiments; however, the efficacy of these strategies has not been compared. Our experiment seeks to evaluate the performance of containment methods in differing plant growth environments. The first location of this study was a growth room fitted with a drip irrigation system to minimize contamination through water splashing between pots. In this environment, we tested the following containment methods: sand (this produces a barrier on top of the soil), doubling up pots (prevents water from splashing up from the bottom), bottom watering (watered from a sealed container beneath the pot, preventing splashing and microbes entering through the bottom of the pot), sand with bottom watering, doubling up pots with sand. The second part of the experiment was conducted at the Matthaei Botanical Garden's Greenhouse where the plants were kept in a shared space and routinely irrigated with mist. We plan to harvest the plants after 6 weeks and examine the roots for rhizobium nodules. The containment methods with the fewest rhizobium nodules will indicate the most effective strategy for preventing contamination. We hope that our results will help scientists researching plant-microbe interactions reduce contamination in their studies.

Clara Shaw, University of Minnesota Duluth

Session: OS 11: Behavior & Defensive Traits

“Predicting virus emergence from initial spillover characteristics”

Spillover of viruses into novel host species occurs frequently. Often, spillover results in dead-end infections in novel hosts, sometimes, in stuttering transmission chains that die out, and rarely, large epidemics and virus persistence. Despite recent work that describes traits of emergent viruses and hosts that harbor them, it remains a challenge to predict whether spillover will result in novel disease emergence. Our goal was to determine if certain characteristics of spillover were predictive of virus emergence. We used a nematode-virus system where different *Caenorhabditis* species have variable susceptibilities to Orsay virus, an environmentally transmitted virus which naturally infects *C. elegans* in the wild. Populations of novel host species were exposed to the virus in their bacterial food, and epidemiological characteristics of the resulting spillover process (i.e. prevalence of infection, intensity of infection, and the degree of virus shedding from novel hosts) were quantified after populations had depleted their food (and, presumably, consumed the virus). To quantify pathogen emergence, twenty adult nematodes were passaged from exposed populations to virus-free plates where they reproduced, initiating new populations to which they would potentially transmit virus. We used quantitative PCR to track virus persistence in passaged host populations for 10 passages or until virus was undetectable indicating its loss. Preliminary analysis shows that *Caenorhabditis* species differ substantially in inherent susceptibility to Orsay virus as well as in prevalence, infection intensity, and ability to shed the virus. We found that sustained transmission was associated with infection prevalence in the exposed population and the ability of exposed hosts to detectably shed the virus, but not with the infection intensity. Though there are few other experimental studies of disease emergence for comparison, our findings are in line with theory and with findings in invasion ecology: the probability of persistence increases with more introductions and pre-adaptation to the novel environment. These findings suggest that continued monitoring of pathogens known to replicate and disseminate from human cells and those that spill over frequently into human populations is important for disease emergence monitoring.

Brianna Shepherd, Holden Forests & Gardens

Session: Poster II

“Fagus grandifolia mortality and growth at the epicenter of Beech Leaf Disease”

Beech Leaf Disease (BLD) is poised to cause major declines in American Beech trees across the eastern United States and parts of Canada. Understanding rates of mortality and changes in growth rates of American Beech as a result of this emerging disease is critical. However, little is currently known about the rate at which BLD kills infected trees. Using long-term data on tree growth and survival from a previous experiment, we quantify rates of mortality and growth in American beech trees inflicted with BLD near the disease's epicenter. Since the initial observation of BLD in Cuyahoga County, OH, in 2014, 75 of the 267 (28%) American beech trees in the study have died. A majority of this mortality was recent, with 2021-2023 displaying the highest levels of beech mortality (56 trees dying across the three years). Analysis of mortality across size classes revealed an uneven distribution, with most of the mortality occurring in trees < 25 cm dbh. Mortality rates were positively correlated with beech abundance (as measured by basal area), suggesting that areas with high concentrations of beech trees may experience higher rates of mortality. We analyzed beech growth for the six years before and six years after the arrival of BLD in the area. Growth rates of beech were significantly lower (p -value < 0.01) in recent years (2017-2022) suggesting slower growth rates in the presence of BLD. Slower rates of growth accompanied by increased mortality of American beech could be catalysts for larger stand level changes in forest composition and function as BLD persists on the landscape and continues to spread into new areas.

