ECOLOGICAL RESTORATION AND SUSTAINABILITY – PARTNERS FOR THE FUTURE

FIFTH MIDWEST-GREAT LAKES SER CHAPTER MEETING

April 12 to 14, 2013

Ohio Agricultural Research and Development Center, Wooster, Ohio

ABSTRACT BOOK

Edited by: Peter C. Smiley Jr., Roger Anderson, David P. Benson, Hua Chen, Young Choi, Charles Goebel, Jennifer Lyndall, Pamela Rice, and Donald Tilton

THE OHIO STATE UNIVERSITY OARDC

SER MIDWEST GREAT LAKES SOCIETY FOR ECOLOGICAL RESTORATION

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PREFACE

The Fifth Annual Meeting of the Midwest-Great Lakes Chapter of the Society for Ecological Restoration was held April 12 to April 14, 2013 at the Ohio Agricultural Research and Development Center (OARDC) in Wooster, Ohio. Meeting attendees for this three day event consisted of 134 students and professionals from 11 states (California, Ohio, Indiana, Illinois, Maryland, Michigan, Minnesota, Pennsylvania, South Dakota, West Virginia, Wisconsin) and the District of Columbia who had affiliations with academia, federal agencies, state agencies, non-profit groups, or consulting firms. Our goal for the meeting was to explore how the field of ecological restoration can assist other disciplines with achieving their sustainability goals and how other disciplines can contribute to ecological restoration. Our scientific agenda consisted of a keynote presentation, two plenary sessions, three symposia, 18 contributed poster presentations, 30 contributed oral presentations, guided tours of the Mellinger Farm and Secrest Arboretum, and three offsite field trips to restoration projects in northeast and central Ohio. Additional meeting events included: 1) a sponsorship reception held in conjunction with the poster session; 2) the annual Chapter business meeting; and 3) an awards ceremony that recognized the Best Student Poster Presentation, the Best Student Oral Presentation, the Student Presenter Who Traveled the Farthest, and outgoing Board members. This abstract book contains the abstracts from all meeting presentations, symposia, and offsite field trips.

ACKNOWLEDGEMENTS

We are very grateful for the tremendous support provided by our generous meeting hosts (Ohio State University's OARDC and the School of Environment and Natural Resources) and our generous meeting sponsors (Genesis Nursery, Ernst Conservation Seeds, The Nature Conservancy, ENVIRON, Davey Resource Group, Stantec, Prairie, Restorations Inc., Biohabitats, Eco Logic, EnviroScience, Reforestation Solutions Inc., the Wilds, Island Press, MAD Scientist & Associates, Spence Restoration Nursery). The financial support of our meeting host and sponsors enabled us to: hold a sponsorship reception; support student participation; defrayed food costs; and to make our Annual Meeting as environmentally friendly as possible. We greatly appreciate the contributions of Hannah Roscoe-Metzger and staff of OARDC's Shisler Conference Center who assisted greatly with planning the meeting and provided onsite help during the meeting. Hua Chen, Xiaoyong Chen, Don Tilton, and Lauren Umek served as judges for the Best Student Presentation Awards. We are also thankful for the participation of the meeting presenters, moderators, tour leaders, field trip leaders, volunteers, and attendees for making our Fifth Annual Chapter Meeting a success.

MEETING HOSTS

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KEYNOTE PRESENTATION ABSTRACT

Wali, Mohan K.*. **Ecosystem restoration: the bedrock of sustainability.** The Ohio State University, Columbus, Ohio. Email: wali.1@osu.edu

Disturbance-restoration-sustainability is a Gordian knot that can be cut only with dire and unintended consequences. Human-induced changes to the Earth have been so immense and widespread that the Anthropocene is under consideration for formal adoption as a new epoch at par with other geologically-recognized periods in Earth's history. Telling as this characterization and proposal are, they pointedly emphasize the need to reverse the most important contemporary environmental issues facing the world today─altered land use and diminished fertility, changing atmospheric, freshwater and oceanic chemistries, and the overall loss of diversity and productivity of the remaining ecosystems and habitats. The severe consequences of climate change have already begun to unfold. Sustained ecosystem services have been shown to be at risk and merely reducing new damage is no longer sufficient. Thus, restoring ecosystems should be the highest priority on our environmental agenda. This lecture will briefly review the advances made in recent decades in understanding ecosystem structure and function in the processes of restoration and, given the growing body of knowledge on the impacts of global climate change at all ecosystem scales, the challenges that lie ahead in education and research. The Herculean task is to bring about public awareness and insistence on the wide-ranging application of science in ecosystem restoration to ensure resource sustainability for all life in the biosphere.

OPENING PLENARY SESSION ABSTRACTS

INTERDISCIPLINARY INSIGHTS FOR GUIDING FUTURE ECOLOGICAL RESTORATION AND SUSTAINABILITY EFFORTS

Heneghan, Liam*. **Ecological restoration: Scientific, philosophical, and sustainability perspectives: a Chicago Wilderness view**. DePaul University, Chicago, Illinois. Email: LHENEGHA@depaul.edu

The ecological restoration of degraded lands is older as a practice than the disciplines that study it, and that seek to advise its proponents. These disciplines, however, have an opportunity to refine the work, and to reflect upon the significance of its outcomes in much the way that intellectual engagement with any praxis – agriculture, hunting, or even art, for example – can augment that practice. The ecological evaluation of restorative management identifies best practices, measures progress towards stated targets, and elucidates basic ecological processes from ongoing manipulations of managed landscapes. The social sciences have clarified the way in which restoration emerges from the institutional governing structures, and seek to identify the processes whereby management is either agreed upon or alternatively provokes opposition in communities adjacent to restoration sites. Philosophical reflection on restoration sharpens our understanding of key conceptual terms, like nature, revises our considerations of our shared ethical obligations, and can help restorationists appreciate the full spectrum of values emerging from attempts to "make nature whole." The influence of restoration on well-being and "topophilia" – an abiding love of place – is studied by environmental psychologists. Restoration may provide profound ways of getting to know a new place, and awaking practitioners from what I call "toponesia", a forgetfulness of place. Using examples from the Chicago Wilderness region I briefly inspect each of these perspectives: restoration from a natural and social sciences, environmental philosophy, and as a sustainability endeavor that can potentially evoke a love for and allegiance to the places that we live.

Iverson, Louis R.*[1], S. N. Matthews[1,2], A. M. Prasad[1], and M. P. Peters[1]. **Modeling with distribution data and traits to assess tree species vulnerability and adaptability under climate change.** [1]USDA Forest Service, Delaware, Ohio. [2]Ohio State University, Columbus, Ohio. Email: liverson@fs.fed.us

The climate is changing. Tree species at any given location are currently under risk of their habitat changing. The degree of change depends on their location relative to their overall range, their particular ecological traits, and the severity of the changing conditions. We attempt to assess species vulnerability and their capacity to adapt to a changing climate in three regions of the eastern United States (i.e., the Northwoods of Minnesota, Wisconsin, and Michigan; the Central Hardwoods of Missouri, Illinois, and Indiana; and the Central Appalachians of Ohio and West Virginia). To do so, we use a series of modeling schemes using species distribution models (called DISTRIB) and life history traits (called Modification Factors, or ModFacs). This approach provides clear inference to potential vulnerabilities of the extant tree species composition. The results provide a comprehensive assessment by presenting location-specific considerations of potential climate change impacts, and making these data readily useable for deliberation of management actions. Specifically, they include a series of tables and maps describing suitable habitat for years ending 1990, 2040, 2070, and 2100 for 70-80 species in each of the six regions. For example, northern Wisconsin had eight major species which were modeled to have large decreases in habitat by 2100, along with 18 species which showed large increases in habitat, while in southern Indiana, there were 8 large decreasers and 10 large

increasers. Each species was also scored for adaptability to cope with increasing climate-related disturbances. Our use of modeling schemes with life history traits (i.e, ModFacs) allowed for more reality in interpretation of the species distribution model outputs and allowed better assessment of likely outcomes via the species' inherent adaptive capacity to change.

Reutter, Jeffrey M.*. **Lake Erie: The best example of ecosystem recovery in the world.** Ohio Sea Grant and Stone Laboratory, The Ohio State University, Columbus, Ohio. Email: reutter.1@osu.edu

In the late 1960s Lake Erie was severely polluted. In 1969 the Cuyahoga River in Cleveland, Ohio caught fire and Lake Erie was called a "dead lake" by the media. Subsequently, Lake Eric became the poster child for pollution problems in this country leading to the formation of U.S. EPA, NOAA, and the first earth day. The lake was choked with excessive algal blooms. We solved this problem primarily by improving sewage treatment that reduced annual phosphorus loading from 29,000 tons to our target of 11,000 tons and the lake became the "walleye capital of the world." Walleye harvests in Ohio grew from 112,000 to over 5 million, charter fishing businesses grew from 34 to over 1200, and coastal marine businesses grew from 207 to over 425. It is easy to show how Lake Erie declined in habitat quality to 1970, improved steadily from 1975 to 1995, and unfortunately habitat quality has again been declining since 1995. In 2002 excessive blooms of blue-green algae returned and grew until 2011. These harmful algal blooms (HABs) are capable of producing 4 toxins that can be fatal to people and animals. HABs are a global problem. I will review the causes of the HABs and possible remedies. Our experience on Lake Erie indicates that habitat quality can be improved and the economic payoff can be significant.

Wilson, Robyn*. **Designing restoration efforts and sustainability initiatives that work: Insights from the social sciences**. Ohio State University, Columbus, Ohio. Email: Wilson.1376@osu.edu

Thomas Heberlein (1974) proposed three fixes to environmental problems: technological, cognitive, and structural. Cognitive and structural fixes directly aim to change the human behaviors causing the problem. Cognitive fixes focus on changing attitudes and beliefs (e.g., persuasive tools aimed at voluntary changes in behavior), whereas structural fixes lead to behavioral change by altering the decision-making environment (e.g., incentives or regulatory based mechanisms). Although a technological fix may at first appear to bypass human behavior and decision making, many technologies are doomed to fail if not widely adopted, highlighting the importance of the behavioral component. To determine which type of approach to take to environmental problem solving it is critical to consider several characteristics that relate to human behavior. Specifically, research in the social sciences can identify whether or not the public and policy makers will support a particular proposed effort and whether or not the proposed effort is likely to consistently change behavior or lead to informed decision among those with the greatest influence on the natural system. Ongoing behavioral research in the context of land use and land management (namely forests and agriculture) will be discussed as examples of the need for integrated human-natural systems research in the design and implementation of a wide range of restoration and sustainability-based initiatives. Such efforts are particularly relevant and necessary given the cognitive challenges of planning and managing systems in a dynamic and changing physical environment.

SYMPOSIA ABSTRACTS

DAM REMOVAL SYMPOSIUM ABSTRACT

Fleece, William C. **Challenges and opportunities in the dam removal project lifecycle**. Stantec Consulting, Cincinnati, Ohio. Email: cody.fleece@stantec.com

The U.S. Army Corps of Engineers National Inventory of Dams documented the existence of more than 76,500 large dams in the United States and estimated that 2,000,000 or more small dams may exist. A substantial proportion of these dams have aged beyond their design life, are structurally unstable, pose threats to human safety (e.g., drowning hazards), degrade water quality, trap fine sediments, store contaminants in the sediment, and preclude fish passage. Removal is often the most cost effective way to address these issues and to facilitate stream restoration. Dam removal immediately restores ecological connectivity between upstream and downstream river reaches. It restores the supply of sediment to gravel starved downstream reaches. The transformation of a lentic system to a lotic system typically produces a number of benefits including increased species richness, increased diversity, and reduced invasive species biomass. However, the financial resource commitment associated with dam removal typically increases with the size of the structure. Large projects may be exceedingly difficult to finance despite the obvious benefits. Dam removal projects are often confronted by a complex suite of technical issues, regulatory requirements, and social dynamics. Consequently dam removals are seldom implemented by a single entity and require the development and maintenance of collaborative relationships with stakeholder groups whose values are often widely divergent. The objective of this symposium is to examine the challenges and opportunities faced by dam removal projects at various points in the project life cycle including pre-project planning, engineering design, permitting, implementation, and post-demolition monitoring with an eye toward the continued advancement of this restoration tool.

