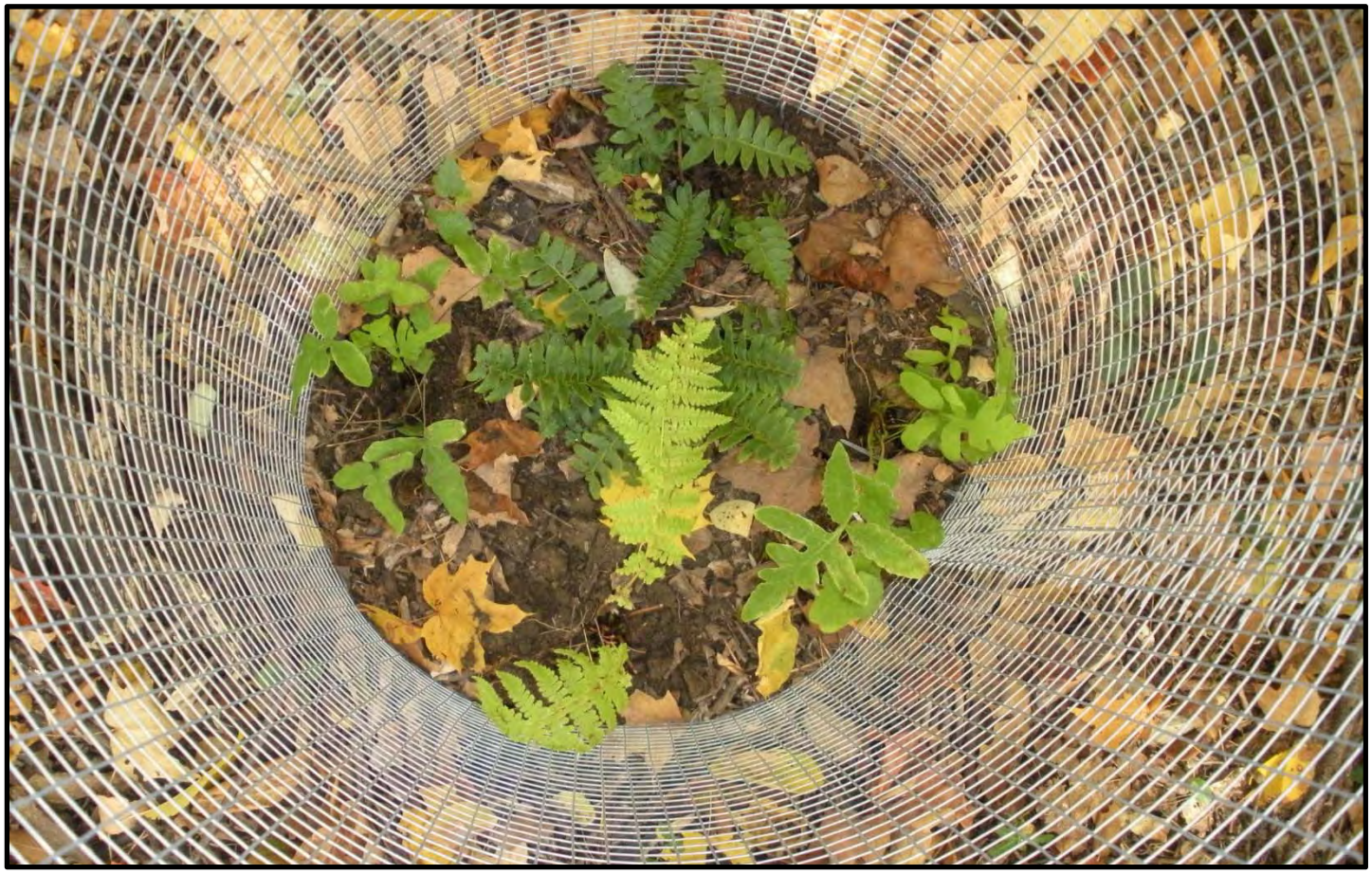
OVERCOMING CHALLENGES TO ECOLOGICAL RESTORATION IN THE 21ST CENTURY



3/29/2016 DRAFT – ABSTRACT BOOK

EIGHTH MIDWEST-GREAT LAKES SER CHAPTER MEETING

April 1 to 3, 2016

Indiana University, Bloomington, Indiana

SER MIDWEST GREAT LAKES SOCIETY FOR ECOLOGICAL RESTORATION

Eco Logic ECOLOGICAL RESTORATION

INDIANA UNIVERSITY

CITY OF BLOOMINGTON parks and recreation

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WELCOME

Welcome to the Gateway to Scenic Southern Indiana and the Eighth Annual Meeting of the Midwest-Great Lakes Chapter of the Society for Ecological Restoration. Our goal for this meeting is to explore the linkages among climate change, invasive species, herbivory, civic engagement, monitoring, and other anticipated challenges to ecological restoration and their impact on ecosystem health. Our scientific agenda for this three day meeting features two plenary sessions, a keynote address, three symposia, two workshops, 24 contributed poster presentations, 42 contributed oral presentations, and two offsite field trips on a range of topics that reflect our meeting theme. This year represents the first time we are able to offer meeting attendees continuing education credits. Our Meeting Hosts (Eco Logic, Indiana University, and City of Bloomington Parks and Recreation) will offer a special joint plenary session and tour as part of the meeting. This joint session will provide an overview of the challenges and successes of campus restoration projects and the associated research, teaching, and outreach activities underway on the Indiana University campus. We hope you will enjoy another outstanding chapter meeting.

2016 ANNUAL MEETING COMMITTEE

The Chapter extends its sincere appreciation to the members of the Annual Meeting Committee for their time and effort in coordinating and developing the Eighth Annual Chapter Meeting: *Rocky Smiley (Chairperson), Mary Damm, Rebecca Dolan, Spencer Goehl, Daniel Larkin, and Jennifer Lyndall*

ACKNOWLEDGEMENTS

We are very grateful for the generous support provided by our meeting hosts and sponsors that enabled us to hold a sponsorship reception, support student participation, defray food costs, and make our Annual Meeting as environmentally friendly as possible. We greatly appreciate the contributions of the members of the Local Planning Committee *(Spencer Goehl (Chairperson), Steve Cotter, Mary Damm, Phil Oser, Heather Reynolds, Paul Rothrock)* who assisted with planning the meeting and provided onsite help. We thank Rebecca Dolan and Martha Holzheuer for their work in enabling us to offer continuing education credits through International Society of Arboriculture and the Society of American Foresters. We are also thankful for the participation of the meeting presenters, moderators, tour leaders, field trip leaders, volunteers, and attendees at our Eighth Annual Meeting.

SPONSORSHIP RECEPTION

Enjoy drinks and snacks while examining poster presentations, viewing sponsorship exhibits, and socializing with colleagues.

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KEYNOTE PRESENTATION

Ladd, Douglas*. **Does ecological restoration need a rethink?** The Nature Conservancy, St. Louis, Missouri. Email: dladd@tnc.org

Ecological restoration as a discipline has matured and developed into a respected field that is an essential component of modern conservation practice. Simultaneously, the world's biological systems have continued to degrade, and today face stresses and changes unprecedented in the post-Pleistocene era. A growing chorus, including some conservationists, is advocating novel approaches to conservation and restoration theory, including some that would previously have been considered heretical. Are these relevant – and how should contemporary practitioners approach ecological restoration?

WORKSHOPS ABSTRACTS

Sedge (*Carex* spp.) Identification (Jordan Hall - Room 122)

Instructor: Rothrock, Paul E. Indiana University, Bloomington, Indiana.
Email: perothro@indiana.edu

This workshop will consist of 3 parts: 1) an introduction to the morphology of the genus *Carex*; 2) an introduction to common species of *Carex* using a free public domain pictorial guide; and 3) an opportunity to "test drive" the new *Carex* key. The genus *Carex*, with over 110 species in Indiana, is an important ecological component of wetlands and forests in the Midwestern United States. It also has a reputation for being a taxonomically difficult group. The pictorial guide, centered on the Chicago Region, illustrates 36 common species of sedge. The "Keys to Nature" online tool for the genus *Carex* provides a format for combining traditional dichotomous keys with rich pictorial content to explicate diagnostic characters. Recently a meta-version for *Carex* in the western Great Lakes region has been completed. Participants will need to bring a wireless-capable computer so that they can access the online key.

Employing Effective Quality Assurance Strategies in the 21st Century – a Workshop on Best Practices in Conducting Data Quality Control Checks in Ecological Restoration Projects (Indiana Memorial Union Oak Room)

Instructors: Blume, Louis[1], Brick M. Fevold[2], Adam Bucher[2], and Judy Schofield[2]. [1]U.S. Environmental Protection Agency, Chicago, Illinois. [2]CSC Government Solutions, LLC, Alexandria, Virginia. LB Email: blume.louis@epa.gov; BF Email: brick.fevold@csra.com; AB Email: Adam.Bucher@csra.com; JS Email: judith.schofield@csra.com

Have you ever questioned the reliability of your monitoring data? (Be honest!) In ecological restoration projects, reliable data are needed to accurately assess ecosystem conditions, track progress toward stated restoration goals, determine the effectiveness of restoration practices, and provide evidence of restoration success. However, restoration projects often lack sufficient quality control assessment necessary to estimate uncertainty and facilitate the collection of data of acceptable quality to support sound decision making. In this workshop, we will share approaches and lessons learned for assessing, improving and documenting the quality of ecological data. Participants will be invited to engage with the speakers, and each other, in practical exercises demonstrating the concepts and applications of quality control (QC) check procedures, including: 1) hot-check; 2) cold-check; 3) blind-check; 4) precision-checks; and 5) calibration-checks. QC checks are an essential component to any monitoring program and can provide the empirical data necessary to estimate uncertainty and evaluate conformance with stated data quality acceptance criteria used to assess compliance and effectiveness in restoration projects. Participants will gain an understanding of quality control best practices, example strategies relevant to their restoration project needs, and a compendium of the presentations, exercises, and recommended resources for enhancing and evaluating the quality of data collected as part of their ecological restoration project.

OPENING PLENARY SESSION ABSTRACTS

OVERCOMING FUTURE CHALLENGES FOR ECOLOGICAL RESTORATION

Brudvig, Lars A. ***The Importance, Challenge, and Prospect of Landscape-Scale Restoration***. Michigan State University, East Lansing, Michigan. Email: brudvig@msu.edu

Ecological restoration holds great promise for recovering and promoting native biodiversity, functioning ecosystems, and ecosystem services to humans. Importantly, in many cases, achieving this promise will require landscape-scale considerations during restoration. Such processes as animal foraging, persistence of patchy populations, ecosystem service spillover, and climate-induced species range migrations all take place at large, landscape-scales that may encompass multiple ecosystems. Moreover, landscape context - the makeup of the landscape that surrounds a particular restoration site - may have strong bearing on the outcome of restoration efforts within a particular site due to the influx of species or other reasons. Because of this, understanding the influences of landscape context may assist with interpreting variation in restoration outcomes. Yet, in spite of the importance of considering landscape-scale considerations in restoration, most restoration ecology research and many ecological restoration activities take place at the scale of sites or smaller. How do we better develop the science and practice of landscape-scale restoration? Drawing on my research and the work of others, I consider this question in context of the challenges and potential strategies for interpreting, guiding, and conducting landscape-scale restoration in the Midwestern United States. These considerations span approaches to monitoring current restoration efforts and the design of new restoration research and projects. I argue that engaging in these and other approaches will be important for interpreting and guiding successful restoration efforts into the future.

Jacquart, Ellen M. ***Strategies for Addressing the Challenge of Invasive Plant Species in Restoration***. The Nature Conservancy of Indiana, Indianapolis, Indiana. Email: ejacquart@tnc.org

Invasive plant species are one of the greatest challenges to restoration practitioners, and perhaps the most common reason for prairie, forest, and wetland restoration failures. From the moment the restoration begins, invasive plant species threaten to take advantage of any disturbance involved and out compete the native plants that are being managed for or introduced. Even if careful attention and management keep them from becoming a problem in the initial restoration, invasive plant species still pose a threat as time passes, especially in ecosystems that undergo periodic disturbances like fire, wind throw, or ice storms. In my presentation I will provide a review of the challenges posed by invasive species in restoration projects and I will discuss specific strategies used in Conservancy and other restorations in Indiana to reduce the impact of invasive species on ecological restoration projects.

Shuey, John A. ***Restoration as a Strategy for Increasing Ecological Resilience and Adaptation for Future Climate Change Regimes***. The Nature Conservancy, Indianapolis, Indiana. Email: Jshuey@tnc.org

Ecological restoration can be viewed as an attempt to return an ecosystem to its historic trajectory that occurred prior to degradation or destruction. Climate change turns this perspective on its head. If we expect our restorations to perform into the foreseeable future, we have to envision alternant trajectories. In states like Indiana, restoration plays a huge role within the conservation community. Thanks to land-use decisions made over the last century, we have broken or at least significantly damaged virtually all of our ecosystems across the state. Instead of lamenting our past ecological blunders, we should embrace a restoration-centric future that allows us to anticipate impending change. We can use ecological restoration as at least partial solutions to increase ecological resilience and better enable ecosystems to respond to change. In my presentation I will discuss how The Nature

Conservancy in Indiana has “placed our bets” in light of the anticipated climatic regimes in the future, and how we are using restoration to specifically address some of the ecological stressors that are likely to drive ecological change over the next several decades.

Glass, Steve. ***Challenges for Ecological Restoration Presented by the Novel Ecosystems Concept.*** The Restoration Ecology Lab. Madison, Wisconsin. Email: sbglass1@mac.com

In recent years new challenges for ecological restoration have emerged in the form of the novel ecosystems concept. Proponents of this theory contend that because of the impacts of human activities, ecosystems are increasingly shifting into irreversible ecological states from which they cannot be rescued by ecological restoration practices. Thus, their argument continues, ecological restoration faces technical constraints--impossibilities even—to achieving desired outcomes of ecological restoration projects and because of this, “ecological restoration is creating false expectations and wasting limited resources.” The contentions of the novel ecosystem proponents have not been subjected to rigorous scientific scrutiny. Further, they ignore that restoration ecologists are trained and long-experienced in dealing with the technical challenges presented by human impacted ecosystems. These ecological challenges are often less of a problem than the socio-cultural and policy constraints already encountered by many ecological restoration projects. The stubborn challenge that the novel ecosystems concept presents to ecological restoration is its troubling policy implications, which may, among other things encourage some to ignore or give up on ecological restoration. The novel ecosystems concept also challenges the fundamental assumptions on which ecological restoration is based and brings into sharp focus some of the discipline’s operational tendencies and practices, which may in fact exacerbate the policy challenge. I will explore how policy develops and impacts restoration projects. I will also present a framework for examining and understanding the complicated and dynamic nature of policy making, present real-life examples to illustrate these points, and make recommendations for turning these challenges into opportunities for strengthening and advancing ecological restoration.

SYMPOSIA ABSTRACTS

RESTORATION IN RIGHTS-OF-WAY SYMPOSIUM ABSTRACT

Holzheuer, Martha. **Restoration in Rights-of-Way – a discussion about improving habitat and creating connectivity in 21st century landscapes.** Environmental Consulting & Technology, Inc., Bay City, Michigan. Email: mholzheuer@ectinc.com

Ecological restoration and ongoing land stewardship efforts tend to target high quality natural areas, but what is being done with the millions of acres consisting of transportation and utility rights-of-way? These corridors are ubiquitous across our 21st century landscape and often represent the only land not currently in use for agriculture or urban development. As such, they provide important ecological restoration and wildlife habitat improvement opportunities. In 2015, the Wildlife Habitat Council released new project guidance on Integrated Vegetation Management (IVM) for infrastructure corridors. The newly formed Rights-of-Way as Habitat Working Group provides relevant information about habitat development within rights-of-way and facilitates networking opportunities among diverse Midwest organizations. Private entities like ITC Holdings Corp. have successfully implemented IVM programs to maintain their utility corridors as functional ecosystems while ensuring electric system reliability. Iowa's progressive Integrated Roadside Vegetation Management Program combines an array of management techniques with sound ecological principles to establish and maintain safe, healthy, functional, and ecologically integrated roadsides. Please join our rights-of-way management and restoration experts to discuss the unique opportunities, challenges, success stories, and lessons learned while making rights-of-way resilient and ecologically significant features in our 21st century landscape.

RESTORATION IN RIGHTS-OF-WAY SYMPOSIUM PRESENTATION ABSTRACTS

Barnas, Sara*. **Rights-of-Way as Opportunities for Conservation Education, Habitat Enhancement, and Sustainability.** Wildlife Habitat Council, Silver Spring, MD. Email: sbarnas@wildlifehc.org

Businesses that integrate biodiversity management and community outreach into their daily operations are well-positioned to have a competitive advantage. Utility companies can be included in this concept by looking to their rights-of-way to meet these goals. As demonstrated by several success stories, vegetation management can be effectively utilized to go above and beyond the objectives of reliability and land management to implement programs promoting environmental stewardship. On-the-ground initiatives in partnership with NGOs can target native ecosystems restoration, control of invasive species, enhancement of pollinator habitat, corridor creation for migratory species, and climate change adaptation, just to name a few. These types of initiatives can, in turn, improve relationships with stakeholders and provide visibility through certification programs, as well as lower vegetation management costs.

Caldwell, Iris*. **Promoting Conservation through Industry Collaboration and Coordination**. Energy Resources Center, University of Illinois-Chicago, Chicago, Illinois. Email: iriscald@uic.edu

The importance of public-private partnerships in habitat restoration can be seen from the successes of programs like the Partners for Fish & Wildlife, or the Bi-State Local Area Working Group in California and Nevada that was able to avoid the Endangered Species Act listing of the greater sage-grouse through proactive conservation and enhancement of habitat on private lands. Given increasing attention on the monarch butterfly and other pollinators, a number of collaborative efforts have emerged to foster conservation activities in key sectors and support an "all-hands-on-deck" approach. The Energy Resources Center (ERC) at the University of Illinois-Chicago has been involved in several of these initiatives and through our land use analyses and industry inquiries helped identify a large opportunity for and interest from utility and transportation organizations to provide pollinator habitat. Finding an absence of an active public-private collaborative focused on pollinator habitat in rights-of-way, the ERC began forming one in March 2015. Since then more than 100 organizations have been directly engaged in the Rights-of-Way as Habitat Working Group. The working group's overarching aim is to provide a forum to collaborate and share ideas, best practices, and other information that promote successful habitat projects along rights-of-way. Activities of the working group include facilitating workshops and webinars, assembling resources for rights-of-way managers in an online database, communicating best practices, developing a unified message about rights-of-way as habitat, encouraging collaboration between landowners, providing industry recognition, and supporting other collaborative initiatives such as the I-35 Monarch Highway, the Keystone Policy Center's Monarch Collaborative, and the Ecological Places in Cities Network's Urban Monarch Landscape Conservation Design project. This presentation will provide an overview of the Rights-of-Way as Habitat Working Group's efforts as well as other similar collaborative conservation initiatives.