Madelynn Sinclair, University of Wisconsin-Parkside

Session: OS 3: Population & Community

“The latitudinal trend in the proportion of migratory bird species in East Asia”

As predicted by island biogeographic theory, studies of island bird faunas in north temperate regions have shown substantial turnover in faunal composition. On tropical islands, however, the rate of turnover seems to be lower. A possible explanation for this lower rate is the paucity of migratory species in the tropics, if migratory species are more prone to extinction and colonization given the challenges and opportunities of semiannual travel. Previous studies of Europe and North America have found greater proportions of migratory species at higher latitudes, and the apparent lack of migratory birds in the tropics has been coarsely demonstrated on a global scale. Here, we extend this research to the East Asian seaboard, including both the Palearctic and Oriental zoogeographic regions. In concordance with earlier research, we find a strong, positive, linear relationship between the proportion of migratory species and latitude. We also compare birds of different ecologies, and find similar trends among land, freshwater, and coastal species, while marine birds have a much weaker, nonsignificant relationship with latitude.

Lizzy Small, Northern Illinois University

Session: Poster II

“Small mammal trophic niche dynamics in response to prescribed fire and bison grazing in tallgrass prairie”

In grasslands, one of the most threatened ecosystems globally, changes in trophic niche can result in changes in ecosystem function. This is especially true for the niche that small mammals in grasslands hold at the center of the food web, therefore making them essential to energy flow within the ecosystem. Understanding drivers of variation in small mammal trophic niche can determine what promotes coexistence between species with similar diet requirements and is critical information in the context of global efforts to reverse the biodiversity crisis and restore damaged ecosystems. Work was conducted at Nachusa Grasslands, owned by The Nature Conservancy and located in Franklin Grove, Illinois. At Nachusa Grasslands, there are approximately 1,600 hectares (4,000 acres) of remnant and restored tallgrass prairie, wetland, and savanna. Reintroducing historical land management techniques, such as prescribed fire and megaherbivore grazing, are also vital to successful grassland ecosystem restoration, however, these disturbances may impact competition and resource availability for small mammal species, resulting in adaptive dietary behaviors. These behaviors are reflected in variations in stable carbon and nitrogen isotopes, of which the values can be used to determine fluctuating trophic niche positions. I will characterize variation in trophic niche for the three most common small mammal species, *Peromyscus maniculatus* (deer mouse), *Peromyscus leucopus* (white-footed mouse), and *Microtus ochrogaster* (prairie vole), coexisting at Nachusa Grasslands. Examining trophic niche dynamics for these species will reveal how they adapt their diet in response to reintroduced disturbance techniques. Wide niche variation with disturbances indicates a more generalist diet that incorporates a wider range of food items. Narrow niche variation indicates a more specialized diet, where fewer food items are consumed. The data collected for this study includes over 160 hair samples from small mammal species. I expect to see variation in trophic niche for these species in response to the presence/absence of bison, fire, and the combination of these factors. I anticipate a narrow niche breadth for the specialist prairie voles and an increase in their measured $\delta^{13}\text{C}$ values in locations with the presence of fire and absence of bison, reflecting C4 grass dominance. I anticipate that generalist small mammal species *P. maniculatus* and *P. leucopus* will have a wide niche breadth in locations with the presence of bison and fire, reflecting increased food item diversity. This work contributes to growing research on grassland restoration and its effects on species at the center of the grassland food web.

Elise Snyder, University of Notre Dame

Session: OS 2: Climate Change & Physiology

“Temperature increases environmental DNA (eDNA) removal rates in flowing waters”

Climate change is expected to increase temperatures in freshwater ecosystems of North America. While the positive relationship between increasing water temperature and the degradation of environmental DNA (eDNA) has been well-documented, no studies have directly measured the impact of temperature on eDNA fate and transport in streams. To investigate how elevated temperature may impact eDNA detection and removal in flowing waters, we conducted experimental additions of Common Carp (*Cyprinus carpio*) and Steelhead Trout (*Oncorhynchus mykiss*) eDNA in recirculating mesocosms (N=12) lined with cobble substrate to compare eDNA removal under varying water temperatures (20-26°C), which we hypothesized would influence biofilm colonization and microbial activity. To estimate eDNA removal from the water column, we collected water samples from each mesocosm six times over 24 hrs, and used sequential filtration to isolate eDNA particle sizes. Total eDNA removal rates were 64% higher for the mesocosms maintained at 26°C compared to 20°C and 23°C. Smaller eDNA particles (0.2 µm) were removed faster ($k=0.36 \text{ h}^{-1}$) than larger particles (>1.0 µm; $k=0.23 \text{ h}^{-1}$), and this difference was greatest at 26°C compared to lower temperatures. These results contrast our previous findings where, under cooler temperatures (14-17°C), larger eDNA particles were removed more rapidly than small particles. These results suggest that eDNA removal in streams and rivers may be dominated by physical trapping at lower temperatures and microbial degradation at higher temperatures. Models will need to account for temperature to accurately predict eDNA removal, particularly in warmer locations and/or seasons, as well as for future climate scenarios.