DAM REMOVAL SYMPOSIUM PRESENTATION ABSTRACTS

Barber, Timothy R., Jennifer L. Lyndall*, Bruce Patterson, and Christine A. Kobyljanec. **The valuation of ecosystem services associated with dam removal as a river restoration alternative.** ENVIRON International Corporation, Burton, Ohio. Email: tbarber@environcorp.com

Dams can provide a number of services, including power generation, flood protection, drinking water supply, and irrigation water supply. However, many advocacy groups and government agencies favor the removal of dams to restore other services, such as natural water flow, fish migration, and high quality habitat. Dam removal or modifications are being evaluated throughout the United States as a potential solution to the growing number of high-hazard-potential dams. Dam removal is expensive. Funding to support this work may be provided by the government through direct action or restoration grants and private parties to address often unrelated environmental liabilities. As part of the decision-making process, the costs and potential environmental impacts (e.g., threatened and endangered species, water and air quality, historic and cultural sites, and social and economic impacts) are evaluated. However, the projected gains (or losses) of ecosystem services are typically only considered qualitatively. If a dam removal project is being considered as a Supplemental Environmental Project or a restoration project to resolve a Natural Resource Damage case, a more thorough analysis is required. In this presentation, we identify the types of services that may be impacted by a hypothetical dam removal project. The level of service gains (or losses) is estimated spatially and temporally by comparing pre-removal service flows (baseline condition) to the projected post-removal condition of the river. Habitat equivalency analysis is used to quantify ecosystem services in discounted·service·acre·years (DSAYs). This form of biological currency can be related to

the cost of dam removal to evaluate cost effectiveness ($/DSAYs) and monetized using values from the existing ecosystem services valuation literature. This approach facilitates the valuation of the net ecosystem services associated with a dam removal restoration project and can provide a framework to engage various stakeholders and communicate potential benefits to the public.

Fleece, William. C.*[1], James K. Kiser[2], Michael A. Hoggarth[3], Travis White[4], Scott D. Peyton[1] and Bryon Ringley[4.] **The role of freshwater mussels in the permitting, design, and demolition of a lowhead dam on the Olentangy River in Columbus, Ohio**. [1]Stantec, Cincinnati Ohio. [2]Stantec, Louisville, Kentucky. [3]Otterbein University, Westerville, Ohio. [4]Stantec, Columbus, Ohio. Email: cody.fleece@stantec.com

In early September of 2012 the Fifth Avenue Dam in the Olentangy River in Columbus, Ohio was demolished. The dam was approximately 152 m, 2.4 m wide, 2.4 m tall, and built of structurally reinforced concrete. The backwater from the dam extended approximately 3 km upstream. Freshwater mussels influenced the direction of this project at in the permitting, engineering design, and implementation phases. Pre-demolition surveys were necessary to complete Section 7 consultation under the Endangered Species Act. These surveys documented high mussel densities, comprised of 11 species, in the reach downstream of the dam. In the engineering design phase, various attributes of freshwater mussel life history were examined to understand potential impacts and to try to optimize habitat quality post-demolition. In the implementation phase, freshwater mussel rescue and relocation was conducted for areas within the construction footprint (two areas downstream of the dam) and for areas subject to rapid dewatering from the lowering of the pool (four areas within the dam pool). The rescue consisted of 515 total hours of search effort where 7,513 mussels comprised of 16 species were moved to nearby locations. The pool was lowered in two phases with the water surface dropping approximately 1.2 m in a matter of hours. Over 219 hours of search effort were expended during the rescue with catch per unit effort ranging between 5 and 156 mussels per hour. The transition zone near the limit of the backwater proved to be an area of unusually high species richness and density. Because of their conservation status, freshwater mussels were an important factor in this dam removal and will feature prominently in future dam removals in the region.

Synder, David*. **Using preservation law to accommodate consideration of cultural resources when proposing demolition of dams**. Ohio Historic Preservation Office, Columbus, Ohio. Email: dsynder@ohiohistory.org

Dams that are engineered and constructed by people are cultural resources. At its core, preservation law asks us to consider preserving important cultural resources as an integral part of the planning, design, and review of construction projects. The regulations for the National Historic Preservation Act and the National Environmental Policy Act do not dictate a certain outcome. These regulations ask us to balance preservation needs with other project needs and objectives. To do this the regulations define a review process that guides us through decision making. Informed decisions are based on a focused evaluation of the importance of cultural resources. In Ohio studies of the historical importance of different types of dams are beginning to provide a broader understanding of the purposes of different dams and through this a better understanding of our history.

Boone, Kyle*, Jerry Sweeten, Donavan Henry, and Rob Simmonds. **The Eel River ecosystem of north central Indiana: stream response to low-head dam removal**. Manchester University, North Manchester, Indiana. Email: kmboone@spartans.manchester.edu

There are nearly 1,100 dams in Indiana streams. Many of these dams, even old low-head dams, pose danger to humans and affect stream ecological integrity. Dams block fish passageway and create a lentic-type environment upstream of the barrier. These upstream pools become a haven for tolerant fish species like common carp (*Cyprinus carpio*). The purpose of this project was to use collaborative partnerships between the Ohio River Basin Fish Habitat Partnership and Manchester University to remove two low-head dams from the Eel River and document stream morphology and biological changes before and after removal. The most downstream dam was located near the town of North Manchester, Indiana (RM 52) and the upstream dam was located near the town of Liberty Mills , Indiana (RM 59). These dams were constructed between 1840 and 1850 to power grist mills and saw mills during European settlement of the region and in disrepair. Monitoring was conducted for a two-year period prior to removal in October 2012. At the Liberty Mills site, IBI (index of biotic integrity) score was 35 just upstream of the dam and at 2 km upstream increased to 52. IBI scores showed similar increases at the North Manchester dam increasing from 35 to 44 over a 2.5 km stream reach above the dam. Qualitative habitat evaluation index scores showed a similar pattern above each dam. Smallmouth bass (*Micropterus dolomeiu*) spawning was significantly greater above the pool of each dam. Subsequent surveys will be conducted over the next two years to document temporal and spatial changes post-removal. These ecological data along with greater human safety suggest removing these structures from Indiana streams will improve recreational opportunities and restore stream ecosystem integrity.

Sullivan, S. Mazeika P.* and Kristin L. Jaeger. **Evaluating linked geomorphic-ecological responses to dam removal**. The Ohio State University, Columbus, Ohio. Email: sullivan.191@osu.edu

The physical, chemical, and biological influences of dams on aquatic ecosystems can be substantial. As of 1999, there were 75,000 dams in the continental United States. Of the ~4,800 dams in Ohio, small and low-head dams are most prevalent and dominate streams and small rivers. Since then, numerous dams have been removed from Ohio waterways. However, despite dam removal's increasing popularity as a river restoration technique, the number of published studies documenting river response to dam removal is limited. Those studies that do exist are often constrained by less than one year of pre-dam removal data collection. In this study, we are investigating the influences of lowhead dam removal on linked geomorphic-ecological processes. Our model system is the lower Olentangy River within Columbus, Ohio where the 77 year-old Fifth Avenue lowhead dam (145 m long, 2.5 m high) was recently demolished. Because of previous work in the system, we have three years of pre-removal data related to aquatic biota, river-riparian food webs, and flows of carbon and contaminants. We are currently collecting geomorphic and ecological post-removal data at three month intervals for 18 months. We anticipate that this research will provide important information relative to short-term responses to the disturbance of dam removal and to river restoration approaches involving dam removal.

Watkins, John R.*. **Water quality and habitat restoration at dams in the Ohio Lake Erie watershed**. Ohio Department of Natural Resources, Wellington, Ohio. Email: john.watkins@dnr.state.oh.us

The presentation will discuss the efforts of the Ohio Department of Natural Resources Non-Point Pollution Program to determine what best management practices could be implemented to enhance water quality or habitat at certain dams in the Lake Erie watershed. The presentation will discuss the overall program, describe various types of dams, review the water quality and habitat issues associated with the types of dams, provide an overview of best management practices associated with dams, and highlight successful habitat restoration efforts at several dam removal projects in Ohio.

SURFACE MINING SYMPOSIUM ABSTRACT

Jaeger, Kristin and P. Charles Goebel. **Challenges of ecological restoration in landscapes altered by surface mining**. Ohio State University, Wooster, Ohio. KJ email: jaeger.48@osu.edu; PCG email: goebel.11@osu.edu

Coal comprises the bulk of United States and global energy sources and coal production remains a chief industry throughout the Appalachian Region and portions of the Midwestern United States. Surface mining is a primary coal extraction method and represents a landscape-scale disturbance affecting long term physical and ecological processes at the watershed scale. Restoration of landscapes damaged by mine drainage, in particular ecosystem function, remains a major regional challenge in large part due to these fundamental and persistent alterations in watershed processes. For example, the collective impact of vegetation loss, compacted terrestrial surfaces, and limited soil substrates for revegetation present challenges to restoration of terrestrial portions of the landscape. Further, subsequent alterations in hydrologic and sediment regimes create challenges to restoration of stream processes and aquatic ecosystems. Finally, additional challenges result from our current lack of comprehensive understanding of how mining-related impacts vary across space and how they are influenced by and interact with natural landscape characteristics and non-mining related stressors such as climate change and land use activities. The objective of the symposium is to present the range of challenges with respect to restoration of surface mined lands, which highlights the current state of knowledge and identifies existing knowledge gaps. This symposium will bring together scientists with expertise in both terrestrial and aquatic systems to: 1) provide a synthesis of existing research on restoration of these lands; 2) introduce regional restoration initiatives; and 3) provide findings from recent research related to surface mining impacts and the challenges of restoration efforts.

SURFACE MINING SYMPOSIUM PRESENTATION ABSTRACTS

Goebel, Charles*[1] and David M. Hix[2]. **Revisiting the past to improve the future: Legacy of OARDC research on mined-land reclamation in Ohio.** [1]The Ohio State University, Wooster, Ohio. [2]The Ohio State University, Columbus, Ohio. Email: goebel.11@osu.edu

Coal mining continues to be an important industry in the Midwestern United State. For example, it is estimated that Ohio has 11.5 billion tons of economically recoverable coal reserves, and over 28 million tons of coal was produced from 10 underground mines and 64 active surface mines in 2011. Many of these recent surface mines, as well as abandoned mined-lands, have been reclaimed as grasslands following the implementation of the 1972 Ohio and 1977 federal regulations. Recent efforts, however, including the Appalachian Regional Reforestation Initiative (ARRI) co-sponsored by

the Office of Surface Mining and regional state government agencies are working to increase the planting of high-value hardwoods on reclaimed coal mined-lands. As part of this initiative, we have been reviewing the half-century of research and practices on reforestation of mined-lands conducted by scientists at the Ohio Agricultural Research and Development Center (OARDC) with an emphasis on how these studies can be utilized to develop specific guidelines for reclaiming mined-lands of Ohio within the context of ARRI's Forestry Reclamation Approach. In terms of creating suitable and non-compacted rooting media, researchers from OARDC have found that grading and fertilizing mined sites has mixed effects on planted tree survival and growth, with *Liriodendron tulipifera* L. exhibiting the greatest decline in survival and growth of the species considered. Furthermore, researchers using both greenhouse and field experiments have compared the competitive influences of common ground covers, different grading and fertilization treatments, and seedling origin (e.g., planted or volunteer) on the growth and survival of different species, including important early successional species such as nitrogen-fixing *Robinia pseudoacacia* L. and key commercial species including *Quercus rubra* L. and *Prunus serotina* Ehrh. Through these efforts, we are identifying gaps in our understanding of how these reclamation practices influence important ecosystem processes, which is providing us with a basis to design retrospective studies to understand how reclaimed sites develop over time.

Barton, Christopher*[1], Carl Zipper[2], Jim Burger[2], Jeff Skousen[3] and Patrick Angel[4]. **Restoring ecosystem services on surface coal mines in Appalachia**. [1]University of Kentucky, Lexington, Kentucky. [2]Virginia Polytechnic Institute and State University, Blacksburg, Virginia. [3]West Virginia University, Morgantown, West Virginia. [4]Office of Surface Mining Reclamation and Enforcement, London, Kentucky. Email: barton@uky.edu

The Appalachian region is a land of contrast—people have suffered from poverty for decades, but the region abounds with natural resources. Appalachian forests support some of the greatest biological diversity in the world's temperate region, but extraction of the region's abundant coal reserves has impacted the landscape. Since 1977, over 6000 km^2 of Appalachian forest have been affected by surface mining, producing significant economic, environmental, and ecological challenges. Successful reestablishment of the hardwood forest ecosystem that once dominated these sites will provide a renewable, sustainable multi-use resource that will create economic opportunities while enhancing the local and global environment. The Appalachian Regional Reforestation Initiative (ARRI) and its partners have undertaken an extensive project to restore forests on surface-mined lands. Research and outreach with all stakeholders was instrumental in advancing knowledge and demonstrating techniques to restore productive forests and ecosystem services on surface-mined lands. Cooperation, consultation, and effective communication between parties have resulted in increased application of the Forestry Reclamation Approach, but significant efforts are still needed to reverse the effects created by this mining practice.