Murray, Amy N*. **Integrated Vegetation Management: Maintaining Electric Transmission Corridors as Ecosystem Components**. ITC Holdings Corp., Novi, Michigan. Email: amurray@itctransco.com

ITC is the country's largest independent electricity transmission company, owning and operating systems in 7 states and managing over 15,000 miles of transmission corridors. Established in 2003, our early challenges focused on improving system reliability through infrastructure upgrades and addressing neglected rights-of-way conditions. We next began crafting best in class, proactive maintenance practices. Best long term utility rights-of-way maintenance contemplates not only safe and reliable electricity transmission but also weaving stewardship into our vegetation program philosophy, execution, and ITC's positive contribution to the landscapes in which we operate. ITC is making this happen, day by day, mile by mile. Our staff is trained and passionate. We are a Tree Line USA utility, awarded numerous *Wildlife at Work* Wildlife Habitat Council certifications and awards, and partner with the Nature Conservancy, land conservancies, municipal parks, state agencies such as Departments of Natural Resources and Departments of Transportation. ITC is actively working to (1) change attitudes that transmission ROW's are sterile or monoculture ribbons, (2) identify high quality habitats and connectivity options within the landscapes of our operating areas, (3) partner with other land managers, agencies, and organizations to maximize opportunities to improve habitats and leverage resources, and (4) enhance relationships between people, places, and powerlines. The presentation will illustrate the ITC approach to creating resilient and ecologically significant features in our landscape, and our unique opportunities, challenges, success stories, and lessons learned.

Roman, Robert B.* **Integrated Roadside Vegetation Management in Iowa.** Linn County Engineering and Secondary Road Department, Marion, Iowa. Email: rob.roman@linncounty.org

Iowa Code 314.22, Integrated Roadside Vegetation Management was created by the Iowa legislature in 1988. The objectives declare it to be in the general public welfare of Iowa and a highway purpose for the vegetation of Iowa's roadsides to be preserved, planted, and maintained to be safe, visually interesting, ecologically integrated, and useful for many purposes. The program is mandated to the state and optional for counties. Linn County has been involved with an IRVM Plan and Program for its transportation corridors since 1990. Public purposes listed in the legislation include erosion control, wildlife habitat, climate control, scenic qualities, weed control, utility easements, recreation uses, and sustenance of water quality. For over 25 years, partnerships between native plant producers in the private sector and various agencies in the public sector in Iowa have produced a wealth of native plant materials that are now available for both public and private use. Transportation corridors in Iowa provide a huge opportunity for multiple purpose planting and management efforts. Linn County has a history of using native prairie species in roadsides going back to 1971. In calendar year 2015, Linn County's native prairie roadside planting efforts again surpassed 10% of the total acreage statewide at the county level in Iowa. The longevity of our native roadway plantings is perhaps greater than that of any other roadway improvement. The resilience of these plantings has been documented in a variety of demonstrations. Challenges and opportunities for ecological restoration in Iowa's roadsides have perhaps never been greater. This talk will discuss how partnerships have diminished the challenges and how communication has enhanced the opportunities for ecological restoration in Iowa's transportation corridors.

SOIL MICROBES IN ECOLOGICAL RESTORATION SYMPOSIUM ABSTRACT

Bach, Elizabeth M1, Jonathan T. Bauer2, and Liz Koziol2. **Soil Microbes in Ecological Restoration**. 1Illinois Natural History Survey, Champaign, Illinois. 2Indiana University, Bloomington, Indiana. Email: ebach@illinois.edu, jonbauer@indiana.edu, ekoziol@indiana.edu

Soil microorganisms play a central role in ecosystem function and maintaining the diversity of plant communities. However, soil microbial communities are susceptible to anthropogenic impacts and management of the soil community may be required to meet restoration goals, including restoration of soil structure and function and the re-establishment of diverse plant communities. Exciting progress has been made in this research area within the tallgrass prairies of the Midwest and Great Lakes region of the United States, with scientists advancing our foundational knowledge of soil ecology, gaining insights into how soil microbial communities respond to ecological management, and developing techniques for the reintroduction of soil microbial communities to restoration sites. This symposium will explore how soil communities change over time, both within a season and with succession. Specifically, the symposium will highlight advances in how re-establishment of diverse native plant communities may shape soil communities over decades and within phenological cycles, how soil microbial communities respond to management including prescribed fire, and how inclusion of soil microbes in restoration efforts can improve the establishment of late-successional plant communities. Presenters will share new insights into how soil microbial communities and the functions they provide may shape the composition of restored plant communities. We will conclude the symposium with a panel discussion, exploring how we might use new knowledge of plant-microbial interactions to develop innovations in restoration practice.

SOIL MICROBES IN RESTORATION SYMPOSIUM PRESENTATION ABSTRACTS

Kathryn M. Docherty[1]. **Toward belowground restoration: understanding the effects of land management on soil microbial communities in a tallgrass prairie.** [1]Western Michigan University, Department of Biological Sciences, Kalamazoo, MI Email: kathryn.docherty@wmich.edu

Agricultural cultivation in the Midwestern United States has caused an 82-99% decline in the tallgrass ecosystems that once dominated North America and has severely impacted the ecosystem services they provide. Current prairie restoration and land management approaches focus on improving aboveground ecosystems, but are poorly integrated with restoration of soil microbial biodiversity and carbon cycling. Restored prairies harbor microbial communities that metabolize more labile forms of carbon and have greater rates of soil respiration than pristine remnant prairies, suggesting that traditional prescribed burn approaches lead to an alternative stable belowground community. Given these fundamental differences in soil microbial structure, it may be possible to use remnant-based soil microbial communities to restore resilience to newly converted soils. In this study, we examined the effects of disturbance on remnant and restored soil microbial biodiversity and function over the course of a year. We measured soil microbial biodiversity, extracellular enzyme activity, soil nutrient status and soil microbial carbon utilization patterns at four seasonal time points. Overall, the remnant communities exhibited lower variability than the restored, suggesting that they are more stable and more resilient to environmental changes. Following this time-series, we conducted a greenhouse experiment to test whether inoculation with remnant-derived soil microbial communities decreases the effects of warming on newly restored soils. We found that warming substantially increased variability in soil microbial properties, as compared to ambient controls. However, when soils were inoculated with remnant soil microbial communities and warmed, variability in response to warming was decreased. These results suggest that soil inoculation may be a useful and cost-effective strategy that land managers can implement to promote resilience in belowground communities. In Summer 2016, we will be conducting pilot studies to test the effectiveness of this approach at the field level.

Sara G. Baer[1], Elizabeth M. Bach[2], Drew A. Scott[1], and J. Six[3]. **Physical and biological factors underlying recovery patterns of soil microbial biomass during grassland restoration on decadal time scales.** [1]Southern Illinois University, Department of Plant Biology and Center for Ecology, Carbondale, IL. [2]Illinois Natural History Survey, University of Illinois, Champaign, IL. [3]Department of Environmental Systems Science, Swiss Federal Institute of Technology, ETH Zurich, Switzerland Email: sgbaer@siu.edu

Understanding processes that promote or constrain belowground recovery from disturbance is needed to predict the potential to restore degraded ecosystems. Grassland is one of the most human-altered biomes through conversion to row-crop agriculture. In addition to drastically reducing plant diversity, cultivation degrades habitat (soil structure) and depletes resources (soil organic matter) for soil microbial communities. Sowing perennial grasses into former cropland generally results in an increasing quantity of lower quality root biomass over time, which should promote soil aggregation through physical entanglement with roots and associated hyphae, as well as microbial turnover in response to carbon inputs from roots. Comparative studies are needed to elucidate the influence of physical and biological factors on recovery of the soil microbiota, presumed to play a key role in soil aggregation and physical protection of carbon during restoration. We used multiple chronosequences (space-for-time substitutions) to quantify decadal recovery patterns of roots, microbial biomass, and soil aggregate structure in response to variation in soil texture and plant diversity. Further, one chronosequence of a few closely co-located restored prairies was used to determine the relative influence of roots, microbial biomass, and soil structure on physically protected carbon.

Chronosequence comparisons on contrasting soil textures demonstrated that adequate clay content is a prerequisite for recovery of the soil microbial biomass and soil aggregate structure. Within a similar soil texture, restoration and management of restored grassland to promote plant diversity resulted in a greater increase in root biomass, more predictable increase in active microbial biomass, and faster recovery of soil aggregate structure than grasslands sown with fewer species and minimally managed. The chronosequence of co-located sites with most soil and management factors controlled resulted in the most variation explained in recovery rates and demonstrated that physically protected carbon is mostly influenced by root biomass.

Elizabeth M. Bach, Andrew N. Miller **Linking above- and belowground phenology: Temporal shifts in microbial communities and activity in restored and remnant prairies.** Illinois Natural History Survey, Champaign, IL. Email: ebach@illinois.edu

A common goal of ecological restoration is to establish a diverse plant community that resembles remnant communities. Research has shown that belowground microbial communities respond to restored plant diversity, moving on an accelerated trajectory toward remnant microbial communities compared with low plant diversity restorations. Total plant community composition requires evaluation at multiple time points to capture early-, mid-, and late-season plants equally. However, soil microbial communities are typically evaluated from a single sampling time, even though research has shown microbial community structure fluctuates temporally. In this research project, I evaluated both soil microbial community structure and activity at five sampling points, tied to key plant growth stages. Samples were taken in both restored and remnant tallgrass prairie on two soil textures (sandy and clayey) in Illinois. Although overall microbial activity was lower in the sandy soil, there was a similar rate of increase in microbial activity across sampling dates. Temporal patterns in microbial activity were similar in remnant and restored prairies, but overall P and N cycling enzyme activity was greater in remnant prairies than restored prairies. This result is consistent with legacy effects of inorganic fertilizer inputs in restored systems. The consistent temporal patterns in microbial activity in both soil types and in restored and remnant prairies indicates changes in temperature, moisture, and plant inputs across the growing season evoke general responses in soil microbial communities.

Bauer, Jonathan T.[1], Liz Koziol[1], and James D. Bever[2]. **Utilizing plant-microbial interactions to restore late-successional plant communities.** [1]Indiana University, Bloomington, Indiana. [2] University of Kansas, Lawrence, Kansas
email:jonbauer@indiana.edu

Plant interactions with soil microbial communities are essential to plant species coexistence and the maintenance of ecosystem function. It is also possible that plant-microbial interactions act as drivers of secondary succession. If so, understanding these interactions will allow us to better predict successional trajectories and to develop innovations in restoration practice that will accelerate the recovery of disturbed ecosystems. My work in the tallgrass prairie has shown that species of high conservation concern are typically late-successional plant species, and plant-microbial interactions are an important component of the life-history tradeoffs underlying shifts in species abundance with succession. Early successional plant species experience stronger negative plant-soil feedbacks than late successional plants, and we have also observed that late-successional plant species respond more positively to mycorrhizal fungi than late successional plants. These experiments indicate that soil microbial communities might be utilized to improve the re-establishment of late successional plant species. We find further evidence that soil communities can determine restoration success from greenhouse mesocosm experiments, where site-to-site variation in the composition of the soil community can have strong effects on the productivity and composition of plant communities. These results suggest that plant-microbe interactions can be incorporated into ecological restoration to improve restoration outcomes, and preliminary results from experimental restorations indicate better establishment of late-successional plant species when inoculated with appropriate microbial mutualists.

Liz Koziol and James D. Bever. **Inoculation with native AM fungi improves establishment, growth, richness and diversity of late successional plant species in a prairie restoration.** Indiana University Bloomington, IN. Email:ekoziol@indiana.edu

Evidence is accumulating that arbuscular mycorrhizal (AM) fungi play a vital role in grassland community dynamics. Studies have suggested that fast growing early successional plants do not greatly benefit from AM fungi, whereas late successional plants greatly benefit from fungal inoculations. Additionally, late successional species have been found to demonstrate greater specificity towards individual AM fungal species (i.e. strongly benefiting from some but not all fungal species). Interestingly, grassland restorations often take place at sites with disturbed soil fungal communities and are often are missing many late successional plant species, both of which are consistent with missing AM fungi limiting their successful reestablishment.To see how grassland plants respond to different prairie AM fungal communities during a grassland restoration, seedlings of eight early and eight late successional plant species were planted into a field restoration in Bloomington, IN. Plants in replicated 1.5m plots were inoculated with either one of four AM fungal species, a mixture of four fungal species, or non-inoculated. The site was also seeded with a 60 species prairie seed mixture. During the first growing season, we found that inoculation with AM fungi improved plant survival by 40% and that certain AM fungal species doubled average plant productivity and fecundity. Some of these growth promoting fungal species also stimulated nearby seed establishment in subsequent growing seasons. Thus, by year three, plots inoculated with certain AM fungal species were twice as species rich and had five times greater desirable biomass relative to non-inoculated plots, which resulted in plant community diversity that is comparable to what can be found in some remnant prairie communities. These results suggest disturbed soil communities may limit prairie plant reestablishment in grassland restorations. We conclude that native prairie AM fungal inoculations can facilitate more species rich restorations with greater community diversity in as little as two years.

RAVINE RESTORATION SYMPOSIUM ABSTRACT

Lenhart, Christian. **Restoration and management in ravines and steep forestland**. University of Minnesota, St. Paul, Minnesota. Email: lenh0010@umn.edu

Restoration and management in forested ravines and steep lands within the Midwestern United States is important because these areas are erosion hotspots and they support unique and valuable natural features. Ravines commonly border larger river valleys or other drainage ways where intermittent streams flow over topographic breaks. Examples include the Minnesota River valley and much of the steep forestland in southern Indiana and Illinois. Soils erosion processes include gully erosion at the heads of the drainage ways with mass wasting and soil creep in the more incised wooded ravines. Many of these areas have undergone natural reforestation since the 1930s as a result of abandonment of agriculture and conversion to public ownership. Typically the ravines contain mesic forest in the shadier portions and more open oak woodland in drier or more managed areas. Research in ravines of the Minnesota River basin has shed light on the hydrologic, vegetative and erosion process interactions in the Seven-Mile Creek watershed. Plant community composition, ground coverage, root traits, and floristic quality are being examined in relation to erosion processes using Revised Universal Soil Loss Equation (version 2) and the Bank Stability and Toe Erosion Model. Findings from the research will help with improved targeting of sub-watersheds for sediment management and better strategies for vegetation management on ravine side-slopes and use of instream wood.

RAVINE RESTORATION SYMPOSIUM PRESENTATION ABSTRACTS

Chris Lenhart[*1], Rebecca Hammer-Lester[1], Brad Gordon[1], and Rebecca Seal-Soileau.[2] **Restoration and management issues in Midwestern ravines and steep forestland.** [1]University of Minnesota, Twin-Cities, [2]U.S. Army Corps of Engineers, St. Paul, Minnesota. Email: lenh0010@umn.edu

Ravines are steep erosion-prone landscape features that can be major sources of sediment to downstream waters. They frequently cause maintenance problems as they headcut into farmland and undermine culverts and bridges. Many ravines and steep forestlands were farmed or grazed in the 1800s to early 1900s and later abandoned to farming and/or converted to parkland, including much of the Shawnee and Hoosier National Forests. Today in the Midwestern U.S they are unique landscape features that often serve as a refuge for forest plant communities because they are located on un-farmable land. As part of a U.S. Army Corps of Engineers interagency study of the Minnesota River to better understand and reduce sediment loading to the river, several ravine studies have been undertaken since 2013. Our study purpose was to better understand hydrologic and geomorphic processes of erosion and the role of soil properties and plant community traits in mitigating sediment delivery downstream. Intermittent flow conditions with steep, exposed ravine walls and variable plant community and soil/rock exposures produce a highly unpredictable and dynamic environment. Many of the ravines surveyed had relatively high-quality plant communities as indicated by the floristic quality index. Plant cover on side slopes is also an important control on sheet and rill erosion. Efforts to restore savanna-like conditions on drier sites with greater native grass understory cover may be beneficial both ecologically and for sediment load reduction. In-stream wood also plays a key role in sediment delivery processes within ravines, acting as sediment-retention dam when wood becomes lodged across the bed. Current management efforts in the Minnesota River basin are focusing on water storage above the ravines and prioritization of high-sediment loading banks. Improved vegetation and in-stream wood management would be helpful from the standpoint of biodiversity, sediment load and park maintenance in parkland throughout the region.

Hammer-Lester, Rebecca*[1], Chris Lenhart[1], Brad Gordon[1], Michael Kramer[1], and Rebecca Seal-Soileau[2]. **Estimating Sediment Erosion and Delivery in a Ravine System in South-Central Minnesota.** [1]University of Minnesota, [2]U.S. Army Corps of Engineers email: hamme510@umn.edu

Ravines provide a complex study environment due to the flashy nature of flow and the great variability year to year in the number of flow events. Mass wasting, sheet/rill erosion, and channel erosion all impact ravines. Mass-wasting events occur primarily due to undercutting followed by slumping. Sheet and rill erosion occur when vegetative communities, especially understory species, are not well-established and do not provide slope cohesion and protection. Vegetation also plays a role in reducing mass-wasting by increasing whole slope cohesion, especially deeper rooting species. Ravines were monitored in 2014 and 2015 for flow and sediment. The Bank Stability and Toe Erosion Model (BSTEM) was used to model erosion rates under various channel, flow, and vegetative conditions. BSTEM provides estimates of erosion by fluvial processes and via mass-wasting in tons/event. These included conditions at the head of the ravine where the banks were steep but relatively short and lower in the ravine where the slopes were both steep and tall (>35ft). In both of these conditions shrub, tree, and grass dominated slopes were modeled. Additionally, the model was run with flow regimes varying from 0.2 ft. to 1 ft. of flow depth. The results from BSTEM will likely show that slope failure is probably in the ravine, especially when the vegetative community is dominated by shallow rooting shrubs or grasses. Trees will likely increase slope stability but will not eliminate the problem of mass-

wasting because the ravine bank slopes are often greater than the angle of repose. By better understanding erosive responses to varying flows and vegetative communities, especially with regards to root depth and percent coverage, we can better understand the type of management and restoration actions that can be most effective in decreasing erosion in ravines.

Gordon, Brad*, Chris Lenhart, and Rebecca Hammer-Lester. **Floristic Quality Assessment and the Role of Vegetation in Ravine Erosion in Southern Minnesota**. University of Minnesota, St. Paul, Minnesota. Email: gordo402@umn.edu

As part of the US Army Corps of Engineers Minnesota River interagency restoration study, the team sought a better understanding of the role of vegetation on erosion in ravine systems and streambanks of the Minnesota River basin. In 2014 and 2015, the study sought to compare the vegetation, root density, and particle size of eight ravine and ditch systems in the Minnesota River basin in order to better understand their similarities for future management practices. The point-intercept method was used along multiple 30-meter transects lining the edge of ravines and streambanks in these systems. The eight ravine systems studied, with the exception of the ditches, contained a mixture of high-quality mesic forest communities with a variety of spring ephemerals and dense canopy cover, but a couple sites still displayed high levels of disturbance. Key findings to date indicate most of the ravine systems surveyed have very similar vegetative communities in their reflections of remnant communities and disturbances based on the species richness and Floristic Quality Index (FQI). The average species richness on each transect was 4 to 7 in the ditches and 7 to 24 in the ravines. Average transect FQI values were 1.4 to 4.5 in the ditches and 6.5 to 19.2 in the ravines. FQI values are somewhat low for late successional stages likely due to these systems having historical disturbances via logging or farming rather than retaining remnant communities as would be seen in old-growth forests in preserved lands. Using the revised universal soil loss equation (RUSLE), the ravines have higher surface and rill erosion estimates than the ditches mostly due to more bare ground in the ravines even though they have a higher canopy cover. While ravines seem to have higher quality vegetation communities they may be lacking the vegetation coverage necessary to prevent soil loss.