Nathan Soley, Iowa State University

Session: OS 4: Conservation & Restoration

“Prairie seed mixes of intermediate grass: forb ratio create vegetation of greater ecosystem services value”

There is increasing awareness of the need for prairie restorations to generate multiple ecosystem services, and we have tested whether seed mix grass: forb ratio influences outcomes towards this goal. We hypothesized that intermediate grass: forb ratios would result in the greatest biomass production, flower production, invasive plant resistance, and butterfly and bee visitation compared to low or high grass: forb ratios. We tested this by seeding 30 x 30 m plots with 11 different grass: forb ratios and measuring responses from the plant and insect community over three years (2021-2023). Our analyses showed significant hump-shaped relationships between grass: forb ratio and these response variables (quadratic, $p < 0.05$), suggesting no significant trade-offs among these ecosystem service indicators at intermediate grass-forb ratios. Our findings provide insight into how seed mix grass: forb ratios affect ecosystem services differently and whether responses covary in a significant way.

Karly Steinberg, Ball State University

Session: Poster I

“Fear factor: how exposure to conspecific alarm cues impacts embryonic behavior and development in *Pimephales promelas*”

Chemical alarm cues secreted by aquatic organisms alert conspecifics to nearby predatory attacks. Most research has focused on responses to olfactory stimuli at adult and larval stages, but limited research suggests embryos can also perceive these cues. Furthermore, embryos may be able to distinguish between cues that signal an attack on eggs vs adult conspecifics. We exposed fathead minnow (*Pimephales promelas*) embryos on days 3, 4, and 5 post-fertilization to alarm cues from either adult or embryonic conspecifics, and observed embryonic activity inside the egg. Our goals were to determine (i) whether embryos differentiate between an adult vs an embryonic alarm cue; and (ii) the stage of development at which embryos first respond to the cues. Preliminary data suggest embryonic activity levels generally decrease over development, and that embryos perceive and respond differently to alarm cues from conspecifics as early as 3 days post-fertilization. Embryos also appear to be able to distinguish between adult and embryonic olfactory cues. The ability to differentiate and respond to chemical cues would suggest that embryos are more cognitively sophisticated than previously thought.

Allison Suddaby, Case Western Reserve University

Session: Poster II

“Defining the ecological range of *Rothia*, an under-appreciated bacteria genus found in host-associated microbiomes”

Advancements in high-throughput sequencing have revolutionized our modern understanding of microbiomes, or the communities of microorganisms that colonize discrete environments. These microbiomes are often dynamic, structurally complex, and functionally diverse, impacting the environment on both micro and macro scales. Thus, it is important to understand the intricate relationships between microbes in these communities and their roles in ecological processes. However, not all microbial taxa have received equal attention, leading to gaps in our understanding of the ecology of key community members. In humans, the Actinobacterial genus *Rothia* has been identified in oropharyngeal environments and has mechanisms to modify the relative abundance and virulence of known pathogenic bacteria. Still, we do not fully appreciate *Rothia*'s distribution within and outside of humans or its functional role. To better understand the diversity and distribution of this understudied genus, we first used a phylogenomic analysis to show that *Rothia* species have been isolated from diverse environments, including in association with human and other mammalian hosts, the built environment, and from roots and soil. Second, we comprehensively *Rothia*'s distribution across the biosphere by curating a dataset of 738 publicly available 16S rRNA gene amplicon sequencing samples from host-associated niches and the environment. Our analysis of these samples showed *Rothia* was most abundant in human oral and respiratory samples, with relative abundances up to 25% in some oral samples. *Rothia* was also detected in non-human mammal samples. Together, this work demonstrates that *Rothia* species are an abundant member of some host-associated environments. Future work will characterize *Rothia*'s behavior and metabolic diversity in these environments using metatranscriptomic and metagenomic approaches, further illuminating the ecology of this abundant but understudied genus.