Merriam, Eric, R.* and J. Todd Petty. **Multi-stressor impacts to streams in the mountaintop mining region of central Appalachia and implications for watershed restoration**. West Virginia University, Morgantown, West Virginia. Email: emerriam@mix.wvu.edu

Mountaintop removal-valley fill (MTR-VF) coal mining causes extensive impairment in downstream systems. However, we currently lack a comprehensive understanding of how mining-related impacts vary across space and how they are influenced by and interact with natural landscape characteristics (e.g., coal geology) and non-mining related stressors. We conducted a regional scale assessment and: 1) quantified surface mining thresholds for specific conductance and biological condition in the

absence and presence of other land use stressors; 2) constructed landscape-based models to explain observed patterns of chemical and biological degradation; and 3) predicted instream response to alternative future watershed development and restoration scenarios. Surface mining thresholds for conductivity and biological condition varied significantly depending on whether or not deep mines and/or residential development were present. A large proportion of streams within the study region were predicted as biologically or chemically impaired given current landscape conditions. Impairment was driven by a combination of additive and interactive effects of multiple stressors. Potential impacts from future surface mining are manageable, but only when coupled with strategic mitigation of pre-existing impacts caused by other stressors (i.e., deep mining and residential development). Our results should improve our ability to identify restoration priorities and develop watershed-specific actions that result in regional improvements in stream conditions.

Miller, Eric* and J. Todd Petty. **Ecological benefits of compensatory stream mitigation in an intensively mined watershed**. West Virginia University, Morgantown, West Virginia. Email: emiller9@mix.wvu.edu

Large scale surface mining in the Appalachians causes significant alteration of headwater catchments, and these impacts may be offset through stream mitigation. There have been over 100 mining related stream mitigation projects in southern West Virginia in the last 10 years. Unfortunately, very little is known regarding the ecological benefits of mitigation projects. In this project we use a before-after-control-impact design to: 1) quantify the ecological benefits of 16 stream restoration projects in the southern West Virginia coalfields; 2) identify factors constraining benefits; and 3) model benefits of mitigation to assist in future site selection. Our results indicate that the benefits of the mitigation include increased fish habitat and bed complexity, increased substrate diversity, increased macroinvertebrate biomass and diversity, and increased fish biomass and diversity. However, elevated total dissolved solids represents a critical factor limiting benefits of habitat restoration actions. Furthermore, mitigation benefits are minimal in streams that are highly isolated by poor regional conditions. Ultimately, our results can be used to guide stream mitigation actions that are more effective in restoring and maintaining ecological function of mined watersheds.

PARTNERSHIP SYMPOSIUM ABSTRACT

McCormack, Mary Beth. **Using partnerships to strengthen ecological restoration.** Cleveland State University, Cleveland, Ohio. Email: mccormackmb@yahoo.com

How can education programs contribute to ecological restoration as a method for achieving sustainability? The purpose of this symposium will be to examine land stewardship as a form of service learning that can be employed to encourage students to learn scientific concepts of ecological restoration. As a form of service learning, land stewardship presents opportunities for students to learn about concepts of ecological restoration through hands-on experiences. Through land stewardship service, primary and secondary students acquire hands-on experiences with the management of natural lands. Students are expected to learn a range of scientific concepts applicable to ecological restoration that range from basic biology concepts to concepts related to land preservation. This symposium will present a survey of collaborations established by northeast Ohio schools with local institutions that practice ecological restoration. Elementary, high school, and college students participate in all aspects of ecological restoration. These partnerships provide valuable ecological restoration work and experiences for students to learn while positively contributing to local ecosystems. This symposium seeks to make two contributions. The first contribution is to formulate a research agenda for land

stewardship as a form of service learning designed to encourage students to learn about scientific concepts of ecological restoration. The second contribution is to explore how hands-on experiences arising from ecological restoration in the form of service learning can help young students understand and value scientific principles underlying ecological restoration. Future research questions include analysis of goals of ecological restoration organizations, incorporation of additional schools or other student-focused organizations, and the outcomes of student learning in subsequent years after their experiences with an ecological restoration project.

PARTNERSHIP SYMPOSIUM PRESENTATION ABSTRACTS

McCormack, Mary Beth*. **Ecological restoration, students, and science in ecological restoration projects - partners for the future**. Cleveland State University, Cleveland, Ohio. Email: mccormackmb@yahoo.com

The purpose of the present study is to investigate land stewardship as a form of service learning that can be employed to encourage students to learn scientific concepts. As a form of service learning, land stewardship presents opportunities for students to learn about scientific concepts through hands-on experiences. Through land stewardship service, primary and secondary students acquire these hands-on experiences with managing natural lands. Students are expected to learn a range of scientific concepts, from biology to purposes of land preservation. It is expected that students will not only learn about science and preservation, but be inspired and grow from these hands-on experiences. Drawing on the scholarship about service learning, this study seeks to contribute ideas and evidence about what and how students learn from hands-on experiences of performing service while doing science. Through its focus on service learning, the present study asks how students may learn from performing meaningful service. The present study intends to make three contributions. The first contribution is to formulate a research agenda for land stewardship as a form of service learning designed to encourage students to learn about scientific concepts, particularly biology and land preservation. The second contribution is to explore how hands-on experiences arising from service learning can help young students make connections across scientific principles. The third contribution is to investigate how reflection of service activities can motivate students to learn about science while engaging in preservation practices that benefit their local communities and care of its natural areas.

Cech, Sarah*. **Ecosystems, ecological restoration and service learning projects with students - partners for the future**. Shaker Lakes Nature Center, Shaker Heights, Ohio. Email: cech@shakerlakes.org

Restoring degraded habitats is a hands-on, labor intensive activity. Invasive plant removal and native plant installation require significant amounts of person hours. Volunteers often provide these hours. Incorporating formal service learning agreement with a local school can ensure that volunteer needs are met. Land managers and teachers with their students can provide labor while students gain hands-on scientific knowledge. Using knowledge and guidance from a land manager for the needs of a restoration project, teachers provide ecological background information to students with regular science lesson. This collaboration prepares students for site visits to participate, complete, and plan restoration work. This type of partnership is beneficial to both land managers and educational partners. By completing physical and intellectual work of habitat restoration students receive “real world” science lessons and are one step closer to feeling a sense of ownership for the restoration site and the greater natural world. Ecological restoration projects gain restoration work from students in labor intensive activities. Realistic goals for each age group and administrative support are necessary.

Understanding restoration project goals while working to meet student volunteer needs based on their developmental needs are critical to successful projects. When service learning opportunities are created and successfully presented, students' sense of ownership can translate into ownership as adults. We are building the next generation of land management volunteers.

Yourd, Ethan*. **Ecological restoration and service learning as partners for the future.** John Carroll University, University Heights, Ohio. Email: eyourd14@jcu.edu

Ecological restoration and service learning creates opportunities for the development of leadership, problem-solving skills, and responsibility in students of all ages. Service-learning programs require commitments and involvement of both an educational institution and a community organization. These programs depend heavily on strong partnerships in order to be successful for students and the community. This presentation discusses the requirements of building and maintaining a strong partnerships in order to develop successful service-learning programs. We examine attributes necessary to foster good partnerships. Partnerships cultivated for restoration projects are examined closely to determine the source of partnership growth and maintenance. As a cornerstone of service-learning programs, partnerships require appropriate use of time, effective communication, and project reflection. It is important to commit enough time to planning and implementing a service learning project because these collaborations require enough time to change as needed. By keeping communication abundant and open, the educational institution and community at large can address challenges, changes, and progress that will naturally arise during the course of service-learning projects. Reflection is necessary both pre- and post-project completion to measure the intellectual growth of students and ensure satisfaction of community partner. Assessing the progress and completion of the project further enables participants to discover their abilities to make positive changes in their community and lives.

POSTER PRESENTATION ABSTRACTS (ALPHABETIC)

Anderson, Roger C.*. **Changes in tree species composition, abundance, and diversity in a remnant historic prairie grove in central, Illinois, USA over a thirty-four year period.** Illinois State University, Normal, Illinois. Email: rcander@ilstu.edu

Fire suppression associated with European settlement during the past century resulted in Midwest woodlands on mesic upland sites transitioning from dominance by fire-resistant, shade-intolerant oak and hickory species to dominance by fire-sensitive, shade-tolerant mesophytes. I studied changes in tree species composition and diversity in one upland forest from 1977 to 2011. The 0.13 km^2 study site was protected since 1833 and currently supports a closed canopy forest dominated by sugar maple. However, when this study was initiated, scattered large (120 to 180 cm dbh) living and dead open-grown burr oaks provided evidence of a more open historic forest. Government Land Office records from 1820 indicated oaks dominated the historic vegetation with a combined Importance Value (IV) of 43.2 and the IV of all species was 100. Historic tree density was 28 trees/ha compared to current densities of 318 trees/ha. In 1977, the dominant tree species was American elm (IV = 29). By 1984 Dutch elm disease had caused a rapid decline in American elm (IV = 1.6) and increased the dominance of sugar maple (IV = 46). In the past 10 to 15 years, browsing by white-tailed deer diminished seedlings of most tree species, except paw paw that is rarely browsed by deer. Sugar maple is browsed in proportion to its abundance unless deer density is high. Aerial deer counts made during the 2007 to 2008 winter yielded a density of 75 deer km^{-2}. Current trajectory of canopy tree recruitment suggests that development of a dense paw paw understory will restrict canopy tree recruitment and diversity. Returning vegetation to historic conditions requires: 1) thinning of sugar maple to near historic conditions; 2) reducing paw paw seedlings and saplings – a fire sensitive species; 3) decreasing deer density to 7-10 km^{-2}; and 4) implementing a prescribed fire regime to maintain oaks.

Barber, Timothy[1], Jennifer Lyndall*[1], Bruce Patterson[1], Ted Conlin[2], Regan Williams[2], Scott Winkler[2], Amy Jo Klei[3], and Danielle Green[4]. **Successful coordination of restoration activities in the Ashtabula River AOC with Federal, State, and private stakeholders.** [1]ENVIRON International Corporation, Burton, Ohio. [2]Ohio EPA, Twinsburg, Ohio. [3]Ohio EPA, Columbus, Ohio. [4]U.S. EPA, Chicago, Illinois. Email: jlyndall@environcorp.com

The lower 3.2 km of the Ashtabula River was designated as a Great Lakes Area of Concern (AOC) in 1985. Historical channelization, shoreline armoring, and upland development virtually eliminated wetlands and riparian buffers along this section of the river resulting in a loss of fish habitat. The Slip 5A peninsula is one of the few locations left in the AOC that is not hard armored with sheet piling and/or lined with boat docks. A series of interconnected projects for this area were proposed as priorities within a habitat restoration and enhancement report. The first project conducted by the U.S. EPA Great Lakes National Program Office involved excavation and construction of approximately 244 m of fish habitat shelf along the northern part of the Slip 5A peninsula in January 2010 as habitat mitigation under the GLLA sediment remediation project. The project was finalized in the spring of 2010 by topsoil placement and planting of aquatic and upland vegetation. In September 2010, Ohio EPA received funding under the Great Lakes Restoration Initiative to complete the remaining 427 m of the habitat restoration on the southern part of the Slip 5A peninsula. Construction began in August 2011 and was completed in June 2012 with installation of aquatic plants on the fish shelf. As part of a natural resource damage settlement, additional restoration activities will be implemented on the Slip 5A peninsula in 2013. These activities include removal of invasive species, construction of a hydraulic connector and creation of wetland habitat, stream bank stabilization, and re-grading and re-planting the

upland portions of the site with native species. The creation of new fish habitat is expected to restore degraded populations of benthic organisms, fish, and wildlife in the AOC, and completes a key management action needed for the restoration and delisting of the Ashtabula River.

Campbell, Alicia C.* and Carolyn H. Keiffer. **Successional chronosequence of woody restoration in strip mined land at The Wilds in Zanesville, Ohio.** Miami University, Oxford, Ohio. Email: campbea6@MiamiOH.edu

Strip mining has had a large impact on the natural successional progression of plant species. This study creates a chronosequence comparing the woody vegetation found on remnant forest patches and reclaimed lands of differing ages. The project was completed at The Wilds, a former strip mine located near Zanesville, Ohio. The goal of this study is to develop a reforestation plan for unreclaimed mined land. Six sites representing three ages (remnant, pre-1966, 1966-1973) were studied. Trees > 1 inch DBH were sampled using the point quarter method along eight 100 m transects. Preliminary results indicated that the species with the highest importance values in the remnant forest are *Quercus rubra, Acer saccharum,* and *Pinus strobus*. *Ailanthus altissima, Robinia pseudoacacia,* and *Acer saccharinum* have the highest importance values in the 1966 to 1973 sites. In the pre-1966 sites *Liriodendron tulipifera, Pinus strobus, Betula nigra,* and *Acer saccharinum* had the highest importance values. Invasive shrubs *Elaeagnus umbellata* and *Rosa multiflora* were abundant in the two mined sites, while native shrubs *Lindera benzoin* and *Rubus occidentalis* were only found in the remnant sites. Generally, the mined sites contain many invasive, pioneer, r species, while the remnant sites contain native, hardwood, K species. The remnant forest sites have on average a greater abundance and diversity of trees than both mined sites. The largest diameter tree in each transect and an additional 16 trees will be cored during February 2012 in order to compare growth rates among the stands. Soil compaction data from each stand is also being collected and analyzed in order to provide more detailed recommendations for future reforestation efforts.

