CULTIVATING ECOLOGICAL RESTORATION WITHIN HUMAN DOMINATED LANDSCAPES

SEVENTH MIDWEST-GREAT LAKES SER CHAPTER MEETING

March 27 to 29, 2015

Chicago Botanic Gardens, Glencoe, Illinois

3/6/2015 DRAFT ABSTRACT BOOK

MEETING HOSTS

SHARP-LOBED HEPATICA SPONSOR

ENVIRON

GENESIS NURSERY

RUE ANEMONE SPONSOR

STANTEC

UNIVERSITY OF ILLINOIS SPRINGFIELD THERKILDSEN FIELD STATION

PRAIRIE-TRILLIUM SPONSORS

APPLIED ECOLOGICAL SERVICES

CHICAGO PARK DISTRICT

ENVIROSCIENCE

JOHN G. SHEDD AQUARIUM

LANDSCAPES OF PLACE, LLC

METRO CONSULTING ASSOCIATES

OZAUKEE WASHINGTON LAND TRUST

PARTNERSHIP FOR RIVER RESTORATION & SCIENCE IN THE UPPER MIDWEST

PRAIRIE MOON NURSERY

PURDUE UNIVERSITY CALUMET DEPARTMENT OF BIOLOGICAL SCIENCES

THE NATURE CONSERVANCY

V3

BLOODROOT SPONSORS

BOLLINGER ENVIRONMENTAL INC.

DAVID BORNEMAN, LLC

ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC.

ISLAND PRESS

PARKLANDS FOUNDATION

TALLGRASS RESTORATION

UNIVERSITY OF ILLINOIS SPRINGFIELD BIOLOGY DEPARTMENT

UNIVERSITY OF NORTHERN IOWA TALLGRASS PRAIRIE CENTER

KEYNOTE PRESENTATION

Malec-McKenna, Suzanne*. **Quality of life through the lens of natural resource**. Chicago Wilderness, Chicago, Illinois. Email: cwadmin@chicagowilderness.org

Abstract forthcoming.

OPENING PLENARY SESSION ABSTRACTS

URBAN RESTORATION AT MULTIPLE SPATIAL SCALES

Anderson, Jim. **Successful restoration of urbanized natural areas in a metropolitan area of Lake Michigan.** Lake County Forest Preserve District, Libertyville, Illinois. Email: janderson@lcfpd.org

Restoration of natural areas that are located within an urban setting present many challenges for restoration ecologists and planners. Natural areas are highly impacted by changes in the natural functions that historically sustained them. Human impacts to hydrology, soils, physical structure, and vegetation composition along with introductions of invasive species have greatly degraded the quality and quantity of natural areas within Lake County, Illinois and the surrounding region. Influences of natural systems like Lake Michigan, river corridors, oak groves, prairies and wetlands have been highly degraded and require substantial resources and finances to restore ecological functions that naturally sustained these systems. Restoration ecologists and planners have to become inventive, resourceful and willing to collaborate to reverse the negative trends influencing our natural communities and species assemblages. In addition, there are other factors that influence the success of restoration efforts that are out of the control of restoration ecologists. Funding and staff are major impediments to implementing successful restoration efforts, but other factors like political will and time can also be very limiting. Recent efforts by the Forest Preserve and its partners have refocused regional efforts to prioritize and implement restoration efforts across larger landscapes and community types. This requires a new strategy for restoring natural areas that includes consideration of current and future stresses of urbanized landscapes that will continue to influence restoration efforts spatially. All of these challenges need to be considered as restoration strategies are considered and implemented across the region.

Glass, William D. **A large scale prairie restoration in an urban setting.** Midewin National Tallgrass Prairie, Wilmington, Illinois. Email: wglass@fs.fed.us

The Midewin National Tallgrass Prairie, a unit of the USDA Forest Service, is located just 64 km southwest of Chicago, Illinois. Midewin is currently around 77 km^2 and will grow to approximately 81 km^2 in the near future. The land was formerly the Joliet Army Ammunition Plant. The Forest Service developed a "Prairie Plan" with public input to determine the direction of the restoration work. The plan calls for restoring large portions of the land into a high diversity mosaic of prairie and wetlands with areas of woodland and savanna along the streams bisecting the landscape. Another major goal of the plan is to continue providing habitat for grassland birds. The large size of Midewin National Tallgrass Prairie allows the Forest Service to reintroduce processes and restoration activities that may not be possible on small units. The large size allows a restoration of the altered hydrology to a more natural state by removing field tiles and filling drainage ditches. Bison will be introduced to return the grazing element of the restored prairie, an important element that has been missing. Bison will also help with grassland bird habitat management. The large size of Midewin National Tallgrass Prairie has its challenges, especially given its location within a rapidly developing urban area. Impacts from encroachment are a problem and other, more subtle impacts including noise and lighting are also negatively impacting the area.

Pizzo, Jack. **Green and natural spaces in your community: a guide to living with and managing naturalized landscapes and natural areas.** The Pizzo Group, Leland, Illinois. Email: jackp@pizzo.info

We all seek to raise awareness in our constituents, friends, neighbors, and clients of their role in the vast ecological system in which they live. All of us live, work, and play within a short distance of a green or natural space and these spaces offer teaching opportunities about our ecological role. These spaces exist as remnant natural areas, new naturalized areas, or are part of the storm water management system. Most people don't understand why these areas exist or how they are managed. This misunderstanding has caused a lack of effective management. Public landowners face the same issues as private landowners and I have found an excellent way to raise their ecological awareness is through the idiom, "Speak to them in a language they understand…". We must have a genuine interest in the constituencies to whom we are speaking and choose our words carefully to gain a mutual understanding. If beauty is what they seek, then sell them that "Good Ecology is Beautiful". If speaking to a physician, use a physiological analogy. If speaking to a hunter, highlight the hunting and harvesting opportunities. Surely, we can use a diverse array of words and ideas. Images are also a great communication tool, but only if they are authentic. If a picture is worth a thousand words, then before and after pictures of a restored natural area is worth a 2000 word essay. I feel it is important to educate the public and professionals who make decisions about green and natural spaces, but also to educate the ecological restoration industry about how to interact with the public. I will discuss the highly visible restoration activities of my company, such as fire and tree clearing, and the esoteric such as the relationship of songbirds, lepidopterans and the genus *Quercus* to the landscape.

Westphal, Lynne M. **Thinking about scale when we're talking about people**. USDA Forest Service, Northern Research Station, Evanston, Illinois. lwestphal@fs.fed.us

Scale is as much an issue in the social sciences as it is in ecological sciences. Social science scales range from the individual to the global. What are the scales used by social scientists? And how do these inform, intersect with, or provide new questions for the act of restoration? Drawing on data from the STEW-MAP (Stewardship Mapping & Assessment Project) database (stewmap.cnt.org), I will highlight the variation of scale of groups participating in stewardship activities throughout the Chicago Wilderness region. Along with understanding scale from the perspective of social science, it is interesting to consider the effect of site scale on human experience of restoration settings. Site scale is relevant to people's interaction with a site, and the experiences available there. While large sites are important both ecologically and for human engagement, small – even tiny – sites also provide very meaningful experiences for people. These experiences may help support restoration of larger scale sites, and they certainly provide meaningful benefits to people, increasing the importance of restoration sites across a very wide range of scales.

SYMPOSIA AND WORKSHOP ABSTRACTS

STUDENT CAREER WORKSHOP ABSTRACT

Lyndall, Jennifer. **Building a resume and preparing for interviews.** ENVIRON, Burton, Ohio, Email: jlyndall@environcorp.com

Bring your resume for an editing session with Midwest-Great Lakes SER Chapter members. We will help you tailor your resume to package your skills and experience so that your resume will stand out from the crowd. Chapter members will also provide tips and strategies to help you successfully network and prepare for interviews. We will discuss how to present and promote yourself in the best manner - including attire, etiquette, social media, and branding. We will also help you tap into the hidden job market (i.e., those job opportunities that are never officially posted) and the numerous resources to find internships and job openings.

LIFE ALONG THE EDGES SYMPOSIUM ABSTRACT

Coulter, Dave. **Life along the edges – a discussion of the value of field margins, hedgerows, and buffers in the modern landscape.** Osage Inc., Oak Park, Illinois. Email: osage59@ameritech.net

Field margins, hedgerows, and buffers are features in the landscape that are - depending on the eye of the beholder - either prized, despised, or somewhere in between. In the early 21st century such vegetated edges are attracting renewed attention, especially in light of recent losses to pollinator and bee populations. On one hand, there is research that points to the habitat that can be gained by thoughtful installation and management of marginal areas consisting of native plantings. Conversely, there are also those who feel that these elements are merely harbors for invasive species, and are potential population sinks that do not really benefit wildlife. If this is an idea that is looking for a home, then where is it? The uses of hedgerows, conservation plantings, and other buffer types have been promoted in agricultural landscapes for many years, and for good ecological reasons. Can and should these plantings be expanded into urban areas? Overseas, the use and management of these marginal areas is a discipline in its own right, based on historical and cultural practices. Might there be room in the American landscape for such features? Where might it be? Are restorationists and landscape managers missing an opportunity to reinvigorate old practices for this modern era?

LIFE ALONG THE EDGES SYMPOSIUM PRESENTATION ABSTRACTS

Caldwell, Wendy.* **Monarchs in the margins: creating and restoring habitat for pollinators**. Monarch Joint Venture, St. Paul, Minnesota. Email: monarchs@monarchjointventure.org

Monarch butterflies are a flagship species for pollinator conservation, but their numbers are declining. While both the eastern and western monarch population numbers measured during the 2014 to 2015 overwintering season were slightly up, the eastern population estimate was still at the second all-time low. In order to conserve this iconic insect, Monarch Joint Venture partners are working together to identify and restore habitat for monarchs across its breeding and migratory range within the United States. These partners range from federal and state agencies to nature centers and academic programs coming together in a coordinated effort to conserve the monarch migration. Education, awareness, research, and monitoring are important aspects of the monarch conservation movement, but habitat restoration and enhancement across their

geographic range is vital to ensuring the monarch migration continues for future generations to enjoy. Roadsides, agricultural buffer areas, hedgerows, utility right-of-way corridors, and other marginal lands all have the potential to provide high quality habitat for monarchs and other pollinators. We're looking to these areas and those that manage them to determine a scientifically-sound and efficient approach to enhancing marginal land in key breeding and migrating areas for monarchs. These areas can serve as corridors connecting natural habitat areas, providing refuge in otherwise low biodiversity areas, and reducing the effects of fragmentation due to cropland conversion and development. Interested individuals and organizations can connect with Monarch Joint Venture partners who have delved into restoring habitat for monarchs in marginal areas and identify ways that you can transform your margins for pollinators.

Ferree, Rhonda J.* **University of Illinois Extension Master Naturalists partner with organizations to restore natural habitats in local communities**. University of Illinois Extension, Havana, Illinois. Email: ferreer@illinois.edu

The University of Illinois Extension Master Naturalist program provides science-based educational opportunities that connect people with nature and help them become engaged environmental stewards. The Program educates and trains adult volunteers to help disseminate natural resource information to the public and to assist with conservation and restoration activities in their local communities. This session will highlight the Master Naturalist program in Illinois. You will learn how this natural resource education and community service program increases environmental literacy and conservation action, thus addressing the growing need to connect people to nature. Special emphasis will be given to Master Naturalist projects working in the areas of natural habitat restoration research, education, and stewardship. Learn how to build new and strengthen existing networking opportunities for partnering with Master Naturalist volunteers on restoration programs.

Ayres Fisher, Adrian*. **Do three shrubs make a hedgerow? Reflections on hedgerow structure and usefulness in several contexts**. Triton College, River Grove, Illinois. Email: adrianfisher@triton.edu

During a meeting a few years ago, someone from U.S. Fish and Wildlife described vast parts of our Midwestern cities and suburbs as "landscapes of death" for migratory birds because these areas possessed trees and grass, but lacked shrubs capable of providing food and shelter. Across large swaths of urban, suburban, and farm land native plant species have been more or less extirpated and use of pesticides has harmed native plants, insects and birds. Little of this land is going to leave human control anytime soon. Even if it cannot be restored in the classic sense, how can we reintroduce native plant communities, thereby helping improve ecosystem health and, not incidentally, beauty? In England, hedgerows have a 4,000 year history of serving as corridors of biodiversity threading through an anthropogenic landscape. Hedgerows could play the same role in temperate North America. The purposeful use of native trees, shrubs, forbs and grasses to form layered, linear landscape elements in diverse situations and at a variety of scales would greatly enrich the places we live and work, including backyards, public parks, institutional campuses, and farms. Indeed, the emerging practices of agroecology and regenerative farming

rely on the use of hedgerows and other field-bordering vegetation. Although this might not be restoration in the strictest sense of its definition, it could be considered a form of reconciliation ecology. While hedgerows may often be too narrow to satisfy landscape ecologists' concerns about edge effects, they can contribute to a web of interconnectivity across an often unfriendly matrix. What are the obstacles? When should they not be used? How can they support the restoration efforts within natural areas? In this talk I will discuss several hedgerow types, a rationale for their use, why they should and how they can be implemented at several scales.

Kleinwachter, Jim*. **Improving existing greenways – using trails and waterways to connect open space.** The Conservation Foundation, Naperville, Illinois. Email: jkleinwachter@theconservationfoundation.org

Many studies have shown the fragmented nature of our open space, and how fragmentation separates wildlife from food sources, limits genetic diversity, is often leading to declining populations in our wildlife, and is certainly a limiting factor in species diversity. With the way development has sprawled across the landscape, the places that could prove to be good connectors for wildlife are roadways, trails, railways, and along creeks and rivers. The Conservation Foundation as part of its conservation and restoration efforts have developed and are marketing a new product – a "Pollinator Meadow" as a turf grass alternative. Designed to be short and attractive both to humans and pollinators we have the opportunity to dramatically change the face of our traditional landscape. We are also working with homeowners, business property owners, schools and churches to fill in the patchwork habitat parcels necessary to sustain our wildlife. Property owners that implement the changes to the environment that we promote can earn a certification in our Conservation@Home and Work programs. Our organization is working to educate the public, and to significantly change the landscape within our region.

Swanson, Stephan J.* **John Kennicott and the history and role of hedgerow plantings at the Grove National Historic Landmark.** Glenview Park District, Glenview, Illinois. Email: Steve.swanson@glenviewparks.org

Noted Illinois horticulturalist Dr. John A. Kennicott (1802- 1863) was an influential promoter of the use of Osage orange (*Maclura pomifera*) trees on the Illinois prairies. The history of Dr. Kennicott's objective assessment of the Osage orange for use in Illinois and his endorsement to farmers will be presented. In addition, the presentation will discuss the historic remnant hedgerows at The Grove National Historic Landmark in Glenview, Illinois and our restoration efforts.

HERITAGE PARK RESTORATION SYMPOSIUM ABSTRACT

Haffner, Ted. **Ecological engineering and restoration within Heritage Park to alleviate downstream Buffalo Creek flooding and water quality impacts**. Terry Guen Design Associates, Inc., Chicago, Illinois. Email: thaffner@tgda.net

Ecological restoration within human dominated landscapes requires careful thought and planning for people and landscapes, as well as multidisciplinary cooperation. As project lead agency, the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) serves 2287 km^2 and approximately 5.2 million residents of Cook County Illinois. Parts of its mission include protecting the health, safety, water quality, businesses and homes from flooding, and management as a vital resource for its service area. This symposium will describe the restoration and creation of a 0.3 km^2 deed restricted buffer adjacent to Buffalo Creek within the boundaries of Heritage Park in Wheeling, Illinois as part of the U.S. Army Corps of Engineers (USACE) / Illinois Department of Natural Resources Levee 37 project of the Des Plaines River. This project is the result of intergovernmental cooperation among MWRDGC, Wheeling Park District, and the USACE to mitigate downstream flooding impacts and increase water quality via use of compensatory storage and other best management practices within this tributary of the Des Plaines River. In addition to the deed restricted area restoration, design requirements included state of the art playfield facilities for ball sports, a new concert/performance venue, and 0.4 km^2 of native habitat restoration surrounding Lake Heritage. Green infrastructure best management practices used included realignment and re-grading of Buffalo Creek to restore natural stream and floodplain functions, native planting, and the introduction of a low-flow channel with mild meanders and riffle structures. This symposium will explore the art, science, success and the challenges of restoring a flowing and flashy creek and updating a community amenity while balancing the requirements of all involved parties to redefine open space that is beneficial to the residents of both Wheeling and Cook Counties.

HERITAGE PARK RESTORATION SYMPOSIUM PRESENTATION ABSTRACTS

Chu, Hsing*. **Heritage park civil and hydrological engineering and best management practices for Buffalo Creek.** AECOM, Chicago, Illinois. Email: Hsing.Chu@aecom.com

The engineering goal that drove the work at Heritage Park was to provide approximately 115 acre feet 141,850 m^3 of storage volume to offset lost flood storage volume from a downstream project on the Des Plaines River. Six basins were excavated that progressively store stormwater within the Park while taking into account human use of park facilities and best management practices to reduce environmental impacts. Hydraulically and hydrologically, the work presented some unique challenges in coordinating information from two separate models for the Des Plaines River and for its tributary, Buffalo Creek, which runs through Heritage Park. Aspects of the civil design to note were the relocation and redesign of the Buffalo Creek channel to mitigate eroded and undercut banks, as well as design of the storage volume alongside new recreational facilities and naturalized areas, construction of a soil-bentonite slurry wall to prevent groundwater intrusion, and revisions to work to reduce impacts to wetlands. The U.S. Army Corps of Engineers permitting process encompassed much of these aspects of design and provided a framework for implementing strategies for protection of Buffalo Creek and wetlands

within the project site. This presentation will discuss the unique civil engineering aspects of the project, integrated within the landscape. Particular attention will be paid to the progressive water storage sequence and the elements which allow this sequence to unfold, including the spillways, pressure valves, and pumps. As these elements are integrated both within park programming and the Buffalo Creek corridor, this presentation will also discuss model based design elements unique to Buffalo Creek redesign and relocation which allowed for the introduction of a low flow creek channel, enlarged floodbench, and riffle structures to maximize stormwater storage, provide habitat, and mitigate historically flashy conditions within the creek.