Rina Talaba, Chicago Botanic Gardens

Session: OS 5: Invasive Species

“Investigating the effect of seed predation by a non-native weevil, *Larinus planus* on pollinator visitation and floral scent of *Cirsium pitcheri*”

Cirsium pitcheri, also known as Pitcher's Thistle, a rare dune plant species endemic to the Great Lakes, is under threat by the invasive seed weevil, *Larinus planus*. Though we know that *L. planus* infestation of *C. pitcheri* causes a decline in seed production, little is understood about other how infestation affects other floral traits. Floral scent, in particular, is composed of volatile organic compounds (VOCs) which signal interactions with pollinators and predators. We collected *C. pitcheri* floral scent samples and insect interactions from Whitefish Dunes State Park (WFDSP) along high-quality dune habitats. Analysis of the floral scent samples uncovered VOCs which are correlated to the signalling plant-insect interactions. Pollinator visitation and richness were higher in infested *C. pitcheri* where there were higher levels of VOCs associated with insect attraction. Terpenoids were found in *C. pitcheri* as a defensive mechanism against predation. The dominating VOC benzaldehyde, however, is associated with the attraction of predators of the Curculionidae family. The increase of benzaldehyde may be a contributing factor to the further growth of *L. planus* despite the positive effect on pollinator interaction. Furthermore, the floral scent makeup of *C. pitcheri* can be used in the development of scent traps to manage against *L. planus* infestation.

Emma Thrift-Cahall, University of Notre Dame

Session: OS 1: Management

“The Impact of Manure Management on Transport Dynamics of Antimicrobial Resistance Genes (ARGs) in Streams”

The use of antibiotics in animal husbandry has contributed to the spread of antimicrobial resistance (AR) in agricultural watersheds via the spread of treated manure to fields as a soil amendment. While acquiring an AR infection can pose significant threats to human health, we lack a comprehensive understanding of the drivers that influence the fate and transport of antimicrobial resistance genes (ARGs) in agricultural landscapes and adjacent waterways. We used experimental streams, and short-term, steady-state additions of manure slurry, sourced from different stages of management, to examine water column ARG removal paired with biofilm accumulation of two medically-significant ARGs (tetracycline-resistant tetW and tetQ). We collected three manure types: before microbial digestion, from an active digester, and post-digestion from a holding lagoon and screened them for various ARGs and the fecal indicator bacR. There was a reduction in ARG and bacR concentrations across some manure management steps (Dunn's test, $p < 0.05$). In experimental streams, water column removal rates of tetQ and tetQ did not differ across manure types (GLM; emtrends, $p > 0.05$). With water column removal, ARGs accumulated in stream biofilms, however their declines with distance did not differ across manure types (emtrends, $p > 0.05$). While the impact of manure management on ARG transport needs further study, the similarity of water column and biofilm removal rates suggests that physical deposition onto biofilm is an important driver of ARG removal in streams.

Scott Tiegs, Oakland University

Session: OS 7: Decomposition & Nutrients

“Global predictions of organic-matter decomposition rates in streams”

Streams and rivers receive vast quantities of terrestrially derived organic matter, and its fate – such as whether it is respired by microorganisms or enters long-term storage compartments downstream – depends on the rate at which it decomposes. Decomposition rates are highly variable across the planet, but large-scale patterns and drivers of this process are little understood. Our consortium of over 150 researchers quantified decomposition rates in 514 streams globally using a standardized cotton-strip assay. We then created a predictive boosted-regression tree model using machine-learning algorithms and high-resolution land-cover, climate and water-quality data. Our model explains 81% of the variation in rates with climatic, geologic and importantly, anthropogenic attributes emerging as the most important predictor variables. From the model we created a global projection – the first of its kind – of decomposition rates that revealed vast areas of rapid decomposition in locations of intense human activity including Southeast Asia, Central Europe and the Midwest United States. Modeled decomposition rates, when combined with genus-level litter-quality attributes, explained rates of leaf-litter decomposition in streams surprisingly accurately (70% variance explained). Our study of cellulose and leaf-litter decomposition provides new insights into carbon cycling in flowing waters, including estimates across vast, unstudied areas of Earth, and suggests that human activities are increasing microbial decomposition in streams and rivers at continental scales.