Lechner, Matthew* and Audrey Sweet. **Erosion Abatement and Restoration on the Shawnee National Forest.** US Forest Service, Shawnee National Forest, Harrisburg and Murphysboro, IL. Email: mlechner@fs.fed.us

The Shawnee National Forest spans southern Illinois and is bordered by the Mississippi and the Ohio Rivers. The area is unglaciated with diverse uplands and broad floodplains. Much of the forest is steep and covered by a fine loess cap of highly erodible soil. The region has undergone numerous shifts in land use. Practices such as past and present agriculture, the planting of non-native pines, and a shift in the fire regime have accelerated erosion and changed forest composition. At present, Forest management is focused on restoring the central hardwood ecosystem and minimizing erosion. The coupling of these objectives has led to a broader watershed management approach. The Shawnee National Forest has a checkerboard-like ownership pattern with numerous private lands interspersed with Forest lands. While in some ways this makes management more difficult, it also encourages collaboration. Much benefit to the watershed can be accrued by working across boundaries. We have several examples of working with our neighbors to everyone's benefit. We will discuss several of these and focus specifically on some work being done on Kinkaid Lake. The Kinkaid Lake reservoir is located in the northwestern portion of the Forest. The reservoir was created in 1970 as a public water source and contains about 73 miles of shoreline and 2300 acres of surface area. The reservoir has since lost more than 2 feet of shoreline and has filled with more than 10 feet of sediment in areas. This upland soil loss has detrimental impacts on soil productivity, water quality, aquatic habitat, recreational opportunities and the useful lifespan of the reservoir. Interdisciplinary teams have been working on

developing erosion abatement and restoration plans. Surveys are currently underway within the watershed to determine the locations of the most severely eroding areas.

JOINT PLENARY SESSION AND TOUR ABSTRACT

Reynolds, Heather1*, Spencer Goehl2*, and Angie Shelton1*. Campus-community partnerships for restoration, research, and education. 1 Indiana University, Bloomington, Indiana. 2 Eco Logic LLC, Bloomington, Indiana. HR Email: hlreynol@indiana.edu; SG Email: spencer@ecologicindiana.com; AS Email: ashelton@mccsc.edu

This joint plenary session and tour will provide an overview of the challenges and successes of campus restoration projects and associated research, teaching, and outreach activities. The plenary session will consist of three presentations that will summarize the restoration, research, and educational activities underway on the Indiana University campus within Dunn's Woods, Wright Wetland, and the Indiana University Research & Teaching Preserve. Dunn's Woods is a 0.04 km^2 wooded area at the heart of Indiana University's Bloomington campus. This site was originally lightly wooded pastureland and it has experienced relatively little disturbance except for the construction of concrete and brick pathways and initial plantings of mostly native trees obtained from local forests. Over twenty non-native plant species have invaded the site and threaten its diverse spring ephemeral flora. The Bloomington Urban Woodlands Project is a campus community group that is conducting research to increase the understanding of the ecological dynamics within the site, working to restore native diversity, and fostering a sense of connection to the site within the Indiana University and Bloomington communities. Wright Wetland is located adjacent to the Jordan River and was created in 2009 as part of mitigation requirements due to impacts on the Jordan River upstream. Originally, the site contained a degraded concrete levee that altered the hydrological regime of the Jordan River. Wright Wetland was designed to support 0.003 km^2 of emergent wetland and sedge meadow communities and 0.005 km^2 of riparian forest. More than 100 native plant species were planted at this site. This restoration site has provided the opportunity to evaluate the effectiveness of native prairie arbuscular mycorrhizal fungi on plant survival, growth, and diversity. The Indiana University Research & Teaching Preserve totals over 6.07 $km^2$of diverse habitats, including the 0.75 km^2 Griffy Woods, that consists mostly of ridges and ravines with mature oak-hickory, beech-maple or black walnut-sycamore-black cherry forests. Deer overpopulation is concern and 15 paired deer exclosure and control plots being monitored to evaluate the effects of deer on forest ecosystems. After the plenary session attendees will have the choice of participating in one of three guided tours of these Indiana University restoration and research projects.

ORAL PRESENTATIONS (ALPHABETICAL ORDER)

Agudelo, Laura. Maria Jose Calderon*, and Germán Camargo. **Development and extension of a glen vertical ecological corridor model for the tropical dry forest in Xeridas plateau, Santander**. Estación Biológica Guayacanal Foundation, Bogotá, Colombia. Email: agudelo.laura@gmail.com

The restauration of the tropical dry forest has faced a wide range of challenges such as: lack of local relicts in order to build a reference ecosystem, fragmentation between the core areas, the hard rainy seasons which make difficult the selection of species and their development in greenhouses, and the social effect of the endurance of the climate variability and the hydric stress related with climate change, lack of interest of peasants towards planting trees that compete for water and soil in their lands. Those factors contribute to increase the difficulty to develop restoration processes, therefore in this study we have designed a methodology for developing of a glen vertical ecological corridor model: this is a conceptual design that involve four microbasins and its application to a microbasin of the Xeridas plateau, municipality of Los Santos, Santander. We took different concepts of the physic characteristics and socioeconomic dynamics of three systems of otherness (peasant farm, agroindustry and suburban parcelling), in order to define the zoning of the glen vertical corridor and to establish the treatments in multiscale levels that involve both biotic and abiotic tools as well as strategies adjusted to the complexity of the scenarios that were identified. With this model we are seeking to its implementation, focusing on the restauration of four key socio-environmental processes: the hydrologic cycle which include the equitable use of water, regeneration of the flora taking into account the main physical limitations (soil and water), recovering of flora and fauna and human settlements.

Anderson, Elsa C.* and Emily S. Minor **Evaluating low-input techniques for increasing plant diversity in highly degraded sites.** University of Illinois at Chicago, Chicago, IL
Email: eholden2@uic.edu

Restoration typically aims to recreate self-sustaining natural communities. Rigorous planting maintenance can provide benefits to local wildlife and human residents. However, locations and funding for restoration projects are limited, and there has been a recent debate about the overall paradigm of restoring historic communities since anthropogenic stressors are relentless. Vacant lots make up a large land area in dense urban areas where green space is limited. In this regard, vacant lots could be valuable sites for modified restoration efforts geared at increasing plant diversity and increasing ecosystem function. Our project evaluates different techniques for installing eight species of native prairie plants (*Asclepias tuberosa, Dalia candida, Echincea pallida, Echinacea purpurea, Solidago rigida, Helianthus occidentalis, Rudbeckia hirta,* and *Panicum virgatum*). Techniques represent a gradient of cost and labor and include seed bombing, broadcast seeding, planting plugs, and intensive gardening. In early May, 2015, we set up 8 test gardens with four 2x2 plots each. Aside from the intensively gardened plot, plants were left to grow relatively untended until fall when we measured species present, vegetation height, and floral resources available. In our first year of data collection, we found that *H. occidentalis* was overwhelmingly the most successful when planted as a plug, and that *R. hirta, E. purpurea,* and *P. virgatum* were fairly successful when broadcast seeded or planted as plugs. The most common weeds in our plots were wood sorrel (*Oxalis acetosella*), black nightshade (*Solanum nigrum*), and lamb's quarters (*Chenopodium album*), Overall, we may have evidence that these planting methods could be reasonable for easily and cheaply increasing floristic diversity and ecosystem services in vacant lots.

Anderson, Roger C[1*], M. Rebecca Anderson[1], Jonathan T. Bauer[2], and Christopher Loebach[3].
Does extreme stochastic climate events affect the density of the invasive garlic mustard (*Alliaria petiolata*) and disrupt the years of alternating abundance of first and second year plants?
[1]Illinois State University, Normal, Illinois. [2]Indiana University, Bloomington, Indiana, [3]3839 North Humboldt BLVD, Milwaukee, WI. Email: rcander@ilstu.edu.

Garlic mustard is a strict biennial plant in North America and can have alternating years of high abundance of 1st- and 2nd-yr plants. We monitored change in abundance of 1st-yr and 2nd-yr plants in permanents plots from 2004 to 2014. Second year plants had high abundance in 2004 and 2006 and 1st-yr plants in 2005 and 2007. However, beginning in 2008 the alternating yearly cycle of abundance was disrupted and 1st-yr plants had high and 2nd-yr plants had low abundances. The high abundance of 1st-yr plants in 2008 was most likely due to germination of seeds in the soil seed bank. This unexpected change in abundance of 1st- and 2nd-yr plants could occur with a reduction in the proportion of 1st-yr plants in 2007 transitioning to 2nd-yr plants in 2008. Declines in garlic mustard have been attributed to a decrease in deer abundance, reduction in production of secondary defensive compounds, and loss of genetic diversity; however, it is highly unlikely that this sharp decline in expected abundance of 2nd-yr plants would be caused by these factors in single year. We concluded that other factors may have played a role in the disruption of alternating abundances of 1st-yr and 2nd-yr plants. We tested the hypothesis that extreme stochastic climate factors were responsible for the decline in 2nd-yr plants in 2008, specifically an unusually hot and dry September in 2007. We compared total precipitation, number of rainy days and contiguous days without precipitation, days with maximum temperatures > 30 C, and mean monthly temperature for September of 2007 and all other years of the study (2004-2014). Means and standard deviations for the variables were calculated for all study years combined, except for 2007. The number of standard deviations away from the group mean for each variable for the 2007 data were determined.

Athanasakes, J. George*[1] and Cody Fleece[2], **Hatchery Creek Stream Restoration Project - A Unique Opportunity to Maximize Trout Habitat, Create Recreational Opportunities and Provide Mitigation Credits.**
[1]Stantec Consulting Services Inc., 10509 Timberwood Circle, Suite 100, Louisville, KY 40223. [2]Stantec Consulting Services Inc., 11687 Lebanon Road, Cincinnati, OH 45241. Email: george.athanasakes@stantec.com

The Hatchery Creek Stream Restoration project is a unique opportunity to utilize the latest stream restoration techniques to maximize trout habitat, create recreational opportunities for the citizens of Kentucky, and provide mitigation credits. The project is located immediately downstream of the Wolf Creek Dam US Fish & Wildlife National Trout Hatchery near Lake Cumberland in Jamestown, Kentucky. The project will extend an existing 400 foot long channel, which is the outflow from the trout hatchery to create approximately 6,000 feet of trout stream habitat. In an effort to maximize habitat and recreational opportunities, the project is being designed to provide a variety of habitat for all life stages of trout and will include a variety of stream types including A, B, C and DA channels. This project has several unique aspects, which are not typical to stream restoration projects in the midwest, including a constant flow of approximately 35 cfs, which is approximately 70% of the upstream bankfull flow, limited sediment supply, and the need to maintain imported spawning gravels. This talk will focus on the design and implementation of this project under a design/build project format. In particular the development of the habitat features will be discussed in detail including the stream type and habitat type selection process and how the different stream types and habitat features relate to the various trout life stages. In order to maximize the habitat and recreational features the design team included aquatic biologists as well as avid fishermen. In addition, input from key project stakeholders was sought throughout the design process including through a two-day QAQC meeting.

Project implementation will also be discussed including the coordination with numerous stakeholders, project staging, and construction methods utilized.

Benedict, Russ*[1], Jordan Drake[1], Ashley Oblander[1], Jessica Riebkes[1,2], Sean Robbins[1, 2,] Abby Saladino[1,] and Gabrielle Wilson[1]. **Impact of early mowing on prairie reconstruction in drought conditions.** [1]Central College, Pella, Iowa. [2]University of Northern Iowa. Email: benedictr@central.edu.

As part of the Prairies For Agriculture Project, this work examined the importance of mowing in the first years of growth following planting in prairie reconstructions. Early mowing is commonly used and may reduce competition between prairie seedlings and weeds. Plots were seeded in fall 2011 or spring 2012 with either 16 or 64 species. Some were mowed during the first year of growth, some during the first two years of growth, and some were un-mowed. Drought conditions prevailed during the first two years of growth, likely impacting our results. To quantify establishment, we counted individual plants in one meter^2 frames; here we discuss results from the fourth year of growth. Data were analyzed with t-tests, and 16 species plots were analyzed separately from 64 species plots as were fall and spring planted plots. The impact of mowing was weak and complex. The majority of comparisons for individual species in un-mowed versus mowed plots (86.2%) were not statistically significant. In fall-planted plots, only 8.4% of comparisons showed statistically significant differences, with these split among the three treatments. For broad measures of plot success in fall–planted plots (cover of native species, number of species, number of total individuals), un-mowed plots were significantly more successful than mowed plots for some measures while others showed non-significant differences. In spring-planted plots, only 9.0% of comparisons for individual species showed significant differences between mowed and un-mowed plots; in those plots with significant differences, mowing led to greater success. Broad measures of success in spring-planted plots showed few significant differences, but mowing led to greater success plots in some cases. Overall, our results are inconsistent with previous findings possibly as a result of drought conditions. These findings are important given that drought is expected to become more common in the future.

Benson, David P.* **Jens Jensen history and the restoration of an historic restoration at the Marian University Nina Mason Pulliam EcoLab.** Marian University, Indianapolis, IN. Email: dbenson@marian.edu

In 1912 master landscape architect, Jens Jensen, designed the Riverdale estate using all native plants in ecologically sensible locations in a manner similar to what a restoration ecologist would perform today. This property is now the Marian University Nina Mason Pulliam EcoLab and is both one of the best preserved examples of Jensen's work and one of the earliest well documented restoration projects in the Midwest. Since 2000, there has been progress toward restoring the Jensen landscape through the removal of invasive shrubs and installation of natives following Jensen's specifications. The history of the site and the plan and progress of the restoration of the historic Jensen restoration will be discussed.

Bohnen, Julia L.* and Susan M. Galatowitsch. **Selecting restoration projects for public funding in Minnesota.** University of Minnesota, St. Paul, MN. Email: bohne001@umn.edu

For lack of a systematic evaluation program, there is no way to know the extent to which grants funding ecological restoration are a strategic conservation investment. The Legislative-Citizen Commission on Minnesota Resources (LCCMR) supported over 450 restoration projects from 1990 to 2010. In 2013 the LCCMR requested an evaluation of previously funded projects with one outcome being the development of ranking criteria for projects proposed for funding. Highly ranked projects would 1) be more likely to achieve desired ecological outcomes and 2) further the goals of a restoration program with broad impacts. In order to develop such criteria, site visits and evaluations of 59 restorations were completed in 2014-15. Project managers were interviewed to gain insight into restoration process and organizational capacity to implement restorations. To quantify the extent of ecological recovery of each site we calculated: 1) the portion of plant species considered part of the potential natural vegetation following DNR Native Plant Community manuals and 2) an index based on the abundances of invasive species. These parameters were used to classify ecological condition as high, medium or low. Using contingency analysis we then screened a variety of factors related to site history, organizational capacity, and type of ecosystem to determine which have the greatest potential to predict post-restoration ecological condition. This analysis suggests starting condition, type of ecosystem, and an organization's internal capacity have the strongest effect on restoration outcome. Programs that need to prioritize restorations for funding should use these criteria to select projects that will optimize outcomes. Other factors, including time since restoration, did not correlate with high quality projects; i.e. significant initial failures were not compensated for with more time.

Bohorquez, Yenni, Maria Jose Calderon*, and Germán Camargo. **Key aspects of the ecological restoration participative methodology in the Magdalena Medio.** Estación Biológica Guayacanal Foundation, Bogotá, Colombia. Email: ypao5840@gmail.com

Due to the social and ecological importance of the tributaries of the Sogamoso river and in the frame of the environmental license obtained by ISAGEN S.A.E.S.P, related with the establishment of the central hydroelectric power station "Proyecto HidroSogamoso", a ecological restoration participative project has been developed with the aim of restoring 300 ha in regions of the Santander department. Using the integration of social and scientific strategies, some process were generated in order to establish restoration agreements with local communities, workshops to identify species useful for the project and capacitation in the field with communities for establishing the restoration process and the recovery of the ecosystem. Nowadays, fifty-eight agreements were signed, allowing to restore 272 ha with 40 native timber species and 148 maintenances have been done in the zone that was restored. Additionally, the infrastructure of different plant nursery places have been built and improved during this project, which have promoted the production of plant material and the participation of the communities in the regions which have contributed to recover the native germoplasm. Therefore, the integration of communities in the recovering of the ecosystem, is an essential tool to generate a system with high social and natural resilence.

Bollinger, Paul *[1]. **Evaluating vegetation responses to the CICN Dolomite Prairie Enhancement Project, Will County, Illinois.** [1]Bollinger Environmental, Inc., Downers Grove, Illinois. Email: pbollinger@bollingerenvironmental.com

The nearly 200 acre CICN Dolomite Prairie Enhancement Project is an effort to restore a unique dolomite prairie ecosystem within 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 acreage 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, DBH 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.

Catchpole, Floyd B.* **Management and Resulting Changes of Steep, Morainal Woodland in the Grand Prairie of Illinois.** Forest Preserve District of Will County, Joliet, Illinois. Email: fcatchpole@fpdwc.org.

Since 2009, the Forest Preserve District of Will County has managed McKinley Woods Preserve by prescription burning, invasive species control and thinning woody vegetation, with deer control beginning in 2010. The steep, densely shaded slopes were divided into three management units. Extensive thinning converted one unit into sunny woodland, another received selective thinning of maples only, and the third received no thinning. All units have been burned on a two year rotation. Plant populations of several species have been monitored and soil erosion changes have been observed. Future management activities, based on adaptive management, will be discussed.

Chen, H.*. **Advances in Restoration Ecology: From Reference Sites to Novel Ecosystems.** University of Illinois Springfield, Springfield, Illinois. Email: Hchen40@uis.edu

Restoration ecology is the field of science that studies the process of ecological restoration. As a young academic field, the conceptual framework of restoration ecology has been developed rapidly. In this talk, I am going to review the most recent advances in restoration ecology, especially the development of dynamic reference and novel ecosystem concept. Historically, reference sites play important roles in restoration ecology because they provide the standards for restoring ecosystem processes and functions. However, many ecosystems are rapidly being transformed into new, non-historical configurations owing to a variety of local and global change. The development of ecosystems that differ in composition and function from present and past systems is increasingly recognized as an almost inevitable consequence of changing species distribution and environmental alteration through climate and land use change. In this talk, I will focus on introducing novel ecosystems and discuss the potential implications of novel ecosystems for restoration ecology. I will use a few case studies of restoration projects I have involved including Emiquon restoration project in this talk. Finally, I will conclude this talk by discussing the implications of the advances in restoration ecology on these projects.