Chen, Liming*, David Kost, and Warren A. Dick. **Abandoned surface coal mine land reclamation using a flue gas desulfurization product.** The Ohio State University, Wooster, Ohio. Email: chen.280@osu.edu

Abandoned surface coal-mined lands are environmental concerns worldwide due to their low productivity and potential strong negative impact on water quality. A field study was conducted to investigate the use of a flue gas desulfurization (FGD) product for reclamation of such sites. The FGD product was applied to acidic abandoned surface coal mine spoil (pH 3.1) in Ohio at 280 Mg ha^{-1} alone or with 112 Mg ha^{-1} yard waste compost. Conventional soil treatment that included 20 cm of resoil material plus 157 Mg ha^{-1} of agricultural limestone served as the control. A grass-legume sward was planted, and plant biomass yields, pH in runoff and tile flow water, soil bacterial populations and diversity, microbial biomass C, and β-glucosidase activity were analyzed in the 16th or17th year after treatments. Plant biomass and β-glucosidase activity on plots treated with FGD product was greater than those plots receiving the conventional soil treatment. The pH was increased by all treatments and was still more than 7.5 in surface runoff and 5.8 in tile flow water 17 years after reclamation. Bacterial populations and diversity, microbial biomass C, and β-glucosidase activity in the reclaimed coal mine plots were significantly increased compared to an adjacent untreated area. These results suggest that FGD product can effectively reclaim acidic surface coal mined lands and provide effective long-term remediation.

Chen, Xiaoyong* and Karen D'Arcy. **Impacts of plant community changes on soil carbon in northeastern Illinois.** Governors State University, University Park, Illinois. Email: xchen@govst.edu

Soil carbon plays a critical role in carbon cycling of terrestrial ecosystems due to its high proportion. Carbon concentration and contents in soils were measured under four plant community types (a prairie, a pure pine forest, a mixed pine-deciduous forest, and a deciduous forest) in northeastern Illinois to determine the influence of land cover changes on distribution and total amount of carbon in the soils. Our results indicated that carbon concentration decreased with increasing soil depth in the four plant communities. No significant differences of carbon concentration were found at the upper soil layers (0 to 20 cm) among the four examined plant types. However, soil carbon concentration in the low soil depth (30 to 100 cm) was statistically greater in prairie than in other three community types. Mean soil organic carbon contents was 336 Mg/ha in the deciduous forest, 474 Mg/ha in the pure pine forest, 577 Mg/ha in the mixed pine-deciduous forest, and 674 Mg/ha in the prairie ecosystem. The preliminary results indicated that exclusion of trees had a significant impact on the total amount and vertical distribution of carbon in soil profile. The restoration of prairie ecosystems is expected to enhance carbon sequestration in soils in northeastern Illinois.

Cochran, Caleb J.*[1,2], Carolyn K. Keiffer[1], Brian C. McCarthy[3], and Jenise M. Bauman[1.] **Overcoming arrested succession: Field survival of backcrossed American chestnuts in mine reclamation.** [1]Miami University, Oxford, Ohio. [2]The Wilds, Cumberland, Ohio. [3]Ohio University, Athens, Ohio Email: baumanjm@miamioh.edu

Anthropogenic disturbances such as mining for coal have caused significant fragmentation to the Appalachian forests of North America. Recovery of these disturbed landscapes is highly dependent on restoration methods that encourage natural succession. Unfortunately, reclamation protocols enforced by the Surface Mining Control and Reclamation Act (SMCRA) of 1977 have not resulted in forest recovery. Field conditions such as compacted soils and aggressive herbaceous groundcover have impeded the success of native tree recruitment and arrested the natural successional pathway. To overcome this, experimental methods such as deep ripping and plow and disking were applied to a SMCRA reclaimed site in Dresden, Ohio. Coupling these methods with plantings of pure American chestnut (*Castanea dentata*) and two types of blight-resistant chestnuts (BC_2F_1 and BC_3F_1) have resulted in high seedling survival. After four growing seasons natural cankers caused by chestnut blight were documented. The objective of this study was to assess seedling survival and growth after five field seasons. Seedling mortality due to chestnut blight was also recorded and related to the disease resistance potential of the backcrossed seedling lines. The growth and survival of chestnuts in plots that employed a soil treatment method were significantly greater than control plots ($p < 0.0001$). In addition, there were notable differences among the soil treatments. Plots that applied the deep ripping had greater survival and growth than the plots that were plowed and disked ($p < 0.05$). When chestnut seed types were compared, pure American chestnuts were significantly larger ($p = 0.0019$). However, survival was greater for the backcrossed chestnut seedlings ($p = 0.0006$), which are showing resistance to natural chestnut blight infection in the field. Results after five years suggest that employing deep ripping methods with backcrossed American chestnut seedlings provide a valuable method for overcoming arrested succession on SMCRA sites.

Enright, Michael P.* and Robert Ligas. **Effects of different herbicides on the resprout rate of lesser celandine (*Ranunculus ficaria*).** Five Rivers MetroParks, Dayton, Ohio. Email: michael.enright@metroparks.org

Lesser celandine (*Ranunculus ficaria*) is an herbaceous plant that is becoming invasive in many flood plains and upland forest areas in the Midwestern United States. We conducted both field and mesocosm experiments in Five Rivers MetroParks, Dayton, Ohio to determine if several commonly used herbicides are effective at controlling lesser celandine. In the field experiment, 10 replicate 1 m^2 plots were treated with glyphosate (active ingredient in Round-up), triclopyr (active ingredient in Garlon 3a), and 2-4 D amine (active ingredient in DMA-III). All plots were completely covered by lesser celandine at first treatment. Plots were surveyed for live lesser celandine each week for 4 weeks after treatment and one year later. All plots exhibited a reduction in coverage after 4 weeks. One year later, all plots show significant regrowth of lesser celandine with the average coverage varying from 64% to 94%. In the mesocosm experiment, live lesser celandine plants were removed from the field, washed to remove native soil and seeds, and replanted in pots. After acclimatization, plants were treated with water (control), white vinegar (Heinz, 5% acid), citric acid (Burn-out 2, 6% acid), imazapyr (Alligare ecoimazapyr, 3% active ingredient), triclopyr (Alligare triclopyr 3, 3% active ingredient), and 2-4 D (Lesco 3 way, 3% active ingredient). Plants were surveyed at one week and one year later. After one year, all treatments except imazapyr showed resprout rates above 60%. The resprout rate for imazapyr was 0%. The results indicate that commonly used herbicides, with the exception of imazapyr, may not effectively control lesser celandine.

Geiger, Donald R.*[1], and James Schneider[2]. **Controlling dense stands of invasive sweet flag, *Acorus calamus*.** [1]Marianist Environmental Education Center, Beavercreek Ohio. [2]Beaver Creek Wetlands Association, Beavercreek, Ohio. Email: dgeiger1@udayton.edu

Rhizomatous, non-native sweet flag (*Acorus calamus*) forms dense, difficult to control populations in natural areas. We explored methods to remove stands of sweet flag that had invaded a pristine fen in the Hershner Reserve of Greene County Parks and Trails. Glyphosate-based herbicide applied as a foliar spray or by wiping leaves killed most of the above-ground vegetation, but failed to kill rhizomes. We explored control by darkening the plants. After mowing to reduce biomass, we covered a stand with plastic film overlain with wood chips. The above-ground vegetation was killed but darkening failed to kill the thick mass of rhizomes. Next we exposed a mowed stand to solar heat applied by covering plants with clear plastic film sealed around the edges with wood chips. Some of the vegetation died, but leaf growth defeated the treatment by lifting the plastic cover and shading the soil. To inhibit leaf growth while applying solar heat we covered the plants with opaque covers of black plastic or discarded swimming pool covers. Heat was confined by sealing the edges with wood chips. Applying the treatments over a growing season killed both leaves and rhizomes. The few plants that possibly were alive were dug out. Inspection of the sites during the following year confirmed that sweet flag plants failed to re-sprout. We used this solarization method to eliminate sweet flag throughout the reserve on well over 929 m^2. Cleared areas were restored with seed gathered from native plants in adjacent fen vegetation.

Gordon, Brad*[1], Paul Rothrock[1], and Paul Labus[2]. **Creating biological benchmarks for habitat assessment following management of wetlands and oak savannas in northwestern Indiana.** [1]Taylor University, Upland, Indiana. [2]The Nature Conservancy, Merrillville, Indiana. Email: bradley_gordon@taylor.edu

As part of their Southern Lake Michigan Rim project, The Nature Conservancy and partners have been striving to restore remnant tracts of native landscape in the Tolleston Strand Plain Macrosite located in northwest Indiana. These sites have a unique "dune and swale" topography with oak savannas and wetlands containing many of Indiana's rare, endangered, and threatened species. Brush and weed control, canopy thinning, and some prescribed burns have been instituted in an effort to restore and maintain community structure. Currently we are assessing the plant communities following management or lack of management at 8 preserves in order to determine restoration success and what future management is necessary. As a part of this study, we seek to create restoration benchmarks based upon floristic quality index (FQI), mean C, species richness, canopy cover, and other metrics through comparisons with best professional judgments (BPJs). Species cover data from 63 transects (each with 15 1 m^2 quadrats) were collected in the summers of 2011 and 2012 and were categorized by seven professionals familiar with the biodiversity of this unique ecosystem. These professionals observed the metric values, site photos, and site maps to categorize each site into one of four categories. These categories include very poor quality, poor quality, medium quality, and good quality. The BPJ categories were analyzed with Kappa analysis to determine the professionals' levels of agreement and then compared with each professional's preferred metric values using discriminant analysis. The hypothesis being tested in this study is that BPJs show significant agreement and the metrics show reactive trends to the BPJ values in order to create biological benchmarks for each quality category.

Green, Donna*. **Ecological restoration and environmental cleanup: enlisting nature to safeguard and recover contaminated land.** Woodridge, Illinois. Email: donna.grn@gmail.com

Ecological restoration has undervalued potential to enhance sustainability and overall performance of environmental cleanups. Additionally, barren, unproductive contaminated land parcels undergoing soil and groundwater remediation present ecological restoration opportunities. Pairing ecological restoration with traditional environmental cleanup methods (e.g., planting already remediated land and landfill caps with native plants) enhances sustainability by reducing consumption of fossil fuels for mowing, increasing carbon sequestration, enhancing biodiversity, providing wildlife habitat, and improving hydrology. Beyond these sustainability benefits, ecological restoration can breakdown or bind contaminates, reduce contaminant runoff and migration, and thereby achieve cleanup goals at lower cost and with fewer added risks than traditional cleanup methods alone. Ecological restoration might in some cases replace traditional environmental remediation methods altogether, particularly when the added risks and environmental impacts of traditional remediation methods are fully accounted for and considered and the benefits of restoring ecosystem services are fully accounted for and valued. The cleanup method of monitored attenuation relies on biological activity of soil and groundwater microorganisms and other natural forces to reduce and stabilize contamination. By actively developing and maintaining all components of functional ecosystems, ecological restoration would appear to offer much greater potential to stabilize and reduce contamination and enhance ecosystem services of formerly barren land. Our traditional and remediation methods have been costly and resource intensive and often result in ecologically barren land. It is time to put nature to work and make ecological restoration a partner in environmental cleanups.

Kinsman, Samantha*, Rachel Shmagranoff, Eric Bird, and Young D. Choi. **Primary production, decomposition, and soil organic carbon in a restored prairie, a cool-season grass pasture, and an old field.** Purdue University Calumet, Hammond, Indiana. E-mail: samanthakinsman@gmail.com

Restoration of prairies has been advocated for numerous reasons such as recovery of biological diversity and ecosystem functions. From 2008 to 2012 we investigated measures of ecosystem function in a restored prairie located in Taltree Arboretum, Valparaiso, Indiana. Specifically, we compared primary production, decomposition of organic matter, and concentration of soil carbon of the prairie with a nearby cool-season grass prairie and an old field. We hypothesized that the higher species diversity or richness of the restored prairie would elevate primary production and carbon sequestration than the old field and the pasture. The species richness was greatest in the restored prairie (47 species) and followed by the cool-season pasture (39 species) and the old field (21 species). H' (species diversity) was greatest in the pasture (2.65) and followed by the prairie (2.39) and the old field (1.50). The greater H' of the pasture was most likely due to establishment of native plant species, in addition to the planting of cool-season grass species, from the adjacent restored prairie. Biomass production was greater in the old field (8.6$\pm$1.1 Kg m^{-2}) than the prairie (6.0$\pm$0.5 Kg) and the pasture (6.0$\pm$1.1 Kg), although the difference was marginally significant (p=0.097). Decomposition of organic matter was also greater in the old field (29.0$\pm$1.7%) than the prairie (15.9$\pm$1.5 %) and the pasture (22.7$\pm$2.6%). Concentration of soil organic matter was less in the prairie (3.9$\pm$0.7%) than the pasture (4.8$\pm$0.7%) and the old field (5.0$\pm$0.6%). Our results suggest that the restored prairie has not reached to the same level of old field for sequestration of atmospheric carbon by both vegetation and soil. Also, we did not find the evidence that supports the hypothesis "promoted primary production and carbon sequestration by vegetation of greater species richness or diversity," after 15 years of prairie restoration in the Taltree Arboretum.