Jeneva Tomaszewski, Saginaw Valley State University

Session: Poster I

“The Effects of Drought on Competitive Interactions Between Barley and Corn”

It is crucial to recognize effects of drought on plant interactions in agricultural and ecological contexts due to recent increases in drought severity. Crowding is an important agricultural phenomenon; studies that pair crowding with drought can help us better understand and project what may be needed in the future for the greatest crop success. In this study, chlorophyll and plant growth were measured in drought and well-watered treatments in a replacement series to assess inter- and intraspecific competition between corn and barley in a greenhouse experiment. Leaf chlorophyll concentration was not influenced by crowding or presence of the competitor but was affected by drought treatment. In the conditions of this study, height and biomass measures in barley were more influenced by competition and in corn were more influenced by drought. Drought reduced height in both species. In well-watered conditions, barley height appeared to be more sensitive to interspecific competition, whereas corn was not affected by the presence of barley. Under droughted conditions, barley height seemed to be more sensitive to intraspecific competition, whereas corn seemed to be more limited by drought than competition. Biomass data from the replacement series indicated limited competition in well-watered conditions. Under drought conditions, intraspecific competition had more of an effect on barley, whereas corn appeared to be more impacted by water availability than either inter or intraspecific competition. Understanding the ecological processes behind this could give insight into understanding plant production in increasingly dry soils.

Tram Tran, Denison University

Session: Poster II

“Tracking incidence and trait changes across disturbances at Konza Prairie LTER”

Understanding biodiversity dynamics in response to environmental disturbances is crucial for effective ecosystem management and conservation. Despite advancements in composition change measurement methods, there remains a knowledge gap in effectively characterizing and quantifying temporal beta biodiversity changes. In this study, we investigate whether classifications reflect an ecological response to environmental manipulation, using a presence-absence (incidence) classification method proposed by Gotelli et al. (2022). We analyze long-term data (20+ years) from the Konza Prairie Long Term Ecological Research (LTER) site in Kansas, for small mammals (14 species), grasshoppers (44 species), birds (81 species), and plants (352 species). We also recorded species' life history traits from published sources (i.e., body size, diet, movement, growth form), as trait differences may influence species response. The disturbance treatment includes fire-burning at 1, 4, and 20-year intervals; with and without bison grazing. Separately for different watershed treatments and taxa, we evaluated each species' sequence of presences and absences to classify it into one of the 7 sub-categories from the 3 main categories: no change, directed change, undirected change. We expect that pulsed disturbance, such as fire, will result in a higher proportion of species exhibiting undirected (recurrent or random) incidence classification. We expect that press disturbance, such as grazing pressure, will result in a higher proportion of species exhibiting directed (increasing or decreasing) incidence classification. Initial results suggest that fire and grazing lead to some plant species “switching” classification incidence, but do not lead to widespread incidence classification changes for small mammal, grasshopper, or bird species. Our findings contribute to filling the knowledge gap by offering a more nuanced understanding of temporal beta biodiversity dynamics in tallgrass prairie ecosystems.

Leah Turner, Ball State University

Session: Poster I

“Environmentally relevant concentrations of citalopram during early development impact social behavior and fear responses in fathead minnows (*Pimephales promelas*).”

A growing number of active pharmaceutical ingredients are entering the waterways, but the potential impacts of these contaminants at the population level are not fully known. For example, citalopram is a commonly prescribed selective serotonin reuptake inhibitor (SSRI) that is often found in waterways and has been shown to exhibit a variety of adverse effects on the behavior and physiology of affected organisms. Although the effects of exposure to citalopram on both juvenile and adult fish are well studied, comparatively little is known about how exposure to this class of antidepressants in early ontogeny (i.e., embryogenesis and larval development) alters innate behaviors, such as conspecific shoaling preferences and fear responses. However, such changes are important because they directly correlate with the likelihood of survival. In this experiment, we exposed fathead minnow embryos (*Pimephales promelas*) to three environmentally relevant concentrations of citalopram, or control water, during embryogenesis and evaluated the effects of developmental exposure on the activity levels of embryos. Embryos were then permitted to hatch and were maintained for 21 days; during this time, half of the embryos received continued exposure and the other half were maintained in control water. At 21 days post-fertilization, the embryos were tested in a social shoaling preference assay and a light-dark preference (fear response) assay. Embryos exposed to citalopram showed higher inactivity and lower burst activity, compared to control groups. Larvae also showed exposure-induced behavioral alterations, including a tendency towards increased risk-taking and increased isolation. These data help fill significant gaps in our understanding of how SSRIs impact the critical early life stages.