Clarkston, Valerie J.[1], and Patrick. A. Zollner[2]*. **Small mammal response to oak savannah restoration in Northwestern Indiana.** [1]Environmental Solutions & Innovations, Inc., Cincinnati, Ohio. [2]Purdue University, West Lafayette, Indiana. Email: pzollner@purdue.edu

Oak savannas are rare in the United States, and few quantitative data exist on how the small mammal community will respond to the restoration of this ecosystem. We investigated the microhabitat variables and minimum number known alive (MNKA) of small mammal species in oak woodlands versus oak savannas to determine if shifts in species composition would occur after restoration. Small mammals were live-trapped, and vegetative measurements collected at the Jasper-Pulaski State Fish and Wildlife Area during the summer of 2009. We used one-way analysis of variance to compare MNKAs of each species to habitat type and multiple linear regression to compare species MNKAs with microhabitat variables. The difference in mouse (*Peromyscus leucopus*) MNKA between habitats was marginally significant. Mouse MNKA was positively correlated with herbaceous cover and basal area of white oak (*Quercus alba*), but negatively correlated with soft mast. However, the ANOVA did not indicate any significant associations between habitat type for the other mammal species. Southern flying squirrels (*Glaucomys volans*) were trapped only in oak woodlands and were positively correlated with basal area of black oak (*Quercus velutina*). Eastern chipmunk (*Tamias striatus*) MNKA was positively correlated with herbaceous cover and negatively correlated with woody stems. Red squirrels (*Tamiasciurus hudsonicus*) were only captured in oak woodlands, and were positively correlated with soft mast, basal area of white and black oak, but negatively correlated with herbaceous cover. Eastern cottontail rabbits (*Sylvilagus floridanus*) were only captured within oak savannah and mounds of plains pocket gophers (*Geomys bursarius*) were also only found within oak savannahs. Our data suggest that oak woodlands converted to oak savanna provide habitat that is unsuitable for species like the southern flying squirrel and red squirrel but that is suitable for species like eastern cottontail rabbits and plains pocket gophers.

Clay, Keith*[1], Johnson, Daniel[2], Shelton, Angie[1], Flory, Luke[3] and Cynthia Huebner[4]. **Effects of overabundant deer in the lower Midwest on native biodiversity and interactions with invasive species.** [1]Indiana University, Bloomington, IN, [2]Yale University, New Haven, CT,[3]University of Florida, Gainesville, FL, [4]US Forest Service, Morgantown, WV. Email: clay@indiana.edu

The density of white-tailed deer (*Odocoileus virginianus*) in many areas of the eastern United States is at record levels due to land use changes and extirpation of large predators. Overabundant deer can have negative effects on woody vegetation but less well understood are effects on other forest characteristics including interactions with invasive species. In a southern Indiana forest preserve with very high deer densities, we manipulated deer browsing over several years in a series of 15m x 15m fenced exclosures with adjacent control plots of equal sizes. Vegetation and soil characteristics were monitored annually in exclosure and control plots over multiple years. There was no recruitment of native tree seedlings in any control plots although there was abundant seedling recruitment inside exclosures. Preexisting tree seedlings also grew faster inside exclosures, as did invasive shrubs, indicating that deer browsing was suppressing invasive shrubs. Mean height, diversity and density of spring ephemeral species were also significantly higher in exclosures, and soils were less compacted than in control plots. In a second experiment, we evaluated how deer browsing and an invasive annual grass, *Microstegium vimineum*, affected survival and growth of native tree seedlings in multiple sites where 1m x 1m plots were planted with one-year old tree seedlings. Half of each plot was fenced to prevent deer browsing and half of the plots had the invasive removed with a grass-specific herbicide. Seedling survival was higher in plots where *Microstegium* was removed and in exclosure plots where deer browsing was prevented. Further, seedling biomass was greatest in exclosures where *Microstegium* was removed, but there was no effect of exclosure with *Microstegium* present. Our results suggest that deer browsing reduces tree seedling establishment and helps limit invasive shrubs, but that the invasive grass may potentially provide refuge from browsing for tree seedlings.

Dolan, R. W.* **Managing a campus prairie demonstration: Learning from the Butler University Prairie.** Butler University, Indianapolis, Indiana. Email: rdolan@butler.edu

The Butler Prairie is a three acre site established from seed of fifty native Indiana prairie plants in 1987. It is believe to be the oldest prairie planting in the state. Located in central Indiana in Marion County, the prairie is on land that was originally flood plain forest along the White River. When the prairie was established, the site had been in lease to a farmer for many years. The close proximity of the prairie to Butler's sciences building allows the prairie to be an outdoor lab for many classes. Management includes the standard practices of prescribed burns, lopping, herbiciding, and hand-pulling of invasives. Over the last five years or so, native non-prairie specialist goldenrod (*Solidago canadensis* and/or *S. altissima*) has greatly increased, while prairie grasses have been on the decline. I will end my talk with an audience participation discussion on the challenges of managing small prairie demonstration sites, with the hope that we can share advice and solutions.

Fleece, W. Cody*. **Demolition of West Milton Dam: A case study of the role of a federally endangered species in a river restoration project.** Stantec Consulting, 11687 Lebanon Road, Cincinnati, Ohio 45241. E-mail: cody.fleece@stantec.com

Demolition of West Milton dam on the Stillwater River in Miami County, Ohio began on October 27, 2014. Prior to demolition activities, pre-project surveys determined that the Federally Endangered snuffbox (*Epioblasma triquetra*) was present in the project area necessitating formal consultation with the U.S. Fish and Wildlife Service. Potential direct effects included crushing of mussels present within the construction footprint, stranding or entrapment of mussels associated with the rapid lowering of the dam pool, and channel adjustments that may dislodge mussels as the bed adjusts to new hydraulic conditions. Mussels were cleared from construction areas using standard techniques. Nearly 3,000 mussels comprised of 14 species were rescued from the dam pool and relocated to an upstream area outside of the influence of the project. Fourteen live snuffbox were rescued from the former dam pool. Mussel assemblages differed markedly as a function of longitudinal position relative to the dam. Assemblages closest to the dam were dominated by opportunistic species whereas those near the upstream limit of the dam pool closely resembled assemblages in free flowing sections of the river. Channel adjustment and sediment export from the former impoundment were controlled through the use of constructed riffles. Riffles were designed to replicate the characteristics of an upstream relocation site where snuffbox was known to reside. Post-construction monitoring is ongoing and will continue until 2020.

Fox, Matt* and Phil Oser. **Challenges and Best Management Practices used on a large scale Oak Barren Restoration at Prairie Borders Nature Preserve.** The Nature Conservancy, Indianapolis, Indiana. Email: matt@ecologicindiana.com

Prairie Border is a series of tracts owned and managed by The Nature Conservancy (TNC) located adjacent to Jasper-Pulaski Fish and Wildlife Area in north central Indiana. Ober Savanna is an oak savanna owned and managed by TNC in Starke County. The tracts are a mosaic of globally endangered oak barrens, wetlands, grasslands, and agricultural fields that form one of the most biologically rich landscapes in the Midwest. Due to fire suppression in these areas, oak barrens communities have become overgrown resulting in the loss of their biodiversity. The dry sandy soils of the savannah are ideal habitat for year round native fauna. Many conservative native plants, including hoary puccoon, wild lupine, lead plant, goat's rue, whorled milkweed, spreading hemp dogbane, and Northern honeysuckle can be found in these areas. The continuance of which depends on the open habitat of a healthy Barren Community. Upon completion of structural restoration, The Nature Conservancy will use prescribed fire as their main management tool. Eco Logic LLC, based in Bloomington Indiana, was awarded the contract for a 141 acre structural restoration on three different Prairie Border parcels. The project encompassed canopy thinning, understory reduction and larger tree removal along fire lanes shared with neighboring property. The major operations occurred over the 2014-15 winter season. A 2 year herbicide re-sprout treatment on the entire project area began in 2015 and will culminate in the summer of 2016. K steps were taken to protect the ecological integrity of the site, while efficiently clearing a large amount of biomass. This presentation will cover the details in the planning and implementation of this large scale restoration and will review best management practices to contribute toward similar large scale restoration projects in the future.

Gray, Colby C.*. **White River and Mississinewa River Water quality and what it means for the proposed Mounds Lake Reservoir.** Delaware County SWCD/FlatLand Resources, Muncie, Indiana. Email: cgray@flatlandresoures.com

The White River Watershed Project and the Upper Mississinewa River Watershed Project are Delaware County Soil and Water Conservation District programs (Indiana) funded primarily through the EPA, Indiana DNR, and local charitable foundations. Both founded in 2001, they are some of the longest consecutively funded Watershed programs in the state. The projects' physical, chemical, and biological data has been collected and analyzed by the Muncie Bureau of Water Quality founded in 1972; one of the oldest local water pollution testing and enforcement agencies in the USA. This presentation will discuss White River and Mississinewa River Water Quality and what it means for the proposed Mounds Lake Reservoir. The Mounds Lake Reservoir is a proposed 2,100 acre lake in Anderson, Indiana on the White River. Currently in various stages of feasibility analysis, the rationale for its development is rooted in a greater need for central Indiana water drought preparedness as well as additional water resources to support future growth in the region. In an effort to forecast the potential water quality of the proposed reservoir, the presentation will provide a comparative analysis of various data sets including: (a) upstream White River water quality, (b) water quality of the adjacent Mississinewa River (which feeds the existing Mississinewa Lake Reservoir), (c) water quality of the Mississinewa Lake Reservoir, and (d) water quality of additional reservoirs in central Indiana. In addition, the presentation will discuss upstream and adjacent land use types and their respective water quality source concerns. After summarizing the trends and relationships between source water quality and both upstream and adjacent land uses, observations will be made about the potential future water quality of Mounds Lake Reservoir along with recommendations for mitigating negative water quality impacts.

Green, Nicholas S.*1, Janice L. Albers1, Michael J. Hooper1, Christina M. Mackey1, Mark L. Wildhaber1, and Thomas W. Pettit2. **Effort allocation for efficient mammal fauna assessment in restored landscapes.** 1U.S. Geological Survey, Columbia Environmental Research Center, Columbia, Missouri. 2University of Maryland University College – Asia, Fussa, Japan. Email: ngreen@usgs.gov

Monitoring of ecological restoration projects is essential to evaluate progress toward restoration goals, identify needs for corrective actions or adaptive management, and to inform the public, stakeholders, and sponsors of a restoration's progress. Restoration monitoring is especially vulnerable to budgetary constraints, often leading practitioners to forego or limit monitoring in favor of maximizing restoration implementation. Therefore, finding cost-effective tools to assess restoration progress is essential. Terrestrial mammal fauna are major parts of food webs and ecosystems that might be restoration targets, so monitoring these species efficiently is important for whole-ecosystem restoration projects. We investigated how different levels-of-effort might affect the assessment of a mammal assemblage. The mammal fauna of three riparian hardwood forest restoration sites in northeastern Indiana were surveyed in May and August 2015 using taxon-specific methods: small mammals were surveyed using live-capture traps; bats were surveyed using ultrasonic detectors; and larger species were surveyed using digital trail cameras. The data for each taxon were then subsampled to simulate what measures of restoration progress might have been obtained using less-intensive monitoring schemes: i.e., designs with fewer sampling units (trapping transects, ultrasonic detectors, or cameras), or designs with sampling of shorter duration or lesser intensity. We used a Bayesian hierarchical framework to model the effects of varying levels-of-effort on measures of community diversity and species abundances. Greater effort always yielded greater numbers of species detected and more precise estimates of abundances. However, the responses of community diversity and species abundances to different intensities of sampling effort were dependent on the structure of sampling and the level at which

outcomes were measured. Results of our analysis inform the design of cost-effective, statistically sound mammal monitoring programs at riparian hardwood forest restorations.

Grieser, Jennifer M.* **Rough around the edges: Lessons learned from restoration activities along the Cuyahoga River in downtown Cleveland**. Cleveland Metroparks, Cleveland, Ohio. Email: jmg2@clevelandmetroparks.com

In July 2014, an entourage of partners (City of Cleveland, Cuyahoga County, Ohio EPA, Trust for Public Land and others) opened the first publicly funded section of the Towpath – a 100+ mile multi-use trail following the Ohio & Erie Canalway. This commenced site management responsibility for Cleveland Metroparks. Deemed Scranton Flats, this project not only included the installation of recreational trail and river pier, but also fish nursery areas, rain gardens and native meadows. Hemmed in by the Cuyahoga River and its industrial ship channel on one side and impervious surfaces on all other sides, this urban project has provided numerous surprises – some good, some bad and some just plain puzzling. Cleveland Metroparks has responded to these surprises through modified management practices, volunteer events, contract bioengineering installation, and student involvement. Only 18 months after making the property publicly available the area boasts premier viewing of nesting Peregrine falcons, numerous species of gulls and other birds, increased fish diversity and quantities, visiting beaver and established native plant essemblage – all in the heart of downtown Cleveland.

Grieser, Jennifer M.* and Sierra C. Wick*. **Utilizing the Stream Functions Pyramid to Determine the Functionality of Mirror Valley Creek, Hinckley, Ohio.** Cleveland Metroparks, Parma, Ohio. Email: jmg2@clevelandmetroparks.com

The Stream Functions Pyramid provides the structure from which to assign a functioning statement to any particular stream. Incorporating survey metrics and protocols from hydraulic, geomorphological, physiochemical, and biological factors, the stream functions pyramid aides in developing a well-rounded approach to stream health. Mirror Valley Creek in Hinckley, Ohio is a highlighted location of interest within Hinckley Reservation of Cleveland Metroparks due to its cold water, aquatic taxa and is currently a priority stream for restoration projects including stream channel reconstruction and riparian plantings. Utilizing the Stream Functions Pyramid, we can determine the functionality of each factor within the system to improve our understanding of the influence of morphological factors on biological communities. Within the hydraulic category, flood plain connectivity functionality was measured using a bank/height ratio. Geomorphology functionality was measured by Large Woody Debris Index (LWDI) surveys, Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) erosion potential curves, bed material characterizations, and a riparian assessment. Physiochemical functionality was determined by analysis of water quality data, including pH, dissolved oxygen, conductivity, turbidity, and various nutrients. Finally, biological functionality was determined by sampling the stream's macroinvertebrate communities. Hydraulic and Geomorphologic surveys indicated channel incision with limited floodplain access and a high rate of stream bank erosion. All physiochemical data was found to be functioning and characteristic of cold water systems, with high dissolved oxygen levels (>8 mg/l), low base temperature (<19 °C), and low nutrient loads. The biological factor was also categorized functioning due to the presence of pollution sensitive EPT taxa. The successful macroinvertebrate community and excellent water quality indicate that the stream can support these largely dependent variables, however further research is required to determine the long-term effect of sedimentation and erosion.

Grieser, Kevin A.*[1], Suzanne Hoehne[1], and Sherese Fortriede[2]. **A River Runs Through It – Redeveloping the waterfront from an ecological perspective.** [1]Biohabitats, Cleveland, Ohio. [2]City of Fort Wayne Community Development, Fort Wayne, Indiana. Email: kgrieser@biohabitats.com

Too often the ecological gems within our communities are neglected or managed haphazardly. Fort Wayne, Indiana has long recognized the importance that being at the headwaters of the Maumee River has played within its history. In 2012, the city pursued the idea of reinvesting in this area; undertaking the Riverfront Fort Wayne-Conceptual Plan. An outcome of this project was the realization that the river and riparian corridors along the St. Marys, St. Joseph, and Maumee Rivers have been neglected and underutilized. The City has since completed a riparian management plan and is currently restoring two sites along the St Marys River identified in the plan. This presentation will focus on the benefits that come from focusing on the importance of ecological function during the planning process, how this process can lead to future projects, and the importance of realizing the value of the ecological gems in our communities.

Groves, Anna M.* and Lars A. Brudvig. **A "good" restoration year relies on more than just rainfall: Inter-annual variation affects initial dynamics of sown prairies.** Michigan State University, East Lansing, Michigan. Email: grovesa2@msu.edu

Ecological restoration can be prone to unpredictable outcomes, but what leads to this variation? For plant communities, conditions during the first year of restoration may contribute to variation among efforts by influencing germination and seedling survival; this, in turn, may impact the community that develops. We are testing this hypothesis, with a focus on the amount of precipitation received by newly sown prairie plantings, with an experiment that manipulates water for the first nine weeks in spring-sown tallgrass prairie plots, across multiple establishment years. We found large differences among the first two years of this study—e.g. 16.9% of sown species germinated in 2014, versus 45.5% in 2015—even in plots for which precipitation was held constant between the two years. Our results show that inter-annual variation heavily influences initial dynamics of sown prairies, yet precipitation surprisingly may not be the driving force behind this variation.

Hausman, Constance E. * **Mirror mirror on the wall, who has the coldest habitat of them all? Primary headwater stream and habitat restoration of Mirror Valley in NE Ohio.** Cleveland Metroparks, Cleveland, Ohio. Email: ceh@clevelandmetroparks.com

One of the challenges facing ecological restoration is mending the impacts of former agricultural land use while also mitigating for increased stormwater impacts in the transition areas where development pressures meets rural landscapes. When these factors combine in primary headwater habitat, the negative downstream impact can be severe. Mirror Valley, a unique subwatershed of the East Branch Rocky River in northeast Ohio, is fed almost entirely by springs and home to a number of rare taxa, including northern red salamanders. It is also the only stream in Cleveland Metroparks that is home to the state-threatened native Ohio brook trout however, this habitat is threatened. The headwaters of Mirror Valley are impacted by the surrounding land use with an adjacent former agricultural field and a reach that must traverse a horse pasture. Increased sedimentation due to streambank erosion and an actively eroding 4' headcut along an ephemeral stream further degrade habitat quality. The restoration efforts set out to address each of these land use stressors. The 6 acre agricultural field was planted with 900 bareroot trees and the extensive edge thicket of woody invasive species was also repeatedly treated to reduce encroachment. The horses were relocated to eliminate the nutrient load and constant browse pressure on the vegetation along the emphemeral stream in the pasture. In addition, the 4'

headcut was repaired with a series of grade control structures that were further reinforced with brush layering and live stakes. The former horse pasture and riparian area was planted with trees and shrubs to reforest ~3 acres of primary headwater habitat. The accomplishments to date for the Mirror Valley restoration have taken 3 years and included ~15 total acres on Cleveland Metroparks property. Future work will focus on upstream stormwater impacts from adjacent property owners.

Heffner, Gail* and David P. Warners.* **Community Engagement for Urban Watershed Restoration.** Calvin College, Grand Rapids, Michigan. Email: dwarners@calvin.edu

Plaster Creek Stewards is comprised of Calvin College students, faculty and staff working with local schools, churches, and community partners to restore health and beauty to the Plaster Creek Watershed **(http://www.calvin.edu/go/plastercreekstewards).** We focus on three areas—education, research, and restoration. Education is critical for building awareness of how Plaster Creek has become so contaminated. Our educational events are always combined with opportunities to take action. We see our primary goal as not to merely restore the creek but to restore the relationship between people and the creek; engaging our community in watershed restoration is critical for long term, sustainable outcomes. Our watershed initiative is characterized by some novel features and approaches. First, Plaster Creek Stewards exists within a college – two of the four members of our leadership team are full-time faculty, and our organizational identity is integrated within the institutional identity of Calvin College. We have discovered numerous benefits for engaging higher education (faculty, students, alumni, etc. from local colleges or universities) in watershed restoration work. Second, because Calvin is a Christian college, we are well-positioned to mobilize the faith community within our watershed to become involved in its care and keeping. Third, we work to establish upstream-downstream relationships between places of worship, schools and businesses for reciprocal visits and projects. Promoting better understanding of upstream-downstream issues and motivating citizens to turn this awareness into action is having a positive rippling effect throughout a watershed. Fourth, we propagate over 50,000 native plants and trees annually from locally collected seeds. These plants, grown in our college greenhouses and nursery, are used in restoration projects, many of which are revenue generators. This presentation will offer lessons learned from our first 7 years of Plaster Creek Stewards experiences as we keep working help bring healing to a much-maligned urban stream.