Haffner, Ted*. **Ecological restoration goals and strategies for locating and designing Heritage Park's natural areas.** Terry Guen Design Associates, Chicago, Illinois. Email: thaffner@tgda.net

Restored areas within Heritage Park encompass 0.07 km^2 and include upland, mesic, and wet mesic hydrologic soil conditions that are directly adjacent to the Buffalo Creek and Lake Heritage water bodies. Prior to restoration, the Heritage Park landscape was primarily comprised of turfgrass and mature trees with a few existing native wetlands associated with each water body. Buffalo Creek had severely eroded banks that were undercut and prone to further scour and Lake Heritage had an expected water level bounce in excess of 1 m from mean normal water levels during large storm events. These water level fluctuations presented unique and problematic issues for restoration and plant establishment that drove both plant and seed selection strategies. This program will address and discuss the plant selection for each hydrologic condition while simultaneously understanding the available resources to maintain and steward the newly created natural areas. Additional complexities included working collaboratively with all involved disciplines to ensure the natural area planting strategies allied with both the overall stormwater mitigation strategies, and the anticipated active and passive uses of the park. This presentation will include a detailed focus on quality issues with restoring large scale engineered construction sites in respect to project specifications, drawing, and drawing notes for native planting so that restoration efforts folded seamlessly within the construction documentation and bidding package. Other discussion points include restoration area plant protection for establishment, as well as describing the conditions set forth by the U.S. Army Corps of Engineers during the permitting process, which reviewed and approved the restoration work of the Buffalo Creek portion of the project and creation of the Deed restricted area.

Inouye, Michelle*. **Contextual introduction to the Heritage Park Project and project background.** AECOM, Chicago, Illinois. Email: Michelle.Inouye@aecom.com

This presentation will focus on the ecological and social co-benefits associated with major infrastructure projects. The initial purpose of the Heritage Park Project in Wheeling, Illinois was to provide compensatory water storage for a levee project on the Des Plaines River. The search for an affordable site with the appropriate capacity resulted in an interagency collaboration which included the Metropolitan Water Reclamation District of Greater Chicago, the Wheeling Park District, and the Village of Wheeling. The presentation will describe the individual needs of each agency and how these goals were developed into a single park vision. The project site

was already actively serving as Wheeling's main regional park. Balancing programmatic park needs and flood control were at the core of the project's design and success. Additionally, the design had to incorporate any development needed to meet the requirements of the lead agencies for the levee project (i.e., Illinois Department of Natural Resources and U.S. Army Corps of Engineers). This presentation will discuss historic land use and ownership, site conditions, permitting issues and overcoming project challenges. We will share how engineering solutions were tightly knitted into landscape and programmed spaces. It will describe the breadth of disciplines required to coordinate and implement such integrated development on public parkland. This presentation will highlight a unique model to develop open space in a thoughtful and technical process.

Raffel, Larry*. **Balancing green infrastructure and programmatic requirements for design and public use at Heritage Park, Wheeling, Illinois.** Wheeling Park District, Wheeling Illinois. Email: lraffel@wheelingparkdistrict.com

In changing the character of a long standing park used by the entire community, the redevelopment of Heritage Park represents the most significant project undertaken by the Wheeling Park District. A critical and thorough public process established a master plan that reflected the goals of the Wheeling Park District in advance of a potential partnership with Metropolitan Water Reclamation District of Greater Chicago or the U.S. Army Corps of Engineers in final site selection and stormwater strategy. Early in the planning process, it was determined that the park should serve both active and passive uses, with space for multiple sports, recreation, and natural areas. The value of active uses such as concession buildings, athletic fields, and pavilions are easily understood as revenue generating facilities. These features define Heritage Park for the community and region. The need for sufficient and conveniently located parking to serve these facilities is also understood. Natural areas provide an equal value, yet are less quantifiable and requires education of the staff, Board of Commissioners, and the general public. While it was the intergovernmental agreement with Metropolitan Water Reclamation District of Greater Chicago that made the development of Heritage Park possible, it was also through this partnership that the Wheeling Park District was able to extrapolate on the natural areas identified in the master plan and clearly highlight a feature that benefits both agencies. Notably, the flood control aspect of the project melds seamlessly with passive and active recreation features. However, in seeking the design balance between natural areas and lawn areas, it is also critical to examine the typical park landscape management practices as well as the end user. Upon completion, the Wheeling Park District expects Heritage Park to achieve our mission to provide memorable experiences in parks and recreation that enrich our communities.

Raffel, Larry*[1], Derrick Martin[2]* , and Keith Jones[2]*. **Heritage Park Natural Areas Project quality control relationship and assessment.** [1]Wheeling Park District, Wheeling, Illinois. [2]V3 Companies, Woodridge, Illinois. Email: dmartin@v3co.com

This presentation will offer insight and assessments of the project from the perspectives of the Wheeling Park District and their project consultant V3 Companies. The intergovernmental agreement stated that Metropolitan Water Reclamation District of Greater Chicago shall design and construct the stormwater storage facilities and recreational amenities, offering both a complexity and an opportunity to bid on the project. Due to the scope and size of the project, and experience level of the Wheeling Park District with creek realignment and natural area installation, the Wheeling Park District recognized that the design and construction of the flood control scope of the project was considerably more complex than the recreation portion. With this in mind, V3 was hired to provide consulting, review, and comment of the design development and construction documentation process. Additionally, V3 continued on in the capacity of consulting engineer for the Wheeling Park District providing expertise during construction, especially that related to the natural areas planting efforts. Wheeling Park District and V3 will discuss their role and scope relating to the Heritage Park project as well as present a detailed account of this relationship and its benefits within the contextual scope of overseeing a large-scale multi-year installation. The Wheeling Park District and V3 will also present lessons learned from the project in terms of scope and complexity and explore what additional considerations and strategies may have further benefited the project from a quality assurance/quality control point of view.

DAM REMOVAL AND WETLAND POLICY SYMPOSIUM ABSTRACT

Fleece, William C.[1], Brian Karczewski[2], and Joey Seamands[1]. **Dam removal and the no net loss wetlands policy**. [1]Stantec Consulting Services, Inc., Cincinnati, Ohio. [2]Stantec Consulting Services, Inc., Cottage Grove, Wisconsin. WCF Email: Cody.Fleec@stantec.com; BK Email: Brian.Karczewski@stantec.com; JS Email: Joey.Seamands@stantec.com

The objective of the Clean Water Act is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters". Dam demolition removes impoundments that degrade water quality, it restores natural physical processes like sediment transport, and it eliminates barriers that alter essential migratory and reproductive processes. However, dam removal may also adversely affect wetlands created by the dam that exist in and around the project area. Direct effects from construction fill are generally small and self-mitigating. Indirect effects from the lowering of the dam pool, and the subsequent altered hydrology, can be quite large and may exceed hundreds of acres. Presently, there is limited precedent on how to reconcile the tradeoffs between the value of improved riverine ecosystem function as a result of dam removal relative to the loss of dam created wetlands in the current regulatory review processes. The objective of this session is to examine the "no net loss wetlands policy" as it relates to dam removal. We will present case studies that 1) characterize riverine impairments from dams and restoration potential, 2) characterize functions and values of wetlands created by dams, and 3) review regulatory and institutional obligations that feature in decisions regarding dams and wetlands. This session will culminate in a facilitated discussion designed to solicit feedback from restoration practitioners on these topics.

Fleece, William C.[1*], Brian Karczewski[2], Jeff Tyson[3], and Joseph Seamands[1]. **The case for dam removal.** [1]Stantec Consulting Services, Inc., Cincinnati, Ohio. [2]Stantec Consulting Services, Inc., Cottage Grove, Wisconsin, [3]Ohio Department of Natural Resources, Sandusky, Ohio. Email: cody.fleece@stantec.com

In the State of Ohio, there are over 5,000 dams with approximately 2,500 regulated by dam safety laws. Total counts for other states are similar. Many of these structures exceed their design life and no longer serve their intended purpose. Some dams pose an imminent safety threat via failure from structural deterioration and/or from hydraulic eddies that trap and drown unsuspecting individuals. Funding to repair, modify, and/or upgrade dams is scarce so many structures persist on the landscape in degraded condition for decades. Furthermore, dams alter the structural and functional elements of aquatic ecosystems at multiple spatial and temporal scales. At the local level, dams transform riverine systems to lentic systems thereby lowering the abundance, diversity, and richness of aquatic communities present in the pool. Dams also interrupt the supply of sediments that are necessary for the geomorphic stability of downstream reaches and for maintenance of critical fish spawning habitats. Aquatic communities and populations, especially migratory species, may be affected by the loss of connectivity between critical habitats that can severely constrain population size. Demolition of dams represents a cost effective means to simultaneously restore aquatic ecosystems and address social and economic problems associated with our deteriorating infrastructure.

Seamands, Joseph[1*], Brian Karczewski[2], and William C. Fleece[1]. **Ballville Dam removal – a case study of wetland mitigation for aquatic resource restoration.** [1]Stantec Consulting Services, Inc., Cincinnati, Ohio. [2]Stantec Consulting Services, Inc., Cottage Grove, Wisconsin. Email: Joey.Seamands@stantec.com

This session will investigate the functional significance of wetlands made by dams and discuss a few of the challenges these wetlands pose in terms of Section 404 and Section 10 permitting for dam removal projects. The first half of this session will characterize functions and values of wetlands created by dams. Then the second half will focus on challenges of permitting with regards to impact determination, wetland restoration and compensatory mitigation. Most dams were constructed over 50 years ago and the oldest of these structures may have been in place for over 150 years. When a dam is constructed on a river, the water surface elevation and the area inundated by storm generated stream flows increases. Large wetland complexes associated with the dam pool form overtime with the total area constrained by factors such as the surrounding terrain, river morphology, and sediment transport. These wetlands are historically man made, but have essentially become a part of the modified river ecosystem. Their functions and values include floodwater storage, sediment retention, nutrient retention, and habitat for wildlife and recreation. Compensatory mitigation for indirect effect of wetlands lost from lowering the pool is a relatively new concept and poses several challenges to resource practitioners. First, how does one quantify the impacts? It is difficult for dam removal projects to determine the extent of impact hydrologic alteration will have on existing wetlands. Second, the physical processes (i.e., flood inundation) that created the dam pool wetlands will still be in place, albeit at a lower elevation. There are no ready-made tools that can be used to estimate and design for new wetland development within the dewatered impoundment. The proposed Ballville Dam removal

project will be used to illustrate some of the technical regulatory challenges associated with compensatory wetland mitigation and dam removal.

Karczewski, Brian[1*], William C. Fleece[2], and Joseph Seamands[2]. **Review regulatory and institutional obligations that feature in decisions regarding dams and wetlands**. [1]Stantec Consulting Services, Inc., Cottage Grove, Wisconsin. [2]Stantec Consulting Services, Inc., Cincinnati, Ohio. Email: Brian.Karczewski@stantec.com

American Rivers, a non-profit group focused on river restoration and conservation, reported that 72 dams were removed from America's rivers in 2014. This amounts to the restoration of approximately 1175 km of waterways across the nation. Most dams are small, low–head structures used for flood control, irrigation, local hydroelectric, and mill power. There are many challenges we face when looking at a dam for potential removal. It's historic significance, the contribution the dam still provides to society, sediment transport, and other environmental factors following removal and regulatory obligations that need to be addressed. Recently, the U.S. Army Corps of Engineers has determined that wetland mitigation was necessary for indirect (secondary) impacts to wetlands through changes in hydrology. This can represent a significant requirement where wetlands that have formed behind dams can amount to more than 1 km^2 on which jurisdictional authority can be imposed. This discussion will focus on one regulatory obligation – section 404/401 of the Clean Water Act. Is the "no net loss policy" creating an undue burden on applicants in their attempts to remove a dam? At present there is limited precedent on how to reconcile the tradeoffs between the value of improved riverine ecosystem function relative to the loss of wetlands created by the dam in the current regulatory review processes. Do the lateral and longitudinal reconnection along a riverine ecosystem realized following dam removal compensate for the wetland loss due to hydrologic change? Should we look to modify the federal permitting process for dam removal? How do we assess the gains in riverine ecosystem health against the loss of wetland function due to secondary impact?

ORAL PRESENTATION ABSTRACTS (ALPHABETICAL ORDER)

Alstad, Amy O.* and Ellen I. Damschen. **Seed size and site stress interact to determine establishment success in prairie restoration.** University of Wisconsin-Madison, Madison, Wisconsin. Email: aalstad@wisc.edu

Restoration outcomes often depend on the establishment success of added propagules. However, successful establishment is a major barrier in many plant communities, with most seeds failing to transition to the seedling stage. We experimentally examined two factors that are likely important in determining establishment success in grassland restoration plantings: environmental stress and seed size. We manipulated environmental stress with prescribed fire, which reduces site stress for propagules by consuming litter and increasing seed-soil contact. The effects of seed size were examined by planting seeds from ten native perennial prairie species with a wide range of seed sizes. We quantified establishment success by counting the number of seedlings of sown species present in each plot. The experiment was conducted in Iowa County, Wisconsin, in an untilled, old field pasture on a south-facing slope. We used an analysis of variance framework to statistically test our hypotheses that species with larger seed will establish more successfully than species with small seeds, but that this advantage will be diminished in low stress (i.e., burned) plots. We found significant main effects of both site stress and seed size on germination. Specifically, we observed a major increase in germination in low stress (i.e., burned) plots and a trend towards higher germination among large-seeded species. We also found evidence supporting our hypothesis that seed size and site stress interact, such that germination rates between high and low stress sites vary more for small seeds than for large seeds. These results bolster our understanding of the factors that impede restoration efforts by limiting establishment success of added propagules and suggest that reducing site stress (e.g., with prescribed fire) prior to seed addition will boost the establishment of all species, but will particularly increase the establishment success of small-seeded-species.

Anderson, Roger C.[*1], M. Rebecca Anderson[1], Jonathan T. Bauer[2], and Christopher Loebach[1]. **Effects of eleven year (2004-2014) garlic mustard (*Alliaria petiolata*) removal on native vegetation.** [1]Illinois State University, Normal, Illinois. [2]Indiana University, Bloomington, Indiana. Email: rcander@ilstu.edu

Garlic mustard (GM) is considered to be a problematic invasive species in eastern deciduous forests and may cause declines in native species abundance and richness. Recent studies suggest that GM is an opportunistic species and increases in abundance under conditions of high deer densities. To evaluate intraspecific competition between 1st-yr (first year) and 2nd-yr (second year) GM plants and the effect of its removal on native vegetation, 240 study plots were established in 2004. From 2005 to 2014, 2nd-yr GM plants were removed annually from one-third of the plots in early March and May after 2nd-yr GM and native plants were established. The remaining plots were non-manipulated controls. Percent cover of all plant species in plots was recorded from early- to late-May annually from 2004 to 2014. Early removal of 2nd-yr GM resulted in an increase of first year plant cover compared to late removal and controls in 2006, indicating that 2nd-yr plants strongly compete with 1st-yr plants. However, by 2007 and later years, early- and late-removal treatments had less cover of 1st-yr GM than the control. For native species cover, there were significant time and treatment effects, but no two-way interaction. Cover of native species for the control was (mean±SE) 77.5%±1.2, for the early treatment was

84.0±1.2%, and for the late treatments was 82.6±1.2%. In control plots, between 2004 and 2007, except 2005, significant negative correlations between GM and native species cover occurred. However, from 2007 to 2010 GM cover declined precipitously from 19.4±1.7% to 2.8±0.6%, and no correlations between GM and native species cover occurred from 2008 to 2010. From 2011 to 2013 modest increases in GM cover between 3.7±0.5% and 5.9±1.2% occurred, along with significant negative correlations between GM and native species cover. These results suggest that modest increases in GM cover might negatively affect native species.

Aschenbach, Todd A.*[1] and Pat Ruta McGhan[2]. **Site preparation for Sand Prairie restoration at the Newaygo Prairies Research Natural Area, Manistee National Forest, Michigan.** [1]Grand Valley State University, Allendale, Michigan. [2]Manistee National Forest, Baldwin, Michigan. Email: aschenbt@gvsu.edu

Sand prairies, once an integral part of Michigan's oak-pine barrens ecosystem, have been degraded mainly due to fire suppression and agriculture. Although restoring sand prairie can increase biodiversity and improve ecosystem function, restoration success may depend on site preparation. At the Newaygo Prairies Research Natural Area, *Carex pensylvanica*, a native, but invasive sedge, dominates targeted restoration sites. This study evaluates five site-preparation treatments that were implemented in 2013 to decrease *C. pensylvanica* dominance: fire, herbicide, fire followed by herbicide, herbicide followed by fire, and no treatment (control). Species richness, cover, and biomass were evaluated in 2014. These results will be used to determine the most effective site preparation method in areas targeted for sand prairie restoration in the Manistee National Forest, Michigan.

Bach, Elizabeth M.[1,2]*, Ryan J. Williams[1], and Kirsten S. Hofmockel[1]. **Soil fungal community composition and ecosystem functioning in restored tallgrass prairies managed for bioenergy.** [1]Iowa State University, Ames, Iowa. [2]Illinois Natural History Survey, Champaign, Illinois. Email: ebach@illinois.edu

In the Midwest, there is increasing interest in restoring and managing ecosystems for both commodity production and ecosystem services. One approach is to harvest cellulosic bioenergy feedstock from reconstructed grasslands. However, it is unclear how these practices may impact soil communities that provide key ecosystem services. Because soil fungi are critical to storing and cycling plant nutrients and carbon (C), we evaluated soil fungal communities, soil C, and nutrient resources in three bioenergy production systems: continuous corn monoculture (*Zea mays*) and reconstructed tallgrass prairie with and without added inorganic nitrogen (N) fertilizer. We did this by sequencing the internal transcribed spacer region of the fungal ribosomal genome from community DNA extracted from soil samples, which yielded 5059 unique operational taxonomic units. Fungal community richness and the Shannon diversity index were 45% greater in both prairies compared with corn (P_{rich}=0.04, $P_{H'}$=0.009). Corn fungal communities differed from fertilized and unfertilized prairie (PERMANOVA; P=0.0001), and both prairies were abundant with unidentified fungi (P=0.001). Vector-fitting analysis indicated corn communities were associated with available nutrients including extractable N (P=0.003) and total Phosphorus (P=0.02). Root biomass (P=0.005), microbial biomass C (P=0.009) and N (P=0.02), and total C and N (P=0.04) were most strongly correlated with fungal

communities in both prairie types. Fungal communities in fertilized and unfertilized prairie bioenergy systems were not distinct from one another. Soil fungi likely both respond to differences in plant inputs and soil resources as well as influence cycling and availability of these resources. We found addition of inorganic N fertilizer did not alter fungal community establishment. However, extracellular enzyme activity (P=0.04) and total soil C and N (P=0.02) were greater in fertilized prairie than unfertilized prairie. Thus, management for optimized aboveground primary production can also meet restoration goals for improved ecosystem services including soil C and N retention and storage.