Catalina Valderrama, John Carroll University

Session: OS 2: Climate Change & Physiology

“Thermal ecology of *Hyloxalus walesi* (Anura: Dendrobatidae), in the Ocetá Páramo, Boyacá-Colombia”

Montane amphibians are exposed to broad temperature ranges throughout the day, making them an excellent study model in thermal ecology. However, research on Andean amphibians is limited. Given the great daily fluctuations in temperature, precipitation, humidity, and solar radiation in the Páramo ecosystem, we expect that *H. walesi* presents a wide range of thermal breath (the difference between minimum and maximum thermal traits). We used field observations and lab experiments to describe variations in thermal traits of a nurse frog, *Hyloxalus walesi* during wet and dry seasons in the Ocetá Páramo in Colombia. Among the traits and conditions, we measured critical temperatures (maxima and minima), body temperature (T_b), thermal behavior of the species, microhabitat temperature (T_{mic}), air temperature (T_a), humidity, and vegetation composition. We confirmed that *H. walesi* presents a wide thermal breath ($\sim 29^\circ\text{C}$ difference between upper and lower thermal limits) that does not vary seasonally. Body temperature was highly associated with microhabitat temperature, suggesting behavioral thermoregulation (thigmothermy) as a thermoregulator mechanism of the species. Our results suggest that the distribution of *H. walesi* is closely associated with specific microhabitats for thermoregulation and vital functions, making this species highly sensitive to habitat loss in Paramo ecosystems.

Alexa Wagner, Hiram College

Session: Poster I

“Forest management drives beta diversity and species turnover in newly recruited woody plant communities”

Second-growth forests tend to be less diverse than their older-growth counterparts. Forest management can be used to encourage diversity in young forests, enhancing resilience of these forests to various threats including pests and pathogens, as well as climate change. Understanding the impacts of forest management on spatial and temporal variability in newly establishing plant communities is key to predicting resultant patterns of biodiversity across the forest landscape. Two critical measures of the spatial and temporal aspects of biodiversity are beta diversity and species turnover. Beta diversity quantifies variability species composition across space, while species turnover quantifies temporal changes in species composition. We monitored the impacts of two common forest management techniques (selective overstory thinning done alone, selective overstory thinning done in tandem with removal of nonnative shrubs, paired with unmanaged controls) on composition, beta diversity, and species turnover in communities of newly recruited woody seedlings within a second-growth forest in Northeast Ohio. Management impacted the composition of newly recruiting woody seedlings in the first two years of study (2020 and 2021), though there was no signal of management treatment on community composition in the third (2022). We found that beta diversity was lower in areas with overstory thinning done in tandem with nonnative shrub removal, compared to forests with no management or managed with overstory thinning alone, indicating that variability in community composition across space was lower within these managed areas. Community composition of newly recruited woody seedlings varied across years (from 2020 to 2022) in plots managed with overstory thinning paired with nonnative shrub removal, as well as unmanaged plots. Interestingly, composition across these three years was relatively consistent in plots managed with overstory thinning alone. Species turnover from 2020 to 2022 did not differ across management treatments. Our findings indicate that management has the potential to drive community composition in newly recruiting woody plant communities, including patterns of diversity across the forest landscape. These effects were more pronounced in the treatment including overstory thinning done in tandem with understory removal of nonnatives.

Shannon Walker, University of Louisville

Session: OS 10: Decomposition & Nutrients

“Fungal endophyte influences dune-building grass growth strategy and productivity in response to nutrient enrichment”

Plants associate with a variety of symbiotic fungi, collectively referred to as the plant mycobiome which can have substantial effects on host plant growth and function. *Ammophila breviligulata* (hereafter, *Ammophila*) is a dominant grass species of Great Lakes coastal foredunes and serves as a host for the systemic fungal endophyte *Epichloë amarillans* (hereafter, *Epichloë*). Previously, *Epichloë* had been shown to increase above and belowground growth in *Ammophila*. However, it is unclear whether this corresponded to changes in *Ammophila*'s overall growth strategy (i.e. fast, acquisitive growth versus slow, conservative growth), which could lead to novel plant function in this system. Any shifts in plant growth strategy due to symbiotic associations could be further magnified by global changes such as anthropogenic nitrogen enrichment, which is known to drive faster, more acquisitive plant growth strategies. We hypothesized that elevated nitrogen availability would compound the effects of *Epichloë* and drive greater above- and belowground growth and a faster, more acquisitive plant growth strategy in *Ammophila*.