Knight, Kathleen S.* and James M. Slavicek. **Using Dutch elm disease-tolerant elms to restore floodplains impacted by emerald ash borer.** USDA Forest Service, Delaware, Ohio. Email: ksknight@fs.fed.us

American elm (*Ulmus americana*) was a dominant species in floodplains and swamps of the Midwestern United States before Dutch elm disease (*Ophiostoma novo-ulmi*) reduced its populations. In some areas, ash (*Fraxinus* spp.) became dominant in these ecosystems. Emerald ash borer (EAB) (*Agrilus planipennis*) is an introduced insect pest that is now spreading rapidly through the Midwestern United States and killing up to 99% of ash trees in infested areas. We have begun a restoration experiment to study methods of reforestation for ash-dominated floodplains impacted by EAB through plantings of native tree species including Dutch elm disease-tolerant American elm. We are testing the effect of planting trees before, during, or after ash mortality by planting in sites in Ohio across a gradient of EAB infestation duration. We will examine the effects of microhabitat, including light, moisture index, herbivory, and herbaceous competition, on the growth and survival of the tree seedlings.

Rose, Sarah J.* and P. Charles Goebel. **Effects of catastrophic natural disturbance on ground beetle (Family: Carabidae) and spider (Order: Araneae) communities.** The Ohio State University, Wooster, Ohio. Email: rose.891@osu.edu

In the Central Hardwood Forest region of the United States, catastrophic winds associated with thunderstorms and tornadoes are important natural disturbances that affect ecosystem structure and

function. However, only a few studies have evaluated the natural succession of a forest impacted by catastrophic winds. In 2010, an EF-2 tornado with winds ranging from 179 to 217 kph impacted the forests of the Secrest Arboretum at the Ohio Agricultural Research and Development Center campus of The Ohio State University, providing an opportunity to quantify the recovery of a relatively undisturbed natural forest ecosystem. Following the tornado, we established a grid of geo-referenced points in the tornado-impacted stand and an adjacent unimpacted reference stand for comparisons of forest composition and structure. In 2012, using these same geo-referenced locations, we installed pitfall traps at each sampling location in order to quantify the ground beetle (Family: Carabidae) and spider (Order: Araneae) communities. Captured ground beetles and spiders were preserved in 70% ethanol and identified to species allowing for comparisons of community composition and abundance. Overall, we found reduced densities of spiders and ground beetles in the tornado impacted compared to the unimpacted stand. As we continue to study these communities, we will develop a better understanding of role that natural disturbances and the legacies of these disturbances play in regulating the structure and composition of ground beetle and spider communities. Such information is important as we develop restoration strategies that emulate natural models of ecosystem development.

Shmagrnoff, Rachel*[1], Samantha Kinsman[1], Eric Bird[1], Jazmin Garcia[2], and Young D. Choi[1]. **Assessment of restored vegetation in the wetlands of Wolf Lake, Hammond, Indiana.** [1]Purdue University Calumet, Hammond, Indiana. [2]Duke University, Durham, North Carolina. E-mail: rshmagra@purduecal.edu

Wolf Lake is a lagoon located in the southern shore of Lake Michigan. Much of its native character has been lost by human activities since the end of 19th century. It has been partitioned into several pools by causeway, railroad and dikes, filled with slags (waste from steel mills), and excavated for sand extraction. Consequently, all islands within the lake have disappeared and the shorelines have been infested by exotic plants. In 2007, U.S. Army Corps of Engineers recreated 17 islands totaling 0.62 km^2, removed exotic plants from 1.5 km of the lake's shoreline, and reintroduced 146 native plant species in both the islands and the shoreline. We initiated a monitoring of the restored vegetation in 2012. Our Non-metric Multidimensional Scaling ordination revealed an apparent conversion from exotic- to native-dominated vegetation in the shoreline. Prior to the restoration, >66% of the shoreline vegetation was dominated by 33 species of exotic plants, most notably purple loosestrife (*Lythrum salicaria*), Kentucky bluegrass (*Poa pratensis*), white sweet clover (*Melilotus alba*), and Eurasian reed (*Phragmites australis*). The relative importance of native species has increased from <34% to 87% in the shoreline and to 95% in the upland plots after the restoration. Among the 83 native species that established after the restoration, three-square bulrush (*Scirpus pungens*) was most dominant in both the shoreline and the upland, followed by green spikerush (*Eleocharis palustris*) in the shoreline and by hardstem bulrush (*Scirpus acutus*) in the upland. Meanwhile, Eurasian milfoil (*Myriophyllum spicatum*) remained as the most dominant macrophyte species as it constituted 15% of the total frequency before restoration and 25% of the total frequency after restoration. The data collected from this survey will be used as a baseline for further monitoring.

Smith, Chelsea* and Mary M. Gardiner. **The composition of lady beetle egg predators varies among egg species and across foraging habitats: considerations for native lady beetle conservation.** The Ohio State University, Wooster, Ohio. Email: smith.7231@osu.edu

The spread of exotic lady beetles (Coccinellidae) coincides with the decline of native coccinellids, leading to the hypothesis that predation by exotic coccinellids on native coccinellid eggs is mechanism for the decline. Our objectives were to determine if exotic coccinellids were dominant predators of native coccinellid eggs and to document the egg predator guild. Video experiments revealed that exotic coccinellids were not dominant predators of egg masses, but did expose a diverse guild of predators. This predator guild varied across habitats, with the greatest diversity found within grasslands and a lesser diversity in crops. Redundancy analysis revealed that two primary egg predators maintained a consistent pattern of predation across both years. Ants (Formicidae) were positively correlated with predation on exotic egg masses, while woodlice (Oniscidea) were positively correlated with predation on native egg masses. In addition, alfalfa may be an important habitat for the conservation of native coccinellids due to reduced egg predation, and excess extraguild prey.

Spencer, Jessica M.*, Corine M. Peugh, and Shana M. Byrd. **Innovative approaches to land management: the agricultural benefits of prairie crops.** The Wilds, Cumberland, Ohio. Email: jspencer@thewilds.org

Marginal lands, including surface mined land (SML), are generally unsuitable for agriculture due to compaction, poor soil nutrients, and presence of invasive plants. Farmers are able to maximize income on marginal land by establishing native prairie as an alternative crop. *The Wilds* Conservation Center, located on SML in southeastern Ohio, is collaborating with a local farm to demonstrate the multiple benefits of prairie in agricultural systems. These benefits include warm-season forage for livestock, wildlife habitat, improved soils, and carbon sequestration, while also providing biomass feed-stock for potential biofuel production. The three year demonstration consists of a 0.2 km^2 prairie established in 2011, using a single seed mix with four different preparation and management techniques. Treatments include tilling and sub-soiling, tilling only, no-till only and no-till with bison grazing. The partner farm is incorporated as a fifth treatment with traditional grazing on cool-season grasses. Monitoring is conducted annually for changes in biodiversity and soil quality. Methods include sampling soil for bulk density and organic carbon, as well as vegetation surveys for species richness and percent cover. Other factors assessed are small mammal diversity through trapping and arthropod diversity via sweep netting. Forage quality and weight gain by bison will be assessed in the third year along with a Life Cycle Analysis of carbon and energy. Preliminary results indicate no significant difference in diversity between treatments, except for the partner farm that had significantly less plant diversity than the tilled ($p=0.007$) and tilled plus sub-soiled ($p=0.009$) treatments. Arthropod family richness was positively correlated with plant species richness ($p=0.03$) across treatments. Baseline soil surveys reveal greater organic carbon at the partner farm, but similar bulk densities between sites. The benefits of incorporating native prairie plantings into traditional agriculture provide additional value to multiple stakeholders including conservationists, farmers, environmental proponents and consumers.

Thada, Adam R.*. **Interseeding forbs in a grass-dominated prairie restoration in northeast Indiana.** Taylor University, Upland, Indiana. Email: adam_thada@taylor.edu

Tallgrass prairie restorations attempt to mimic pre-colonization levels of biodiversity and provide associated ecosystem services, but they frequently fail to match the species richness of prairie remnants. Many restorations become excessively dominated by C_4 grasses due to the lack of historical disturbance patterns as well as insufficient propagule availability. Forbs comprise the bulk of floral diversity in a prairie, but interseeding new species usually requires a disturbance mechanism to allow germination and establishment of new plants. The use of fire, grazing, and mowing have been well-researched, but are not feasible in some restorations. Recent research suggests a pretreatment of haying could provide a competitive advantage to interseeded forbs, while avoiding the stimulative effects of fire on the C_4 grasses. Application of a grass-specific herbicide during the growing season may provide further benefits to the new seedlings by reducing canopy cover of the dominant grass. These two treatments may prove useful for the Upland Prairie Restoration (Upland, IN) that has become dominated by *Andropogon gerardii* (Big bluestem) as a consequence of nearly two decades of annual prescribed burns. I propose a factorial design to measure seedling establishment of four native forb species undergoing two treatments: 1) a pretreatment of haying in place of the annual spring fire; and 2) application of grass-specific herbicide at varying times throughout the growing season. Where management options are limited, haying and herbicide application could constitute effective tools for prairie restorationists.

Zilla, Brian*, James DeGroff, and Dennis J. Taylor. **Scan me maybe: Sustaining interest in wetlands and restoration using QR codes.** Hiram College, Hiram, Ohio. Email: zillabj@my.hiram.edu

Lack of student interest in studying science subjects in k-12 education and introductory college courses is easily remedied through the study of restored wetlands using smartphones, the method of choice for communication and learning for today's students. Our paper explores how a wetland restoration project coupled to a biomonitoring protocol can sustain student interest through Quick Response (QR) Codes. In partnership with the colleagues at the Cleveland Metroparks, the Ohio Environmental Protection Agency (OEPA) and three urban school districts, we developed webpages accessed through QR codes that are currently placed strategically in the newly restored Frohring Wetlands at the Hiram College James H. Barrow Field Station. QR codes are linked to pages describing plants of the wetland (native vs. invasive), describing the restoration of these wetlands, and describing what factors were important for their rapid development. We also developed QR code pages linked to each of the six metrics of the Ohio Rapid Assessment Method (ORAM) developed by the OEPA. These six ORAM pages answer commonly asked questions by neophytes (in our case k-12 students and undergraduates) who are using the ORAM for the first time. We report results from 60 undergraduate students using this QR code system for learning how to use the ORAM. We also report results of student assessments of their own learning gains. Our hope is that this QR code system will be replicated in other restored wetlands to build and sustain interests in science and conservation in the next generation of citizen scientists.

ORAL PRESENTATION ABSTRACTS (ALPHABETIC)

Albro, Sandra L.* and Geri E. Unger. **Urban vacant lots as green infrastructure.** Cleveland Botanical Garden, Cleveland, Ohio. Email: salbro@cbgarden.org

Cities throughout the midwestern United States are experiencing growth in the abundance of urban vacant land as a result of localized population loss. While unkempt vacant parcels can contribute to the "broken window effect" that perpetuates disinvestment in declining neighborhoods, they can also be important sources of ecological and social services. We will describe work being undertaken in Buffalo, New York, Cleveland, Ohio, and Gary, Indiana to repurpose vacant land as green infrastructure to mitigate point source pollution, nonpoint source pollution, habitat loss, and economic decline. Such work addresses lingering questions about green infrastructure as a supplement or alternative to grey infrastructure investment—namely, maintenance methods, financial costs, performance of vacant lots under different types of reuse, and green infrastructure as a neighborhood amenity. It also seeks to shape urban greening methods to fit available resources and observed patterns of commercial and residential land vacancy. Working through these practical constraints will be necessary for the widespread adoption of green infrastructure into long-term plans for urban redevelopment.