Barak, Rebecca S*[1,2]., Andrew Hipp[3], Marlin Bowles[3], William Sluis[4], Rebecca Tonietto[1,2], and Dan Larkin[1]. **Patterns of phylogenetic diversity in remnant and restored tallgrass prairies in Illinois.** [1]Chicago Botanic Garden, Glencoe, Illinois. [2]Northwestern University, Evanston, Illinois. [3]Morton Arboretum, Lisle, Illinois. [4]Trine University, Angola, Indiana. Email: BeckyBarak@u.northwestern.edu

Biodiversity is a big deal. Diverse plant communities tend to be more productive, stable, resistant to invasion, and resilient to future change. Therefore, it is not surprising that biodiversity is by far the most commonly measured and reported restoration outcome. However, biodiversity can be quantified in many ways, and different diversity measures may have different roles in a restoration context. Phylogenetic diversity is a measure of the evolutionary history contained within an ecological community. Assessing phylogenetic diversity of sites can provide a deeper understanding of the extant plant community and may help to better model restorations after remnants. Our study system, the tallgrass prairie, is one of the most endangered habitats on Earth. Though prairie restoration has a relatively long history in the Midwest, restored sites continue to fall short of remnant prairies in terms of diversity and other restoration goals. We studied patterns of phylogenetic diversity in remnant and restored Illinois prairies to test the following hypotheses: 1) restored prairies will have lower phylogenetic diversity than remnant prairies, and 2) restoration decisions will influence phylogenetic diversity. We found lower phylogenetic diversity in restored prairies, and some evidence that restoration and management decisions impact phylogenetic diversity of both remnant and restored prairies. Our results indicate that phylogenetic diversity can factor in to restoration planning and monitoring to better model prairie restorations after reference sites.

Bassett, Tyler*. **Prairie restoration for the provision of ecosystem services.** Michigan State University, Hickory Corners, Michigan. Email: basset17@msu.edu

Widespread land conversion from natural ecosystems to urban, industrial, and agricultural uses has severely reduced the capacity for nature to provide many ecosystem services that improve human wellbeing. Agriculturally dominated regions such as the Midwestern United States maintain ecosystem services such as food production at the expense of other services, such as biodiversity and environmental quality. Prairie restorations may return multiple ecosystem services to agricultural landscapes, including pollination services, biofuels production, nutrient retention, carbon sequestration, erosion control, and habitat for rare and declining species. However, realizing the benefits of restoration requires a better understanding of which services should be the focus of restoration efforts, and the restoration methods that maximize those

services across a range of environmental conditions. With surveys and interviews throughout southern Michigan, I assessed stakeholder values for ecosystem services and their motivations for restoration work. Then, using field data from 29 prairie restorations, I tested how differences in management decisions (seed mix richness and composition, prescribed fire) resulted in provision of some of the ecosystem services valued by these landowners. Landowners conducting prairie restorations broadly valued both biodiversity and environmental quality, but the restoration of biodiversity was generally not correlated with the provision of other ecosystem services. Restoration for ecosystem services requires prioritizing services based on social valuation and ecological benefits, and tradeoffs may exist between services that are maximized by opposing management strategies.

Basta, Nicholas T.[1]*, Dawn M. Busalacchi[1], Lakhwinder S. Hundal[2], Kuldip Kumar[2], Richard P. Dick[1], Roman P. Lanno[1], Jennifer Carlson[1] Albert E. Cox[2], and Thomas C. Granato[2]. **Restoring ecosystem function in degraded urban soil using biosolids, biosolids blend, and compost.** [1]The Ohio State University, Columbus, Ohio. [2]Metropolitan Water Reclamation District of Greater Chicago, Cicero, Illinois. Email: basta.4@osu.edu

Many soils at former industrial sites are degraded. The objective of this research was to determine the ability of compost, biosolids, and biosolids blends to improve soil ecosystem function with minimal potential impact to surface water. Treatments rototilled into top 12.5 cm of soil were biosolids at 202 Mg ha^{-1}, biosolids at 404 Mg ha^{-1}, compost at 137 Mg ha^{-1}, or a blend consisting of biosolids applied at 202 Mg ha^{-1}, drinking water treatment residual, and biochar. Rainfall runoff from experimental plots was collected for 3 years. One year after soil amendments were incorporated, a native seed mix containing grasses, legumes, and forbs was planted. Soil amendments improved soil quality and nutrient pools, established a dense and high quality vegetative cover, and improved earthworm reproductive measures. Amendments increased soil enzymatic activities that support soil function. Biosolids-treatments increased the Shannon Diversity Index for grasses. For the forbs group, control plots had the least diversity index, and the biosolids blend had the greatest diversity index. Biosolids and compost increased the number of earthworm juveniles. In general, biosolids outperformed compost. Biosolids increased nitrogen and phosphorus in rainfall runoff more than compost before vegetation was established. Several microconstituents (i.e., pharmaceutical and personal care products) were detected in runoff water at concentrations below the probable no-effect levels, which should pose little impact on the aquatic environment. Future restoration design should ensure that runoff control measures are employed to control sediment loss from the restored sites at least until vegetation is established.

Beck, Jared J.*, Stuart Wagenius, and Gretel Kiefer. **Turning up the heat: prescribed fire and the reproduction of *Echinacea angustifolia*.** Chicago Botanic Garden, Glencoe, Illinois. Email: jared.j.beck@gmail.com

Prescribed fire is a common management strategy used to restore and manage tallgrass prairie habitat. Although effects of burning on plant community composition and diversity in prairies are well-documented, the consequences of fire for plant reproductive fitness and long-term population dynamics remain poorly understood. In this study, we examined effects of prescribed

fire on the survival and reproduction of *Echinacea angustifolia* (narrow-leaved purple coneflower), which is a long-lived species distributed widely across grasslands in North America. Remnant populations of *Echinacea angustifolia* in the predominantly agricultural landscape of western Minnesota have served as a model system for studying the ecological and evolutionary consequences of habitat fragmentation. To characterize the relationship between fire and reproductive fitness, we mapped and assessed annual reproductive effort and survival in more than 500 *Echinacea angustifolia* individuals located within a regularly burned prairie remnant between 2001 and 2014. The 38 hectare remnant was segregated into two management units, each burned three times since 2001 at roughly five-year intervals. We hypothesized that prescribed burns would enhance plant reproductive fitness in the following growing season by: 1) increasing the likelihood that *Echinacea angustifolia* flowered; 2) increasing per capita reproductive effort (the number of flowering heads per plant); and 3) decreasing the spatial isolation of flowering *Echinacea angustifolia*. Here we present the results of longitudinal demographic analyses evaluating these hypotheses and discuss the implications of prescribed burns for the reproduction and population dynamics of *Echinacea angustifolia* as well as the conservation, restoration, and management of tallgrass prairies.

Benedict, Logan*[1, 2], Mike J. Lemke[2], Felipe Velho[3], Luzia Cleide Rodrigues[3], Keenan Dungey[2], Angela Kent[4]. **Plankton community changes in the early phase of Thompson Lake restoration, Emiquon Preserve, Illinois.** [1]Univeristy of Illinois Therkildsen Field Station at Emiquon, Lewistown, Illinois. [2]University of Illinois Springfield, Springfield, Illinois. [3]University of Maringa, Maringa, Brazil. [4]University of Illinois Champaign-Urbana, Urbana, Illinois. Email: lbenedic@uis.edu

The physical restoration of Emiquon and Thompson Lake began in 2007 after decades of agricultural use. Microbial "loop" plankton communities serve as responsive biotic indicators due to their position in the food web and their responsiveness to physical and chemical changes. The objective of this study was to complete a five-year time series monitoring effort to capture changes in ecosystem structure and function that would occur in the early restoration of a lake on a river floodplain not yet connected to its flood pulse source. Water from Thompson Lake was sampled weekly for bacteria and physical and chemical parameters, and bi-weekly for phyto- and zooplankton (n=3; March to November from 2008 to 2012). Bacterial community composition was assessed by DNA fingerprinting and other plankton described by microscopy. In 2008, the low dissolved nitrogen waters of Thompson Lake were clear, but became more turbid in 2010 and 2011 as dissolved phosphate rapidly increased. This change resulted in an extensive cyanobacterial bloom (*Aphanizomenon flos-aque)* in 2008 and 2009, followed by decrease abundance and greatest diversity of cyanobacteria in general in 2010. 2010 was a pivotal year that resulted in a microbial community regime shift with eukaryotic autotrophs more than doubling in abundance by 2011 and dominated by classes Bacillariophyceae, Chlorophycea, and Cryptophyceae. The most abundant ciliate orders of Oligotrichada and Hymenostomatida had a 1:3 in 2009 and then a 2:1 ratio in 2012. These results indicate that the lake has gone through an early stage transitional change that resulted in significant changes in the plankton communities.

Bingham, Joel*. **A conceptual framework for restoration performance assessment.** EnviroScience, Inc. and University of Akron, Akron, Ohio. Email: jbingham@enviroscienceinc.com

River and stream restoration is a billion dollar industry without a clear means to evaluate its influence on the ecology or society. Today, restoration projects are evaluated by methods and tools not specifically designed to assess stream restoration. The stream restoration industry is at a point where a lot of product has been produced but the performance remains in question. "Is it working?" is a question which looms over every stream restoration project. The answer to the question will hopefully come from the development of performance assessment standards and the creation of a conceptual framework that encompasses the operating limits of performance. In order to evaluate performance, project success must be defined in terms of target goals within the full spectrum of potential performance. Recently, discussions regarding performance have been directed at determining goals and success and are only concerned with one end of the spectrum. There is a process of change that occurs with the on-the-ground application of restoration that is missing from the on-going argument of defining success. Therefore, a framework is needed for which the goals, no matter how many or few, can function as a target within a framework representing restoration's practical process of change. Simply stated, every project begins at an initial condition, ends at another condition, and then evolves to yet another condition. Three distinctly separate states existing along a continuum of condition, each caused by a different mechanism of change. A proposed framework representing these states will be introduced and discussed as a foundation for future development of more standardized restoration performance assessments.

Bohnen, Julia L.* and Susan M. Galatowitsch. **Evaluation of publicly funded restorations in Minnesota.** University of Minnesota, St. Paul, Minnesota. Email: bohne001@umn.edu

Monitoring and evaluation of ecological restorations are essential for knowing whether projects are achieving their specific goals. Unfortunately, very few projects in Minnesota or elsewhere worldwide are evaluated past the initial implementation phase. In 2013, the Legislative-Citizen Commission on Minnesota Resources requested an evaluation of the outcomes of restoration projects funded by the Environment and Natural Resources Trust Fund (ENRTF), a significant source of project support in Minnesota. We are conducting this evaluation and assessing how the ecological and social context of restoration projects effect the likelihood of achieving project goals. ENRTF supported over 450 ecological restoration projects from 1990 to 2010. Surveys were sent to the project managers of 172 ecological restoration projects in order to categorize the projects by ecosystem type (prairie, forest, or wetland), age (3-10 years or 10+ years), restoration action (planted or vegetation management only), and level of continued management (continuous or intermittent/nonexistent). Surveys were returned for 92% of the projects. Of those, 46% reported receiving regular management post implementation. Restoration plans were reviewed for a subset of 87 projects. Less than half of these projects were guided by specific restoration goals and only one-third included more than a minimal description of proposed restoration actions. Field surveys were conducted for 48 of these projects. Preliminary analysis of field survey data estimates that 85% of projects at least minimally meet project proposal goals based on cover of native species or the prevalence of introduced or invasive species. We are currently assessing the extent to which success is based on level of planning, management, and initial

conditions. The outcome of this evaluation will be to provide programmatic guidance to the Legislative-Citizen Commission on Minnesota Resources.

Bollinger, Paul *[1]. **Pre- and post-restoration vegetative data collection for the CICN Dolomite Prairie Enhancement Project, Will County, Illinois.** [1]Bollinger Environmental, Inc., Downers Grove, Illinois. Email: **pbollinger@bollingerenvironmental.com**

The CICN Dolomite Prairie Enhancement Project is an effort to restore a unique dolomite prairie ecosystem within 0.81 km^2 of the Chicago Region. Dolomite prairies are considered globally impaired by the Nature Conservancy and have been identified as a high preservation-restoration priority by the Chicago Wilderness consortium. This project resulted from a nearby industrial development and instead of buying credits from a mitigation bank, several agencies recommended the unique approach of enhancing this habitat. This project added increased land area to this unique habitat type and improved biodiversity, which would otherwise continue to be degraded by invasive species and the lack of fire. Ongoing enhancement activities consisted of clearing invasive brush and herbaceous plant species and reintroducing fire. Our research consisted of collecting baseline data before enhancement activities occurred so future success can be measured. Data was collected by reviewing available information and conducting on-site quantitative sampling of vegetation within 298 circular plots. Sampling included: trees (species, number, diameter at breast height, and percent canopy coverage), shrubs (species and number of stems), and herbaceous species. Based on historical reviews and sampling on-site dolomite prairie remnants, we determined that this area was mostly dominated by dry to wet dolomite prairie at presettlement times and has become dominated by invasive trees and shrubs within the last 60 years. Our target for post-enhancement activities includes native grasses and plants specifically adapted to dolomite prairies.

Brunner, Jack*[1], Amber Bixler[1], Marino Solorio[2], and Carl Wodrich[3]. **Habitat restoration and community revitalization: Grand Calumet River and Roxana Marsh**. [1]Tetra Tech, Chicago, Illinois. [2]East Chicago Planning Department, East Chicago, Indiana. [3]Indiana Department of Natural Resources, Indianapolis, Indiana. Email: jack.brunner@tetratech.com

Under the Great Lakes Legacy Act, the U.S. Environmental Protection Agency Great Lakes National Program Office and its non-federal partners funded a project to clean up contaminated sediment and restore habitat along a portion of the Grand Calumet River and at Roxana Marsh in northwest Indiana. This unique region is one of the most industrialized areas in the country as well as home to some of the most diverse native plant and animal communities in the Great Lakes Basin. To date, the cleanup of the Grand Calumet River has addressed over 535, 188 m^3 of contaminated sediment. Along a 4.02 km stretch of the river in Hammond and East Chicago, Indiana, contaminated sediment was removed through hydraulic dredging and mechanical excavation and a cap was then placed to isolate any remaining contamination. A wetland habitat restoration plan was also implemented for this large-scale project, during which several implementation challenges were overcome. Dredging and excavation of Roxana Marsh not only removed contaminated sediment, but also eradicated *Phragmites* from the marsh. The marsh was restored with native plants and an open water pond to provide additional habitat diversity and help prevent the return of *Phragmites*. Roxana Marsh and other habitat restoration activities

along the Grand Calumet River also serves as an anchor to community revitalization activities and as a means to connect disparate neighborhoods in the human-dominated landscape of northwest Indiana.

Buss, Clayton D.*, Hua Chen, Amy McEuen. **Storage of soil organic carbon and total nitrogen in restored wetlands and croplands of Illinois: a chronosequence approach.** University of Illinois at Springfield, Springfield, Illinois. Email: claytonbuss@outlook.com

Wetlands play an important role in carbon and nitrogen cycle. The loss of wetlands for croplands results in the release of carbon from soil organic matter into atmosphere. It is not clear how soil organic carbon (SOC) and total nitrogen (TN) of wetlands restored from croplands in Illinois change with restoration age. The overall goal of this study was to determine SOC and TN storage of four restored marshes with different restoration ages in Illinois. We examined SOC and TN stored in the top 40 cm of soil in restored wetlands in Illinois and a cropland near each wetland, which remains similar to cropland from which the wetland was restored. The younger wetlands were restored 7 years ago (Emiquon) and 11 years ago (Pecatonia). The older wetlands were restored 15 years ago (Spunky Bottoms) and 17 years ago (FAP 313). A chronosequence technique was used to evaluate if restored older wetlands store more SOC and TN. Differences between restored wetland and cropland storage were also examined. The SOC and TN storage (Mg/ha) at each site was 48.03 and 5.51 at Emiquon, 74.02 and 9.18 at Pecatonica, 78.08 and 10.72 at the Spunky Bottoms, and 43.49 and 4.76 at FAP 313. The greatest effects on SOC and TN were age of restoration and site type (i.e., wetland or cropland). The interaction between age and site type was significant ($p<0.001$) for SOC and TN. Additionally, SOC storage was affected ($p<0.05$) by soil depth, and the interaction between age, site type, and depth. SOC storage was greater in restored wetlands than croplands and appeared to increase with wetland age for three of the four sites, but was the least in the oldest site (FAP 313). The oldest site's low SOC values may relate to small site size, community composition, or soil parent material.

Carrington, Mary E.*, Lauren Baldacci, Neal Jankowski, Chad Kirian, Michael Levins, Anthony Merisko, Malek Mohammad, and Gloria Robertson. **Congruence between bee and plant taxa in Illinois tallgrass prairie restorations.** Governors State University, University Park, Illinois. Email: mcarrington@govst.edu

Tallgrass prairies, once widespread habitat for pollinators, currently exist as rare, small, fragmented remnants. Increasingly, prairie reconstructions are being established to increase habitat for native plants and animals, including pollinators. Although bee community species composition might serve as a gauge of tallgrass prairie restoration success, data on pollinator communities in prairie restorations are rare. In this study, we quantified plant and bee species composition in ten northeastern Illinois tallgrass prairie restorations in 2013. We expected congruence between bee and plant communities (i.e., correlations between bee species composition patterns with plant species composition patterns). In each site, we quantified plant and bee species composition along two 100 m transects. A principal component analysis (PCA) was conducted separately on plant and bee species composition data. To determine congruence between bee and plant species compositions, a Pearson correlation coefficient was calculated

using loadings on the first bee PCA axis vs. loadings on the first plant PCA axis for all ten sites. The first plant PCA likely represented a gradient of decreasing restoration age, as species typical of older restorations had high negative loadings, and more aggressive, weedy species had high positive loadings. The first bee PCA axis generally described a gradient from polylectic, generalist taxa to oligolectic taxa. Site loadings on the first bee and plant PCA axes were negatively correlated (r = -0.61, p = 0.03), suggesting congruence between plant and bee communities. Results of this study indicate that plants typical of older prairie restorations tend to be associated with oligolectic bee species. We suggest that oligolectic bee taxa might serve as indicators of prairie restoration success.