In 2010, we established a factorial experiment with 90 4m² plots in Leelanau State Park, Michigan to test the effects of *Epichloë* on *Ammophila* growth. Half of the plots were planted with *Ammophila* that had been inoculated with *Epichloë* (E+), while the other half contained *Ammophila* that had been sham-inoculated (E-). In 2016, we added nitrogen (N) enrichment treatments to a subset of this experiment [low N fertilizer (0.5 g NH₄⁺/m²), high N fertilizer (10g NH₄⁺/m²), or no N fertilizer (control)]. Individual tillers of *Ammophila* from each plot were collected in 2021 and analyzed for a variety of above- and belowground plant traits. At the individual plant level, we found that E+ *Ammophila* had greater tiller density, higher specific leaf area (SLA), and smaller individual tillers, indicating a faster growth strategy compared to the E- *Ammophila* plants. However, at the population-level, E+ and E- plants did not differ in total biomass under control conditions, while low N fertilization increased total biomass for E- plants but high N fertilization increased total biomass for E+ plants. Overall, these results reflect dynamic interactions among plant growth strategy, resource availability, and associations with fungal symbionts in this dominant plant species. Such changes in dominant plant growth strategies and functional traits may have cascading effects on community structure and ecosystem function in the future.

Xueqi (Sharon) Wang, University of Guelph

Session: OS 10: Decomposition & Nutrients

“The Effect of Nutrient Transport Downstream on Food Web Stability in an Experimental Freshwater Meta-Ecosystem”

Recent theory suggests that accumulation of nutrients downstream in riverine systems can amplify the magnitude of phytoplankton and zooplankton blooms (variance-driven destabilization) and/or lead to competitive replacement of phytoplankton (mean-driven destabilization). We used an experimentally-controlled 3-node network of freshwater microcosms with green algae, cyanobacteria, and *Daphnia magna* to test these hypotheses. Nutrients and detritus accumulated significantly downstream, reaching maximum values in the terminal nodes, resulting in small increase in abundance for green algae and *D. magna* populations. There was no evidence of complete competitive exclusion of green algae, but cyanobacteria equilibrated at densities 50% higher than those of green algae in all nodes by the end of the experiment. Our results support the theoretical prediction that unidirectional flow in riverine systems contributes to accumulation of nutrients downstream and increased bacterial activity, but these changes were of insufficient magnitude to produce variance- or mean-driven destabilization of food web relationships downstream in our experimental system.

Thomas Wassmer, Siena Heights University

Session: OS 9: Population & Community

“Population structure of the Rainbow Scarab, *Phanaeus vindex* (Coleoptera: Scarabaeidae) in SE Michigan”

Until now, little is known about the population structure and mobility of temperate dung beetles including the rainbow scarab, *Phanaeus vindex* (MacLeay 1819), although this knowledge is essential for their conservation as pastures become increasingly rare and the landscape fragmented by monocultures and urbanization. Here, we estimated population size, longevity, and dispersal within and between pastures. For 3 yr, we life-trapped beetles every week on 2 adjacent farms in SE Michigan, determined their sex, male morph, and size, and marked their elytra with individual tattoo patterns before releasing them. We marked a total of 470 rainbow scarabs of which 14 were recaptured once and 2 were recaptured twice. The sex ratio was not significantly sex-biased but fluctuated between months with no apparent uniformity between years. While the minor to major male ratios were unbiased in 2019 and 2020, they were marginally minor-biased in 2021. The gross population estimates for the 2 farms were 458-491 and 217 rainbow scarabs, respectively. Beetles traveled distances of up to 178 m within farms. No beetles dispersed between farms. One large female was recaptured after 338 days documenting the first cold hardiness and long lifespan of a cold-temperate dung beetle species in the wild. The low population estimates on both farms indicate 2 vulnerable populations with no or extremely limited connectivity. Supplementary funding for the land stewardship of small-scale cattle farmers could stabilize populations of native dung beetles and maintain their ecosystem services.

