Proposal Abstracts From 2023 Student Grant Awardees

Each year the Society of Wetland Scientists (SWS) receives proposals for its Student Research Grants Program. Through this program the Society aims to develop and encourage wetland science as a distinct discipline by providing support in student education, curriculum development and research. To support this goal, partial funding of wetland-related research is offered to undergraduate and graduate students from an accredited college or university worldwide through a competitive grants program. These grants are intended to aid student's costs of travel, room, and board during field investigation and equipment/supply costs required for research. This year SWS has awarded grants to ten students. Abstracts from their proposals for research are presented below. Congratulations to all and we look forward to reading the results of their research in the future.

BIOSWALE REMOVAL OF HEAVY METALS

Blessing Aleladia, Loyola University, Chicago, IL, USA

Proposal Abstract: Constructed wetlands, such as bioswales, are engineered systems that mimic natural purification processes to treat wastewater. Invasive plant species found in bioswales have the potential to act as phytoremediators by removing pollutants from water and soil. However, without proper management, invasive species can become a nuisance and lead to economic losses. Hence, eco-friendly approaches to managing invasive species while simultaneously removing pollutants from the soil are required. The proposed study aims to investigate the heavy metal removal capacity of invasive plant-derived biochar under different pyrolysis conditions, such as temperature and residence time, simulating an Illinois Tollway bioswale.

A multivariate experiment will be conducted in a greenhouse using common invasive wetland plant materials, including *Typha x glauca*, *Phragmites australis*, and *Rhamnus cathartica*, subjected to pyrolysis under varying conditions. The performance of invasive plant-derived biochar will be evaluated using analytical and statistical methods to identify the most effective types for the removal of heavy metals from the Illinois Tollway bioswale.

The study's significance lies in its potential to provide effective and sustainable solutions for restoring Illinois Tollway bioswales degraded by heavy metal pollutants and invasive plant species. The optimized production of biochar with high heavy metal adsorption capacity will provide a valuable resource for the remediation of contaminated soils in similar bioswales, contributing to the development of innovative and ecologically responsible strategies for managing constructed wetlands.

GREAT LAKES COASTAL WETLANDS RESTORATION

Adellia Baker, State University of New York (SUNY), Brockport, NY, USA

Proposal Abstract: Great Lakes coastal wetlands support a diverse community of wet meadow vegetation that is maintained by fluctuating lake levels. These plant communities have been increasingly invaded by hybrid cattail (*Typha x glauca*) as higher, more stable lake levels have resulted from water regulation on Lake Ontario. While recent restoration efforts around Lake Ontario have focused on restoring the wet meadow habitat through managing cattail and updating the lake regulation plan, the effects of these methods on other invasive species (such as reed canary grass, *Phalaris arundinacea*) have not been fully studied. We will conduct vegetation and soil sampling in 18 wetlands around southern and eastern Lake Ontario and the Upper St. Lawrence River to determine how cattail management impacts the wet meadow zone following changes to water regulation under Plan 2014. Three of these wetlands have previously had chemical and mechanical cattail treatments implemented, while the remaining 15 wetlands have not been treated. Additionally, we will conduct a greenhouse study where we will apply five combinations of nitrogen and phosphorus levels to pots with reed canary grass and native Canada bluejoint grass (*Calamagrostis canadensis*) to determine how the growth of these species is impacted by soil nutrient levels. Results of this research could be used by practitioners to guide restoration methods as well as future changes to water regulation to make coastal wetlands more productive and resilient to invasion.