Collings, Rebecca*. **Chicago Wilderness Excellence in Ecological Restoration Program – how to establish and accredit best practices in ecological restoration.** The Field Museum, Chicago, Illinois. Email: rcollings@fieldmuseum.org

Chicago Wilderness is a regional alliance of organizations working together to restore nature and improve the quality of life for all who live here, by protecting the region's lands and waters. One of the key initiatives of Chicago Wilderness is to restore the health of local nature, using the Chicago Wilderness Biodiversity Recovery Plan as our guide. Many Chicago Wilderness natural resource managers have led the way in ecological restoration, using science and on-the-ground experience to develop best practices. A group of Chicago Wilderness professionals developed the Excellence in Ecological Restoration Program in an effort to recognize high-quality restoration sites and develop professional standards of excellence in natural resource management and ecological restoration. In addition to outside recognition the program provides the applicant with an opportunity for a comprehensive self- assessment of their program and policies. This model of accreditation has proven successful in other sectors, such as the U.S. Green Building Council's LEED certification process. As the program matures we hope it can be expanded to become a regional or national model for recognizing best practices in ecological restoration.

Christensen, Tory L., Benjamin J. Cook*, and Jodi M. Refsland. **Chew on this: thoughts for improving the effectiveness of prescribed grazing based on practitioner experience.** Wetland Habitat Restorations, Minneapolis, Minnesota. Email: Ben@whr.mn

Prescription grazing (PG) is the controlled use of livestock grazing as a vegetation management strategy implemented to target the removal of undesirable and/or invasive species while eliminating or minimizing the need for mechanical and chemical control methods. PG has been part of land management practices in the United States for over a century. However, little has been published regarding the development of targeted grazing practices as a tool for the restoration ecology industry. Our restoration ecology company invested in a livestock division in order to expand the diversity of restoration management methods available to us. Our findings from the first year of implementing this innovative restoration practice. The target invasive in our case study is buckthorn (*Rhamnus* spp.), and over the course to develop grazing strategy best practices including grazing timing, paddock set-up and herd health within two different restoration sites in a season. We evaluated the economics of grazing efficiency and analyzed the cost-benefit of PG against other restoration strategies. Our best practices can be integrated at

both the level of project planning and grazing implementation to increase the overall effectiveness of prescribed grazing and to raise awareness among the public, practitioners, and land managers on the use of livestock as a viable ecological restoration tool.

Dietz, Alyssa K.*and Helen J. Michaels. **Soil and litter legacy effects of Lake Erie invasive flowering rush (*Butomus umbellatus*).** Bowling Green State University, Bowling Green, Ohio. Email: akdietz@bgsu.edu

The negative impacts of aquatic emergent invasive species have been observed throughout freshwater wetlands of the Great Lakes. However, even following the removal of these dense monocultures, invasives can influence native ecosystems through long-term chemical and biological changes in native soils, known as legacy effects. Our research investigates the legacy effects of the understudied wetland invasive flowering rush (*Butomus umbellatus*) on the reestablishment of native seedlings in simulated shorelines of restored wetlands along Lake Erie. To examine potential challenges to the restoration of Lake Erie marshes following management for eradication of *B. umbellatus,* a seed mix comprised of twenty five native species was sown into three soils with different *B. umbellatus* invasion histories and subjected to single and combined treatments of living stands of *B. umbellatus* vegetative propagules and litter. In fall of 2014, the total species number was counted and above ground biomass was harvested. Preliminary analyses indicate that soil invasion history had no effect on the number species present, but the total number of species significantly differed among seeded treatments. Trays with *B. umbellatus* litter had significantly greater number of species compared to trays with established propagules. This surprisingly beneficial influence of *B. umbellatus* litter awaits further support from the results of ongoing analyses of biomass data. Our work looks to better understand the influences of prior invasion by *B. umbellatus* on native wetland communities in order to provide managers with better strategies for wetland restoration.

Dolan, Rebecca W.*[1], Kelly Harris[2], and Mark Adler[3]. **Community involvement to address a long-standing invasive species problem: Civic Ecology Practice in action.** [1]Butler University, Indianapolis, Indiana. [2] Current-Consulting, Indianapolis, Indiana. [3]Keep Indianapolis Beautiful, Inc., Indianapolis, Indiana. Email: rdolan@butler.edu.

Invasive non-native species (INS) are likely found in every city around the globe, but their impacts in urban settings have not been as often addressed as their impacts in natural areas or agricultural settings. The multiple impacts of INS in cities make them ideal candidates for civic ecology practice, where local environmental stewardship action is taken to enhance green infrastructure and community well-being in urban and other human-dominated systems. We present details of a community driven program focused on removal of an INS, Amur bush honeysuckle (*Lonicera maackii*), from banks of a creek in Indianapolis, Indiana in the midwestern U.S.. Unlike many Civic Ecology Practices, this project was motivated by community response to the long-developing environmental, social and economic impacts of Amur honeysuckle. Following months of planning , over 2,000 volunteers removed more than 760 m^3 of Amur honeysuckle from 0.12 km^2 of land along Fall Creek during a single day as part of the 2012 Eli Lilly and Company Global Day of Service (LDOS). The LDOS Amur honeysuckle removal served ecological and environmental goals of removing an invasive

species, and helped foster in citizens a sense of place and connection with Indianapolis' historical Kessler Plan, reflecting local history and culture. Aspects of the project can serve as a model for action in other cities. We will discuss an underappreciated impact of INS in cities, which is their role as biological agents of visual pollution that block views of natural landscapes and disconnect citizens from nature.

Funk, Joseph C.*[1], and Samantha K. Chapman[2]. **The application of habitat suitability modeling to invasive species management for ecosystem restoration.** [1]Geosyntec Consultants, Kennesaw, Georgia. [2]Villanova University, Villanova, Pennsylvania. Email: JFunk@geosyntec.com

One important design consideration when undertaking ecosystem restoration is the ecosystem's susceptibility to invasive plant intrusion. It has been hypothesized that climate change will provide an opportunity for the range expansion of invasive plants. In order to test this hypothesis we utilized MaxEnt, a species distribution modeling software, to model the habitat suitability of four of the main invasive plant species of the northeastern United States on a nationwide scale under current climate scenarios and scenarios in the year 2070. MaxEnt uses a gridded environment to model a probability distribution of habitat suitability for a given species and allows the user to model at any spatial scale as long as data at an appropriate resolution is available. We used a combination of land use/land cover data and climatic conditions from the WorldClim data set at a 2.5 arc-minute resolution as model inputs. However, any data type can be used as long as the data are in a grid format. Of the four species we analyzed (*Alliara petiolata*, *Elaeagnus umbellata*, *Rosa multiflora*, and *Microstegium vimineum*), we only found the potential for one species (*Alliaria petiolate*) range to expand under 2070 climate scenarios. One species, *Elaeagnus umbellata*, is predicted to have a smaller habitat suitability range under future conditions, and the other two species, *Rosa multiflora* and *Microstegium vimineum* maintained similar habitat suitability under current and future scenarios. Our findings show that not all invasive species analyzed will benefit (i.e. range expansion) from the effects of climate change and that application of this modeling methodology has further promise for application to other invasive species management issues. Additionally, this methodology offers the potential for analyzing habitat suitability for a range of species of interest for restoration (native species) and conservation (endangered and threatened species) purposes.

Graff, Shawn* and William Mueller. **Importance of Lake Michigan/shoreline restoration efforts to birds.** Ozaukee Washington Land Trust, Belgium, Wisconsin. Email: sgraff@owlt.org

The Ozaukee Washington Land Trust and the Western Great Lakes Bird and Bat Observatory have teamed up to manage a site known as Forest Beach Migratory Preserve (FBMP) in Belgium, Wisconsin. FBMP was a former golf course that has been transformed into a migratory preserve. Restoration plans for the golf course along with ongoing management has been overseen by regional biologists with a goal to create a mosaic of habitats suitable for migratory birds that need a place to stop along their journey. The Western Great Lakes Bird and Bat Observatory uses the former club house at FBMP as their headquarters where they conduct their research. For migratory birds, migration periods may have profound effects on the survival

of bird species. Conservation strategies aimed at the protection of migratory birds are incomplete without including migratory bird airspace, flyway, and stopover habitat preservation. Within the Upper Midwest region the open waters and habitats adjacent to the Great Lakes are heavily used by migrating birds of more than 275 species. The Western Great Lakes Bird and Bat Observatory conducted surveys from 2010 through 2014 between northern Door County and the Wisconsin/Illinois border. These surveys were among the first conducted in increasingly deep-water areas of western Lake Michigan up to 16.1 km offshore. Our results indicated that considerable movement and high concentrations of waterfowl and waterbirds occur in the deeper, offshore waters of Lake Michigan. Likewise, determining the importance of onshore stopover sites for migratory land birds is increasingly a focus of avian ecologists and a central piece of effective avian conservation policy and delivery. We will focus on the research conducted by The Western Great Lakes Bird and Bat Observatory and how Ozaukee Washington Land Trust is using this information to assist with the ongoing stewardship management of the site.

Grieser, Jennifer*[1], Kimm Jarden[2], and Anne Jefferson[2]. **Results of West Creek Ecosystem Restoration Project through green infrastructure**. [1]Cleveland Metroparks, Parma, Ohio. [2]Kent State University, Kent, Ohio. Email: jmg2@clevelandmetroparks.com

The West Creek Ecosystem Restoration project addresses the question of hydrologic impacts and pollution reduction of street scale investments using green infrastructure stormwater control measures, such as front yard rain gardens, street side bioretention, and rain barrels. West Creek is a 36 km^2 subwatershed of the Cuyahoga River that contains approximately 35% impervious surface. Cleveland Metroparks manages West Creek Reservation, which includes its namesake waterbody. The park is located downstream of upland, medium density residential development. In order to improve stream function through the park, Cleveland Metroparks installed stormwater retrofits in these upland neighborhoods. Flow meters were installed to measure total discharge, velocity, and stage pre–and post-stormwater control measures construction. We used a two-paired before-after-control-impact design that paired two sets of treatment and control streets within the watershed to evaluate the influence of installing stormwater control measures. Our results show reduced peak flows and total storm volumes and increased lag times for storm events on the streets with green infrastructure. Project partners include West Creek Conservancy, Kent State University, and City of Parma. Project funders include U.S. Environmental Protection Agency's Great Lakes Restoration Initiative, Northeast Ohio Regional Sewer District, and Northeast Ohio Areawide Coordinating Agency.

Grill, Rebecca F.*[1] and Adam R. Thada*[2]. **Wetland restoration and enhancement in the Chicago Wilderness: a five year look at the 25-acre Skokie River Woods project.** [1]Park District of Highland Park, Highland Park, Illinois. [2]Cardno Inc., Walkerton, Indiana. Email: rgrill@pdhp.org; adam.thada@cardno.com

Skokie River Woods is a 0.10 km^2 wetland restoration and enhancement project in Lake County, Illinois that involved multiple funding, management, and consulting partners. Initial planning was conducted in 2008 and funding secured in 2009. Restoration work began in 2010, consisting of woody shrub and tree clearing, control of invasive herbaceous species, excavation to hydric

soils, and installation of a water control structure. We will focus on the results of five years of herbaceous monitoring and well data detailing the project's development. Also, we will discuss opportunities and challenges raised by multiple-partner restoration collaborations across the course of a project timeline, as well as restoration work in fragmented and human-dominated landscapes.

Hausman, Constance E. * and Jennifer M. Grieser. **Restoring a golf course: an Ohio case study in progress at Acacia Reservation.** Cleveland Metroparks. Cleveland, Ohio. Email: ceh@clevelandmetroparks.com.

Acacia Reservation was once a privately owned country club until its purchase by the Conservation Fund and subsequent donation to Cleveland Metroparks in 2012. Within the confines of the deed, Cleveland Metroparks will restore the 0.62 km^2 property to its natural state, which includes 1) extensive terrestrial forest restoration of several upland habitats and 2) restoring 426 m of Euclid Creek and two headwater streams with associated floodplains and riparian wetlands. All streams on site are impacted by increased peak and total stormwater flows from urban development upstream. The Acacia Reservation restoration project will be one of the largest single urban watershed restoration projects undertaken in Cuyahoga County to date. This presentation will illustrate the importance of understanding baseline conditions prior to restoration implementation. To properly document pre-restoration conditions, forty permanent research plots with photo plot documentation have been established across the site to monitor vegetation change over time. Euclid Creek conditions were assessed using the Bank Erosion Hazard Index and macroinvertebrate surveys. This presentation will also illustrate how community outreach and civic engagement are necessary to implement urban ecosystem restorations. To date, community involvement for the Acacia restoration project has included: 1) holding public meetings; 2) establishing academic and professional research partners; and 3) conducting bioblitz studies. Lastly, this presentation will highlight priority projects identified within the ecological restoration master plan developed in collaboration with Biohabitats. To date, upwards of 2.5 million dollars have been garnered from various grants and funding sources to implement the first phase of restoration projects. This work will focus on reestablishing the sites natural hydrology with individual restoration projects in stream, riparian, wetland and upland habitats.

Hausman, Constance E.* and Terry L. Robison. **Emerald ash borer infestations in urban environments: a multifaceted management approach incorporating citizen science and restoration.** Cleveland Metroparks, Cleveland, Ohio. Email: ceh@clevelandmetroparks.com

Public land management agencies are among those dealing with the effects of emerald ash borer. Knowing the location, quantity, size, and infestation status of ash trees can help managers prioritize areas for tree removal and identify areas for restoration. Public safety is a key issue driving management decisions on when and where to remove trees. However, staff time to survey may be limited depending on budget restrictions and other priorities. To assist with tree inventory, we designed and implemented a citizen science based 'Ash Mapping' tree survey of Cleveland Metroparks all-purpose trail using volunteers to collect data on tree locations, size, and condition. The 137 km of all-purpose trail mostly border the parkways, but also loop

through natural areas and is the most used feature by walkers, runners, bicyclists, roller bladers, and strollers. The data collected through this program generated detailed maps that summarized numbers of ash trees by location, size, and woodpecker feeding activity. Woodpecker feeding activity is used as a proxy for emerald ash borer infestation levels. These maps helped identify hot spot areas where ash tree removal was priority due to infestation condition and safety hazards. These maps were further used to identify restoration zones where accelerated light gaps would increase disturbance and invasive species establishment. This project data contributed to developing restoration plans that have recently been selected for funding from the USDA Forest Service Great Lakes Restoration Initiative Emerald Ash Borer Mitigation program. As part of an educational outreach effort we developed the following website (www.cleveland-metroparks.github.io/eab/) to inform the public about emerald asher borer and to share details about our citizen science Ash Mapping project and subsequent forest management and restoration efforts. This presentation will discuss how the citizen science program facilitated the restoration plan and how that plan will be implemented.

Jackson, Laura L.*. **Replacing lost monarch butterfly (*Danaus plexippus*) habitat in the upper Midwest: building elements of a successful program.** University of Northern Iowa Tallgrass Prairie Center, Cedar Falls, Iowa. Email: Laura.L.Jackson@uni.edu

The monarch butterfly (*Danaus plexippus*) has experienced steep declines over the last ten years. Research suggests that loss of breeding habitat in the upper Midwest U.S. is the most important factor. The Presidential Memorandum to promote the health of honeybees and other pollinators in 2014 committed federal agencies to create significant habitat on the ground in 2015, but the most important areas for monarch recovery according to demographic models are also areas with low federal land ownership. I review the efforts of Monarch Joint Venture and its constituent conservation groups to develop an effective restoration strategy for the upper Midwest U.S.. The Tallgrass Prairie Center's twenty-five years of experience leading the Integrated Roadside Vegetation Management Program in Iowa promotes the use of native vegetation for low maintenance multi-functional roadsides and provides some useful insights. In addition to landowner incentives, a successful program of monarch habitat creation will need to include: a) policy favoring source-identified native seed; b) a grants program for seeds and equipment; c) landowner access to high quality technical support; d) public education about monarchs and their habitat needs, e) regional coordination to carry out the program, f) a sustained approach either through local volunteers or a governmental role; and g) focus on meeting population goals.

Knight, Kathleen S.*[1], Rachel Hefflinger[2], Robert Ford[3], Kelly Baggett[1], and James M. Slavicek[1]. **Factors affecting establishment and growth of planted tree seedlings in floodplains impacted by emerald ash borer.** [1]USDA Forest Service, Delaware, Ohio. [2]The Ohio State University, Wooster, Ohio. [3]The City of Columbus, Columbus, Ohio. Email: ksknight@fs.fed.us

A restoration experiment was planted in 2011 to study methods of reforestation for ash-dominated floodplains impacted by emerald ash borer (EAB, *Agrilus planipennis*) through plantings of native tree species including Dutch elm disease-tolerant American elm *(Ulmus americana*). Three floodplain restoration sites in Ohio were chosen to encompass a gradient of

EAB infestation duration and canopy openness. Containerized tree seedlings of three species were planted on a randomized grid in replicated plots in each floodplain in 2011. Sycamore (*Platanus occidentalis*) and pin oak (*Quercus palustris*) were from local seed sources. American elm tree seedlings were generated from a cross between two Dutch elm disease-tolerant selections. The effects of restoration design as well as microhabitat on the survival and growth of the tree seedlings were examined. The American elm seedlings performed better than locally-adapted sycamore and pin oak seedlings. All three species tolerated severe flooding, surviving complete submersion in flood waters for several days during the spring and fall. Restoration design factors tested included deer protection, planting stock size, and tree species. Deer protection, with woven wire cages placed around individual trees, had a positive effect on seedlings of all species at all sites. The effect of planting stock size varied among different sites. Microhabitat effects measured for each planted seedling included canopy openness, moisture index, and herbaceous competition from native and invasive herbaceous species. Canopy openness had a positive effect on seedling survival, with the most pronounced effects on sycamore seedlings and moderate effects on elm seedlings. Understanding the differences among tree species in their responses to restoration design and microhabitat variables will allow managers to customize planting strategies to maximize restoration success. Overall, the Dutch elm disease-tolerant American elm seedlings performed well and should be considered as part of an underplanting or replanting strategy in floodplain forests affected by disturbance.

Kobal, Scott N.*[1], Rachel A. Reklau[1] and Wayne A. Lampa[2]. **Ten years of demographic changes in Du Page County Woodlands.** [1] Forest Preserve District of Du Page County, Wheaton, Illinois. [2] The Morton Arboretum, Lisle, Illinois. Email: skobal@dupageforest.org

Between 1979 and 1985 a total of 0.405 ha monitoring plots were established in wooded communities throughout Forest Preserves in Du Page County, Illinois to obtain information on the composition and structure of these areas and to evaluate ecological changes taking place in this urbanized county. Tree demography sampling involved measuring and recording every tree greater than 8.9 cm diameter at breast height within the plots. While these data yielded important baseline data on the number of stems per acre and species composition, as well as changes in values over the years, it did not address mortality and recruitment of individual trees. Beginning in 2004, all trees were tagged and mapped using a global navigation satellite system to better assess mortality and recruitment patterns in different woodland types. This presentation will evaluate the losses of individual trees within these plots in the last ten years, particularly in oaks, and new threats such as the emerald ash borer (*Agrilus planipennis* Fairmaire). It will also discuss species recruitment within the plots, which has mostly been dominated by shade tolerant species such as *Prunus serotina* Ehrh. (black cherry), *Acer saccharum* Marshall (sugar maple), *Tilia americana* L. (basswood), and *Ulmus americana* L. (American elm).