Lemke, Michael J.[1*], Heath Hagy[2], Andrew Casper[3], Hua Chen[1], and Keenan Dungey[1]. **Aquatic habitat restoration in the LaGrange reach of the Illinois River floodplain.** [1]University of Illinois Springfield, Springfield, IL. [2]Forbes Biological Station, Illinois Natural History Survey, Havana, IL. [3]Illinois River Biological Station, Illinois Natural History Survey, Havana, IL. Email: mlemk1@uis.edu

There is growing societal interest in restoring rivers and floodplains to re-establish ecosystem services, including reduced flood damage, nutrient processing and supporting fisheries and wildlife. Nowhere in the United States is there a system of lakes and wetlands on a river floodplain that have been so extensively studied, manipulated, and restored to different levels than along the middle, or LaGrange, reach of the Illinois River. Floodplains have been significantly degraded over the last century with wetlands associated with backwater lakes suffering from increased sedimentation and altered hydrology. Here, we give brief summaries of some of the primary efforts for floodplain conservation and restoration over the last century and relate lessons learned from approaches taken that may be useful in future endeavors. By evaluating how well theory predicts the biotic responses (e.g., pattern of floral and faunal succession) to practical application of manipulating floodplain drivers, like water inundation, we are better able to use theory for future restoration efforts. Further implementation of experimental work would address long-term questions enabling scientists to better predict outcomes beyond the regional level.

Maier, Craig M.[1] **Prescribed Fire and Invasive Plant Species In the Upper Midwest: Ongoing Efforts to Organize Current Knowledge from Research and Management.** [1]Tallgrass Prairie and Oak Savanna Fire Science Consortium. Madison, WI. Email: cmaier.tpos.firescience@gmail.com

Recent review of the scientific literature on fire and invasive plant species in the eastern United States indicates that formal studies have been sparse. When land managers in the Upper Midwest were surveyed about their information needs with respect to fire management, invasive species ranked among the top priorities. In light of having limited research to draw on, managers have suggested that one way to begun overcoming this information gap is to provide an online database to collect and share case studies from their peers in the region. Beginning in 2014, the Tallgrass Prairie and Oak Savanna Fire Science Consortium (TPOSFSC) has partnered with the Midwest Invasive Plant Network to add such case studies to the Online Invasive Plant Control Database. Initially, the response from land managers has been limited to less than ten case studies—at first glance, this is surprising, given that several hundred professional land managers in the region employ fire to control invasive species. However, given the rule of thumb that roughly one percent of practitioners will contribute content to an online forum, this response rate is not unusual. The TPOSFSC is re-evaluating how to best gather and share site-based observations from fire practitioners to better inform future land management and research.

Marek, Mike* Kron, Zach **Protecting habitat in the face of development: a story of Monarch habitat preservation and restoration.** Marek Landscaping, LLC, Milwaukee, Wisconsin. Email: mike@mareklandscaping.com

Protecting, preserving and maintaining natural habitat for wildlife in urban areas can be a challenge. There are numerous interests that threaten the integrity of the open natural areas. In order to ensure the longevity of these valuable spaces, it takes the collaboration and cooperation of numerous public and private entities, as well as a strong visionary to see it all through. Our presentation is a case study of one such example: the Monarch Trail, located on the Milwaukee County Grounds in Wauwatosa, Wisconsin. In 2006, a passionate Wauwatosa resident named Barb Agnew began an organization called The Friends of the Monarch Trail (FOMT) to ensure the preservation of a wooded and prairie parcel utilized by thousands of monarchs along their migration path. Over the past 10 years, FOMT has forged partnerships with every landowner and tenant on the properties. For example, FOMT convinced WDOT to allow their property specifically for prairie establishment and to use butterfly friendly seed mix on other roadside projects. Marek Landscaping was hired in 2012 to do initial brush work, prairie and oak savannah establishment, and invasive control. This presentation will lay out both the restoration methods as well as the story of the project.

Mason, Mary E.[1]*, David W. Carey[2], Mark D. Miller[2], Ryan J. Matko[1], Therese M. Poland[3], Kathleen S. Knight[2] and Jennifer L. Koch[2]. **A restoration strategy for green ash threatened by emerald ash borer**. [1]The Ohio State University, Columbus OH, [2]USFS Northern Research Station, Delaware OH, [3]USFS Northern Research Station, East Lansing MI. Email: mmason@fs.fed.us

Ecosystems impacted by the near synchronous loss of ash trees as a result of invasion by the emerald ash borer (EAB) face unique challenges in restoration. Studies have shown that as EAB induced mortality approaches 100 percent, new ash regeneration ceases because ash does not form a persistent seed bank. Restoration through artificial regeneration is limited by the lack of available seedlings with resistance to EAB. We are pursuing a dynamic genetic conservation strategy that takes advantage of genetic variation within natural populations under impact of EAB by targeting uncommon individual genotypes with confirmed levels of resistance to EAB. Through long-term monitoring of plots in natural stands, we identified surviving ash trees that retained healthy canopies for two years or more after all other ash in the stand had died. Bioassay experiments confirmed that these trees possess an increased level of resistance due to multiple types of host defense responses, including mortality of early instar larvae, development of larvae with significantly lower weights, and reduced adult feeding preference of foliage. The low frequency of these survivors can be increased at the population level by accelerating the process of natural selection through traditional tree improvement to develop resistant seedlings for the restoration of EAB impacted areas. We are using a ‘containerized orchard’ approach to produce full-sibling families through cross- pollinations between potted grafts of lingering ash parents to test the heritability of the phenotypes identified. Both the parent genotypes and resulting progeny will be tested using egg bioassays and in longer term field trials. Our goal is to identify multiple sources of heritable resistance in genetically diverse backgrounds to develop resources for restoration, such as seed orchards, to produce regionally appropriate seed for planting.

McEuen, Amy*, and Megan Styles. **Gardening as a metaphor for modern restoration: Lincoln Memorial Garden as a case study.** University of Illinois Springfield, Springfield, IL. Email: amceu2@uis.edu.

Given anthropogenic global changes, using past ecosystems as restoration targets is becoming increasingly tenuous. Restorationists and conservationists are grappling with how best to create and maintain systems that will be resilient and maintain biodiversity and ecosystem services. Gardening is a metaphor that has potential to engage the public and emphasize our role in creating resilient ecosystems. However, some conservationists dislike this metaphor in part due to historic associations with visions of a completely human dominated landscape. We argue this metaphor is useful and can broaden approaches to biodiversity conservation to fit particular communities and their local goals. As an example we discuss the history of Lincoln Memorial Garden in Springfield, Illinois which was designed by Jens Jensen in 1936 as a living tribute to Lincoln. This forest differs markedly from past ecosystems yet achieves many conservation and educational goals. Such an approach of blending biological and cultural goals in site-specific, community–based ways may provide a path forward as we work to enhance biodiversity conservation across all landscapes.

Millbrand, Zachery E* and Robert Grese. **Habitat suitability model for grey wolf populations in Michigan using hiking, snowmobile, and forest trails.** University of Michigan, Ann Arbor, Michigan. Email: zmill@umich.edu

For the past 20 years, models to predict probabilities of ideal habitats for wolves in the Great Lakes Region have relied on the variable of road densities of highways, paved-roads, and roads passable without the use of four-wheel drive as a proxy for human accessibility. Recent studies have shown that this is a more descriptive method than predictive, and that the accuracy of previous models is approximately 60%. Furthermore, other studies have shown that wolves may themselves utilize roads for both travel and prey procurement, and that wolves have a higher tolerance for human activity than thought previously. Due to the increase in data available and improved geographic information analysis methods, I will be exploring whether or not other variables alone or in conjunction with road densities will be more descriptive of current grey wolf habitat in Michigan. This analysis will consist of layers of hiking trails, snowmobile trails, and forest road densities. I will also be seeking to test this new methodology by georeferencing it against previously obtained field and telemetry data of grey wolves in Michigan. With the placement of the grey wolf in Michigan back on the Endangered Species list in December 2014, the need for better understanding of habitat which will support the species is needed. Based on the expansion of findings for previous models, more accurate and robust modeling efforts can then be used in the future to calculate ideal population sizes and to assist management officials in better targeting conservation efforts. Since the days of Aldo Leopold, human-wolf interactions have been blamed on habitat loss and fragmentation. If more robust modelling methods are used in conjunction with education and outreach efforts, it is possible to better conserve the species in accordance with federal law, as well as predict future potential habitats.

Oser, Phil*, Don Miller & Brenda Howard. **Indianapolis Parks Land Stewardship's Early Detection and Rapid Response Program for Marion County.** Eco Logic LLC, Bloomington, Indiana. Indianapolis Division of Public Works, Indianapolis, Indiana. phil@ecologicindiana.com

The City of Indianapolis Land Stewardship Division restores and protects natural areas in park properties and greenways, ensuring that these areas are sustainable resources for people and wildlife. Land Stewardship cares for more than 1,200 acres of woodlands, prairies and wetlands that serve as home to many species of flora and fauna. Land Stewardship coordinates invasive species control, wetland restoration, reforestation, and native planting efforts throughout the city with volunteer groups and contractors. Eco Logic LLC has worked closely with the Land Stewardship for over 15 years implementing restoration projects on approximately 30 to 40 parks per year. With the arrival of many new invasive plant species, such as Japanese Stiltgrass, Land Stewardship felt that there was a need to develop an early detection and rapid response (EDRR) program designed to identify and treat new infestations early. EDRR programs help to detect new populations of invasive species before they become firmly established in a given area. This critical aspect of weed management can help land managers minimize damage to valuable ecological resources, while also saving substantial dollars spent on controlling the pest. The program and species list are reviewed and updated annually. Initially, fifteen species were selected and placed into two categories that were created to capture both species that had not yet been detected or reported in Marion County and those that are present but not in large outbreaks, posing what Land Stewardship feels are "winnable battles." Eco Logic has developed and implemented a program for Land Stewardship staff, contractors and volunteers that greatly increases the chances of successfully detecting and controlling a new invasive plant population.

Palus, James D.*, Erin E. Andrew, P. Charles Goebel, David M. Hix. **Environmental influences on canopy disturbance histories in mature oak–hickory forests in southeastern Ohio**. The Ohio State University, Columbus, OH. Email: palus.5@osu.edu

A comprehensive understanding of a forest's disturbance history is critical to understanding how anthropogenic influences have affected its natural disturbance regime. Such information provides insight into the underlying mechanisms driving contemporary forest change. In the unglaciated Allegheny Plateau of southeastern Ohio, forests are currently undergoing a transition from oak–hickory (*Quercus–Carya*) dominance to mesophyte dominance (e.g., *Acer rubrum*). This transition has been attributed in part to the suppression of fires that became common practice post-EuroAmerican settlement. It is unclear, however, whether this transition is occurring at similar rates among different ecosystem types. For example, it is possible that the environmental conditions and canopy disturbances associated with xeric, south-facing slopes result in a faster transition to mesophytic species than on mesic, north-facing slopes. Using tree cores collected from two different ecological land type phases (ELTPs; as described in the ecological classification system for the Wayne National Forest developed by Hix et al. (1997)), we examined the canopy disturbance history of two contrasting south-facing and north-facing ELTPs. Overall, we found a higher frequency of canopy disturbance (as reflected by periods of release and suppression) in the xeric, south-facing ELTPs than mesic, north-facing ELTPs. We surmise that the higher frequencies in canopy disturbance will result in a faster transition to more mesophytic species on xeric, south-facing ELTPs when compared to more mesic, north-facing ELTPs. The inherent differences in the disturbance regimes of these contrasting landscape positions contribute to our understanding of forest stand development and the influences of environmental factors in oak–hickory forests.

Price, Edward P. F.[1]*, Greg Spyreas[2], and Jeffrey W. Matthews[1]. **Taxonomic homogeneity and differentiation in compensatory mitigation wetlands in Illinois.** [1]University of Illinois at Urbana-Champaign, Department of Natural Resources and Environmental Science, Urbana, Illinois. [2]Illinois Natural History Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign, Champaign, Illinois. Email: epprice2@illinois.edu

Biotic homogenization has been identified as a major contributor to the biotic impoverishment of ecosystems. It has been suggested that restoration activities, such as compensatory wetland mitigation, may drive taxonomic homogenization in plant communities. We compared patterns of taxonomic homogeneity between 146 naturally occurring wetlands and 38 compensatory mitigation wetlands throughout the state of Illinois. Similarity indices based on pairwise comparisons between wetland sites were used to analyze the degree taxonomic homogeneity in naturally occurring and mitigation wetlands. Unlike previous work, both species occurrence and species abundance data were used. Linear regression was performed to test for differences in the rate of change in similarity over geographic distance. Results indicate that taxonomic homogeneity in emergent wetlands and forested wetlands (herbaceous layer) is significantly lower for mitigation wetlands than it is for natural wetlands. The canopy layer of forested mitigation wetlands, however, displayed a higher degree of taxonomic homogeneity than natural sites based on species occurrence. Taxonomic similarity decreases with distance and shows no significant differences in the rate of turnover between natural and mitigation sites. An exception to this is the herbaceous layer in forested mitigation wetlands, which shows no distance trend. Our results indicate that mitigation wetlands in Illinois are not driving taxonomic homogenization, but rather, contribute to taxonomic differentiation. This may be due to differing restoration strategies, intensity of management, and land use histories. The tendency for taxonomic homogeneity in the forest canopy layer of mitigation wetlands, however, may be due to homogenous tree stock plantings. It is important to remember that both taxonomic homogenization and taxonomic differentiation can reflect potentially undesirable ecological conditions and can contribute to them. Entities responsible for restoration activities over broad regions should ensure their efforts neither erode beta diversity through homogenization, nor contribute to regional biotic impoverishment reflected in unstructured taxonomic differentiation.

Smiley Jr., Peter C.*[1], Karolyn M. Stillman[1], Marissa A. Lauer[2], and William C. Fleece[3]. **Spatial and temporal trends in freshwater mussels within an agricultural watershed in central Ohio.** [1]USDA Agricultural Research Service, Columbus, Ohio. [2]Ohio State University, Columbus, Ohio. [3]Stantec, Cincinnati, Ohio. Email: rocky.smiley@ars.usda.gov

Freshwater mussels (Family Unionidae) are among the most threatened freshwater species within the United States. Mussels within watersheds in the Midwestern United States have been impacted by historical and current agricultural practices. Understanding the spatial and temporal trends of mussels within agricultural watersheds can provide information to assist with the design of watershed restoration projects. Our research questions were: 1) does mussel community structure differ spatially within the Upper Big Walnut Creek watershed (UBWC)? and 2) is there a difference in mussel species composition between historical and current mussel surveys within the UBWC? We surveyed mussels from 31 sites over a two year period (2014 and 2015) and compiled historical data collected prior 1980 on mussel occurrence within UBWC, an agricultural watershed in central Ohio. Generalized linear model analysis indicated that mussel species richness differed ($P < 0.05$) among stream types, but abundance did not. Mussel species richness was greater in midsized tributaries located adjacent to the mainstem of the Big Walnut Creek than the small headwater streams. Species richness within the larger mainstem sites did not differ from the headwater streams or the tributary sites. Seven species were documented during historical surveys prior to 1980 and five species were

documented during current surveys in 2014 and 2015. The slippershell mussel *(Alasmidonta viridis)* and cylindrical papershell (*Anodontoides ferussacianus)* were documented in the historical surveys, but not during the current surveys. Species composition was similar (Jaccard's Index = 0.71) between historical and current mussel surveys. Our results also suggest that watershed restoration projects should focus on mussel conservation within UBWC tributary sites and mussel restoration in the headwater and mainstem sites.

Sterrenburg, Lee W.* **Revisiting the large Goose Pond Indiana wetland and prairie restoration -- Sixteen years after the conservation easement (2000) and seven years after completion (2009).**
*Goose Pond FWA volunteer, Linton, Indiana. Email: sterren@indiana.edu

We might divide the narrative of the Goose Pond Indiana restoration into two phases. Much of early or first phase assessment and publicity about the large 7139 acre restoration easement focused upon avian and wetland successes. Numerous players and stakeholders had inducements to produce results for their diverse investments or goals. The largest WRP/NRCS project in the USA at the time quickly became a bird and hunting success story. Bird populations had global importance. GP under Indiana DNR ownership since 2005 became a "Globally Important Bird Area" for Northern Bobwhite. Iconic birds included King Rails, Eastern Whooping Cranes (the world's most Endangered Crane), Roseate Spoonbill and a host of Gulf birds, 35 species of shorebirds, breeding Federally Endangered Interior Least Tern, Greater White-fronted Goose, and Northern Pintail. The restoration strategy made the wetlands different from previous agricultural practices: breaking tiles, removing drainage tubes, building self-enclosed impoundments, intentionally making wetlands that could not be drained, and constructing internal wetland macro-topographies with slopes and terraces like rivers have (but with no river). All this helped the bird successes. Water ran downhill but much of the entire restoration was in effect a sink. A "second phase reassessment" reveals the wetlands are far more permeable and exposed to global invasives than early plans and strategies assumed. Asian jumping carp jump at GPFWA and Eagle Marsh. Eurasian watermilfoil and many other invasives choke the wetlands. Siltation is rampant. Bird tracking has entered a new phase with advances in electronic and satellite technologies and emphasis upon global views and complete life cycle studies. Global mapping and understanding of invasives should hopefully generate some creative solutions. Rethinking some basic NRCS wetland restoration practices may be in order. The Sunday April 3 field trip to Goose Pond FWA will visit some of the unfolding solutions.

Straub, Craig A.* and Brian J. Kwiatkowski. **Woody Debris Management: An Approach to Mimic Natural Recovery Processes in Riverine Systems.** Apex Companies, Cincinnati, Ohio. Email:cstraub@apexcos.com

Aukerman Creek is located in Preble County, Ohio and is in the late stages of channel widening. The creek was undergoing systemic erosion and mass wasting of stream banks, often with catastrophic impacts to adjacent properties and infrastructure. Three bridges have been washed away or damaged in the past three decades. The creek was also aggrading, depositing sediment eroded from adjacent reaches. The deposits occur as channel bars, which redirect flow and initiate adjustments in planform geometry. Deposition also impairs in-stream habitat, as deeper pools and interstitial spaces in coarse substrate become embedded with fine silt, sand and sediments. The functionality of the adjacent riparian forest was impaired from the predominance of invasive species of vegetation. The restoration approach addressed these sources of aquatic habitat impairment by restoring natural flow, reducing the erosive power and associated streambank erosion, improving water quality, and enhancing the ecological function and value of the riparian corridor by removing invasive vegetation. Boulder clusters were installed to restore a stable pool-riffle complex, improve sediment transport, dissipate energy, provide toe of slope protection and provide grade control. Wood structures in the form of toewood revetment mimic the natural recovery processes in riverine systems and were installed in high stress locations along outside meander bends. Harvested logs, limbs and rootwads are installed in a "criss-crossed" or "woven" pattern, anchored with boulders or cobble ballast, and backfilled with branch packing and native gravel. The toe revetment was installed along the toe of the excavated slope, to provide partially submerged toe protection and crucial in-stream habitat for fish to feed, rest, and escape predation.