Anderson, Roger C.*[1], M. Rebecca Anderson[1], and Erica A. Corbett[2]. **Are white-tailed deer a keystone species in tallgrass prairies?** [1]Illinois State University, Normal, Illinois. [2]Southeastern Oklahoma State University, Durant, Oklahoma. Email: rcander@ilstu.edu

We examined changes in forb species abundance, floristic quality, and diversity (H') in response to deer browsing and fire from 1992 to 2001. Our study site was a species rich remnant prairie (100 forb species) in Goose Lake Prairie State Park (GLPSP), 70 km southwest of Chicago, Illinois. Deer densities in GLSPSP varied from 32 to 50 deer km^{-2} between 1992 and 1997 and declined to 7 to 9 deer km^{-2} following initiation of fall hunting in 1997. The study area was divided into four 24 m x 16.5 m quadrants. We used thirty-six 25 cm x 25 cm quadrats to sample browsed and unbrowsed stems in each quadrant. After the 1992 sampling, two quadrants were enclosed with a deer proof fence and two were left unprotected. Forb stems with flower buds, flowers, or fruits were counted in three belt transects (2 m x 16 m) in the four quadrants from 1998 to 2001. Stem count data obtained for forbs species in protected and unprotected plots each year were analyzed using DCA (Detrended Correspondence Analysis). DCA axis one ordered samples along a deer browsing intensity/duration gradient. Species stem counts were regressed against sample DCA scores. Five species had positive responses to browsing and ten species responded negatively. A weighted floristic quality index decreased with increasing browsing. Forb diversity was greatest at intermediate levels of browsing intensity. Flowering stem diversity was less ($p < 0.001$) on unprotected (H' = 1.29 to 1.70) than protected plots (H' = 1.92 to 2.26). Flowering stem counts were ($p < 0.001$) greater on protected than unprotected plots in years without burning (1999 and 2001). Deer browsing has profound effects on prairie forb diversity, floristic quality, and their selective browsing affects species abundance. Land managers can maintain greater diversity prairie, but with lower floristic quality by accepting moderate deer browsing.

Bingham, Joel D.*. **Urban stream and wetland restoration "more than bankfull" considerations for design and construction.** EnviroScience Inc., Stow, Ohio. Email: jbingham@enviroscience.com

Urban stream and wetland restoration has its own set of unique challenges that involve flooding, hydraulic modeling, public perception, public protection, infrastructure, multiple government and municipal agencies, local politics, and stressed environmental conditions. Combine these with the unique dynamics of a lacustrine system and it creates a complex project. This presentation discusses a case Great Lakes Restoration Initiative funded project on the lower Euclid Creek, Cuyahoga County, Ohio, where challenges arose with merging many objectives of the City of Cleveland, U.S. Army Corps of Engineers, Ohio EPA, and local residents to achieve federal flood control standards while meeting the ecological stream and lacustrine wetland restoration goals. The construction also took place amongst active pedestrian trails of Wildwood State Park that created an interesting dynamic of public education, perception, safety, and diverse opinions.

Brownknight, Jason K.*. **Leveraging funding and volunteers to combat woody invasive species and *Ranunculus ficaria*.** Cincinnati Nature Center, Milford, Ohio. Email: jbrownknight@cincynature.org

Cincinnati Nature Center (CNC) lands exist as islands of biodiversity surrounded by urbanization and agricultural land use. One of the largest threats to CNC biodiversity is nonnative invasive species. Over two dozen species of nonnative invasive species exist on CNC lands and include the Amur "bush" honeysuckle, garlic mustard, tree of heaven, Japanese wisteria, Japanese honeysuckle, autumn olive, and lesser celandine. Each of these species present significant threats to native biodiversity at CNC. However, lesser celandine (*Ranunculus ficaria*) may be the most difficult to combat. This herbaceous invasive plant poses a grave threat to native spring flora. Currently, nearly 1.2 km^2 of mature hardwood forest at CNC is infested with lesser celandine. To combat this threat the Department of Conservation and Stewardship at CNC is leveraging funding and volunteers to combat both woody invasive species and lesser celandine. In 2011 CNC enrolled in the USDA Natural Resource Conservation Service Environmental Quality Incentives Program (EQIP) to improve 0.4 km^2 of hardwood forest by removing nonnative woody invasive species over a five year period. The EQIP program pays CNC for every acre that is treated and re-treated for woody invasive species in the project area. The first two years of this program have been completed with over seventy volunteers contributing over 3,000 hours toward the treatment and re-treatment of woody invasive species on 0.2 km^2 at CNC. As a result, CNC has received over $20,000 from the EQIP program. This funding is being used to hire a local environmental contractor to treat lesser celandine in a section of over-mature hardwood forest at CNC. In 2012 0.14 km^2 of infested habitat was treated for lesser celandine using EQIP funds. In 2013 the same area will be re-treated and an additional 0.06 km^2 will be treated.

Cole, James B.*[1], Roy Kroll[2], and Jason Lewis[3]. **Restoring hydrologic connectivity, fish passage, and coastal marsh at Ottawa National Wildlife Refuge in the Maumee River watershed Area of Concern.** [1]The Nature Conservancy, Swanton, Ohio. [2]Ducks Unlimited, Ann Arbor, Michigan. [3]U.S. Fish and Wildlife Service, Oak Harbor, Ohio. Email: jbcole@tnc.org

Historically, Western Lake Erie Basin (WLEB) had one of the most extensive and productive coastal wetland complexes in the Great Lakes. These diverse and dynamic habitats support plant and animal communities, provide fish spawning and migratory bird stopover habitat, feed the open-water food web, improve water quality, reduce floods, and protect shorelines. Despite being widely recognized

for their numerous benefits, these systems are at risk. Only 5% of Lake Erie's historic coastal wetlands remain, most of which are diked. Although a necessary practice given historic Great Lakes water levels, diking often cuts wetlands off from Lake Erie and makes them unavailable to aquatic species that rely heavily on coastal habitats. Sediment flow that is critical for wetland maintenance has been altered through shoreline hardening, dredging, and watershed land use. Low areas have been filled for agriculture and development. Many government agencies, not-for-profit organizations, industries, and citizen groups recognize the necessity of restoring WLEB coastal habitats, but oftentimes work is uncoordinated and occasionally competing, because of the many demands for these diminished habitats. Over the last three years, The Nature Conservancy has partnered with Ottawa National Wildlife Refuge and Ducks Unlimited to restore wetlands and uplands on federally-protected land near Lake Erie. This presentation will provide an overview of our restorations, particularly the Blausey tract near the Toussaint River, and our work to demonstrate multiple objective wetland management for the WLEB coasts. In summary, the restorations will improve the ecosystem by restoring critical habitats and processes at the local scale, while integrating the management needs of numerous nested targets like migratory birds, fish, and abiotic processes into the design.

D'Alessandro, Domenico*. **Conversion of existing marinas to fish refugia.** D'Alessandro & Associates, Algonquin, Illinois. Email: domenico.dalessandro@comcast.net

There are approximately 380 marinas with direct access to the Great Lakes on the United States side that if converted to fish refugia could accommodate many fish species and help offset the loss of aquatic habitat. The marinas are most numerous near major urban centers and therefore can provide aquatic habitat where it is most lacking. Marinas already have protective seawalls and barriers that keep large wave action from disturbing the inner harbor's tranquil waters. With some alteration, the existing floating docks would provide support to the proposed series of reef-like vertical aquatic habitats specifically designed for this purpose. These floating and submerged habitats are fitted with small solar-powered pumps and water jets to filter and aerate the water and provide aesthetic value to the marina customers. It is expected that they will also eliminate some odors associated with water stagnation. These marina conversions are not meant to replace wetland mitigation and restoration, but they do provide additional habitat creation opportunities in some of the most restricted and built up areas at a fraction of the cost of the creation of a wetland ecosystem. Where feasible and cost effective vertical watershed units will be proposed for additional habitat creation on land associated with marinas.

Dilley, Mark A.*, Jenny Adkins, Brent Macolley, and Luke Soposki. **Community partnering for maximum return on investment of public funds: two ecological restoration project examples from central Ohio.** MAD Scientist & Associates, LLC., Westerville, Ohio. E-mail: mark@madscientistassociates.net

Ecological restoration projects are often accomplished with grant funding from public sources and with budgets that are modest or even tight. Developing partnerships not only adds value to a project, but also helps to stretch available resources and foster a sense of ownership for the project within the local community. Properly managed, this can result in higher-quality projects that are more sustainable in the long-term due to on-going public awareness and interest. Partnerships are also highly regarded by the granting authorities because it elevates their status and generates beneficial publicity that highlights the value of their program. Community partners also derive many benefits such as, furthering their own sustainability efforts by promoting stewardship of natural resources and creating environmental

education opportunities. MAD Scientist & Associates has been fortunate to have had the recent opportunity to work on two Ohio wetland construction projects that were funded through Section 319 Clean Water Act grants by Ohio EPA and the U.S. EPA: 1) The Reynoldsburg City School District's Alexander W. Livingston EcoLab and 2) City of Westerville Highlands Park "Extreme Marsh Makeover." We will share details of these two projects, including a brief history of each site, the partnerships that emerged to accomplish the projects, and the beneficial outcomes that have resulted from involving multiple partners. We will also offer (and ask for!) ideas to help restoration professionals take advantage of partnering opportunities in the communities in which they work.

Emery, Mary E.*[1] and Gary Bentrup[2]. **Using appreciative inquiry to identify best practices in multi-functional planning.** [1]South Dakota State University, Brookings, South Dakota, [2]U.S. Forest Service, Lincoln, Nebraska. Email: mary.emery@sdstate.edu

Multi-functional planning often requires planners to work in new and challenging environments. The U.S. Forest Service has developed resources to support multi-functional planning and is looking at developing additional tools and resources to support this work. In the first phase of this project we looked at who was using *Conservation Buffers: Design Guidelines for Buffers, Corridors, and Greenways* and how. We also completed a Delphi study of experts in the field to determine the merit of the Guide. In this third phase of the project, we are collecting data on existing approaches to planning and identifying additional tools and approaches that could be useful to those engaged in multi-functional planning. This presentation reports on the results of ten interviews conducted with active professionals in the field to determine successful approaches to multi-functional planning and to identify common tools used in the process. The interviews were designed using Appreciative Inquiry, an approach that focuses on identifying successes and the factors that contribute to those successes. Analysis of the data indicates that planners often work in complex and political environments. Factors contributing to successful projects include the ability to work in teams, to be open minded, and to appreciate and respect inter-and multidisciplinary approaches. GIS, soil surveys, and other maps are tools that used most often to support these planning efforts.

Gilland, Keith E.* and Brian C. McCarthy. **Microtopography influences early successional plant communities on experimental mine land reclamations**. Ohio University, Athens, Ohio. Email: kg548007@ohio.edu

Surface mining for coal represents one of the most severe forms of anthropogenic disturbance to the forests of the eastern United States. Reclamation methods adopted under federal law after the late 1970's have led to a state of arrested succession, with a general failure to achieve pre-disturbance conditions. New methods of reclamation have been proposed with the goal of returning mined land to its former forested state through the use of compaction reducing techniques that create large amounts of microsite heterogeneity. We examined the effect of fine-scale topographic relief, soil physical properties, and reclamation style on early plant community development on an experimentally reclaimed mine site in eastern Ohio. We sampled plots at four microsite types and at different distances from the remaining forest edge in both experimentally and traditionally reclaimed areas of surface mine. Non-parametric multivariate ANOVA on distance matrices indicated significant differences in plant community composition among microtopographic positions and reclamation types. These microhabitat positions also exhibited significant differences in measured soil properties (e.g., soil moisture, texture, bulk density) that likely affected community composition. Plots in the traditionally-reclaimed areas had no woody plant colonization, indicating a state of "arrested

succession" common to older sites reclaimed using traditional methods. Our results suggest that the creation of heterogeneous microsites at the time of reclamation markedly accelerates succession and promotes enhanced plant community diversity. Expanded application of the methods used here could allow for a faster return to the former forested state of highly disturbed lands than previously used reclamation methods.

Goss, Charles W.*[1], P. Charles Goebel[1], and S. Mažeika P. Sullivan[2]. **Transitions in land cover, ecological thresholds, and restoration of stream ecosystems in agricultural landscapes**. [1]The Ohio State University, Wooster, Ohio. [2]The Ohio State University, Columbus, Ohio. Email: goss.44@osu.edu

Ecological thresholds correspond to abrupt changes in ecosystem attributes and are particularly important for understanding the effects of land-cover change on stream ecosystems. In human modified landscapes, native vegetation is often cleared for agricultural and urban development. Remaining forest patches are often small and isolated with influences on stream ecosystem structure and function that are largely unknown. In particular, the effects of distinct forest edges associated with the transitions from agriculture to forest remain unresolved. In order to better understand potential threshold relationships between stream characteristics and distance into a forest patch, we studied streams flowing through forest patches in agricultural landscapes of north-central Ohio. To address our objectives we sampled along transects running from upstream agricultural land through downstream forest patches (up to 1 km). Overall, our results provide evidence for abrupt changes in streams systems relatively soon after entering a forest patch. We found threshold changes in nine different macroinvertebrate taxa within the first 350 meters of entering a forest patch. Similarly, temperature and nutrient concentrations exhibited abrupt changes soon after entering forest patches, indicating that these variables may drive patterns in macroinvertebrate communities along agriculture-forest transitions. Alternatively, we found no evidence for systematic changes in leaf decomposition along this gradient. This suggests that functional parameters such as decomposition may operate over asynchronous spatial scales, and/or are less sensitive to changing land use than macroinvertebrates and other abiotic characteristics. We conclude that even relatively small patches of forest have the potential to appreciably influence stream dynamics, and that conservation and/or restoration of small, discontinuous patches of forest may be important for maintaining high quality stream conditions in agricultural landscapes.