Lawrence, Beth A.[1,2*], Yarency Rodriguez[1], Shane Lishawa[2,3], and Nancy Tuchman[2,3]. **Herbicide management of invasive cattail (*Typha* × *glauca*) increases porewater nutrient concentrations.** [1]DePaul University, Chicago, Illinois. [2]University of Michigan Biological Station, Pellston, Michigan. [3]Loyola University Chicago, Chicago, Illinois. Email: blawren6@depaul.edu

Invasive wetland plants are the primary targets of wetland management to promote native plants and wildlife habitat, but little is known about how commonly implemented restoration techniques influence nutrient cycling. We tested how experimental mowing, herbicide application, and biomass harvest (i.e., removal of aboveground biomass) treatments of *Typha* × *glauca*-invaded mesocosms altered porewater nutrient (nitrate, ammonium, soluble reactive phosphorus) concentration and supply rate, vegetation response, and light penetration to the soil surface. We found that while herbicide application eliminated the target species, it also reduced native plant density and increased porewater nutrient concentration (nitrate, soluble reactive phosphorus) and supply rates (nitrogen, phosphorus, potassium) up to a year after treatments were implemented. Herbicide application may increase the likelihood of reinvasion by problematic wetland invaders because it promotes nutrient enrichment that may cause eutrophication and deleterious algal blooms in adjacent aquatic systems. Our results suggest that biomass harvest should be considered by managers aiming to reduce *Typha* density to increase native plant abundance and avoid leaching nutrients downstream.

Lenhart, C., [1]*, Doug Kane[2], Peter Lenhart[3], Adam Dangler[2], Alison Rifenburgh[2], Rikki Gurule[2], Susie Stoepfel[2], and Troy Parrett[2]. **Ecological restoration, research and education on farmland in the former Great Black Swamp of Ohio.** [1]University of Minnesota, St. Paul, Minnesota. [2]Defiance College, Defiance, Ohio. [3]Defiance Mercy Clinic, Defiance, Ohio. Email: lenh0010@umn.edu

An ecological restoration project was initiated in 2004 on farmland in the former Great Black Swamp region of northwest Ohio to restore 16.2 ha of glacial lake plain and beach ridge communities including forest, savanna and prairie communities. The landowners did plant inventories, abundance and coverage estimates, and monitored wetland hydrologic outflow from 2012 to 2014. Defiance College students did further inventory, tree diameter measurements, and nutrient (nitrogen and phosphorus) measurements in adjacent ditches for a restoration ecology class in 2014. A moderately diverse prairie supporting over 70 native species was established with low invasive species coverage. Eight state listed threatened or endangered plant species were re-established in the prairie and savanna. Restoration of swamp forest and savanna proved more challenging with a 31% tree survival rate over nine years. The marsh/wet prairie recreated in the glacial lake bed had low plant diversity, but retained over 99% of rainfall within the 16 ha drainage area in 2012 and 2013, suggesting a potential nutrient loading reduction of at least 200 kg/year nitrate and 20 kg/year phosphorus to the Maumee River that flows into Lake Erie. Restoration on private land is challenged by low funding and staff levels for management. Additionally, the loss of elm (*Ulmus americana*) and ash (*Fraxinus spp.*), former dominants in the lake plain community indicates the need for restoration of a hybrid plant community types. Future work will include control of invasive plants and controlled prairie burns. Long-term change in plant community structure and wetland outflow will be monitored along with nitrogen and phosphorus outflow. Management practices that support sustainable agriculture, the use of

native plant species, and water quality improvements will be pursued through the recent formation of a non-profit organization, the Maumee River Basin Center for Ecological Restoration, working in partnership with colleges, schools and government agencies.

Loebach, Chris A.* and Roger C. Anderson. **Experimentally measuring seed dispersal distances of the invasive plant, garlic mustard (*Alliaria petiolata*).** Illinois State University, Normal, Illinois. Email: cloebac@ilstu.edu

Garlic mustard, an herbaceous plant, has aggressively invaded North American woodlands, where it displaces native ground layer vegetation and reduces native species diversity. It has been extensively studied to understand its impact on native communities and for developing control methods. One overlooked aspect of its ecology is seed dispersal distances. Current estimates are based on untested observations. Experimentally measuring seed dispersal distances is important for predicting rate of spread, understanding its invasive ability, and for improving control strategies. To measure dispersal distances, seeds traps were placed in a sector design around three seed point sources. Point sources consisted of 15 second-year plants within a 0.25m radius circle. The number of seeds in a point source was estimated at the beginning and end of the experiment to predict the number of seeds dispersed. Sectors were placed every 45 azimuth degrees beginning at zero degrees north. Traps were placed at intervals of increasing distance from the point source ranging from 0.25 to 3.25 m. Trap number per interval increased with distance to maintain constant sampling effort. Traps were in the field prior to silique dehiscence and were collected after the majority of seeds were dispersed. The number of seeds in each trap were counted. Five dispersal functions that describe the probability of a seed landing into an area at a specific distance were fit to the data via maximum likelihood. The Weibull function had the best fit and predicted that seed density quickly declined as distance increased. The average dispersal distance was 0.40 m with the majority of seeds dispersed within 1.85 m. The Weibull function and parameter estimates from this study can be used to predict the amount of seed being dispersed into specific areas of interest, which will improve our understanding of garlic mustard's invasion ability.

MacDonald, Cody* and Shawn Graff. **Great Lakes Restoration Initiative in southeastern Wisconsin.** Ozaukee Washington Land Trust, West Bend, Wisconsin. cmacdonald@owlt.org

We will discuss the success stories and lessons learned from our three year, six county, half a million dollar Great Lakes Restoration Initiative grant. The end deliverable requires that 6.07 km^2 of wetland, riparian and shoreline habitat are treated and protected from four wetland invasive species (*Phragmites*, purple loosestrife, lyme grass, Japanese knotweed). We have created partnerships with over 30 organizations and have coordinated with more than 50 individuals to plan project logistics. Ozaukee Washington Land Trust has directly implemented or coordinated with partnering organizations to conduct over 60 separate projects. These projects range in size from eradicating pioneer stands of purple loosestrife in a 4047 m^2 wetland to treating and controlling *Phragmites* infestations along the I-94 corridor frontage road right-of-ways through three counties. We have also targeted and controlled lyme grass throughout a 24 km stretch of Lake Michigan shoreline that encompasses over 85 participating homeowners. Management strategies, depending on site conditions range from integrative management

including mowing, herbicide application and prescribed burning to raising and releasing biocontrol for plants such as purple loosestrife. Although successful, a lot of creative planning and problem solving was essential in making these projects happen. Infestations encroaching into private properties and determining how to best allocate grant resources have been obstacles Ozaukee Washington Land Trust has had to overcome. An innovative mapping analysis has also been created that spatially documents and portrays all infestations managed, and identifies areas at risk to the invasion of a targeted invasive species. Maps produced using this analysis not only helps to calculate areas deemed protected, but can also be used as a management tool to forecast where target species can spread, which can help to direct monitoring efforts.

Marek, Mike*. **Floating Islands: surrogate fish habitat in the Milwaukee River Estuary.** Marek Landscaping, LLC, Milwaukee, Wisconsin. Email: mike@mareklandscaping.com

An estimated 80% of native Great Lakes fish rely on wetlands for part of their lifecycle. Due to industrialization, large areas of the Milwaukee River Estuary have been hard armored and no longer have wetlands or the healthy, connective aquatic/riparian habitat necessary for fish and other aquatic organisms. A partnership between Marek Landscaping, LLC, Groundwork Milwaukee, Southeastern Wisconsin Regional Planning Commission, Milwaukee Metropolitan Sewerage District, Wisconsin Department of Natural Resources, and University of Wisconsin – Extension was formed to bio-mimic wetlands in the estuary through the use of Floating Islands. The Floating Island design uses a blend of synthetic and natural floating media from which plants grow. The media also provide a large amount of surface area to form the basic building block for the bottom of the food chain, the paraphytic organisms and biofilms. These organisms colonize and create food sources on which the smallest fish and zooplankton feed. By providing refuge and food, the project team is reducing barriers and improving longitudinal connectivity between upstream spawning/nursery habitat and Lake Michigan. Funding for the project comes from the Great Lakes Restoration Initiative, the Fund for Lake Michigan, and the Milwaukee Metropolitan Sewerage District. I will address how Floating Islands improve the fisheries of the Milwaukee River Estuary by creating habitat at small spatial scales. Preliminary results of biological monitoring of islands installed in 2013 and 2014, and the implications of these findings for the estuary as a whole will also be discussed.

Meissen, Justin C.*[1], Susan M. Galatowitsch[1] , and Meredith W. Cornett[2]. **Can harvesting too much wild tallgrass prairie seed cause population declines? An experimental approach at Spring Prairie, Minnesota.** [1]University of Minnesota, Saint Paul, Minnesota. [2] The Nature Conservancy in Minnesota, North Dakota, and South Dakota, Duluth, Minnesota. Email: meiss060@umn.edu

Seed is collected from remnant habitats using a variety of mechanical techniques to meet demand from more and larger tallgrass prairie restoration projects in the Great Plains of the United States. However, harvesting too much seed may deplete populations of species with life histories that rely on seed to reproduce and persist. We established a large field experiment to investigate how prairie forbs with different life histories respond to seed harvest in order to understand whether overharvesting can cause population declines, and if so, what mechanisms cause the declines. Based on our previous work, we hypothesized that more frequent (how often seed is removed)

and intense (how much seed is removed) seed harvest would result in population growth declines in short-lived, non-clonal species but would not affect population growth in long lived, clonal species. We propagated over 4000 seedlings of six forb species (both short-/long-lived, and clonal/non-clonal) from seed, and transplanted them into experimental populations at Spring Prairie, a remnant tallgrass prairie in northwestern Minnesota. We subjected the planted populations to a variety of commonly used seed harvesting methods by manipulating dormant season fire, seed harvest intensity and seed harvest frequency. We used a brush harvester to simulate low intensity harvest and a mow and remove method to simulate high intensity harvest, which also allowed us to understand whether high intensity techniques could cause mortality in harvested populations. Although populations have just recently matured enough to produce seed, initial results suggest a beneficial role of fire. Forthcoming results from this work will be used to verify the usefulness of life history traits in developing sustainable seed harvest guidelines, and also to understand how much and how often seed should be harvested to maintain native plant populations in tallgrass prairie remnants.

Michaels, Helen J*, Alissa Barwinski, and Alexandra Hill. **Nectar resources for oak savanna butterfly restoration.** Bowling Green State University, Bowling Green, Ohio. Email: hmichae@bgsu.edu

Several rare butterflies, including the federally listed Karner Blue, and Ohio state listed Frosted Elfin and Persius Dusky Wing, are native to oak savannas of Ohio's Oak Openings. Habitat restoration efforts have emphasized increasing the availability of one larval host plant, *Lupinus perennis*, and the abundance of nectar sources. However, minimal research has been done on the nutritional value of nectar plants. In a pilot survey of savannas at three field sites, we sampled flowers of 30 forbs previously reported or likely to be visited by Karner Blue butterflies. We collected nectar from flowers from which pollinators had been excluded for 24 – 72 hours. Samples were analyzed for nectar volumes, sugar concentrations, and amounts of total amino acids. We found substantial inter-specific variation in nectar volume, concentration, and composition. Species often recognized as "butterfly plants" had greater amino acid or sugar concentrations (or both). Our results suggest butterfly restoration plans consider increasing planting of selected species that are more likely to provide enriched nectar resources for adults.

Morgan, Benjamin* and Louise Egerton-Warburton. **Documenting baseline communities of arbuscular mycorrhizal fungi in a threatened Mexican seasonally dry tropical forest.** Chicago Botanic Gardens, Glencoe, Illinois. Northwestern University, Evanston, Illinois. Email: benmorgan@u.northwestern.edu

Two major challenges facing restoration are determining whether restoration practices effectively restore below ground communities and processes, and the need to establish pre-disturbance baselines to serve as restoration targets. The latter is particularly challenging in human-dominated ecosystems, where appropriate pre-disturbance systems may be disappearing rapidly or absent altogether. In this study, we address both these challenges in a Mexican seasonally dry tropical forest systems that is threatened by rapid expansion of urban centers and commercial tourism. We sampled arbuscular mycorrhizal fungal communities from the roots and surrounding soil of five ecologically important tree species (*Acacia cornigera*, *Brosimum*

alicastrum, *Bursera simaruba*, *Ceiba pentandra*, *Metopium brownei*) from two minimally managed sites in the Yucatan Peninsula, and documented baseline arbuscular mycorrhizal fungal communities using ultra-high-throughput Illumina sequencing of a ribosomal DNA barcode region. We identified 544 molecular taxa, over 98% of which were identified to genus or species level with at least 80% confidence, and documented significant effects of both host species and site on arbuscular mycorrhizal fungal community structure. These results indicate that communities of these essential plant symbionts are highly diverse and variable across this ecosystem, suggesting that conservation and restoration efforts cannot assume that small protected areas adequately protect regional arbuscular mycorrhizal fungal biodiversity, and need to specifically account for these communities to promote effective restoration of important dominant plant communities. Our study provides an effective methodology for rapidly assessing arbuscular mycorrhizal fungal communities in large numbers of samples simultaneously. We also report host-species-specific baseline communities that can serve as a basis for continuing to develop soil community targets for future restoration of seasonally dry tropical forests in this region.

Niehaus, Jeff * and Joel Bingham. **Sometimes they do come, if you build it - recovery of a fish community in an urban landscape.** EnviroScience, Inc., Stow, Ohio. Email: jniehaus@enviroscienceinc.com

The main stem of the Little Cuyahoga River and a nearby headwater tributary in Akron, Ohio were the focus of three restoration projects constructed between 2010 and 2012. Prior to restoration, the sites exhibited degraded conditions typical of urban impacts, creating a perpetual state of non-attainment of state water quality standards. Together, the projects restored over 2.0 km of sinuous channel, and created 6070 m^2 of new wetland and 12,545 m^2 of new floodplain. Over 150 specific habitat features for fish, macroinvertebrates and other wildlife were also restored. Two low-head dams were removed on the main stem, but two barriers to fish recruitment remain downstream. Since completion, stream morphology, habitat, and the riparian areas have been monitored annually to comply with permitting requirements. Fish communities were voluntarily evaluated in 2014 using Ohio EPA biocriteria methodology. While not required by permit, biological monitoring was conducted along with habitat and morphology to measure improvements. The results showed a significant improvement, which resulted in attainment of state standards. Restoration in urban systems is sometimes overlooked or discouraged due to assumptions of low recovery potential or lack of tangible results, but this particular set of projects indicates otherwise. The conclusion from these projects is that the improvement in fish communities was the result of an improvement in the physical habitat and morphologic systems without a corresponding improvement in water quality or recruitment potential. This suggests that some impaired urban systems have the capacity to meet state standards given certain physical changes that improve habitat and morphologic function. Analysis of the recruitment potential within the watershed or between fish barriers can be an effective means to determine if a project is viable, or help set attainable performance goals.

Overbeck, Will W.[1*], Brad Semel[2], and John C. Nelson[1]. **Hydrologic restoration and plant community response at a rare graminoid fen in northeastern Illinois**. [1]Illinois Nature Preserves Commission, Springfield, Illinois. [2]Illinois Department of Natural Resources, Springfield, Illinois. Email:willwoverbeck@aol.com

Gladstone Fen Nature Preserve, located in the Boone Creek Watershed of McHenry County, Illinois, was the study site for hydrologic restoration of a groundwater driven fen. The graminoid fen and associated sedge meadow were degrading due to hydrologic alterations from construction of a mid-century spring box and an artificial pond. Erosion and down-cutting in the main spring run resulted in a zone of hydraulic depression and wetland soil dehydration. We achieved hydrologic restoration by raising the invert elevations of the streambed back to historic levels and the installation of an infiltration trench and level spreader at the outflow of the artificial pond. The main goal was to rehydrate the peat soils with highly mineralized groundwater which was primarily being discharged as surface flow. Nested piezometric groundwater wells were used to monitor soil hydration and quantify groundwater elevations. Four permanent vegetation transects were established to quantify changes in native plant communities. Results indicate a return of cool groundwater flow to the hydric soils. In addition, obligate and facultative wetland plants recolonized the site including the conservative fen indicators (*Carex leptalea*, *Carex sterilis*, *Cirsium muticum*, *Chelone glabra*, *Cypripedium candidum*, *Doellingeria umbellata*, *Eleocharis elliptica*, *Gentianopsis procera*, *Hierochloe odorata*, *Juncus brachycephalus*, *Lobelia kalmii*, *Oligoneuron ohiense*, *Parnassia glauca*, *Potentilla fruticosa*, *Rhynchospora capillacea*, *Sium suave*, and *Solidago uliginosa*). Although hydrologic restoration was deemed successful, several new non-native plants (*Eriochloa villosa*, *Glyceria maxima*, *Phragmites australis*, *Lythrum salicaria*) were observed naturalizing along edge habitats and still persist in low numbers. Hydrologic restorations require additional attention to vegetation establishment, especially invasive plant management. Further restoration activities are critical to the overall success of biodiversity recovery. Continued monitoring, management, and propagule reintroduction will be necessary to sustain the ecological integrity of the graminoid fen, sedge meadow, mesic prairie and associated bur oak savanna.

Phillips-Mao, Laura* and Susan M. Galatowitsch. **Model-based scenario planning to develop climate change adaptation strategies for rare plant populations in grassland reserves**. University of Minnesota, Saint Paul, Minnesota. Email: phil0308@umn.edu

Incorporating climate change into conservation and restoration decision-making at site and population scales is challenging due to uncertainties associated with localized climate change impacts and population responses to multiple interacting impacts and adaptation strategies. We explore the use of spatially explicit population models to facilitate scenario analysis, a conservation planning approach for situations of high uncertainty. We developed dynamic, linked habitat suitability and metapopulation models using RAMAS GIS to consider management and monitoring options for a grassland reserve in Minnesota (USA) in order to support a hydrologically sensitive rare orchid (*Cypripedium candidum*). We evaluated 54 future scenarios combining changes in drought frequency, increased depth to water table, and multiple configurations of increased invasive species cover and management. We assessed how individual and combined climate change effects impacted population viability of the current *C. candidum* population, as well as the suitability of potential future on-site climate change refuges.