METHANE IN RESTORED WETLANDS

Michael Beall, Clemson University, Clemson, SC, USA

Proposal Abstract: Since the 18th Century, 40 – 90% of the wetlands in the Midwest and Great Plains region were drained for agriculture. These wetlands provided valuable ecosystem services in the form

of climate regulation, wildlife habitat, and water purification. The Conservation Reserve program promoted wetland restoration in this area, which resulted in an 81% increase in wetlands. A massive campaign across 15 states in the Central U.S. is underway to quantify and evaluate plant and soil carbon stocks, vegetation communities, and greenhouse gas fluxes in these restored wetlands. Despite this comprehensive environmental data collection, no protocols exist to investigate microbial communities. Small-bodied wetlands are responsible for a disproportionate amount of greenhouse gas emissions, mainly methane. These wetlands exhibit a large range of variations in methane emissions that differ by orders of magnitude. This significant variation affects freshwater greenhouse gas budgets which negatively impacts our ability to accurately model climate change. We aim to evaluate the environmental conditions that promote or inhibit methane production to better understand the greenhouse gas variation in these sites. We will use methyl coenzyme M reductase (mcrA) and particulate methane monooxygenase (pmoA) gene abundance coupled with extensive environmental data to identify key conditions that result in methane cycling variation. We will begin our intensive sampling campaign during the summer of 2023 in Ohio. The project will continue in Michigan and Indiana over the next several summers. This project offers an exciting opportunity to research methane variation across a spatial and temporal scale in restored wetlands of the Midwest. Through this research, we aim to develop our understanding of restored small-bodied wetlands aligned with the mission statement of the Society of Wetland Scientists to promote best practices in wetland research, restoration, and management.

SALT IMPACTS ON FRESHWATER WETLAND SOIL

Nicolina Lentine, Montclair State University, Montclair, NJ, USA

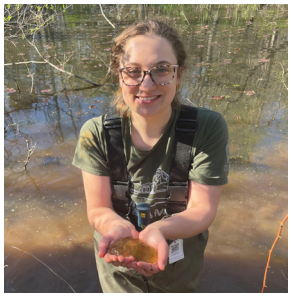
Proposal Abstract: Rising sea waters pose a serious threat for many coastal environments. The gradual increase of saltwater moving into coastal soils can negatively impact soil function, leading to reduced seed germination and reduced plant vigor. Cheesequake State Park (Matawan, NJ) had a salt concentration increase within its cedar swamp area and further increases in salinity are expected. Previous research at Montclair State University (MSU) has examined the impact of artificial root exudates on heavy metal contaminated soil as a treatment to increase soil function. Root exudates are compounds that plants release into soil; they nourish microorganisms and promote healthy soil function. While MSU research shows artificial root exudates can revitalize metal contaminated soils, there is no research on how they may influence saline soils. The goal of this experiment is to determine how two treatments (salinity and root exudates) can impact soil function, and if artificial root exudates can offset the negative consequences of increasing soil salinity. Soil collected from Cheesequake State Park will be treated with artificial root exudate and salt solutions. The concentration of each solution within a given pot depends on where it fits within an experimental matrix. Phosphatase activity, soil salinity, soil pH, and soil moisture will be measured from soils in each pot. The results will provide a greater understanding of how salt influx can impact soil. They will show whether the addition of artificial root exudates can offset the effects of salinity, and whether there is a 'threshold' salinity level above which plants do not survive.

LANDSCAPE AND GENETIC DIVERSITY IN WESTERN MEXICO WETLANDS

Efrain Noriega Rico, Instituto de Ecología, A.C., Xalapa, Veracruz, Mexico

Proposal Abstract: Wetlands act as natural connectors between terrestrial and aquatic ecosystems and maintain biodiversity at regional and landscape scales. Wetland conservation in Mexico could benefit from understanding functional connectivity for aquatic plants. This research aims to identify the landscape factors that determine functional connectivity (e.g., gene flow) and genetic diversity of the California bulrush (*Schoenoplectus californicus*) in wetlands of western Mexico by using a landscape genetics approach. We will collect 15 to 30 leaf tissue samples of *S. californicus* individuals from natural and artificial wetlands in the states of Michoacán, Guanajuato, and Jalisco to extract genomic DNA. A total of sixteen nuclear microsatellite markers developed for *S. americanus* will be transferred and genotyped to estimate genetic diversity and differentiation, and to statistically test their relationship with landscape elements. Wetland conservation strategies in highly modified landscapes can be informed by identifying which landscape elements affect gene flow and genetic diversity for a typical wetland plant species.