Grieser, Jennifer*[1], James Rodstrom[1], Claire Weldon[1], and Derek Schafer[2]. **West Creek Ecosystem Restoration Project: retrofitting neighborhoods to reduce water quantity and improve water quality.** [1]Cleveland Metroparks, Cleveland, Ohio. [2]West Creek Conservancy, Parma, Ohio. Email: jmb2@clevelandmetroparks.com

The West Creek Ecosystem Restoration Project is part of an overarching protection and restoration process where impairments have been established, solutions to impairments have been identified, and broadly supported activities have been designed, resulting in high probability of significant, positive measurable results. This planning laid the groundwork for receiving a Great Lakes Restoration Initiative grant from the United States Environmental Protection Agency. With Cleveland Metroparks as the lead, other lead partners include West Creek Conservancy, Northeast Ohio Regional Sewer District (NEORSD), City of Parma, and Northeast Ohio Areawide Coordinating Agency. West Creek (36 km^2), a subwatershed of the Cuyahoga River Watershed, is part of the Cuyahoga River Area of Concern for Lake Erie. This urban watershed contains approximately 35% impervious surface. This

Project aims to address directly connected impervious area (DCIA) with a street level, experimental approach by consolidating stormwater control measures along two streets adjacent to West Creek Reservation. A Before-After-Control-Impact study design evaluating biology and hydrology will quantify the effectiveness of these measures to reduce DCIA to thresholds that will allow West Creek to attain warm water habitat. Considering the broad array of environmental services provided by green infrastructure and ecosystem-based projects, the team will also assess beneficial social impacts. NEORSD recently instituted a Regional Stormwater Management Program, applying a stormwater utility fee to individual homeowners, businesses, and schools according to impervious area. Participation in this project will assist homeowners with receiving a 25% credit on the fee. By working directly with the City of Parma to allow these practices and by value-engineering the project design to make costs reasonable, the West Creek Ecosystem Restoration Project can serve as a model for adopting green infrastructure in neighborhoods throughout Northeast Ohio.

Heslinga, Justin L.*. **Building flexible ecological quality models for land management decision-making.** Cardno JFNew, West Olive, Michigan. Email: justin.heslinga@cardno.com

Every day, land managers must make decisions on how to use limited time and financial resources to achieve management or restoration goals in parks, preserves, and other natural areas. Too often, "shotgun" or other ad hoc approaches are employed in the management of natural areas, resulting in ineffective or inefficient management. Using objective, science-based approaches to rank natural areas in terms of ecological quality offers a better way to prioritize areas for management, leading to more effective management outcomes. These types of models have been developed for use at the landscape scale and within specific ecosystem types, but are not widely used within the context of on-the-ground management and restoration. In this presentation, I will describe the process of creating a simple, flexible model that uses quantitative ecological data to prioritize management areas and can be used to inform management decisions.

Jefferson, Anne J.*[1], Sandra Clinton[2], and Mackenzie Osypian[2]. **Evaluating the effects of restoration on transient storage and ecosystem services in urban headwater streams**. [1]Kent State University, Kent, Ohio. [2]University of North Carolina at Charlotte, Charlotte, North Carolina. Email: ajeffer9@kent.edu

In urban watersheds, the capacity of streams to provide essential ecosystem services is often limited as a result of channel straightening, incision, and removal of geomorphic features. Stream restoration seeks to provide stream stability while reestablishing ecosystem services, but restoration alone may not mitigate the effects of watershed land-use change and urbanization. Stream restoration activities frequently impact transient storage and hyporheic exchange, the processes by which water movement is slowed down or temporarily detained at the surface or in the streambed. Transient storage and hyporheic exchange zones are important regulators of nutrient retention and stream temperature, and they harbor diverse biological communities. However, it is unknown how successful stream restoration activities are at creating ecologically effective storage and exchange zones that promote improved water quality and diversity. In Charlotte, North Carolina, we have evaluated restored and unrestored streams to quantify and compare transient storage. Our goal is to evaluate the relative success of restoration activities for ecosystem services in urban and forested watersheds. We measured increased transient storage and greater variability in upwelling and downwelling vertical hydraulic gradients in restored relative to unrestored reaches. However, restored reaches had lesser hydraulic conductivity of bed sediments, which was likely related to the construction of the restoration.

The net effect of restoration was to greatly increase instream transient storage, while not appreciably increasing hyporheic exchange. Evaluating the ecological effects from changes in transient storage was complicated by the effects of canopy removal around stream restoration projects, the combination of which resulted in greater water temperatures and reduced benthic diversity. While current practices of urban stream restoration may be successful in creating channel stability, coupling watershed-scale management of stormwater and nutrients with restoration techniques designed to enhance ecologically effective storage and exchange may be required for restoration success in a holistic sense.

Kautza, Adam R.* and S. Mazeika P. Sullivan. **Influences of land cover on reciprocal aquatic-terrestrial invertebrate fluxes: Implications for biodiversity and riparian restoration in a multi-use river system.** The Ohio State University, Columbus, Ohio. Email: kautza.1@osu.edu

The impacts of landscape alteration on riverine ecosystems have received significant attention. However, the effects of these human-caused disturbances on ecosystem processes, such as aquatic-terrestrial energy fluxes, and their consequences to biodiversity remain largely unresolved, particularly within the context of sustainable river restoration. To assess the impact of landscape alterations to reciprocal energy flux dynamics we surveyed aquatic emergent insect and riparian arthropod fluxes at 12 reaches of the Scioto River (Ohio, USA) representing a gradient of urban, agricultural, and forested land cover. We calculated flux diversity, biomass, and density, as well as mean body size of individual organisms. We found that both aquatic emergent insect diversity (i.e., evenness) ($R^2 = 0.34$, $p = 0.06$) and density ($R^2 = 0.26$, $p = 0.10$) were positively associated with forested land cover. We also observed that mean body size of terrestrial arthropods entering the river decreased with a concurrent increase in urbanization ($R^2 = 0.57$, $p < 0.05$). Given the importance of invertebrates to higher consumers, both aquatic (e.g., fish) and terrestrial (e.g., birds and spiders), our results will likely have broad implications for cross-boundary dynamics of carbon and energy transfer and the structure of consumer assemblages in riverine food webs. For example, aquatic insect emergence patterns may be linked to changes in aerial insectivorous bird communities in riverine landscapes. We anticipate that our results will inform restoration professionals in designing projects that consider ecosystem function as well as structure.

Koch, Jennifer L.[1], David W. Carey[1], Kathleen Knight*[1], Therese Poland[2], Daniel A. Herms[3], and Mary E. Mason[3]. **Lingering ash: hope for restoration of ash in the Midwest.** [1]USFS Northern Research Station, Delaware, Ohio. [1]USDA Forest Service, Delaware, Ohio. [2]USDA Forest Service, East Lansing, Michigan. [3]Ohio Agricultural Research and Development Center, Wooster, Ohio. Email: jkoch@fs.fed.us

When the emerald ash borer (EAB) infestation was first discovered in the Detroit, Michigan area and surrounding suburbs, reports indicated that all native ash species were highly susceptible. Variation in the response of native ash species to EAB may have gone unnoticed because the vast majority of street trees are clonal horticulture selections, representing a limited number of genotypes. As the beetle spread away from urban areas into more genetically diverse native stands, a small number of healthy ash trees have been discovered in areas where EAB has caused almost complete mortality of mature ash trees. A subset of these "lingering ash" trees have been propagated for further evaluation. A research planting for evaluation of field performance is being established in Delaware, Ohio. Work is also being done to develop an "early" screen for EAB-resistance, using both foliar feeding preference studies with adult beetles and egg bioassays to compare larval development. Adult feeding preference studies identified some lingering ash genotypes that were significantly less preferred than susceptible

controls. Experiments performed by affixing eggs onto grafted ramets demonstrated that some of the lingering ash selections did not differ from the susceptible controls, but other selections were significantly different having lower larval weight, differences in overall larval development, and/or larger numbers of larvae killed by host tree defenses. One lingering ash genotype was significantly different from susceptible controls in both the adult feeding and egg bioassays. These results demonstrate a measurable phenotype that explains why some "lingering ash" have tolerated EAB attack longer than the majority of their counterparts, and indicate that more than one mechanism may be responsible. Full-sib families are being generated to carry out genetic studies to confirm that EAB-tolerance is a heritable trait and to understand the mode of inheritance so that a breeding program may be initiated.

Kovalcik, Paul*[1] and Joe Berg[2]. **Stream restoration as a tool for meeting TMDL goals: recommendations from the EPA's expert panel.** [1]Biohabitats, Inc., Cleveland, Ohio. [2]Biohabitats, Inc., Baltimore, Maryland. Email: pkovalcik@biohabitats.com

In order for restoration to be broadly adopted by society, practitioners need to build a consensus on how restoration projects can deliver benefits, whether narrowly defined benefits to a single species (e.g., re-establishment of brook trout) or broad-based benefits that are widely valued by society (e.g., barrier island and coastal wetland restoration in the Gulf). Stream restoration has been a popular and growing form of restoration that has been alternately praised and condemned by practitioners and researchers. As a result, consensus on the value of stream restoration has been elusive. This presentation focuses on recognized societal benefits associated with stream restoration, and a recent attempt to assign various pollutant removal benefits with different types of stream restoration as part of the EPA's Chesapeake Bay Program. TMDL (Total Maximum Daily Load) goals set by the EPA are sufficiently aggressive that all possible means to meet the goals are being investigated. Stream restoration is being viewed by the regulated community as an important tool to reduce nutrient and sediment loads to receiving streams. This presentation will provide an overview of the year-long effort undertaken by the stream restoration expert panel commissioned by the EPA's Chesapeake Bay Program to evaluate whether stream restoration can be used as a tool to improve our receiving streams and if so, establish conservative sediment and nutrient reduction efficiencies associated with the practice. These conclusions can then be evaluated and used to establish regulatory norms that other regions can use for meeting water quality load reduction goals.

Lacerda, Thomas*[1], Cris Peck[1], Ariel Pund[1], Joel Bingham[2] and Dennis J. Taylor[1]. **Restoring degraded wetlands: a case study of the Hiram College Frohring Wetlands integrating public and private agencies with education and restoration.** [1]Hiram College, Hiram, Ohio, [2]Enviroscience, Stow, Ohio. Email: lacerdata@my.hiram.edu

We describe the evolution of an inventory of the wetlands of the James H. Barrow Field Station in Hiram, Ohio into a sustainable partnership engaging undergraduates, high school teachers, and scientists from private industry and public agencies. The initial goals of this summer internship program were to locate, determine, evaluate, and delineate all wetlands of the James H. Barrow Field Station. We documented the poor conditions of three wetlands constructed within the past 15 years and the excellent conditions of many floodplain wetlands adjacent to Silver Creek, a cold water stream running through an untimbered beech-maple forest. At the same time we surveyed local educators who incorporate wetlands into environmental curricula at their schools. We discovered a need for a set of more robust easily accessible wetlands that could sustain heavy use by educational groups that were

having a significant negative impact on the unique floodplain wetlands. Based on needs for model wetlands for educators, we report here the steps of this multilevel project in restoring two of the degraded wetlands so that they could incorporate and sustain the needs of the educators. The project employed three college interns working with high school and university community partners in education as all developed future curricula utilizing the new model wetlands. The project also engaged the services of scientists from the National Park Service, a private wetland consultant, and private firms (Enviroscience and Riverworks) specializing in floodplain construction and restoration. This presentation will describe how the wetlands served an integral role in developing and now in sustaining the established and new partnerships of this restoration program.