Simulation results allowed us to prioritize adaptation strategies and monitoring guidelines to inform adaptive management for our model system. For example, preventing further spread of invasive species into the current *C. candidum* population is an important low-risk resilience strategy for this site. However, under more serious climate change scenarios, higher-risk strategies, such as protecting critical recharge areas, become essential. Our analysis revealed few viable recipient sites for on-site translocations, further highlighting the importance of maintaining high quality habitat for the current *C. candidum* population. Allocating limited monitoring resources toward detecting changes in depth to water table and assessing *C. candidum* population responses to severe drought will more efficiently inform decisions about when to shift from low-risk resilience approaches to higher-risk resistance and facilitation strategies. Applying this scenario-based modeling approach to other high-priority populations will enable conservation decision-makers to develop sound, cost-effective, site-specific management and monitoring protocols despite the uncertainties of climate change.

Shaw, Kristin***.** **Ecological Places in Cities (EPIC): urban conservation at multiple scales.** Eastern Tallgrass Prairie and Big Rivers Landscape Conservation Cooperative, Bloomington, Indiana. Email: Kristin_Shaw@fws.gov

In 2012, 83 percent of the United States population was living in urban areas. As the population continues to increase in urban areas, so does residential and commercial development, consequently leading to potentially damaging impacts on wildlife habitat and ecosystems. While conservation efforts have traditionally been focused in non-urban environments, as more and more people flock to large cities there is a growing trend across the conservation community towards conserving urban ecological areas. The Eastern Tallgrass Prairies and Big Rivers Landscape Conservation Cooperative along with the Upper Midwest Great Lakes Landscape Conservation Cooperative are helping communities across these two landscapes share best management practices, collaborate on conservation projects, create large landscape conservation designs, and lastly help urban residents reconnect with nature. Hear how EPIC was created, operates at a regional, community and site scale, and projects currently happening because of the collective impact of EPIC.

Shuey, John* and Chad Bladow. **Climate change adaptation at the site level – using restoration and management to enhance ecological resilience.** The Nature Conservancy, Indianapolis, Indiana. Email: Jshuey@tnc.org

Climate change will have a dramatic impact on biodiversity and conservation in Indiana. Models agree that Indiana will be warmer with an annual increase in precipitation. Precipitation will increase primarily during the cooler months with a tendency for extreme events. Models also consistently predict that increased summer temperatures combined with annual patterns of precipitation will significantly increase drought stress during the late growing season. From an ecological standpoint these changed climatic patterns will create "winners and losers". In light of this perspective our restoration strategies capitalize on creating "resilient winners". Using black oak savannas and oak-hickory forests as examples, we discuss how Indiana Chapter of The Nature Conservancy "places our bets" with adaptation strategies designed to anticipate future predicted climate regimes. Climate change will like have two primary impacts in these systems:

1) drought induced plant mortality and 2) altered near surface hydrology impacting mesic and hydric habitats. To increase resiliency in uplands, we are emphasizing managed transformation of fire suppressed woodlands towards open oak barrens / oak woodlands habitats. These are assumed to be drought resistant relative to mesic closed canopy conditions. Our target transitional states are natural assemblages that once characterized habitats in the region before fire suppression. In savanna areas, water table restorations in agricultural fields adjacent to the conservation area are designed to lessen the impact of severe drought on mesic grasslands and wetlands, especially relative to breeding habitats for amphibians and reptiles. Together these two simple strategy adjustments are designed to increase internal resilience to predicted future environmental perturbations – an important first step towards a more resilient future.

Slowinski, Thomas E.*, Michael P. Famiglietti, and Walter G. Levernier. **The DuPage County MEGA Project-the restoration of one mile of the West Branch DuPage River and 350 acres of the West Branch Forest Preserve.** V3 Companies, Woodridge, Illinois. Email: tslowinski@v3co.com

The Forest Preserve District of DuPage County (FPDDC) and DuPage County Stormwater Management in conjunction with City of Chicago O'Hare Modernization Mitigation Account and an Illinois Environmental Protection Agency grant are restoring 1.85 km of the West Branch DuPage River and an adjacent 1.42 km^2 of the 2.93 km^2 West Branch Forest Preserve in Bartlett, Illinois. Construction activities performed in 2013 included grading and stabilizing the channelized river, removing field tiles, installing water control structures, and the clearing of 1.34 km^2 of invasive woody vegetation. A major component of the river restoration was to raise the river bed to reconnect the river to the floodplain and adjacent wetlands. The planting of native vegetation occurred throughout 2014 and included the restoration of emergent, wet prairie, mesic prairie, savanna, and fen communities. The presentation will focus on both the construction and native plant establishment aspects of the project. In order to meet the goals and grant deadlines of the Forest Preserve District of DuPage County and DuPage County Stormwater Management, the river restoration construction methods were modified from a river bypass pumping system to a phased diversion channel. The presentation will also cover vegetative adaptive management and monitoring which occurred throughout 2014.

Smiley Jr., Peter C.*[1] and Eric J. Gates[2]. **Evaluating the feasibility of adding small instream wood as part of restoration efforts in channelized agricultural headwater streams.** [1]USDA Agricultural Research Service, Columbus, Ohio. [2] Ohio State University, Columbus, Ohio. Email: rocky.smiley@ars.usda.gov

Instream wood is important for fish in headwater streams because it promotes the development of pool habitat and provides cover from predators during periods of low flow. The benefits of large instream wood have been extensively documented and the reintroduction of large instream wood is often part many stream restoration projects in the United States. Less is known about the role of instream wood, particularly small instream wood, within the numerous channelized agricultural headwater streams that occur throughout the Midwestern United States. Small instream wood additions within channelized agricultural headwater streams in the Midwestern United States are more likely to be accepted by the agricultural community than large instream

wood additions because it would be perceived as less of a drainage hindrance. Understanding the influence of small instream wood will provide information that will help develop needed guidelines for introducing wood as part of restoration efforts in channelized agricultural headwater streams. We conducted a before-after-control-impact experiment in the summer of 2011 where we sampled fishes and hydrology before and after the addition of small instream wood to pools within channelized agricultural headwater streams in central Ohio. The amount of instream wood was greater in the treatment pools than the control pools after the small instream wood addition. No differences in fish community structure or hydrology occurred between control and treatment pools before or after the addition of small instream wood. Our results indicate that adding large instream wood might be needed to benefit fishes and that it is possible to add instream wood to degraded agricultural headwater streams without impacting drainage capacity.

Straub, Craig A.* and Brian J. Kwiatkowski. **Floodplain restoration: Resolving water quality impairments with a non-point source pollutant attenuation system.** Apex Companies, Cincinnati, Ohio. Email: cstraub@apexcos.com

A floodplain pollutant attenuation system was constructed along the East Fork Mill Creek in Cincinnati, Ohio to improve water quality and enhance aquatic and riparian habitat. Ecological restoration techniques were implemented as a mechanism to accelerate secondary successional processes to improve ecosystem function, reduce nutrient loading and increase biodiversity. The project was initiated in response to accelerated commercial, industrial and public sector development that led to problems such as channel erosion, flooding, woody debris jams, and water quality impairments. Approximately 0.02 km^2 of riparian buffer and 0.05 km^2 of floodplain were restored. Instream grade control on the East Fork Mill Creek was established by the installation of engineered rock riffles. Floodplain restoration consisted of altering the micro-topography to provide surface water conveyance and storage in the form of a 0.70 km swale and pocketed pool areas. A water level control structure was installed at the outlet of the floodplain wetland to accommodate manipulation of the water surface elevation and draw-down time, and to establish and support wetland hydrology. To maximize attenuation potential, tree and shrub container stock were planted, along with seed mixes and herbaceous plugs to establish mesic prairie and emergent wetland plant communities. Soil techniques were employed to encourage colonization and establishment of biotic communities. Leaf litter and organic material were used to inoculate wetland and pool areas with bacteria, fungi, and invertebrates to initiate the food chain. Biomass of eradicated woody invasive species from the existing riparian corridor was placed in pool areas to support amphibian philopatry and movement, providing egg laying sites, cover and refugia. Canopy structure was provided along the north edge of the pools to allow variation of the hydro-period and partial shade to moderate water temperature.

Tsang, Byron*[1], Zhanna Yermakov[1], Keith Jones[2], and Gary Sullivan[3]. **Wetlands restoration at Big Marsh: challenges and opportunities.** [1]Chicago Park District, Chicago, Illinois. [2]V3 Companies, Woodridge, Illinois. [3]The Wetlands Initiative, Chicago, Illinois.
Email: Byron.Tsang@ChicagoParkDistrict.com

The restoration of Big Marsh is an important opportunity to reclaim critical avian resources in the Calumet Region. Despite being severely impacted by slag and fly dumping, invasive plant species, and altered hydrology, 0.49 km^2 of marsh remain as habitat for wetland birds within this site. In 2011, the Chicago Park District acquired the property and is now beginning to restore hydrologic function, manage invasives, and once again establish hemi-marsh to support rare and threatened species. The restoration will be coupled with development of outdoor education and recreation opportunities for the public. I highlight the history and industrial legacy at Big Marsh and review existing site conditions and challenges of restoring hemi-marsh and upland habitat and biodiversity in this brownfield site.

Thomforde, Stephen, L.*. **Grazing lawns as a model for urban lawns.** Great River Greening, St. Paul, Minnesota. Email: sthomforde@greatrivergreening.org

The grazing lawn biotic community represents the most evolutionarily advanced, productive, and provisional terrestrial ecosystem ever. A predictive framework based on the first and second laws of thermodynamics elucidates a biosphere trend towards maximizing solar energy capture and degradation through the grazing lawn model. This model postulates that a living earth desires to become, in multiple themes and variations, one large grazing lawn. The grazing lawn concept is first described by S. J. MacNaughton in a foundational paper titled "Grazing Lawns: Animals in Herds, Plant Form, and Coevolution". Although the paper is based in the Serengeti, the general principles apply anywhere herbivores are/were common, including the Great Lakes Midwest Ecoregion. Prehistoric evidence suggests grazing lawns have been a prominent planetary feature for the past 30 million years, and are the emanation of many current plant and animal species including Poaceae, Asteraceae, Fabaceae, Bovidae, and Cervidae. Prior to Midwest settlement, grazing lawns were common throughout the region creating a mosaic of intensely grazed and lightly grazed patches across the landscape. Despite their prominence and functional capacity, grazing lawns are rarely described as target trajectories in restoration, mainly because North American vegetation models used to inform restoration are negligent to the symbiotic feedbacks between vegetation and herbivores. This presentation describes the grazing lawn concept and how it fits into the North American landscape, especially as a suitable substitute to urban lawns, including residential, commercial, and public spaces that still require some form of annual maintenance. Grazing lawn species, installation procedures, and maintenance regimes are also described. Finally, we see how an urban grazing lawn model can be used to inform rural land restoration. Grazing lawns could again become a prominent landscape feature to the benefit of ecological integrity including wildlife, pollinators, water quality, carbon sequestration, food-fiber production and aesthetics.

Tonietto, Rebecca K.*[1,2] and Daniel J. Larkin[2]. **Bee community composition along a restoration chronosequence in the Chicago Wilderness region.** [1]Northwestern University, Evanston, Illinois. [2]Chicago Botanic Garden, Glencoe, Illinois. Email: rebeccatonietto@u.northwestern.edu

We evaluated the effects of tallgrass prairie restoration on native bee communities in a chronosequence of restorations with unmanaged old fields as controls and prairie remnants as reference sites in northeastern Illinois, USA. We measured bees' responses in terms of alpha diversity, community composition, and beta diversity from both taxonomic and functional-trait perspectives. We collected 6,501 bees representing 131 species, 32 genera and 7 families. Species of interest include four individuals of *Bombus affinis*, a bumble bee reported to be in decline regionally. Overall, we found prairie restorations to contain diverse and abundant bee communities, including bee species characteristic of high quality habitat. Bee community composition of restorations was intermediate between old fields and remnants, and correlated with forb community composition. Using taxonomic or trait-based data, beta diversity was greater among restorations compared to old fields or remnants, and greater than expected by chance.

Warneke, Christopher*, Kayri Havens, and Pati Vitt. **Feeding preferences of the biocontrol weevils *Larinus minutus* and *Larinus obtusus*: implications for *Cirsium pitcheri* restoration.** Chicago Botanic Garden, Glencoe, Illinois and Northwestern University, Evanston, Illinois. Email: warneke@u.northwestern.edu

Pitcher's thistle (*Cirsium pitcheri*), a threatened plant endemic to the Great Lakes dunes, faces many threats including habitat loss, climate change, and invasive plants. One of the delisting requirements for the species at the federal level is establishment of two of self-sustaining reintroductions at former occurrence sites in Illinois and Indiana. Due to the human-dominated nature of that shoreline and the difficulties associated with restoration in such a system, it is important to consider and manage for the assortment of threats this species faces in order to maximize success of the effort. Recently, the Pitcher's thistle has come under a new threat from a suite of biological control weevils that cause plant death directly or lead to losses of seed, lowering the population growth rate below the thistle's naturally low rate. These weevils are most problematic in the southern portions of the thistle's range, where reintroductions are being attempted. While the effects of these species have been documented, it is less clear if there will be negative effects on Pitcher's thistle from the more recently introduced weevils *Larinus minutus* and *Larinus obtusus*. These weevils are generally specific to knapweeds (*Centaurea*) and were introduced to control spotted knapweed (*Centaurea stoebe*), a noted invasive that threatens Pitcher's thistle in its own right. Although these weevils are fairly host specific, they have been shown to feed on Pitcher's thistle in laboratory choice and non-choice tests of both floral and leaf tissue. This new information contributes to management of these two weevils and their knapweed host, and also informs the restoration projects that are ongoing in the Illinois/Indiana region. Considering the complex interactions between the various native and exotic plant and weevil players in this system, land managers must consider their approaches and landscape context carefully to successfully restore Pitcher's thistle or similar species.

POSTER PRESENTATIONS (ALPHABETICAL ORDER)

Abernathy, Jessica E. * and Mark Sherrard. **The utility of tallgrass prairie reconstructions as a bioenergy feedstock.** University of Northern Iowa, Cedar Falls, Iowa. Email: abernjaa@uni.edu

Two of the more pressing, yet opposing, ecological challenges that we face at the global-scale are the loss of biodiversity and rising demand for energy. Many ecological experiments have shown the importance of biodiversity for ecosystem services and functions, but the simultaneous demand for energy has led to greater conversion of natural landscapes to energy production crops (e.g., corn for ethanol). One potential solution to these seemingly opposing issues would be to grow diverse native vegetation for bioenergy. Native tallgrass prairie produces large amounts of aboveground biomass, but also provides great habitat for wildlife. In this study, we compared the productivity and ecosystem services provided by four potential bioenergy feedstocks of contrasting diversity: 1 species - a switchgrass monoculture; 5 species - a mix of C4 grasses; 16 species - a mix of grasses, forbs and legumes; and 32 species - a mix of grasses, forbs, and legumes. Each diversity treatment was replicated four times on three different soil types (clay, loam, and sandy soil) for a total of 48 plots (0.33-0.56ha each). We compared productivity by harvesting all plant material to ground level in 10 randomly placed 0.3m^2 quadrats per plot. Over the five year study, the switchgrass monoculture, 16 species mix, and 32 species mix produced the same amount of aboveground biomass, with the switchgrass monoculture producing significantly more biomass than the 5 grass mix. As we attempt to meet the bioenergy goals mandated by the Energy Policy Act (2005) and Energy Independence and Security Act (2007), our results indicate that diverse mixtures of native tallgrass prairie plants are a reliable source of bioenergy and also provide the habitat benefits that come with increased diversity.

Anderson, Roger C.*. **The ParkLands Foundation: a grassroots conservation organization.** Illinois State University, Normal, Illinois. Email: rcander@ilstu.edu

The ParkLands Foundation mission is to preserve, protect, and ecologically restore historic natural lands in the middle and upper Mackinaw River watershed. These lands are dedicated primarily for preserving biological diversity of native plants and wildlife, and secondarily for passive public recreation, environmental education, and scientific research. The ParkLands Foundation was founded in 1967 in McLean County, Illinois when the county had 3.08 km^2 of potential outdoor recreation area and needed 20.23 km^2. Because there was no public organization that would increase public outdoor recreation lands, private individuals took up this task. Loring Merwin, recognized Foundation founder, stated in an organizing meeting, "Two things are obvious – potential outdoor recreation here is disappearing under the plow and under plans for residential subdivisions; and the taxpaying public is not yet ready to act." ParkLands purchased or received donations of land with potential to provide outdoor recreation. By end of the 20th century, ParkLands had accumulated 6.74 km^2 of land in McLean and adjacent Woodford Counties. The Foundation developed 11.3 km of hiking trails for public use in the 2.83 km^2 Merwin Preserve. ParkLands Foundations had no paid staff until 2002, and volunteers did all of the work including legal, financial, and restoration. Today, the Foundation has a fulltime Land Steward, a part-time administrator, and paid interns, but volunteers are essential for achieving ParkLands' long-term goals. ParkLands holdings today include 12.14 km^2 in Woodford (9 preserves) and McLean (15 preserve) Counties that contain upland oak-hickory and

floodplain forests, restored oak-savannas, wetlands, and reconstructed prairies. Two preserves, Ridgetop Prairie in Woodford County and the Merwin Savanna Nature Preserve, McLean County, are dedicated Illinois Nature Preserves and two preserves are Illinois Land and Water Reserves. The Foundation owns 16.1 km of river frontage on the Mackinaw River and has established four public canoe launches.

Basey, Adrienne C.*[1], Andrea T. Kramer[2], and Jeremie Fant[2]. **Producing native plant materials for restoration: ten rules to collect and maintain genetic diversity.** [1]Northwestern University, Evanston, Illinois. [2]Chicago Botanic Garden, Glencoe, Illinois. Email: adrienne.basey@u.northwestern.edu

Ecological restoration aims to assist the recovery of degraded, damaged, or destroyed ecosystems. Restoration practitioners increasingly recognize the value of using ecologically appropriate and genetically diverse native plant material to support ecosystem recovery and long-term persistence in the face of unpredictable current and future conditions. However, producing genetically-diverse native plant material can be incredibly challenging. Each step of production, from procuring raw material to installing produced material into a restoration site, has the potential to impact the genetic diversity of the produced material. Here we examine each of the production steps, from wild land seed collection through seed or seedling production. We outline each step where genetic diversity can be lost or gained, and describe ten rules that can be used to maintain high genetic variability in native plant material throughout the production process.