Umek, Lauren[1]*, Patricia O'Donnell[2], Robbie Sliwinski[3], Michael Lange[1], and Julia Bachrach[1]. **Connecting ecology and design in Jackson Park: An ecological restoration in the Olmsted style.** [1]Chicago Park District, Chicago, IL. 2Heritage Landscapes, LLC. Charolette, VT. [3]U.S. Army Corps of Engineers, Chicago, IL. Email: lauren.umek@chicagoparkdistrict.com

Public parks and open spaces are vital for urban residents and visitors. There has been a recent increase in the incorporation of native plants and ecological restoration into park design and management. The increase of native ecosystem restoration into formal parks poses some unique opportunities as well as several challenges. Ecological restoration goals may not fit the needs of urban park use (safety, aesthetics, recreation, etc) while traditional park design often requires resource intensive management to maintain the aesthetic character and quality of experience. This is particularly true when a park has a high profile, is historically significant, and management resources are challenged. The Chicago Park District and the U.S. Army Corps of Engineers are partners on the restoration of Jackson Park that integrates an ecosystem restoration and cultural landscape improvement. Designed by Frederick Law Olmsted and located along Chicago's lakefront, Jackson Park is best known as the "backyard" of the Museum of Science and Industry and the site of the 1893 World's Columbian Exposition" or the "white city". This presentation will outline how a team of ecologists, landscape architects, engineers, planners, and historians worked together to design a restoration of the public park that balances the potentially conflicting goals of maintaining historical elements of the park while restoring and enhancing native ecosystems. It will highlight common goals and methods of restoration as well as areas of contention, where disciplinary approaches were challenged and the solutions and methods for compromise. The restoration of Jackson Park embraces 21st century sustainability through a historically based and integrated project of landscape preservation and ecological restoration in a public, urban park.

Warrix, Adam R.* and Jordan M. Marshall. **Callery pear (*Pyrus calleryana*) response to fire in a managed prairie ecosystem.** 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, IN, managed by Little River Wetlands Project (LRWP). Before 2009, Arrowhead Prairie was primarily used for agriculture. Following LRWP acquisition, the property has undergone active management including native plant seeding and prescribed fire. The prairie was divided into a north and south section using a historic ditch, with the south section burned in April 2014 and the north section burned in May 2015. Fire in both years top killed Callery pear individuals, with 100% producing epicormic shoots and 83% producing more than one epicormic sprout. In contrast, 13% of individuals had epicormic shoots without fire. Trees were significantly shorter than prior to the burn; however root collar diameter was not different, suggesting that resources were used in primary growth. While fire did 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, although no trees produced flowers during the duration of the study. Plant age likely plays an important role in response to fire, with seeds and fruits succumbing. However, older seedlings may survive with increased epicormic shoot production.
Oral presentation, Student presentation

Wodrich, Carl J*, Brad C. Baldwin, David D. Carr. **Development of the Indiana Stream and Wetland Mitigation Program: an in-lieu fee mitigation program.** Indiana Department of Natural Resources, Indianapolis, Indiana. Email: cwodrich@dnr.in.gov

The Indiana Department of Natural Resources (DNR) has been in the process of developing and seeking approval for a statewide in-lieu fee program for stream and wetland mitigation for impacts permitted under Section 10 of the Rivers and Harbors Act, Sections 404 and 401 of the Clean Water Act by the U.S. Army Corps of Engineers and the Indiana Department of Environmental Management. Additionally, the DNR is working on an in-lieu fee program for permits issued by the DNR's Division of Water for adverse impacts to fish and wildlife resources under its Construction in a Floodway, Construction in a Navigable Waterway, and Construction in Public Freshwater Lake regulatory authorities. In addition to being a benefit to the regulated community, the in-lieu fee program is ecologically preferable according to the 2008 Federal Mitigation Rule over permitee-responsible mitigation and will be an additional tool in DNR's tool box for restoration and conservation in the State of Indiana.

Wodrich, Carl J*[1], Emily J. Stork[1], Anne Remek-Kominowski[2], Ashley Snyder[2], Daniel Sparks[3], William Tucker[3], Paul Labus[4]. **Restoration of the Grand Calumet River Area of Concern: Achievable through Partnerships.** [1]Indiana Department of Natural Resources, Indianapolis and Merrillville, Indiana. [2]Indiana Department of Environmental Management, Indianapolis and Valparaiso, Indiana. [3]U.S. Fish and Wildlife Service, Bloomington, Indiana. [4]The Nature Conservancy, Merrillville, Indiana. Email: cwodrich@dnr.in.gov

The Grand Calumet River (GCR) and Indiana Harbor Canal were identified in 1987 as an Area of Concern (AOC) by the International Joint Commission (IJC). The area within and surrounding the AOC is one of the most heavily industrialized areas in the United States and efforts have been underway for decades to reduce the amount of pollutants discharged to the GCR and improve water quality. Even with these efforts, legacy contaminants in the sediment continue to be the most significant contributing factor for impairment of most beneficial uses in the AOC. Dredging and capping of these legacy contaminants in the river and adjacent wetlands has been underway since 2010 that will significantly contribute towards delisting of the AOC. The state Natural Resource Trustees have partnered with the USEPA Great Lakes National Program Office (GLNPO) through the Great Lakes Legacy Act (GLLA) to carry out remediation and restoration of the river and adjacent shelf wetlands within the GCR. Finally, to fully address the habitat-related beneficial use impairments in the AOC, IDNR, IDEM, USFWS and The Nature Conservancy have been working on restoring globally rare dune and swale along with other important habitats to contribute towards delisting the GCR as an AOC. Over the past 18 months, the USEPA's AOC program has been working with these AOC partners to fund management actions that will contribute towards delisting the AOC through the Great Lakes Restoration Initiative via direct funding grant opportunities. None of this incredible work would be successful without the partnerships that have been established and maintained over the last couple of decades.

Yankowiak, Betsy*. **Four major challenges managing wetland restoration after federal invasive species control project in large urban wetland restoration site**. Little River Wetlands Project, Fort Wayne, Indiana. Email: b.yankowiak@lrwp.org

Located in Fort Wayne, Indiana, Eagle Marsh is the largest non-coastal, urban wetland restoration in the United States. Eagle Marsh managed by the non-profit Little River Wetlands Project (LRWP) and is enrolled in the NRCS Wetland Reserve Program. Wetland restoration began in 2005. Adjacent land use includes active railroad tracks, a waste water treatment plant, landfills, an interstate highway and junction, a county park, residential, and a business office complex. Within five miles, land use includes Fort Wayne International Airport, two active gravel pits, and General Motors Assembly Plant. Electric powerlines bisect the property and carry almost half of Fort Wayne's electricity; the lines are an emergency backup for General Motors Assembly Plant. In December 2015, a 9,000+ foot long earthen berm was completed at Eagle Marsh to separate the Great Lakes and Mississippi River Watersheds to stop the spread of Aquatic Nuisance Species, including Asian carp. LRWP faces four major restoration challenges resulting from the watershed separation project. (1) The restoration of 45 acres disturbed during project in an urban setting. (2) Hydrology changes that will impact plant communities outside of the project area. (3) The watershed separation project lowered the old berm on the right-descending bank just downstream of wastewater treatment plant to allow flood waters to flow into areas of Eagle Marsh. The wastewater treatment plant is expanding to accommodate an additional billion gallons of water annually in an effort to reduce combined sewer overflows into local rivers and to process wastewater from the expanded General Motors Assembly Plant. (4) Another challenge to these newly disturbed areas is the threat of callery pears trees (*Pyrus calleryana)* that are invading the property from the adjacent business' landscape.

Zirbel, Chad R.[*1], Emily Grman[1,2], Tyler Bassett[1,3], Lars A. Brudvig.[1] **Do functional traits predict plant assemblages and ecosystem functioning of restored prairies?** [1]Michigan State University, East Lansing, MI. [2]Eastern Michigan University, Ypsilanti, MI. [3]W.K. Kellogg Biological Station, Hickory Corners, MI. Email: zirbelch@msu.edu

Restoration outcomes are notoriously variable, in terms of recovering particular species assemblages, enhancing ecosystem functioning, and other benchmarks of success. Assessments based on functional traits, or characteristics of species, may improve understanding of restoration outcomes, because traits relate to how individuals respond to environmental conditions, affect trophic interactions, and influence the ways that ecosystems function. Unfortunately, evaluations of restorations based on functional traits are rare. Within 29 restored prairies, we evaluated the relationships between environmental conditions (fire frequency, surrounding landscape composition, land-use history, site age, and soil characteristics), 4 functional traits of the plant communities (vegetative height, seed mass, specific leaf area, and pollination vector), and levels of six ecosystem functions (above and belowground biomass, floral cover, decomposition, and predation of arthropods and seeds). We found that environmental conditions affected values all four traits (R^2=0.17 to 0.42). Our ability to explain variation in ecosystem function ranged widely (R^2=0.09 to 0.46), with both traits and environmental conditions being important predictors of function. Yet, no one set of environmental conditions or traits influenced all functions in the same direction. This result illustrates that heterogeneity in site conditions and restoration management will be necessary to promote a diverse set of ecosystem functions across a landscape. Together, these findings suggest that both trait composition and environmental conditions play a role in shaping ecosystem functioning during restoration, and their importance is dependent on the function of interest. Through better matching the traits of species added during restoration to environmental conditions and by using management techniques, such as fire, to alter these conditions at restoration sites, we may be able to more reliably establish desired community composition, and achieve desirable levels of ecosystem functioning. Moving forward, trait-based approaches to conducting and assessing restoration might produce more predictable outcomes.

POSTER PRESENTATIONS (ALPHABETICAL ORDER)

Bennett, Daniell[1*], Alex Johnson[2], Keenan Dungey[1], and Michael Lemke[2.] **The effect of flooding on water quality in restored and unrestored Illinois River floodplain lakes.** [1]University of Illinois Springfield, Department of Chemistry, Springfield, IL. [2]University of Illinois Springfield, Department of Biology, Springfield, IL. Email: dbenn3@uis.edu

Although part of the complex ecology of dynamic flood-pulsed river systems, flooding dictates the degree of disturbance and extent of river-floodplain connection that is proportional to its duration and magnitude. In a changing landscape under river control and increased alteration, it is difficult to understand the restoration ecology and function, especially when the area is altered by flood. The objective of this analysis of historical data was to compare trends in water quality measurements in Illinois River floodplain shallow lakes that varied in the degree of flooding (i.e., disturbance) and extent of restoration. Water quality variables were compared from a restored lake with limited flooding (Thompson Lake, flood of record 2013; TL13), a restored lake that was connected to the river and flooded (Long Lake, 2013; LL13), a connected and flooded unrestored lake (Big Lake 2002; BL02) and a restored lake on the floodplain that did not flood (LL02). A high concentration of ammonia accompanied flooding in the unrestored floodplain lakes, with no effect in lakes minimally connected to the river. BL02 increased in ammonia after the flood likely due to algal decomposition. Nitrate increased with the flood pulse in connected lakes (BL02, LL13), then decreased to low levels three months post-flood. It appears that nitrate contributed to algal growth given the three month post-flood increase in chlorophyll a in BL02 and LL13. It seems that the river connection is a greater influence on the biotic response of these shallow lakes than is the state of their restoration.

Blume, Louis[1], Brick M. Fevold*[2], Craig Palmer[2], Molly M. Amos[2], Adam Bucher[2], and Judy Schofield[2]. **Effective quality assurance strategies in the 21st Century – Guidelines in data quality assurance and quality control in ecorestoration projects.** [1]U.S. Environmental Protection Agency, Chicago, IL. [2]CSC Government Solutions, Inc., Alexandria, Virginia. Email: blume.louis@epa.gov; brick.fevold@csra.com; molly.middlebrook@csra.com; adam.bucher@csra.com; craig.j.palmer@csra.com; judith.schofield@csra.com

In ecological restoration projects, environmental decisions require reliable data of known quality necessary to accurately assess ecosystem conditions, track progress toward stated restoration goals, determine the effectiveness of restoration practices, and provide evidence of restoration success. However, ecological restoration projects often lack sufficient quality assurance and quality control (QAQC) best practices necessary to guide data quality improvements and that allow for an 'evidence-based' assessment on the quality of the data used in determining restoration success. Project planners are encouraged to develop QAQC best practices that focus on '*building-in'* quality strategic planning and quality control monitoring procedures to assure the production of quality data necessary to support sound decision making essential to the implementation of a successful ecorestoration project. Quality Assurance (QA) is 'process-oriented' and includes the strategic planning and adaptive management considerations through informed planning in project design and the definition of data quality indicators (DQIs) used to assess specific data quality objectives (DQOs). Quality Control (QC) is 'product-oriented' and is most effective when integrated as part of an adaptive management framework to document quality oversight and to support decision-making throughout the project lifecycle. Quality control in ecorestoration project management includes the collection of field data following 'QC check' procedures designed to assess whether routine data are being collected within acceptable standards of accuracy, bias and precision. QC checks are an essential component to any monitoring

program and provide the empirical data necessary to estimate uncertainty in project data quality. By incorporating QAQC best practices as part of quality strategic planning, ecological restoration project planners will increase their confidence in data quality and their ability to assess the effectiveness of their ecological restoration effort.

Chavez, Samantha J.*[1], Anthony Yannarell[1], and John Taft[2]. **Plant-microbe linkages in encroached hill prairie communities.** [1]University of Illinois at Urbana-Champaign, Urbana, Illinois. [2]Illinois Natural History Survey, Prairie Research Institute, Champaign, Illinois. Email: sjchave2@illinois.edu

Plants and soil microbes are linked through biotic interactions, but they may also respond to common environmental drivers. Understanding how plant and microbial communities respond to each other and to environmental gradients can contribute to understanding patterns of beta diversity above and belowground. In this study we investigated the relationships between plant and microbial communities, as well as environmental variables across a gradient of vegetation communities: open hill prairie habitat, the woody encroached edges, and the surrounding woodlands. We collected plant species composition and cover of all rooted vascular plants using a modified Daubenmore cover-class scale and did Illumina sequencing for microbial community composition. We also measured environmental variables such as light, distance between plots, and soil edaphic factors. We ran Generalized Dissimilarity Models (GDM) for plant and microbial community response to each other's communities and all environmental variables. Based on our GDM, turnover in the soil bacterial community was the strongest driver of plant community beta diversity. However, plants also responded to changes in the fungal community and abiotic factors such as moisture, elevation, light availability, nitrate, and pH. Bacterial and fungal community turnover was driven almost exclusively by pH and ammonium gradients, with plant species composition having little to no impact on changing the microbial communities. Despite this, microbial community composition was broadly different between prairie habitats, shrub-encroached borders, and woodland. Additionally, neither plant nor microbial communities showed evidence of strong autocorrelation when sampled at the scale of our study. Our results suggest that relationships with soil bacteria can be just as important as environmental drivers in determining plant species turnover. However, soil bacterial communities do not respond to plant species composition per se, but they are instead influenced by general habitat characteristics along the grassland to woodland gradient.

Colin, Sara*, Elsa C. Anderson, Emily S. Minor. **Native seed species preference among native avian foragers in Chicago, IL.** University of Illinois at Chicago, Chicago, IL. Email: scolin2@uic.edu

Tallgrass prairies are the most threatened biome, and most prairie habitat available today has been intensively restored. Habitat restoration often has an end goal of providing high-quality habitat for native plants and animals, however there is not much information about how the restoration process itself offers resources for local species. In an attempt to further understand native plant and animal interactions, we sought to find the native plant species, and the treatment condition of their seeds, preferred by seed predators that are predominantly birds. At our study site in Chicago, IL, we set out trays of 8 species of stratified and unstratified native seeds to evaluate whether birds preferred to consume seeds that had been cold/moist treated for 30 days versus standard dried seeds. Under natural conditions, where seeds fall off the plant and often overwinter on the ground outside, stratified seeds would be available to seed predators. Our preliminary findings suggest that seeds that undergo a 30 day cold/moist stratification are more readily consumed by seed predators than those that do not. This preference seemed to be true for all species of seeds, but *Helianthus occidentalis* and *Dalea candida* were the most preferred overall. Understanding seed species preference and the preferred treatment

conditions of the seeds furthers the knowledge needed for successful restoration of native plant species.

Damm, Mary C.*[1], Marc Bogonovich[2], and James D. Bever[3]. **Prairie microgeography.** [1]Indiana University, Bloomington, Indiana. [2]Openwords LLC, Bloomington, Indiana. [3]University of Kansas, Lawrence, Kansas. Email: mdamm@indiana.edu

We introduce the term microgeography to highlight an aspect of plant community ecology that has received little attention. Plant ecologists commonly study spatial patterns and measure richness and diversity at scales ranging from continents, to communities, to plots. However, plant ecologists less regularly examine these patterns at a scale less than a square meter. Much can be learned about a plant community at a scale of the individual plant and its closest neighbors. Microgeography considers the spatial structure of plants at a geographical scale of centimeters. More specifically, microgeography documents patterns of species richness of a single point, spatial arrangement of plants with respect to neighboring conspecifics and other species, and measure community composition similarity decay over distances of centimeters. Microgeographical patterns can then be used to evaluate theoretical and applied concerns, such as theories that aim to explain plant species diversity (*e.g.*, plant-soil feedback theory) and measure "success" of a restoration or reconstruction. We used a microgeographical approach to examine the spatial structure of native and reconstructed tallgrass prairies in Iowa. Using a $0.5m^2$ point-intercept frame with intercepts 10 cm apart, we recorded all species present at each of 49 points. We sampled 7 frames in each of 3 native and 2 reconstructed black-soil prairies. We found that the 2 prairie types differ in spatial structure. Native prairies have greater species richness than reconstructed prairies all the way down to a single point. Native prairies also have lower similarity than reconstructed prairies between neighboring plants at distances of centimeters. From our findings and associated experimental work on a number of tallgrass prairie species and soil microbes, we suggest that plant-soil feedback may be an important mechanism explaining differences between the spatial structure of plants in native and reconstructed prairies.

DiGiovanni, Jane P.*, William P. Wysocki, Sean V. Burke, Melvin R. Duvall, Nicholas A. Barber. **The role of hemiparasitic plants: influencing tallgrass prairie quality, diversity and structure.** Northern Illinois University, DeKalb, IL. Email: z1035591@students.niu.edu

Pedicularis canadensis (Orobanchaceae) and *Comandra umbellata* (Santalaceae) are two root hemiparasitic plant species found in tallgrass prairie communities of the Chicago Region. Managers are interested in utilizing these species to reduce dominant prairie grasses and thereby increase ecological diversity and quality in prairie restorations and urban plantings. A field observational study at five tallgrass prairie sites investigated the association of hemiparasite abundance with metrics of phylogenetic and ecological diversity as well as floristic quality. Although no reduction in C_4 grasses was detected, analysis of the field data found a significant association between hemiparasite abundance with increased floristic quality at all five sites. Hemiparasite abundance and species richness was associated significantly at one restoration site. A mesocosm experiment investigated response to parasitism by *P. canadensis* in species representing six different functional groups of the tallgrass prairie. The annual legume *Chamaecrista fasciculata* had the greatest significant dry biomass reduction among six host species. The C_4 grass, Andropogon gerardii had significantly greater shoot biomass when grown with the hemiparasite. Overall, host species biomass as a total community was significantly reduced, consistent with other investigations that demonstrate influence on community structure by hemiparasitic plant species.