SPOTTED SALAMANDER AND CLIMATE CHANGE



Shayna Rosenbloom Earl, University of Louisville, Louisville, KY, USA

Proposal Abstract: Anthropogenic climate change is driving shifts in natural temperature regimes. In addition to global warming, temperatures are becoming increasingly variable. Many organisms rely on seasonal temperatures across life stages as they grow and reproduce, among other critical aspects of their lives. A lot of work has been done on how increases in mean temperature might impact organisms, but there is a gap in our understanding on the impacts of increases in variation. Amphibians are especially susceptible to environmental change, particularly in earlier life stages. Increases in temperature have been shown to cause shifts in their phenology, decreases in body size, and an increase in premature mortality. The purpose of my work is to collect data on natural temperature variance and salamander growth, survival, and abundance in ponds across central Kentucky and southern Indiana. Spotted salamanders (*Ambystoma maculatum*) are widespread across the eastern United States and develop from egg to adult in one year. Their developmental timing will allow me to follow populations from egg to larvae to metamorphosis in a realistic experimental setting. I will visit ponds monthly to measure pond temperature, pH, invertebrate communities, and salamander presence, size, and waterborne stress hormone (corticosterone) levels. I anticipate that the results will show that higher and more variable temperature will lead to lower survival and body size, as well as increased expression of stress hormones, of the salamanders pre- and post-metamorphosis. The results from this experiment will inform us on natural pond variation in this region and help to illustrate how spotted salamanders are reacting to shifts in temperature regimes. Once we have more of an understanding of how spotted salamanders are being impacted, we can work to implement conservation strategies.

PEATLAND AND CARBON CYCLING

Jessica Rush, University of Colorado, Boulder, CO, USA

Proposal Abstract: Northern peatlands are important wetland ecosystems that store large amounts of carbon. However, with global climate change, these peatlands may shift from carbon sink to sources. To understand the fate of this carbon, we must look to how microbial processes control carbon greenhouse gas emissions. This proposal aims to understand how warming and elevated atmospheric carbon dioxide concentrations impact the reduction of solid-phase, redox-active organic terminal electron acceptors and subsequent carbon dioxide and methane production. To understand the legacy effects of these two factors, peat will be collected from the Spruce and Peatland Responses Under a Changing Environment Project in northern Minnesota. This project exposes peat to a range of different warming and elevated carbon dioxide scenarios, making it an ideal study site. Peat will be incubated at a common temperature back in the lab and analyzed for changes in organic matter reduction and carbon greenhouse gases. I hypothesize that peat that has been exposed to higher temperatures and elevated carbon dioxide will have more oxidized and redox-active organic matter, suppressing methane production. In a complementary study, I will install "peat peepers" where cores are taken to incubate a common peat substrate in experimental field conditions. This will control for peat heterogeneity to help us further understand how the experimental conditions at the project are affecting redoxactive organic matter. With the experimental project soon to be shutting down, this summer is the opportune time to investigate the effects of these long-term experimental manipulations on peatland carbon cycling. This work will inform peatland scientists on how two majors concerns of climate change, increased temperature and carbon dioxide, are affecting these important carbon sinks, potentially linking them to further amplifying feedback.