**Daelyn A. Woolnough, Central Michigan University, Biology Department
and Institute of Great Lakes Research**

Session: OS 2: Climate Change & Physiology

“Distribution and physiology of native and invasive bivalves in the Kalamazoo River watershed, MI, USA and the importance of outreach for conservation”

Invasive species are introduced exotic species that have both economic and ecological impacts on their environment. *Corbicula* (corbiculids) is a complex genus of invasive bivalves that have been observed negatively impacting native fauna, including declining assemblages of native freshwater mussels. We considered how corbiculid and native mussel distributions relate to each other and whether the presence of corbiculids is associated with native mussel physiological condition. 207 random sites were visited and bivalve surveys were conducted at 122 sites across the Kalamazoo River watershed to obtain corbiculid and native mussel distribution data. Physiological condition was quantified by determining glycogen levels and fatty acid analyses in one species of native mussels at a subset of sites with varying corbiculid densities. Glycogen was not correlated with corbiculid densities, water temperature, or stream catchment size class. Results from fatty acid analysis demonstrated limited overlap in diet between native and invasive bivalve species therefore competition for food between corbiculids and native mussels may not be as prevalent as previously predicted.

The public often is interested in knowing more about native mussels and since 2019 we have participated in multiple outreach events. With a portable trailer that can house live native mussels we taught varying audiences about the diversity, history, and unique life-cycle of native freshwater mussels. These events have been very successful in advancing the understanding of the importance of these imperiled organisms that provide free ecosystem services within the watershed.

The findings from this research, as well as success of outreach, are important to furthering scientific understanding on the relationship between native mussels and invasive corbiculid mussels. Together research and outreach will aid in the conservation of understudied and rare native freshwater mussels.

John Yunger, Governors State University

Session: OS 11: Behavior & Defensive Traits

“Predation and dispersal of acorns and maple seeds in temperate deciduous forests.”

The size of seed dispersers and their specialized hoarding behaviors can influence seed fate in many plant species. We examined whether members of a rodent community differed in their effectiveness as seed dispersers and how this relationship may be altered by seed species and predator presence. Northern red oak acorns and silver maple seeds were marked with aluminum tags and placed in size-selective rodent exclosures. The exclosures allow selective access of rodents based on body size: (1) *Peromyscus leucopus* only, (2) *Peromyscus* and *Tamias striatus* access, (3) exclusion of all vertebrates and (4) open access for all vertebrates. A split-plot design with half the seed stations exposed to coyote urine was used to examine the effects of predator presence on seed fates. Maples were removed at a significantly greater rate than acorns. This may be attributed to the all access and *Tamias* access treatments, where chipmunks remove large numbers of seeds using their cheek pouches. The vast majority of the acorns were consumed in two days on the open treatment. *Peromyscus* scatter hoarded acorns at almost twice the rate of larder hoarding; *Tamias* scatter hoarded at about the same rate as larder hoarding. On all treatments, consumption rates of seeds did not decline significantly after the fourth day. The predator treatment did not have a significant effect. Cameras found that omnivores such as raccoon, opossums, and skunks, but not deer or turkey, consumed a large number of seeds.

Alison Zachritz, University of Michigan

Session: OS 3: Population & Community

“The forgotten pillar of global change: Synthetic chemicals such as PFAS require integration of ecology and toxicology”

Ecological interactions are carried out against the backdrop of, and are often affected by, global change. The Millennium Ecosystem Assessment highlights five drivers of global change: 1) climate change, 2) land modification 3) introduced species, 4) biodiversity loss and 5) pollution. While “pollution” often encompasses biologically active compounds like nutrients, which are well studied, the proliferation of synthetic chemicals has not received the same level of attention, even though the rate of synthetic chemical production now outpaces other agents of global change—including rising CO₂ concentrations, nutrient pollution, and habitat destruction. Our research focuses on the ecological impacts of a synthetic chemical class, PFAS, on aquatic ecosystems. We posit that PFAS may have impacts on ecosystem function and have found some supporting evidence. We recently demonstrated in a field investigation that decomposition and respiration were suppressed downstream of a known PFAS source. Likewise, we are studying whether PFAS, like other persistent organic pollutants (e.g., PCBs), are transferred from the Great Lakes to tributary systems by spawning salmon; we have thus far confirmed that PFAS are maternally offloaded to salmon eggs, possibly representing a potential pathway of contamination to stream fishes via egg consumption, and are conducting studies to further explore these questions. Our results will be integrated with other key work to exhibit the breadth of ecological skillsets needed to address contaminants as agents of global change.

THANK YOU!



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