Duke, Shawn T*[1], Steven N. Francoeur[2], and Kristin E. Judd[2]. **Effects of *Phragmites australis* invasion on carbon dynamics in a freshwater marsh.** [1] Cardno Inc., West Olive, Michigan. [2] Eastern Michigan University, Ypsilanti, Michigan. Email: shawntduke@gmail.com

Common reed (*Phragmites australis*) is an invasive grass that is altering wetlands in the Great Lakes region. To determine the effect of *Phragmites* invasion on wetland carbon (C) dynamics, we investigated environmental conditions, plant litter decomposition, and release of gaseous C from sediment pools in *Phragmites*-dominated and pre-invaded *Typha* stands in a coastal freshwater marsh. Reciprocal litter bag transplant experiments revealed greater annual mass loss of both species' litter at *Phragmites*-dominated sites ($p<0.05$), but no difference in intra-stand decomposition between species. Incubation experiments revealed no difference in sediment CO_2 release between *Phragmites* and *Typha* under oxic or anoxic conditions. Under anoxic conditions CH_4 release was significantly greater from *Typha* sediments ($p<0.05$). Leaching rates of DOC from plant litter were >50 % lower from *Phragmites* litter, and responses (CO_2 release) of *Phragmites* sediments to leachate additions were greater than those of *Typha* sediments, indicating differences in sediment microbial communities. Our results suggest that *Phragmites* invasion may increase litter decomposition and reduce CH_4 emission through environmental changes that alter microbial activity and/or composition, but the net effect of these changes on wetland C accumulation will depend on net primary production.

Grieser, Jennifer M.* **Improving urban watershed health through creation of stormwater treatment wetland.** Cleveland Metroparks, Parma, Ohio. Email: jmg2@clevelandmetroparks.com

Opportunities for improving watershed health in an urban environment can be limited due to lack of effective prescriptions as well as space and funding constraints. Big Creek Connects, a nonprofit watershed organization, took a deliberate approach to identifying appropriate measures and locations by first developing a balanced growth plan, which recommended focusing on stormwater retrofits as the means to improving the health of Big Creek. This urban stream is a tributary of the Cuyahoga River within the Area of Concern, which empties into Lake Erie at Cleveland, Ohio. Big Creek Connects then pursued a stormwater retrofit inventory and prioritization, which identified the Fern Hill Stormwater Treatment Wetland as one of the highest ranking projects to pursue. City of Parma then received a Surface Water Improvement Fund grant from Ohio EPA and turned the project over to Cleveland Metroparks to manage. Cleveland Metroparks completed construction of the nearly 1 acre treatment wetland where an underutilized area of mowed lawn previously existed. The project intercepts a storm sewer which drains 50 acres of high density residential development and redirects the outflow into a pretreatment forebay before flowing into the main wetland cell and eventually outletting to Big Creek. During installation heavy equipment operators noted the continuous flow of water even during extended dry periods. Cleveland Metroparks contact Northeast Ohio Regional Sewer District, who identified multiple leaks within Cleveland Division of Water drinking lines, and are working to resolve the leaks in order to then detect suspected sanitary illicit discharge. Over 7,400 herbaceous and woody plants were installed by contractors and volunteers to enhance the function of the wetland. Daily visitors reflect on the beauty of the project while resting on overlooking benches or passing by on adjacent All-Purpose trails.

Gurholt, Carli R*[1], Tanya E. Cheeke[1], James D. Bever[2]. **Mycorrizal responsiveness differs among non-native, late-, and early-successional prairie species.** [1]Indiana University, Bloomington, Indiana. [2]University of Kansas, Lawrence, Kansas. Email: cgurholt@indiana.edu

Early successional plants, such as non-native asters and grasses, often colonize disturbed prairies, preventing the establishment of native, late successional species. The reduction of mycorrhizal density with disturbance can confer a competitive advantage to non-native plants if they have low dependency on mycorrhizal fungi compared to native, late successional plant species. To test whether non-native plant species have low mycorrhizal responsiveness to AM fungal species compared to early- and late-successional plants, we inoculated six non-native plant species, three early-, and three late-successional species with one of five different AM fungal species isolated from remnant prairies in Indiana. Mycorrhizal responsiveness was calculated as total biomass with AM fungal inoculation / total biomass without AM fungal inoculation. We found that the late successional grasses, such as little blue stem (*Schizachyrium scoparium*) and big blue stem (*Andropogon gerardii*), were very responsive to AM fungi, and grew up to twenty times bigger when inoculated with AM fungi than without. Early-successional and non-native grasses had negligible or negative mycorrhizal growth responses. Interestingly, both native and non-native asters, including *Echinacia pallida*, *Rudbeckia hirta*, Dandelion, and Chicory, were generally responsive to AM fungi, and grew two to five times bigger when inoculated with AM fungi than without. We also saw differences in plant growth among the different fungal treatments. *E. infrequens* generally improved the growth of late successional native prairie plants while inhibiting the growth of non-native grasses. *S fulgida*, on the other hand, had a negative effect on growth of both native and non-native plants, regardless of successional stage. This study shows that although inoculating native plants with AM fungi can be an important step for improving plant growth, plant-fungal specificity is also an important consideration for increasing the success of restoration ecology efforts.

Hileman, Jonathon T*, Holum, Erika M*, LeClaire, Ellé M*, Bargy, Mary, Foster, Jacob, Golan, Julianne, Hibbard, Brody, Koll, Seth, McClanahan, Devon, Slater, Adria, Vance, Savanna, Zuniga, Sarah, and Mullen, Renée . **Getting to the Root of the Problem: Botany Students turn Activist to Formulate Policy in Favor of Native Plants.** Eureka College, Eureka, Illinois. Email: jhileman14@eureka.edu, eholum13@eureka.edu, and eleclaire14@eureka.edu

Community engagement can be a major setback to implementing sustainable solutions to environmental challenges. In Eureka, Illinois, Botany students created a model for sustainable stormwater retention by constructing a rain garden behind Sanders Hall at Eureka College. Yet, as neighbors complained about the aesthetic appeal regarding the use of native plants, Botany students sought to educate the public and amend the city's weed ordinance to allow the use of native plants as a solution to stormwater retention. In order to implement this strategy, our first step was to speak to the public about the use of native plants. As a class, we learned about the benefits and fallbacks of various native plant species in Illinois. We navigated the diverse ecological landscape of the Prairie State and shared our findings with the larger public. Feedback was successful, and we proceeded to tell the city council about the use of native plants for stormwater mitigation. After communicating our idea, we drafted an ordinance for the city's Public Safety committee. We prepared a list of weeds defined by the State of Illinois, a list of native plant species, and a draft bill to amend the city ordinance. After the first draft was sent back for revisions, we presented the new documents to the mayor and city council. After an hour and a half of debate, the bill passed on a vote of 6-1. As students, we realized that implementing sustainable solutions can be challenging, yet achieved through education and good, constructive public relations. We got to the root of our city's stormwater problem to propose a greener, cleaner, and more sustainable solution for all.

Hussey, Juliana* and Shana M. Byrd. **Evaluating Tree Species Survival and Vegetative Competition Following Release of Saplings at The Dawes Arboretum Bottomland Reforestation Project.** The Dawes Arboretum, Newark, Ohio. Email: juliehussey7@gmail.com

Determining best management practices for reforestation is important to effective ecological restoration and competition from vegetation during establishment can influence sapling mortality. This study aimed to determine baseline survival per species under various management regimes. Exertion of labor per management technique was also evaluated. In March of 2015, 16 bottomland species were planted at The Dawes Arboretum in a cleared agricultural field, prepared by a prior year annual crop. Flags delineated 10 x 10ft (3.04 x 3.04m) spacing within 70 rows on a 7 ac (3.64 ha) site. Mid-March through early-April 2015, trees were planted at every flag marker, for a total of 3,091 saplings. Following 2 months of establishment, 3 different control methods helped reduce vegetative competition among saplings. Each treatment was applied to approximately 1/3 of the site, including 1) hand weeding, string trim, and mow 2) string trim and mow and 3) mow only. A subset of 3 control rows separating treatments received no management. Individual tree survival was recorded and ground cover subplots were collected from 13% of the entire plot area. Results yielded average overall survival of 78%. The highest rate of survival per species was red maple (*Acer rubrum*) at 100%, while lowest rate of survival was silver maple (*Acer saccharinum)* at 3%.Within management regimes, highest survival was observed within plots receiving treatment 2 (string trim and mow) at 81%, while the lowest survival was seen in treatment 3 (mow only) at 74%, indicating excess vegetation may influence survival. Treatment 2 (mow and string trim) required 43% less labor than the most intensive approach (treatment 1), showing additional labor did not result in higher survival. Factors including progressive planting dates, herbivory, loss of planting flag and variable soil conditions likely influenced results. Data will serve as a baseline condition for future project evaluation.

Kelleher, Eric*, Julie Kelleher and Young D. Choi. **Arthropod diversity and trophic levels between restored prairie and fallow agriculture fields at Taltree Arboretum.** Purdue University Calumet, Hammond, IN. Email: ekellehe@purduecal.edu

Arthropod diversity is one component of natural systems which adds important ecosystem services such as pollination, natural pest control and decomposition. With increased native plant diversity found in restored prairies compared to fallow fields we sought to determine if arthropod diversity would be affected by the restoration. Over the summer of 2014 we studied arthropod communities using baited pit-fall traps at six sites located within Taltree Arboretum in Valparaiso, IN. Each site was sampled 5 times from June through August 2014. The six sites included four restored prairie sites, a fallow agriculture field and a stand of *Phalaris arundinacea* (canary reed grass) collectively called fallow-*Phalaris* sites. A total of 29,890 arthropods were counted and identified to 18, 12, 8 and 10 herbivore, carnivore, omnivores, and detritivore, respectively, families in 10 orders. Family counts by trophic level were not significantly different between sites: respectively, herbivore, carnivore, omnivore, and detritivore families for prairies sites were 16, 11, 8, and 9 while fallow-*Phalaris* were 17, 10, 8, and 10. Taxon richness and diversity were also not significantly different between restored prairie (44 families; H' = 2.24) and fallow-*Phalaris* (45 families; H' = 2.50). However, our NMS (nonmetric multidimensional scaling) ordination revealed a divergence of arthropod communities. The herbivore abundance was significantly higher in the prairie (1,085 ± 303 individuals) than the fallow-*Phalaris* (383 ± 128), while the opposite was true for carnivores (665 ± 185 and 1500 ± 307) in the prairie and fallow-*Phalaris*, respectively, sites). Alydidae (broad-headed bugs, 1220 ± 229) and Elateridae (click beetles, 244 ± 30) characterized the prairie sites while the fallow-*Phalaris* sites were characterized by Lycosidae (wolf spiders 623 ± 270), Carabidae (ground beetles, 372 ± 157) and

Lampyridae larvae (lightning-bug larvae, 355 ± 139). This divergence suggests a shift in arthropod assemblage in the restored prairie.

Kelleher, Julie*, Eric Kelleher, and Young D. Choi. **Vegetation Survey in Gaps Created by Emerald Ash Borer (*Agrilus planipennis*) Infestation in Coffee Creek Watershed, Chesterton, Indiana.** Purdue University Calumet, Hammond, IN 43623. Email: jckelleh@purduecal.edu

The exotic pest inadvertently introduced from Asia in the 1990's, the Emerald Ash Borer (EAB) (*Agrilus planipennis*), has girdled ash trees (*Fraxinus* spp.) throughout eastern and Midwestern North America. The devastating effect of EAB was also evident in Coffee Creek Watershed, Chesterton, IN, where more than 50 infected ash trees were culled between 2012 and 2015. The senescence and eventual removal of the trees led to the creation of gaps within the canopy. The objective of this study was to characterize the dynamics of trees and shrubs within the gaps where ash trees were removed and compare them with reference sites. Gap sites were characterized by open canopy (canopy closure 10 $\pm$ 4%) with the dominance of *Fraxinus americana* (density 16 $\pm$ 5 stems ha^{-1}, basal area 44 $\pm$ 14 m^2 ha^{-1}) and *Juglans nigra* (19 ± 10 stems ha^{-1}, 14 ± 10 m^2 ha^{-1}). The reference sites were best described as closed canopy (93 $\pm$ 3%) and the dominance of *Acer saccharum* (7 ± 3 stems ha^{-1}, mean basal area) and *Asiminia triloba* (13 ± 10 stems ha^{-1}, 12 ± 11 m^2 ha^{-1}). Our NMS (Non-metric Multidimensional Scaling) ordination revealed a divergence in understory vegetation between gap and reference sites. *Rosa multiflora* (mean density 15 ± 8 stems ha^{-1}; basal area 23 ± 9 m^2 ha^{-1}) and *Rubus occidentalis* (16 ± 6 stems ha^{-1}; 12 ± 4 m^2 ha^{-1}) appeared to be the major species in the gap sites, while *Lindera benzoin* (23 ± 10 stems ha^{-1}, 17 ± 4 m^2 ha^{-1}) and *Parthenocissus quinquefolia* (30 ± 7, 13 ± 8 m^2 ha^{-1}) dominated in reference sites. This divergence suggest a gradient in shade-tolerance for the shrubs from the open gap to the closed reference sites.

Lauer, Marissa A.[1], Peter C. Smiley Jr.*[2], Karolyn M. Stillman[2], and William C. Fleece[3]. **Associations between freshwater mussels (Family Unionidae) and their host fishes within an agricultural watershed in central Ohio.** [1]Ohio State University, Columbus, Ohio. [2]USDA Agricultural Research Service, Columbus, Ohio. [3]Stantec, Cincinnati, Ohio. Email: rocky.smiley@ars.usda.gov

The diversity of freshwater mussel communities has declined over the past several decades within agricultural watersheds in the Midwestern United States. Host fishes play an important role in the life cycle of freshwater mussels because they serve as hosts for parasitic mussel larvae to ensure successful mussel reproduction and colonization of new areas. Understanding the relationships between freshwater mussels and their host fishes can guide the design of mussel restoration strategies within lotic ecosystems. Our research question was: what are the relationships between the community structure of freshwater mussels and host fishes in the Upper Big Walnut Creek watershed (UBWC), Ohio? Our field study was conducted from June to August 2015 in eleven UBWC sites. Mussels were collected using quadrat and visual search techniques. Fishes were collected with a backpack electrofisher. We also measured selected physical and chemical variables. Simple linear regression analyses was used to determine the relationships between species richness and abundance of mussels and host fishes. We also conducted simple linear regression analyses to examine the relationships between mussel species richness and abundance with watershed size, discharge, and turbidity. We did not observe a relationship ($P>0.05$) between mussel species richness and abundance with host fish species richness and abundance, nor did a relationship ($P>0.05$) occur between mussel species richness and abundance with discharge and turbidity. We also did not observe a relationship ($P>0.05$) between mussel species richness with watershed size. However, a positive relationship ($R^2=0.508$, $P=0.013$) between mussel abundance with watershed size was documented. Our initial results suggest mussel

restoration efforts should be targeted within larger subwatersheds in the UBWC and other similar agricultural watersheds in Ohio.

Lesko, Jennifer*, Douglass Jacobs. **Reintroduction of American chestnut (*Castanea dentata*) underplanted in a gradient of light intensity and weeding treatments applied to non-native *Pinus strobus* plantations.** University, West Lafayette, Indiana. Email: leskoj@purdue.edu

American chestnut (*Castanea dentata*) was once a major forest component in its native range but was decimated by chestnut blight (*Cryphonectria parasitica*), becoming functionally extinct by 1950. Now, blight-resistant hybrids that are 95% American chestnut have been developed through backcross breeding, and these hybrids are ecologically equivalent to pure American chestnut. Restoration is beginning, but gaps in knowledge about chestnut's growth strategy and ecology present a challenge. 60,000 ha of non-native conifer, mainly pine, plantations of little economic value currently exist in Indiana, Ohio, and Illinois. These plantations provide a valuable opportunity for restoration. Chestnut prefers the subxeric acidic soils in conifer stands and will likely have little competition from mesophytic tree species. In a field trial, we examined chestnut's growth when underplanted in a gradient of light intensity and weeding treatments applied to pine plantations. It was expected that underplanted chestnut seedlings will: thrive in pine plantations, exhibit greatest growth in shelterwood treatments, grow faster than northern red oak, and respond positively to weed control. In west central Indiana, three plantations of white pine (*Pinus strobus)* were each divided into overstory removal, shelterwood, and control treatments. American chestnut and Northern red oak (*Quercus rubra*) seedlings were underplanted within each treatment area. Each site was subjected to midstory removal and fencing to prevent deer browse. Measurements compared survival, growth, site environmental conditions, and metabolic processes (gas exchange, plant moisture stress, foliar nutrients) of treatments and species. Results show that chestnut survival and growth were significantly higher than northern red oak. Chestnut seedling growth and gas exchange was highest in the shelterwood treatment. However, there was no difference in growth between weeding treatments. These trial results shed light on chestnut's optimal growth strategy and indicate it can successfully compete in conifer plantations, especially under intermediate light and canopy cover.

Manning, Jacob D.*[1], Donald P. Althoff[1], Alyssa L. Balter[2], and Grace J. Dietsch[2]. **First year survival of broadcast-planted oak and hickory seeds in a reverted agricultural field.** [1]University of Rio Grande, Rio Grande, Ohio. [2]Five Rivers Metroparks, Dayton, Ohio. Email: s300718693@students.rio.edu

Deforestation continually degrades our natural ecosystems resulting in many species of flora and fauna at risk because of loss of optimal habitat. Agriculture dominates a majority of the landscape in western Ohio, and when such lands are acquired by conservation agencies and organizations they often choose to establish wooded habitat by planting seedlings. This reforestation practice often requires tremendous amount of time and money, but many of the techniques are neither efficient nor successful for large-scale projects. The Five Rivers Metroparks near Dayton, Ohio, often reforests such fields that were previously in crop production. In an attempt to become more efficient, >62,700 hardwood seeds—mostly oak and hickory—were collected and broadcast-planted on a 4.0 ha reverted agricultural field in November 2014. Belt transect sampling was conducted the following summer (2015) to determine the first-year survival of the oak and hickory seeds. Within the sampled area 2,502 total seedlings were detected which calculated to 0.317 seedlings per sq/m, and projected to an estimated 12,576 seedlings present in the entire 4.0 ha field. Thus, for all species combined, >20% of the seeds successfully germinated and began growing to a detectable height by July 2015. Overall, shagbark hickory had the

highest survival rate (53.6%) as seedling survival was not independent of species ($p<0.001$). Red oak had the highest survival rate (32.8%) among oak species (vs. white, bur, and chinquapin). There were a considerable amount of seedlings growing across the entire field, and the planting can be considered a success thus far. Although total success cannot be determined for several decades, broadcast-planting appears to be a reasonable method of forest restoration as it greatly reduces the amount of time and funds needed to be successful versus the conventional approach of germinating seeds in a nursery and transplanting 1- to 2-year old seedlings.