Benedict, Melissa M.*[1] and A. Maria Lemke[2]. **Benthic macroinvertebrate community response to large-scale lake restoration.** [1]University of Illinois, Springfield, Illinois. [2]The Nature Conservancy, Lewiston, Illinois. Email: mlannan@uis.edu

Benthic macroinvertebrates were quantitatively sampled over a 10 year period to quantify how these communities responded to large-scale restoration of a historical floodplain lake along the Illinois River, Illinois. Thompson Lake is a 24.28 km^2 backwater lake that was separated from the main channel of the Illinois River by levees in the early 1920's, and subsequently farmed for corn and soybean production for almost 90 years. Pumps that transferred water from agricultural ditches to keep the land dry for farming were turned off in the spring of 2007, and the area has since been reinundated from precipitation and groundwater sources. Benthic macroinvertebrates were collected using an Ekman dredge from eight to 15 sites at approximately one month intervals over three one year periods from: pre-restoration agricultural ditches (2004-2005), early lake restoration habitats (2008-2009), and five years after inundation (2013-2014). Water quality parameters collected at each sampling site included water temperature, dissolved oxygen, conductivity, and pH from surface water, and near sediment habitats. Depth, total suspended sediments, chlorophyll *a*, and Secchi transparency were also collected at each site. Oligochaetes and chironomids were dominant in both systems throughout the 10 year period. However, some community composition changes have been observed as lake status has changed. Community composition changes include increased densities of caddisflies, dragonflies, damselflies, *Caenis* mayflies, and fingernail clams during the restoration period. Our goal is to estimate secondary production of benthic macroinvertebrates during the restoration of Thompson Lake as part of a

series of concurrent studies conducted along the Illinois River that address the complexities of restoring and managing floodplain habitats for biodiversity and ecosystem function.

Campbell, Ryan E.*. **Fermilab Seed Rate Study: impacts of seed mix weight on prairie restoration success.** Fermi National Accelerator Laboratory, Batavia, Illinois. Email: ryancamp@fnal.gov

With the rapid disappearance of tallgrass prairie throughout its historic range, many efforts have been made to convert farm fields back into this prairie ecosystem. Few studies have examined how initial weight of prairie seed mix influences outcomes and success of restoration. Goldbum et al. (2013) found that on sand-loam soil at Nachusa Grasslands, seed mix weights of at least 56 kg/ha, using 128 species, resulted in restoration plantings with desirable plant diversity. The objective of our study was to examine the effect of initial seed mix weight on plant community diversity on clay loam soil, typical of most agricultural lands being converted back to prairie. Our study was established in winter 2010 at Fermi National Accelerator Laboratory in Batavia, Illinois. Ten m^2 plots (n=4) were randomized in a complete block design and planted with 116 species using five seed rates (0, 11.2, 33.6, 56.0, and 78.5 kg/ha). During the second growing season, plant cover and richness data were collected and used to calculate plant diversity (Shannon-Wiener). Ninety-six species were observed in the plots and 45 of the 116 species planted were present overall. Total vegetation cover and species richness were greatest in the 33.6, 56.0, and 78.5 kg/ha plots. Similarly, plant diversity was greatest in 33.6, 56.0, and 78.5 kg/ha plots and significantly different than the control and 11.2 kg/ha plots. Despite soil differences between the Fermilab site (clay-loam) and Nachusa (sand-loam) our study suggests that after two years, a similar minimum seed mix weight (56.0 kg/ha) can be used to achieve diversity goals when restoring tallgrass prairie plant communities, although less (33.6 kg/ha) may suffice. Given rates of establishment and succession, these plots will need to be observed over greater time scales to determine long-term success related to seed mix weight.

Chavez, Samantha J.* and Anthony Yannarell. ***Microstegium vimineum* invasion impacts the functioning of archaeal and bacterial nitrification.** University of Illinois at Urbana-Champaign, Urbana, Illinois. Email: sjchave2@illinois.edu

Invasive species are known to cause shifts in resource availability. *Microstegium vimineum* is an invasive grass that is disrupting forest ecosystems in the eastern and southern United States that has been found to increase soil nitrification rates. In this study we investigated how *M. vimineum* invasion affects the soil microbial communities responsible for nitrification. We used nitrogen potential recovery assays to determine the contribution of different types of nitrifying organisms to the total nitrification rate of invaded and uninvaded forest stands. We also used molecular techniques (quantitative PCR and DNA community fingerprinting) to investigate how *M. vimineum* invasion affects the abundance and community composition of nitrifying microorganisms. We found that total nitrification potential was greater in invaded plots than in uninvaded plots, and the ammonia-oxidizing archaea exhibited the greatest invasion-related increase in nitrification rates. We also found that invaded plots contained greater numbers of nitrifying organisms than uninvaded plots, and the community composition of ammonia-oxidizing archaea was significantly altered in invaded plots compared to uninvaded plots. Our results support previous research that *M. vimineum* increases nitrification rates. Furthermore, our

results link *M. vimineum* invasion to changes in the activity, abundance, and community composition of the dominant ammonia-oxidizing archaea that contribute the most to the increased nitrification potential of invaded soils. This link between invasive *M. vimineum* and the soil community can affect availability of nitrogen species in forests soils, which may in turn lead to changes in plant community composition in the wake of this invasion.

Chen, Xiaoyong*. **Spatial distribution of large woody debris in Thorn Creek watershed in Northeastern Illinois.** Governors State University, University Park, Illinois. Email: xchen@govst.edu

In-stream large woody debris (LWD) is an important component of a forested watershed, and the spatial distribution of LWD influences many significant hydrological and ecological processes in both terrestrial and aquatic ecosystems. Thus, understanding the spatial pattern of LWD with forest stream ecosystems is valuable for better understanding of the stream and riparian linkages in terms of structure, function and productivity of aquatic ecosystems, and may be critical for sustainable management and restoration of streams. In this study, the size, frequency, volume, decay statement, position, and orientation of LWD were investigated in three reaches (upstream, midstream and downstream reaches) in Thorn Creek, Northeastern Illinois. The Neighbor K statistics was used to evaluate the spatial pattern of LWD along the stream. The spatially random, aggregation and uniform distribution of LWD were identified in the study sites. Our results showed that the total number of LWD ranged from 18 to 58 per 100 m stream with a mean of 34 piece/100m. The volume of LWD was 3.27 m^3 per 100 m^2 upstream, 1.56 m^3 per 100 m^2 midstream, and 2.42 m^3 per 100 m^2 downstream. More than 80% of LWD was in the dimension of less than 4 m length and 20 cm diameter. About 40% of LWD was in the middle decomposition stage (decay class 3) and the proportion of LWD in the early stage of decomposition was less than 3%. Moreover, most of LWD was located in the streambed (63%) and oriented paralleled to flow (63%). Our results highlight the heterogeneity of LWD distribution in the watershed, and the characteristics of LWD should considered by forest and watershed managers in planning sustainable watershed management strategies.

Cook, Benjamin J.*, Jodi M. Refsland, and Tory L. Christensen. **Developing goat grazing as a land management tool in Minnesota land restoration.** Wetland Habitat Restorations, Minneapolis, Minnesota. Email: Ben@whr.mn

Prescription grazing (PG) is a highly managed form of rotational livestock grazing designed to achieve specific pre-defined management objectives. PG has been part of land management practices in the United States for over a century. Our objective was to determine the feasibility of PG as an applicable restoration tool for commercial entities in Minnesota through investment and implementation. To begin, we required animal husbandry training for our staff in order to develop a livestock management division within our company. Coordination with land managers accommodated necessary site proposal modifications conducive to the grazing strategy for the identified target species *(Rhamnus and Lonicera spp.).* We examined the grazing preferences and rates of three goat breeds (60 animals) on two sites over one grazing season and recorded control success, logistics, economy, and marketability of the grazing process. We determined that more investment and awareness in PG as an ecological restoration tactic is necessary to

make PG viable in a commercial application. An unexpected result was the increase in public involvement and interest in ecological restoration projects. Moving forward, we propose that project proposals include prescription grazing as part of a suite of land management tools in order to increase economic efficiency of grazing. We also suggest a multiple season grazing strategy to increase undesirable species control. As a company we will continue to examine the use of PG to control a broader range of invasive species. Ideally, PG in the future will be one of many tactics used to restore Minnesota's native lands and greatly reduce the amount of chemical controls used on a restoration site.

Damm, Mary C.*[1], Marc Bogonovich[2], and Dan Specht[3]. **Plant species associations in native and reconstructed Iowa tallgrass prairies.** [1]Indiana University, Bloomington, Indiana. [2]Openwords LLC, Bloomington, Indiana. [3]Deceased. Email: marydamm@gmail.com

The eastern tallgrass prairie is a highly diverse and endangered ecosystem. Tallgrass prairies have been planted across Midwestern states in an attempt to recreate the landscape nearly lost to agricultural conversion. Plant species richness and diversity and community composition differ between native and reconstructed prairies and at different spatial and temporal scales. In this study we asked which plant species are associated with one another in native and reconstructed prairies and how the associations differ or are the same between the prairies. We suggested potential relevance of the plant associations to restoring prairie to the landscape and native prairie ecology. In Iowa we sampled three native (Cayler Prairie, Hayden Prairie, Steele Prairie) and two reconstructed (Borlaug Farm, Lakeside Lab) tallgrass prairies. In each prairie, we established seven 70 cm x 70 cm (0.5 m^2) plots stratified randomly in mesic prairie. We estimated plant cover using the point-intercept method. We measured plant canopy height and litter depth and sampled and weighed aboveground biomass and litter in each plot for community-associated variables. As part of a larger study, we collected soil samples for nutrient analyses. We analyzed plant species composition and community and soil variables with a nonmetric multidimensional scaling ordination. In the ordination, Axis 1 differentiated the reconstructed prairies with cool-season (C3) grasses associated with the Borlaug Farm and warm-season (C4) grasses associated with Lakeside Lab. Axis 2 separated the native from reconstructed prairies with habitat conservative species *Amorpha canescens, Carex bicknellii, C. meadii, Helianthus rigidus*, and *Sporobolus heterolepis* associated with native prairies and less habitat specific *Monarda fistulosa* and *Elymus canadensis* associated with reconstructions. Axis 3 separated the C4 grasses, *Sorghastrum nutans* and *Andropogon gerardii.* Litter depth correlated with axis 3, which could represent a burn gradient reflecting fire management of the native prairies.

Ellingson, Emily K.*[1, 2], James M. Bradeen[1], and Stan C. Hokanson[1, 2]. **Evaluating the genetic diversity of an endangered tree species, eastern hemlock (*Tsuga canadensis*), in Minnesota to provide a framework for conservation.** [1]University of Minnesota, Saint Paul, Minnesota. [2]The Minnesota Landscape Arboretum, Chanhassen, Minnesota. Email: ellin155@umn.edu

Eastern hemlock, a slow-growing and long-lived conifer, exists at the edge of its range in northeast Minnesota. It has suffered substantial decline in Minnesota in the last century due to fire, logging, and climate conditions, resulting in several scattered native populations totaling

less than fifty trees. In addition to these wild populations, there are cultivated trees at the Minnesota Landscape Arboretum in Chanhassen, Minnesota derived from an extirpated wild population at Mille Lacs Lake, as well as cultivated trees of unknown but possible Minnesota origin at the Eloise Butler Wildflower Garden in Minneapolis. Our study will look at the genetic diversity within and between remnant, disjunct native Minnesota populations, cultivated Minnesota populations, and larger, contiguous populations within the species' center of diversity. We have collected foliage samples for DNA extraction and PCR amplification, and will collect quantitative data, such as DBH and height, for all Minnesota native individuals and all cultivated individuals of native or unknown origin. We will use previously published *Tsuga canadensis* derived microsatellite markers to determine the relatedness of these populations to investigate the origins of unknown trees and identify genotypes with unique alleles that may be of conservation value. We will also investigate inbreeding levels within disjunct populations. The results of this study will provide a genetic framework that can be used to inform conservation decisions and aide in the recovery of this endangered tree species by identifying potential seed orchards and ex situ germplasm repositories.

Finch, Jessamine*[1,2], Courtney Devoid[3], Kayri Havens-Young[1], and Jeffrey Walck[4]. **Dispersal strategy predicts tolerance ranges for dormancy loss and germination for two Midwestern forbs: implications for seed sourcing under climate change.** [1]Chicago Botanic Garden, Glencoe, Illinois. [2]Northwestern University, Evanston, Illinois. [3]Middlebury College, Middlebury, Vermont. [4]Middle Tennessee State University, Murfreesboro, Tennessee. Email: jfinch@chicagobotanic.org

Seed sourcing for restoration is a controversial topic. Once the golden rule, local provenancing has received criticism given the realities of climate change and habitat fragmentation. Recent recommendations highlight the advantages of predictive, composite, and admixture sourcing. To select the best-suited plant material for a restoration, species' environmental tolerance ranges must be understood. Tolerance ranges are unique to each life stage and encompass an optimum bounded by maximum and minimum thresholds. Ranges vary between species, and presumably within and among populations. Species with small neighborhood size are expected to be more specialized to local climate and have narrower ranges. Seed dormancy and germination are critical stages in plant regeneration. To evaluate the relationship between neighborhood size and tolerance range, we selected two native species contrasting in dispersal strategies and presumably neighborhood size: *Penstemon digitalis* (gravity dispersed) and *Asclepias syriaca* (wind dispersed). Both species are widespread and restoration relevant. We predicted tolerance ranges for cold stratification and germination would differ among populations and be positively related to neighborhood size. *Asclepias* seeds were collected from Missouri (38°N), Illinois (41°N), and Minnesota (44°N), and *Penstemon* seeds were collected from Missouri (38°N) and Illinois (41°N). Seeds were stratified at six, eight, and 10 weeks (3°C) and incubated on a thermogradient table set from 15 to 30°C for three weeks. Germination responses differed significantly by species and latitudinal seed source. The tolerance range of *Penstemon* (small neighborhood) was narrower than that of *Asclepias* (large neighborhood). However, *Asclepias* populations were more differentiated than those of *Penstemon*. Results support a positive relationship between neighborhood size and tolerance range breadth, but do not support greater local adaptation in species with small neighborhoods. When considering seed sourcing options

for restorations, it is vital that practitioners consider species neighborhood size and tolerance zone, especially given the complication of climate change.

Flower, Charles E.*[1], Robert A. Ford[2], Robert P. Long[2], Miquel A. Gonzalez-Meler[1], and Kathleen S. Knight[2]. **Using data from permanent forest monitoring plots in northwest Ohio to guide restoration in forests impacted by emerald ash borer.** [1]University of Illinois at Chicago, Chicago, Illinois. [2]USDA Forest Service, Delaware, Ohio. Email: cflowe3@uic.edu

In part because of global trade and climate change, forest pest and pathogen outbreaks are becoming increasingly prevalent altering forest communities and ecosystem functioning resulting in the need for restoration. As restoration funding is limited, identifying areas most susceptible to losses in biodiversity and ecosystem services is necessary. In response to the emerald ash borer (EAB) outbreak in North America, permanent research plots were deployed in Ohio and monitored annually thereafter. Analysis of data from this network can guide post-disturbance forest management and restoration initiatives. Results indicate that mortality of infested ash stands progresses in a characteristic pattern over two to five years. Additionally, post-EAB ash forests sequester less carbon and lose more nitrogen to leaching. Succession in these communities is dictated in part by remnant species composition and prevalence of newly created canopy gaps caused by EAB-induced tree mortality that provides the opportunity for invasive plants to proliferate. If left unchecked, invasives can impact recruitment of canopy and understory trees. Finally, trees from the genera *Acer* and *Ulmus* exhibited the greatest relative growth rates during the disturbance recovery and represent the likely successors following ash mortality. After *Fraxinus*, trees from the genera *Acer* were the most abundant in these forests, their increased prevalence may lead to the competitive exclusion of other genera. Our research suggests that pre-disturbance surveys may be used to optimize forest management and restoration responses. Post-disturbance restoration may be used as an opportunity to manage forests for greater diversity enhancing future resilience to disturbance. In sites with low densities of non-ash trees, trees may be seeded or planted to enhance species diversity and control measures for invasive plants may be necessary. Sites with adequate densities of non-ash trees, especially those with adaptable species able to respond to the post-disturbance conditions**,** are less likely to require intervention.

Hevey, Jr., Robert D.*[1] and Louise Edgerton-Warburton[1,2]. **Ectomycorrhizal community recovery in a *Quercus* savanna following restoration from a *Rhamnus cathartica* invasion.** [1]Northwestern University, Evanston, Illinois. [2]Chicago Botanic Garden, Glencoe, Illinois. Email: RobertHevey2011@u.northwestern.edu

Ectomycorrhizal (ECM) fungal communities may be negatively impacted by invasion of non-native, exotic species. The question remains as to how these communities rebound once the exotic species are removed. In this study, we documented the changes in ECM species richness and diversity and a community structure following the removal of *Rhamnus cathartica* (buckthorn) from a *Quercus macrocarpa* (bur oak) savanna. The ECM community in a bur oak savanna in Milton, Wisconsin was monitored over three consecutive years (2010 to 2012) following the partial removal of buckthorn in 2009. More than 3200 bur oak root tips were collected, examined and sorted into morphological types, sub-samples of which were identified

to species level using sequencing. Twenty-six sequences were identified as unique species of Ascomycota and 38 as unique species of Basidiomycota. We found distinctly different ECM communities in the cleared versus invaded area. Within two years, the ECM community showed a strong, positive response to the removal of buckthorn (hereafter cleared). Species richness and diversity measures were significantly greater in the cleared area (44 species) than the buckthorn-invaded area (31 species). In addition, three taxa considered early successional. *Scleroderma*, *Pachyphloeus*, members of the Pezizales, dominated the invaded area while the principal genera (*Inocybe*, *Tuber*, *Cortinarius* and *Boletus)* in the cleared area were more conservative. Only 11 ECM species occurred in both areas. Some of the differences in ECM community were explained by higher levels of soil moisture and organic matter in cleared versus invaded areas. Overall, these data indicate that the removal of an invasive species can result in rapid and positive increases in ECM diversity that, in turn, may have important consequences for ecosystem function.