ANDEAN PÁRAMO PEATLANDS

Patrick Skillings, Michigan Technological University, Houghton, MI, USA

Proposal Abstract: The páramo peatlands store vast quantities of carbon below ground as peat soil in amounts greater than carbon stored in all the aboveground biomass of tropical forests. Approximately 43% of the Andean páramos are found in Colombia. However, due to a combination of increasing temperatures in the tropics, and anthropic activities such as drainage, peatlands can quickly lose large amounts of soil carbon to decomposition, contributing to atmospheric greenhouse-gas concentrations. As part of a peatland mapping effort, we have visited over 1900 sites in the páramos across the country. After analyzing soil samples for carbon % on each site, we found many sites that were classified as herbaceous uplands actually have high C percentage >30%, results only expected for peatlands. For this project, I will address the following question: Are these herbaceous uplands with high C% areas wetlands? 17 sites were selected to be revisited. Vegetation,

soils, and hydrologic characteristics for each site will be measured and compared to known peatlands and uplands. A more precise classification for these sites will be determined. This project has important implications for land use management and conservation efforts in the Andean páramos because it will improve soil carbon stock estimates in the mapping process and may expand the extent of wetland areas beyond what is currently classified.

MICROPLASTICS AND WETLANDS

Marcela Strane, University of Houston, Houston, TX, USA

Proposal Abstract: Microplastics (MPs) are widely studied contaminants that can negatively impact public health and the environment, such as wetlands. The mobilization and transport of MPs in the environment from terrestrial to freshwater ecosystems are not well understood. I hypothesize that MPs mobilization and transport from terrestrial systems can be characterized by the critical shear stress induced by precipitation runoff. In this project, I propose studying land applied biosolids to understand how MPs may be released into the environment from this potential source. Biosolids are carbon-rich solids derived from domestic wastewater that is often used as fertilizer. Biosolids retain ~90-99% of the microplastics that enter the wastewater treatment plant (WWTP) and are land applied to agricultural fields. MPs may be re-released into the environment after mobilization by precipitation events that produce runoff. Environmental buffer strips of non-agricultural land are required in some biosolids application areas to capture and retain pollutants that may be transported from land-applied biosolids by precipitation runoff. A gap in knowledge exists about the extent of microplastics released from agricultural systems, the efficacy of buffer strips to capture transported MPs, and finally, the concentration of MPs that are from agricultural systems in wetland ecosystems. Wetlands can behave as filters and sinks for microplastics that accumulate throughout the water and soil column and affect the overall health of the community. The mechanisms of microplastic mobilization and transport into wetlands have not been extensively studied. The proposed lab-scale experiments and field-scale testing will provide the necessary information to describe MPs mobilization by critical shear stress and to model MPs capture in environmental buffers. The knowledge gained in this research will improve our understanding of the mechanisms of MPs mobilization and the extent of potential MPs transport from terrestrial to freshwater ecosystems.

BLANDING'S TURTLE AND ROAD MORTALITY

Lauren White, University of New Hampshire, Durham, NH, USA

Proposal Abstract: The development of roads that bisect wetlands is a threat to wildlife due to associated habitat fragmentation and disruption of migration routes, which can lead to road mortality. Blanding's Turtle is an endangered residential wetlands species in New Hampshire whose population is uniquely vulnerable to this threat. The creation of eco-passages at these road crossings can reduce mortality and re-connect fragmented wetlands. While the issue of road fragmentation impacts the migratory safety of wildlife, it inherently impacts the health and connectivity of wetland systems, which has implications for wetlands conservation, restoration, and management. The project proposed here will create a better understanding of the priority location and design of eco-passages connecting wetlands that are bisected by a road. The increased aquatic organism passage (AOP) on which this project will focus pertains not just to Blanding's Turtle but will increase safe passage for myriad species of fish and other migratory wildlife that reside in wetlands. Our team collected data about 268 existing wetland culverts and coded a model that organizes these culverts, or sites, in order of prioritization for restoration based on a literature review of key design components. This proposal will implement a monitoring protocol at ten sites, 5 deemed high-risk by the model and 5 assigned low-risk. The aim of this protocol is to determine the accuracy of the model to identify the risk of road mortality. By conducting roadkill surveys and camera trapping at these ten sites for eight weeks, we will be able to determine top-priority sites for restoration and create conceptual engineering eco-passage designs for these selected sites. The conclusions of this study will better inform wetland scientists about techniques for increasing habitat connectivity and management.