Mattwig, Melissa A.*[1,2], Lauren Umek[2,3,4], Byron Tsang[2,3]. **Urban parks of the future: soil analysis of the Chicago Park District natural areas.** [1]Allegheny College, Meadville, Pennsylvania. [2]Chicago Botanic Garden, Glencoe, Illinois. [3]Chicago Park District, Chicago, Illinois. [4]DePaul University, Chicago, Illinois. Email: mattwigm@allegheny.edu

The Chicago Park District's Natural Areas Program employs traditional management techniques similar to other regional land managers. In southern Chicago, some new parks have been built upon post-industrial brownfields with imported soils. We compared the plant community and soil characteristics of two established prairies and two post-industrial sites with imported sediment soil along Chicago's lakefront. Sites were characterized by vegetation quality and soils were characterized by physical (moisture and texture), chemical (NO_3, NH_4, K, PO_4, pH), and biological (decomposition rate, and enzymatic activity) properties. Nutrient content, decomposition, and enzymatic activity were dramatically elevated at one post-industrial site (Steelworkers), but comparable among reference sites and the other post-industrial site (USX). At Steelworkers, soil chemical properties varied widely between sampling locations. At reference sites, soil pH generally reflected plant diversity, but this trend was not observed with the post-industrial sites. The altered soil quality and biodiversity of the post-industrial sites with imported sediments suggests that these sites require a modified management approach that anticipates high invasive species growth and accounts for elevated nutrients and altered soil biodiversity.

Moore, Jesse.* and Fiona Becker. **Not your typical Mitigation Project, Forest Restoration and Enhancement at Chelsea Flatwoods.** The Nature Conservancy, Nashville, Indiana. Email: jesse_moore@tnc.org

Located in southeastern Indiana Chelsea Flatwoods is a large, rectangular remnant of very wet flatwoods, and was confirmed by the Indiana Natural Heritage program in 1990 as the largest and most diverse Bluegrass Till Plain flatwoods left in the state. Due to growing business demands a local auto parts manufacturer, Arvin Sango, Inc. (ASI) needed to expand its existing manifold assembly building, as well as add several other buildings, drives, parking areas, a retention pond, and landscaping. The proposed development will result in impacts to the entire 1.77 acres of forested wetland and all 1,800 linear feet of an ephemeral/intermittent stream on the ASI property. Restoration and enhancement at the Chelsea Flatwoods Nature Preserve was chosen as the method of compensatory mitigation in this case because increasing the quality of this particular wetland site will promote the spread of Endangered, Threatened, and Rare (ETR) plant species as well as expand a unique wetland community type (flatwoods). In addition, this project is being designed to increase local flood storage volume which will help sustain the overall watershed health. Based on an 8:1 mitigation enhancement ratio, Chelsea Flatwoods received about 19 acres of forest and hydrological restoration. In October of 2015 the forest and hydrological restoration work was completed with follow up treatments for re-sprouts planned for the early summer of 2016. Success criteria for the mitigation areas include, mean Floristic Quality Index (FQI) and mean conservatism (C)-values within the restored wetland must remain

constant or increase each year, wetland restoration area must continue to meet wetland criteria per the United States Army Corps of Engineers Wetland Delineation Manual Technical Report Y-87-1 (January, 1987) and the Midwest Regional Supplement (2008). Success criteria must be met for two (2) consecutive years within a five (5) year period.

Oblander, Ashley*[1], Jordan Drake[1], Jessica Riebkes[1,2], Sean Robbins[1, 2], Abby Saladino[1], Gabrielle Wilson[1], and Benedict, Russ[1]. **Winners and losers: plant establishment during prairie reconstruction in drought conditions.** [1]Central College, Pella, Iowa. [2]University of Northern Iowa. Email: oblandera1@central.edu.

This work is part of the Prairies For Agriculture Project (PFA), a long term study that seeks to benefit humans and nature by incorporating diverse prairie plantings into the agricultural landscape. The early stages of the PFA were impacted by drought conditions in 2012 and 2013, which appeared to slow establishment of some species. This study quantified establishment of prairie plants during the first three years of reconstruction; the first two of these were in drought conditions. By comparing our results to other research, we identified species that usually are successful early in prairie restorations but did not establish well at our site. These plants, some of which are important in Tallgrass Prairies, include Big Bluestem (*Andropogon gerardii*), Canada Wildrye (*Elymus canadensis*), Yellow Coneflower (*Ratibida pinnata*), Stiff Goldenrod (*Oligoneuron rigidum*), Leadplant (*Amorpha canescens*), and white prairie clover (*Dalea candida*). Drought is one possible explanation for the low success of these species at our site. Additionally, several plants in our plots established better than expected, especially Sawtooth Sunflower (*Helianthus grosseserratus*), Blackeyed Susan (*Rudbeckia hirta*), White Sage (*Artemisia ludoviciana*), and False Sunflower (*Heliopsis helianthoides*), possibly because they are tolerant of dry conditions and benefitted from the lack of competitors. Additionally, some species have established well and now are spreading into adjacent plots, including Western Wheatgrass (*Pascopyrum smithii*), Black-eyed Susan, and Sawtooth Sunflower. In some plots, the success of *Helianthus grosseserratus* and *Heliopsis helianthoides* appears to be slowing the establishment of other species. This possibility needs further exploration.

Oschrin, Emma* and H.L. Reynolds. **Co-occurring invasive plant species: how multiple invasions affect plant community dynamics.** Indiana University Bloomington, Bloomington, IN. Email: eoschrin@indiana.edu

Decades of research have demonstrated that invasions by individual plant species can dramatically reduce native biodiversity, yet few studies address simultaneous invasions by multiple plant species. It is therefore critical to extend investigations of invasion dynamics to include co-occurring invasives. Invasive-invasive interactions can be additive, where impacts of multiple invaders are the sum of individual effects, or non-additive, where impacts of the invasive species are greater or lesser than as single invaders. In non-additive interactions, co-occurring invasive species may compete with or alternatively facilitate each other, potentially reducing or enhancing each others' effects *non-linearly*. Such interactions may have potentially profound implications for managing invasives and promoting native communities. We conducted a mesocosm study under controlled greenhouse conditions to investigate interactions among co-occurring invasive species and communities of native prairie species under one of four treatment conditions: without competition from invasives, with each single invader, with paired combinations of invaders, and with all invaders present. The sign (competition or facilitation) and magnitude of invasive-invasive interactions was dissected by growing invasive species alone, in pairs, and all together. We hypothesized that invasive species from dissimilar functional groups would non-additively facilitate each other. We found that co-occurring invasive response was often non-additive, and varied with invader functional group identity and richness.

Struckhoff, Matthew A.*[1], Keith W. Grabner[1], Janice Albers[1], Michael Hooper[1] and Scott Fetters[2]. **Relationships between vegetation sampling intensity and information content for bottomland hardwood restoration monitoring.** [1]U.S. Geological Survey Columbia Environmental Research Center, Columbia, Missouri. [2]U.S. Fish and Wildlife Service Indiana Private Lands Office, Warsaw, Indiana. Email: mstruckhoff@usgs.gov

To assess the progress of habitat restorations, resource managers require monitoring methods that are appropriate to the goals of the restoration effort and to the resources available for monitoring. To provide guidance for bottomland hardwood restorations in the Great Lakes region, the relationships between vegetation sampling effort and data information content were explored with data collected using multiple sampling intensities at three restoration sites in northeast Indiana. Coupled with assessments of woody stem survival and recruitment, ground flora community development was assessed using multiple plot sizes (relevés of 25, 50, 75, and 100 m^2, and in plots consisting of four 1 m^2 quadrats). The percent of total species and the percent of vegetative cover represented by detected species showed positive logarithmic relationships with sampling effort (time or area). On average, sampling one 25 m^2 plot required 45 percent of the time but captured between 60 and 70 percent of the species relative to a 100 m^2 plot. Collectively, sampling 25 m^2 plots detected 77 percent of the species representing 86 percent of the vegetative cover within 100 m^2 plots. Sampling the smallest relevés detected the most frequent and abundant species and was as effective as sampling the largest relevés in detecting differences between sites using multivariate analyses. Quadrat sampling detected fewer species, showed higher variability within sites, and was less able to detect differences between sites, suggesting that the total sampled area may have been too small. Results suggest that more sample points with less sampling effort (smaller area or less time) may be more efficient for site-scale assessments of community development than are larger and fewer plots. Because smaller plot sampling detects fewer species, it may be less appropriate where the detection of a particular or infrequently occurring species is a criterion defining restoration success.
Poster presentation

Sturdevant, Angela.* **Don’t speculate, calculate! A simple new tool to calculate long-term stewardship costs and save future headaches.** The Nature Conservancy, Indianapolis, Indiana. Email: asturdevant@tnc.org

Ever wondered how to ensure your restoration project is successful 10, 20, 50 years from now for truly lasting conservation results? You can’t just walk away once the restoration work is done. Long-term protection and management, or stewardship, is critical to ensure the resources you’ve restored continue to function and thrive. However, the costs associated with long-term stewardship are inherently difficult to predict and consequently are often underestimated. To support better long-term cost calculation and management, the Conservancy’s Mitigation Learning Network convened a group of national experts from within and outside of the Conservancy to develop a stewardship calculator and accompanying handbook. These resources will allow restoration specialists and land managers to more accurately estimate the costs of long-term protection and management and, in turn, the amount of funding that should be set aside in a stewardship endowment to provide a secure source of funding into the future. The calculator prompts the user to consider all appropriate tasks, grouped into “Land and Easement Stewardship” and “Land Management and Maintenance.” This accessible tool helps consolidate and highlight common expenses to improve the ease and accuracy of calculating costs. The calculator has been designed to be used by both easement holders and land managers, and will be

available for free on Conservation Gateway for distribution beyond the Conservancy. This poster highlights the components of the calculator as well as key factors that affect cost estimation.

Wilson, Gabrielle*[1], Jordan Drake[1], Ashley Oblander[1], Jessica Riebkes[1,2], Sean Robbins[1, 2], and Abby Saladino[1,] and Russ Benedict[1]. **Impact of season of planting on prairie reconstruction in drought conditions.** [1]Central College, Pella, Iowa. [2]University of Northern Iowa. Email: benedictr@central.edu.

As part of the Prairies For Agriculture Project, a long term study seeking to benefit humans and nature by incorporating diverse prairie plantings into the agricultural landscape, this work examined impact of season of planting on plant establishment. Plots were seeded in fall 2011 or spring 2012, with 16 or 64 species. Some plots were mowed during the first year of growth, some during the first two years of growth, and some were un-mowed. Drought conditions began in fall 2011 and persisted until late summer 2013, likely impacting our results. To quantify establishment, we counted plants in one meter^2 frames. Data were analyzed with ANOVA with mowing treatment used as a covariate (GLM in Minitab); 16 species plots were analyzed separately from 64 species plots. Data from the fourth year after seeding is presented here. Fall-planted plots were more successful than spring-planted plots. When each species was analyzed individually and results from 16 species and 64 species plots were combined, 28 comparisons between spring and fall plots showed statistically significant differences ($p \leq 0.05$), 6 were approaching significance ($0.10 > p > 0.05$), and 22 were not statistically significant. For the 34 comparisons that were statistically significant or approaching significance, fall plots had more individuals per meter^2 than spring plots in 32 species. Additionally, in both 16 and 64 species plots, fall planting led to significantly higher native cover, higher number of species, higher number of individuals (NS in 16 species plots), and lower non-native cover than spring plots. Whether better performance of fall plots was due to drought conditions is difficult to assess based on experimental design but that is a likely explanation. Given that droughts and other altered weather patterns are expected to increase in the Midwest with changing climate, planting prairie reconstructions in fall may be advisable.

Woeste, Keith[1]*, Kathleen Knight[2], Christian Marks[3], Cornelia Pinchot[2], Paul Schaberg[4], and Jim Slavicek[2]. **A way forward for American elm.** [1]USDA-FS, Northern Research Station Hardwood Tree Improvement and Regeneration Center, West Lafayette, IN. [2]USDA-FS, Northern Research Station Forestry Sciences Laboratory, Delaware, OH. [3]The Nature Conservancy, Connecticut River Program, Northampton, MA. [4]USDA-FS Northern Research Station, Burlington, VT. Email: kwoeste@fs.fed.us.

The American elm (*Ulmus americana*) was once a dominant tree in riparian areas, floodplains, and urban forests. Dutch elm disease (DED) (*Ophiostoma ulmi* and *O. novo-ulmi*) caused the loss of millions of American elm trees throughout its former range, and it causes the loss of many trees today. Of the over 100,000 American elms tested for resistance to DED, only nine cultivars with adequate DED tolerance have been identified. A multi-year R&D plan has as its goal the restoration of American elm to forest and urban habitats. Its first aim is to develop a genetically diverse DED-tolerant American elm population as a base for research and deployment. American elm test plots in Delaware, OH contain about 7,200 trees, including survivor trees from MI, IL, IN, and OH, of which 730 have been tested for DED tolerance. The remaining trees will be tested in 2016-2021. Trees with sufficient DED-tolerance will remain as a genetically diverse seed orchard and be re-propagated to produce regional seed orchards for VT and MN. Pollen from genetically diverse, newly-identified survivor trees is being used for controlled crosses onto known DED-tolerant selections. Seedlings from these crosses will be used to develop new DED-tolerant cultivars. We are assessing regional adaptation and cold tolerance of selected elms by planting progeny from 20 genotypes in our seed orchard into

experimental restoration sites ranging from National Forests to sites degraded by emerald ash borer, riparian zones degraded by livestock, and mine reclamation lands. Numerous other out-plantings of DED tolerant elms are linked in a multi-site, multi-collaborator network to assess their growth, mortality, and the threats that affect their success in restoration. We are also investigating the role of root grafts in DED transmission, morbidity, mortality and the developing genetic tools and populations to study DED tolerance.

OFFSITE FIELD TRIP ABSTRACTS

Sterrenburg, Lee*. **Large-Scale shallow water wetland and native grass prairie restoration**. Indiana University, Bloomington, Indiana. Email: sterren@indiana.edu

Field trip participants are responsible for their own transportation. The location of this field trip is the Indiana Department of Natural Resources Goose Pond Fish and Wildlife Area in Green County, Indiana. Directions to the site can be found at the Goose Pond website (http://www.in.gov/dnr/fishwild/3094.htm) The field trip will begin with an overview of the historical land use of the area and the Goose Pond restoration project. The Goose Pond restoration project was the biggest USDA NRCS Wetland Reserve Project in the United States in 2000. The project serves as showcase for some of the accomplishments and challenges of large-scale restoration projects. Participants will have the opportunity to view the restoration infrastructure and to learn about the unanticipated challenges presented by invasive plants, invasive animals, excessive algae growth and other issues related to restored wetlands that cannot be drained and are exposed to periodic flooding and how these challenges were addressed. Participants will also have the opportunity to learn about the major successes of the project, especially for the birds as 275 bird species have been documented onsite. Current research projects involve monitoring of avian population trends. Only two portable toilets are available onsite. Participants may want to use restroom facilities in nearby Linton, Indiana prior to arrival. Participants are encouraged to bring binoculars for viewing wildlife.

Shuey, John*, and Chad Bladlow*. **Increasing ecological resilience in southern Indiana forests as adaptation for future climate change regimes**. John Shuey and Chad Bladow. The Nature Conservancy, Indianapolis, Indiana. Email: jshuey@tnc.org

Transportation will be provided for this field trip. The location for this field trip is the Hitz-Rhodehamel Nature Preserve in Brown County, which is approximately 45 minutes east of Bloomington, Indiana. This field trip will look at aggressive adaptation strategies in dry forest communities to increase ecosystem resilience to the predicted future climate. Future climates are expected to have very significant effects on forest habitats in Indiana. Prolonged late summer drought-stress, when precipitation is expected to be at its minimum and temperatures at their highest, will likely have the greatest effect on mesic tree species currently dominating the regeneration of dry/mesic forests. Ironically, on-going management of ecological processes (fire suppression) over several decades has increased the mesic nature of southern Indiana forests, further increasing their vulnerability to future climatic regimes. Current pilot-projects at the Hitz-Rhodehamel Nature Preserve have resulted in a positive response of dry/mesic forests to thinning and burning. This field trip will inspect the results of several prescribed fires and forest thinning treatments. Please wear clothes and shoes suitable for hiking off trail in moderately rugged terrain.

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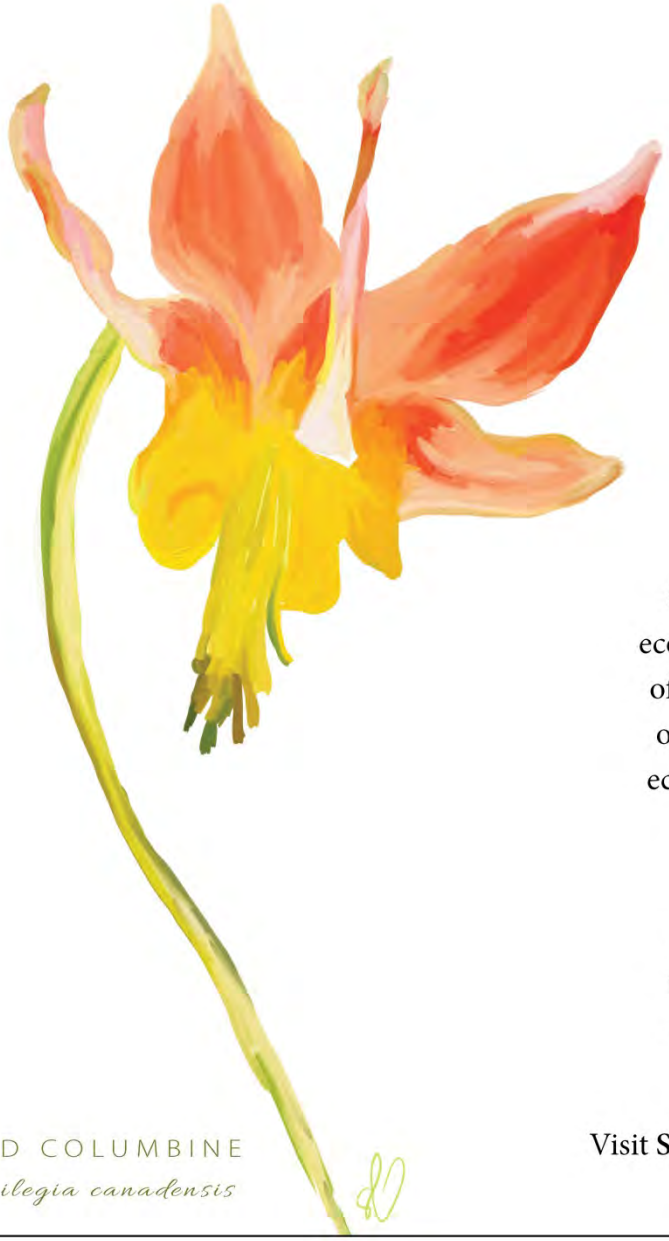

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