Ingram, M.[1], Glass, S.[2]* and M. Wegener[3]. **Incorporating human impacts into restoration planning at the University of Wisconsin Arboretum.** [1] University of Wisconsin, Madison, Wisconsin. [2] The Restoration Ecology Lab, Madison, Wisconsin, [3] University of Wisconsin-Madison Arboretum, Madison, Wisconsin. Email: sbglass1@mac.com

The University of Wisconsin-Madison Arboretum practices restoration in an urban landscape rife with the impacts of human activities. Here, it works with a mix of remnant, restored, and novel ecosystems where even the restored and remnant communities contain new species and fundamentally altered ecological processes such as hydrology and fire. In addition to the usual restoration challenges of balancing priorities, working with complex and dynamic systems, and climate shifts is added the complication of negotiating restoration policy, targets, and outcomes. In this contested landscape, restoration (on both an individual project level and the overall Arboretum program) is a negotiation between City and University land use policy, Arboretum research and outreach goals, neighbor relations, differing user interests and citizen visions of the landscape, and City, state, and federal regulations for storm water management, air quality, prescribed fire smoke dispersal, and threatened and endangered species management. Negotiations are weighted by large power and resource differentials between the parties. In this super-charged and unpredictable atmosphere, establishing, communicating, and achieving specific restoration targets is a challenge—often, the best we can do is to move towards any positive restoration outcome. The Arboretum restoration case shows that we must view ecological restoration "not only as a technical task but also as a social and political project." The realization that restoration planning and implementation operate in a political arena will not come as a surprise but, we suggest, gives insight into the constraints of restoration and provides an expanded perspective on opportunities of the task. Restoration is not a straight march from the restoration plan to the finished product. It requires that from the outset of any restoration we engage with citizens and agencies, build public involvement, familiarize ourselves with the regulatory arena and research and understand the legacies of anthropogenic as well as natural processes.

Gordon, Brad*, Christian Lenhart, Dean Current, and Nikol Ross. **Nitrogen reduction in a constructed wetland and wetland mesocosms.** University of Minnesota, St. Paul, Minnesota. Email: gordo402@umn.edu

The need for understanding the effectiveness of constructed treatment wetlands in Minnesota continues to grow as agencies create goals to limit the amount of nitrogen and phosphorous released into the Mississippi River and other freshwater bodies in the state. These nutrients can be directly hazardous to aquatic life and humans at high concentrations. Reducing their release into the environment is also significant as states seek to reduce nutrients contributing to algal blooms similar to and including the dead zone in the Gulf of Mexico. In 2013 a 2185 m^2 treatment wetland was constructed to remove nitrates from row-crop tile drainage discharging into Elm Creek in southern Minnesota. This continuing study aims to understand the effectiveness of the constructed wetland as well as the contributions of the ecology in the wetland at reducing nitrogen flowing into the nearby creek. Water chemistry in the wetland has been studied for the past two growing seasons to determine changes in nitrates flowing in and out of the wetland. The vegetation and soil have also been studied using wetland mesocosms to better understand the contributions of some of the wetland's plant species and soil in denitrification. Findings from this study could be used to improve the effectiveness of future best management practices and wetland restorations through improved wetland design and plant species selection.

Majka, Brian R*. **Current trends in natural shoreline engineering.** GEI Consultants of Michigan, P.C., Allendale, Michigan. Email: bmajka@geiconsultants.com

Natural shorelines along lakes and rivers are rapidly becoming commonplace throughout the country for their combined ecological, aesthetic, and economic benefits. This session will discuss current trends in research, education, design, engineering, materials, and construction that lead to effective natural and living shorelines in both wild and urban settings.

Ning, Chen*, Gregory Mueller, Louise Egerton-Warburton, and Andrew Wilson. **Functional response of ectomycorrhizal fungal community to nitrogen deposition on slash pine (*Pinus elliottii*) plantation in south-central China.** Chicago Botanic Garden, Glencoe, Illinois. Northwestern University, Evanston, Illinois. Email: chenning2012@u.northwestern.edu

Anthropogenic nitrogen (N) deposition can alter ectomycorrhizal (ECM) fungal communities, but the effect on functional diversity is not clear. In human-dominated and degraded ecosystem, debate centers on whether species are functionally redundant, and on how much diversity is necessary to maintain ecosystem function and serve for restoration practices. In this study, we address this problem in an exotic pine (*Pinus elliottii*) plantation in south-central China, which was exposed to 3 years of experimental elevated N deposition. We characterized the ECM fungal communities associated with trees from three different N deposition levels by microscopy, and direct sequencing of fungal ribosomal DNA. Activities of three hydrolytic or oxidative enzymes were quantified in soils surrounding ECM root tips for each of the 15 dominant morphotypes per N treatment. We found that higher N deposition reduced taxonomic richness of the ECM fungal community to a greater extent. The relative abundance of observed

mycorrhizae formed by Thelephoraceae and *Cenococcum* species decreased in N addition plots, whereas Atheliaceae species and *Russula* species increased. In addition, acid phosphatase activities of ECM root tips were repressed by N addition, whereas potential polyphenol oxidase was stimulated by high N input. Protease activities did not significantly vary among the three different treatments even though there was a change in ECM community diversity and composition. The results indicate an ecologically functional redundancy of proteolytic ability existing across the pollution gradients, and we do not expect this ecosystem service to be compromised by long-term N deposition. Our study provides a better understanding of functional traits related to ECM fungal communities as well as developing an effective restoration strategy on forest plantation management in these subtropical regions.

Palmer, Craig J.[1], Martin A. Stapanian[2], Timothy E. Lewis[3], Molly M. Amos[1], Louis J. Blume*[4], Karen Rodriguez[4], and Judith Schofield[1]. **Efforts to improve the reliability of data collected to determine ecological restoration project success.** [1]CSC, Alexandria, Virginia. [2]U.S. Geological Survey, Sandusky, Ohio. [3]U.S. Army Corps of Engineers, Vicksburg, Mississippi. [4]U.S. Environmental Protection Agency, Chicago, Illinois. Email: Blume.Louis@epa.gov

Ecological restoration requires the collection of reliable data for planning, implementation, and assessment purposes. Often these data are collected as observations (e.g., species identification) or estimates (e.g., cover or abundance class) based on best professional judgment. The challenge for ecosystem restoration specialists is that little guidance or training is available on how to ensure the quality and reliability of such data. An Interagency Ecosystem Restoration Quality Committee in the Great Lakes region has been developing quality assurance guidance for data collection during ecosystem restoration projects. The committee holds periodic training workshops to assist restoration professionals with the implementation of these practices. The committee hosts monthly webinars in which the challenges associated with projects such as habitat restoration or invasive species control are discussed. The committee invites participation and support from the SER community with these efforts.

Riebkes, Jessica*, Dave Williams, and Laura Jackson. **Effect of predator satiation on seed predation in roadside prairie plantings.** University of Northern Iowa, Cedar Falls, Iowa. Email: riebkesj@uni.edu

Restoration efforts in the tallgrass prairie ecosystem are inhibited by high seed cost and as little as 10% emergence of planted, pure live seed. This study examined the portion of loss due to seed predation and sought to reduce this predation in new roadside prairie plantings. Studies document the occurrence of predation in several plant communities and across all plant families, but little is known about how to manipulate seed predators, especially in a restoration setting. On three sites where prairie seed was recently drilled, we attempted to satiate seed predators by providing a plentiful source of birdseed as a supplemental food source to the prairie seed. The goal of this method was to capitalize on the evolutionary principals of optimal diet theory and masting. We quantified seed predation through the use of a buffet experiment during the same fall as the planting and we will monitor seedling emergence in the growing season following the fall plantings. We expected a reduced loss of prairie seed in the supplemental seed treatment of the buffet experiment. During the growing season, we expect to find increased seedling

emergence in the supplemental seed treatment. Preliminary results of the buffet experiment show limited seed predation and temporal variation at each of the sites. Reducing predation on prairie seed through the use of supplemental seed could provide a practical, inexpensive strategy to improve prairie restorations across the Midwest.

Roberts, V.M. Summer*. **Determining suitable parcels for restoration and conservation in Washtenaw County, Michigan using MCE analysis**. University of Michigan, Ann Arbor, Michigan. Email: vmsrob@umich.edu

Land conversion to agriculture or residential development often causes habitat fragmentation of natural areas, which can result in five phenomena: 1) a reduction in total habitat area, 2) an increase in the ratio of edge to interior habitat, 3) isolation between formerly connected habitats, 4) the conversion of one habitat into smaller remnants, and 5) a reduction in the average size of remaining habitat patches. In 2003, the City of Ann Arbor, located in Washtenaw County in Southeastern Michigan, instituted an Open Space and Parkland Preservation Millage with the intent to protect open farmland, natural areas, and land along the Huron River. However, land acquisition decisions within the greenbelt and surrounding areas could be improved and made more ecologically relevant through a concerted effort to decrease fragmentation on a countywide scale. This project attempted to minimize habitat fragmentation within Washtenaw County by using a Multi-Criteria Evaluation analysis within GIS to prioritize parcels with the following attributes: 1) proximity to protected parks; 2) parcel size; 3) slope; 4) distance to roads and other development; and 5) distance to streams/wetlands/rivers. The analysis examined how fragmentation across the county was affected by different attribute weights and produced six scenarios (three "Conservation Only" scenarios and three "Conservation and Restoration" scenarios). These scenarios were then analyzed using Patch Grid Spatial Statistics (FragStats Interface) in ArcGIS to identify the scenarios that could be used to guide future land use planning in the goal of maintaining ecological connectivity at the county level. Unsurprisingly, the scenarios that placed distance to waterways as the most important factor were the least fragmented. These scenarios were then used to identify potential parcels that could be targeted to collectively prevent and reduce habitat fragmentation within the county, while also protecting vulnerable waterways within the confines of political boundaries.

Rothrock, Paul*[1] and Paul Labus[2]. **Assessing restoration status of dune and swale communities, South Shore Lake Michigan.** [1]Indiana University, Bloomington, Indiana. [2]The Nature Conservancy, Merrillville, Indiana. E-mail: perothro@indiana.edu

The Tolleston Strand Dune and Swale region in Indiana's Gary-Hammond-East Chicago corridor has experienced dramatic modification by urban-industrial activity. Nonetheless, globally significant nature preserves persist with oak savannas clothing ridges and marshes, pannes, and wet prairies in the swales. Given the continuous management issues presented by fire suppression and invasive exotic species, a simple restoration assessment tool is needed. Initial metric development was based upon sampling 27 savannas and 26 swales. Transects were composed of 15 1-m^2 quadrats. Site quality of savannas and swales was estimated using best professional judgment of a panel of seven regional botanists. Analysis of variance was used to test a suite of potential structural and floristics metrics against the best potential judgment of the

panel. Five savanna and four swale metrics were chosen. For both savannas and swales metrics included shrub cover, exotic species cover, species richness, and mean conservatism. Savanna metrics also included canopy cover. We validated metric performance by analyzing 35 pre- and post-restoration sites. Since initial phases of savanna restoration may actually reduce mean conservatism, a better metric may be the number of conservative species. Mean conservatism also needs to be cautiously applied in initial phases of swale restoration when vegetation cover is low.

Simmons, Matthew*[1], Chris Sthultz[1], and Jessica Dowler[2]. **The influence of patch-burn grazing on plant community structure in a restored Minnesota tallgrass prairie.** [1]University of Minnesota Crookston, Crookston, Minnesota. [2]Natural Resources Conservation Service, Britton, South Dakota. Email: msimmons@crk.umn.edu

Conversion of prairies to agriculture, supression of fire, and the near extirpation of bison have significantly altered prairie structure and function. Currently, less than 1% of native tallgrass prairie remains. Recent prairie restoration efforts, such as patch-burn grazing (PBG), have attempted to reestablish historic disturbance regimes. In summer 2011, PBG was initiated in northwest Minnesota at Glacial Ridge National Wildlife Refuge, the site of the largest prairie and wetland restoration in the United States. Objectives of this study are to assess and compare responses of prairie plant communities between PBG and a traditional burn-only approach. Results after four years indicate that cattle utilization was higher on recently-burned patches than on unburned patches, but fence lines and areas near water sources were also heavily grazed and/or trampled. Visual obstruction readings showed that vertical plant structure was more heterogeneous in the PBG unit than in the control. Average litter depth was less in the PBG unit than in the control, and frequency of bare ground was greater in the PBG unit than the control. Plant species composition also differed between the PBG unit and the control. Our results indicate that PBG increases spatial heterogeneity in terms of plant height, litter depth, and ground cover over traditional burn-only treatments. This has important implications for increasing diversity of ground-nesting birds and other wildlife in restored prairies. However, the greater amount of bare ground in the PBG unit may increase soil erosion compared to burn-only treatments, and the heavily-disturbed areas around water and along fence lines may be more susceptible to future invasion by exotic species.

Talkington, Nora E.*[1,2] and Andrea Kramer[2]. **Can experienced genotypes improve grassland restoration outcomes?** [1]Northwestern University, Evanston, Illinois. [2]Chicago Botanic Garden, Glencoe, Illinois. Email: noratalkington2012@u.northwestern.edu

Invasive plants have the ability to alter biotic and abiotic conditions of ecosystems and can be a selective force. If the conditions for Darwinian evolution are met, considerable selective pressures are exerted on native remnants from exotic plants. In cases where the presence of an invasive does not lead to the complete decimation of the local native plant population, individual plants can coexist with exotics in a remnant population. Remnant natives may be able to compete with a specific invasive better than individuals within the original un-invaded native population. By selecting native plant lineages that have already demonstrated resilience to a particular exotic, land managers have the potential to increase the probability of native

reestablishment at invaded sites. In addition, it is likely that the plant material used for restoration has been inadvertently selected for high reproductive output, as opposed to other traits such as rapid vegetative growth, which could lead to reduced competitive ability of re-seeded native plants in restored sites. This study investigates whether sourcing from experienced populations of a Colorado Plateau native perennial grass (*Sporobolus airoides)* that have been growing with an aggressive invasive species (Russian knapweed, or *Acroptilon repens*), may be a more suitable choice for restoration of knapweed-degraded habitat than naïve or commercially available sources. Using a common garden and competition trials established at the University of Utah's Rio Mesa Center in spring 2014, I recorded survival, growth, and reproductive output of two generations of *S. airoides* seed collected from long-term *A. repens*-invaded sites and adjacent un-invaded sites under competitive and non-competitive conditions. Additionally, I compared wild-collected and commercially sourced *Sporobolus airoides*. Results from this study have direct implications for informing seed sourcing strategies for restoration aimed at increasing the establishment and persistence of native species at restoration sites where invasive species are present.

Tiemens, Rebecca*, Rachel Shmagranoff and Young D. Choi. **Primary productivity of a restored prairie and an old field in Taltree** Arboretum, Valparaiso, Indiana. Purdue University Calumet, Hammond, Indiana. Email: ydchoi@purduecal.edu

Prairie restoration has been as a means to increase plant species diversity and to promote ecosystem functioning. According to the biodiversity-ecosystem functioning (BD-EF) hypothesis, promotion of species richness and diversity would enhance primary productivity and complementarity. While primary productivity is a measure of ecosystem function, complementarity among diverse species is a way to maintain stability in primary production and other ecosystem functions. We tested the BD-EF hypothesis by comparing plant biomass production in high-diversity a restored prairie (H′=2.39 with 47 species) and a low-diversity old field (H′=1.50 with 21 species) that were located in Taltree Arboretum, Valparaiso, Indiana. In doing so, we hypothesized that the plants in restored prairie would produce greater biomass than the old field. The restored prairie exhibited an increase in it aboveground biomass production from 7,297 kg ha^{-1} in 2011 to 9,208 kg ha^{-1} in 2014, while the opposite was true for the old field (from 9,256 kg ha^{-1} in 2011 to 7,903 kg ha^{-1} in 2014). The belowground biomass decreased from 1,469 kg ha^{-1} to 861 kg ha^{-1} in the old field from 2012 to 2014 and fluctuated in the restored prairie between 1,176 and 1,937 kg ha^{-1} during the same period. Our results suggest that the high species diversity has promoted primary productivity upon the development of restored prairie community, supporting the BD-EF hypothesis. The reduction of biomass in the old field was likely due to a decline of the most dominant species (*Solidago nemoralis*), suggesting a lack of complementarity by other species in this low-diversity community. However, the evidence is not conclusive yet to support the complementarity effect of BD-EF hypothesis. A longer-term study is needed.

Warrix, Adam R.* and Jordan M. Marshall. **Influence of fire on Callery pear in a managed prairie.** Indiana University-Purdue University Fort Wayne, Fort Wayne, Indiana. Email: warrar01@ipfw.edu

Callery pear (*Pyrus calleryana*) is an invasive tree introduced to North America as an ornamental from southwest Asia. It easily invades disturbed areas, causing a disruption to mid- to late-successional species establishment. The purpose of this study was to assess Callery pear demographics in a managed prairie and quantify the effects of a prescribed fire management strategy on Callery pear density and recruitment. This study was conducted at Arrowhead Prairie, Allen County, Indiana, managed by Little River Wetlands Project. Before 2009, Arrowhead Prairie was primarily used for agriculture. Following Little River Wetlands Project acquisition, the property has undergone active management including native plant seeding and prescribed fire. The prairie was divided into a north and south section, with the south section burned in April 2015 and the north section left unburned as a control. Fire top killed Callery pear individuals, with 100% producing root sprouts and 83% producing more than one root sprout. In the unburned section 13% of pear individuals produced root sprouts. In the burned section, trees were approximately 30 cm shorter than prior to the burn. However, the mid-season stem heights for burned trees were not different from the pre-season stem heights for the unburned trees. While fire did not reduce stem height, it did increase the number of stems occurring within the burned section. Root stored reserves provided necessary energy to produce numerous sprouts by the majority of pear trees. Continued field work for this project will follow these trees for additional growing seasons assessing growth and reproduction.

Wegener, Mark* and Joy B. Zedler. **Curtis Prairie: More than a prairie…**. University of Wisconsin-Madison, Madison, Wisconsin. Email: mark.wegener@wisc.edu

Curtis Prairie at the University of Wisconsin-Madison Arboretum is renowned as an early prairie restoration, dating to the first plantings of native species in 1935. By the 1960s, plantings and prescribed burning achieved dominance by native forbs and graminoids, and the site was used as a regional reference plant community for prairie restoration. Now, at 80 years, its wetland components are gaining recognition and being mapped to improve planning for managing urban stormwater runoff. Wetland vegetation covers about a fifth (22.3%) of the 29 ha site. Nutrient-rich urban runoff seems responsible for strong dominance by six wetland plant species that tend to form monotypes (mapped as polygons from GPS ground surveys). The monotypes have high biomass, but low species richness. In all, monotypes make up 47% (3.04 ha) of the 6.4 ha of wetland. Widespread invasions of woody plants (especially monotypes of native gray dogwood, *Cornus racemosa*) are yet to be mapped, and impacts of shrubs on prairie diversity will be assessed in summer 2015. Wetland vegetation and shrub dominance have reduced the area of tallgrass vegetation in Curtis Prairie. We predict that changing climate and urban pressures will favor monotypic wetland vegetation by increasing runoff and eutrophication of the lower elevations. The mapping of monotypes is an important monitoring tool for this prairie-restoration icon.