Lampe, John K.*. **An "un-extreme" makeover (or lazy person's restoration) of a private urban natural landscape in the Twin Cities metropolitan area**. St. Paul, Minnesota. Email: john@wowcoweb.com

Privately owned urban natural areas need to be restored to supplement professionally managed preserves. This is especially true as urban sprawl steadily marches outward from urban cores. However, many private urban natural lands are not high functioning ecosystems. This presentation will describe an "un-extreme" restoration plan which has guided work on a piece of private property in the Twin Cities metropolitan area. The 0.05 km^2 was historically an oak savanna, then a pasture, and then a pine plantation in the 1960s. When we started our restoration in the 1990s the habitat was a poor quality, mostly tightly-packed pines and buckthorn. The restoration plan does not have a specific ecosystem (e.g., oak savanna) as its objective. Instead, the objectives are to: 1) create higher quality wildlife habitat; 2) reduce fire risk; 3) control established invasive species and eradicate new invaders; 4) utilize resources such as wood and wildlife such as deer in a sustainable way; 5) provide an area for recreation and learning; and 6) achieve these objectives with minimal work and expense. We have used a hodge-podge of techniques such as thinning tightly packed pine trees by girdling to create snags, felling trees to create downed coarse woody debris, clear-cutting and raking thatch in small openings for prairie plants. We have used minimal mechanized equipment and no prescribed fire except in burn piles. A key question our restoration raises is whether this "non-radical makeover" can noticeably improve the quality of the ecosystem and achieve our other objectives. If it can, it may provide ideas for other private landowners who cannot undertake massive restoration efforts.

Lenhart, Chris*, David Smith, Ann Lewandowski, and John Nieber. **Development of a basin-wide strategy for reduction of ravine, bluff and stream bank sediment in the Minnesota River Basin**. University of Minnesota, St. Paul, Minnesota. Email: lenh0010@umn.edu

Research now indicates that the majority of sediment exported from the Minnesota River is derived from stream bank and near-channels sources, amplified by recent stream flow increases. Due to Clean Water Act regulations and other concerns there is a need to develop a comprehensive approach to reduce channel erosion. An approach for prioritizing channel erosion reduction strategies over the 44,030 km^2 Minnesota River Basin is being developed with a focus on social, logistical and economic issues in order to develop a strategic framework for action. Building on previous studies, the areas with the greatest channel-derived sediment yield will be assessed in GIS using a region-specific empirical tool for stream bank sediment. Existing data on channel erodibility, bank erosion risk, and geomorphic metrics will be used in combination with socio-economic factors to rank the priority for channel stabilization and/or ecological restoration. The most cost-effective sediment reduction strategies for ravines, bluffs, and stream banks will be identified from the existing toolbox from an

economic analysis conducted on projects around Minnesota. A second major goal of the project is to develop strategies for control of channel erosion that are specific to each channel type and geomorphic setting that are viable from an economic standpoint, as many are too costly for widespread application. A third related goal is to address economic needs of landowners by identifying riparian practices that are compatible with agricultural systems. These multi-use strategies must enhance ecological services while providing economic benefit to landowners for widespread adoption. The use of alternative perennial crops, rotational grazing, controlled drainage, and direct stream restoration practices are all appropriate in different settings. Case studies of sediment reduction projects will provide insight into practical site location, cost, social and implementation issues in different regions and landscape settings within the basin.

Majka, Brian* and Stu Kogge. **Wetland and stream restoration techniques following emergency response actions to the line 6B oil leak in Marshall, Michigan**. Cardno JFNew, West Olive, Michigan. Email: brian.majka@cardno.com

On July 26, 2010, Enbridge Energy, Limited Partnership (Enbridge) responded to a leak on the Line 6B pipeline, part of its Lakehead System, near its Marshall, Michigan pump station. An estimated 20,082 barrels (3193 m^3) of crude oil was released from Line 6B. Of that, an estimated 8,033 barrels (1277 m^3) reached Talmadge Creek and the Kalamazoo River. Within a day of being contacted by Enbridge, Cardno JFNew conducted ecological assessments of existing biota and resources of the wetland and floodplain areas affected along Talmadge Creek. Draft restoration plans were developed and Cardno JFNew commenced implementation of stream and wetland restoration efforts along the creek and floodplain within days using standard and unique restoration techniques given technical challenges associated with the site. To date, Cardno JFNew has been responsible design and implementation of ecological restoration measures in affected streambanks and floodplains throughout Talmadge Creek and the Kalamazoo River.

Meyer, Lars A.* and S. Mazeika P. Sullivan. **Influences of ecological light pollution on stream-riparian diversity: implications for restoration.** The Ohio State University, Columbus, Ohio. Email: meyer.541@osu.edu

Loss of aquatic and terrestrial biodiversity is associated with urbanization. Certain land growth models predict global urban land area could increase by 1,527,000 km^2 by the year 2030, with concomitant increases in artificial night lighting, such as roadway and security lighting. However, the impacts of artificial night lighting on riparian ecosystems remain poorly resolved. From 2010 to 2011, we investigated the daytime effects of artificial night lighting on riparian arthropod assemblages at a suite of urban streams in Columbus, Ohio representing a gradient of artificial night lighting intensity (0.01 lux – 4.00 lux). We observed a negative relationship between night lighting and riparian arthropod family richness ($R^2 = 0.24$, $p < 0.001$) and density ($R^2 = 0.18$, $p = 0.045$). We also found that greater levels of night lighting were related to lesser relative abundance of omnivorous arthropods ($R^2 = 0.19$, $p < 0.001$), but a greater relative abundance of ground-dwelling arthropod predators ($R^2 = 0.25$, $p < 0.001$). Our results indicate that artificial night lighting may contribute to shifts in community composition, potentially through increased predation activity and changes in food sources. To ensure informed and sustainable stream-riparian restoration efforts, biological effects of artificial night lighting should be considered. In particular, our results indicate that limiting lighting hours, adaptive lighting controls (i.e., motion activated, etc.), and targeted efficacy lighting systems may help mitigate the effects of artificial night lighting.

Nyamai, Priscilla A.*[1], Charles P. Goebel[2], David, M. Hix[1] and Gregory R. Corace III[3]. **Initial regeneration and litter decomposition response following a variable-retention harvest in mixed-pine forests of eastern Upper Michigan.** [1]The Ohio State University, Columbus, Ohio. [2]The Ohio State University, Wooster, Ohio. [3]Seney National Wildlife Refuge, Seney, Michigan. Email: nyamai.1@osu.edu

Fire suppression and legacies of past land management have led to significant changes in the structure and composition of mixed-pine forest ecosystems of the Northern Lake States. These changes, including poor natural regeneration of red pine (*Pinus resinosa* Ait.) and eastern white pine (*P. strobus* L.), fuel accumulations outside of the natural range of variation, and increases in dominance of short-lived and fire-sensitive species have ignited efforts to restore these ecosystems. In 2010, we implemented a variable-retention harvest aimed at improving conditions for regeneration of red pine and eastern white pine while reducing live fuels through the harvest treatments. Stand basal area was reduced by up to 70% in six stands randomly assigned to two spatial harvest patterns: residual trees dispersed uniformly or aggregated in a matrix of uncut patches with 0.003 km^2 gaps created. Two years following treatment, our results indicate greater densities of naturally regenerated eastern white pine ($F= 12.1$, $p = 0.015$) seedlings in the treated stands compared to the unharvested control stands, but no significant differences in red pine seedling densities. Canonical correspondence analysis relating seedling densities and environmental variables suggests fuel characteristics (e.g., coarse and fine fuels, duff and fuelbed depths) and overstory composition as factors that strongly influence patterns observed in the post-harvest regeneration-layer species composition ($F= 1.765$, $p = 0.014$). We did not observe significant treatment effects on litter decomposition. These initial seedling response to treatments suggests that variable-retention harvesting may be useful for regeneration of eastern white pine, but additional efforts (e.g., use of prescribed fire) may be needed to further improve conditions for regeneration of red pine. Furthermore, additional complementary studies, including those examining potential impacts on structural complexity and wildlife habitats are needed to develop a broader understanding of ecological impacts of variable-retention harvesting in these mixed-pine ecosystems.

Prasad, Anantha M.*[1], Louis R. Iverson[1], Stephen N. Matthews[1,2] and Matthew P. Peters[1]. **Facilitated restoration of tree species under future climates.** [1]USDA Forest Service, Delaware, Ohio. [2]The Ohio State University, Columbus, Ohio. Email: aprasad@fs.fed.us

Species movements due to human-induced climate change are on the increase. Additionally, some species are likely to become vulnerable if they are not able to migrate fast enough to keep pace with the projected climate change. Tree habitat distribution models predict suitable habitats under future climates, but the likelihood of colonization of these habitats is uncertain. Based on historical migration rates and current landscape fragmentation, it is possible to use dispersal-kernels (probability distribution functions) to enable source regions to colonize suitable sink habitats beyond the current species boundary. Appropriate dispersal-kernels can accommodate rare long-distance dispersal events that have been responsible for tree species marching across continents during the Holocene. We accomplish colonization of suitable sink habitats using a spatially explicit cellular model called SHIFT and in the process explore suitable corridors and patches available for facilitated migration of four tree species. The suitable corridors and patches can be evaluated for their species-restoration potential based on the vulnerability and desirability of the tree species in question.

Rieck, Leslie O.* and S. Mažeika P. Sullivan. **Ecological-geomorphic linkages in urban streams: implications for restoration.** The Ohio State University, Columbus, Ohio. Email: rieck.6@osu.edu

Understanding the influence of stream geomorphology (including changes in substrate composition, channel geometry, and habitat availability) as a driver of fish communities is critical to effective urban stream restoration. In this study, we investigate potential influences of urban-induced changes in geomorphology on fish assemblage density and diversity in streams in the Columbus metropolitan area, Ohio, USA. Our results indicate that both individual geomorphic descriptors as well as channel stability influence stream fish communities. For example, fish assemblage diversity was positively associated with median sediment size (R^2=0.543, p=0.010), density was positively related to width-to-depth ratio (R^2=0.467, p=0.029), and the number of sensitive darter species increased with greater pool-pool spacing (R^2=0.693, p=0.003). Actively adjusting urban streams appear to support greater fish assemblage diversity and density than altered streams that have reached a new equilibrium state. For fish communities, these results support the use of an integrated geomorphic-ecological approach to urban stream restoration. Considerations of channel equilibrium may also be important.

Rothrock, Paul E.*[1], Brad Gordon[1], and Paul Labus[2]. **Floristic quality of eight dune and swale nature preserves, Lake County, Indiana.** [1]Taylor University, Upland, Indiana. [2]The Nature Conservancy, Merrillville, Indiana. Email: plrothroc@tayloru.edu

The Gary-Hammond urban corridor occupies the near shore of southern Lake Michigan, a region that also possesses globally significant nature preserves. These preserves, remnants of the Chicago Lake Plain dune and swale region, protect parallel bands of oak savanna and interdunal wetlands. Brush and weed control, canopy thinning, and some prescribed burns have been instituted in an effort to restore and maintain community structure. Currently, we are assessing plant communities following management or lack of management at eight preserves in order to determine restoration success and what future management is necessary. We sampled vegetation in Beemsterboer Natural Area, Brunswick Savanna, Pine Station Nature Preserve, Dupont Natural Area, Gibson Woods Nature Preserve, Ivanhoe Nature Preserve, Cline Avenue Dune and Swale Nature Preserve, and Tolleston Ridge Nature Preserve during the summers of 2011 and 2012. We shall report on floristic assessments based upon over 50 transects each composed of 15 1-m^2 quadrats. In general, the oak savannas (based upon mean C and FQI) were closer in floristic quality to historical communities than interdunal swales. The latter often were degraded by invasive species or dense cover by *Cephalanthus* or the recent removal of these monocultures. Some oak savannas, notably Beemsterboer Natural Area, Gibson Woods Nature Preserve, and Cline Avenue Dune and Swale Nature Preserve have high canopy cover usually by black oak (80% or greater) and some decline in species richness per quadrat. However, transect-level diversity remains high. Several perplexing management issues, especially related to restoration in the urban context, will be discussed.

Sharma, Kuhuk*[1,2] and Parwinder S. Grewal[1,2]. **Restoring ecosystem services of urban soils: the use of nematode community as a bioindicator to reestablish the missing links in the soil food webs.** [1]The Ohio State University, Wooster, Ohio. [2]The Ohio State University, Columbus, Ohio. Email: sharma.203@osu.edu

Urban agriculture offers a means of local self reliance and food security especially in disadvantaged neighborhoods. However, there are concerns about poor soil quality in cities. Nematodes form an important and diverse component of the soil food web with presence across multiple trophic levels.

These nematodes have emerged as excellent bioindicators of disturbance and currently offer the most comprehensive insight into the structure and function of the soil food webs. We analyzed nematode communities in vacant lots in two disadvantaged neighborhoods in Cleveland, Ohio and Columbus, Ohio. Our results showed that in comparison to relatively undisturbed forest sites, nematode food webs in urban vacant lots had significantly less structural complexity and lacked higher trophic guilds such as predatory and omnivorous nematodes, thus severely limiting the ecosystem services potential of the soil. Therefore, we propose a new approach to improve soil food web complexity in the targeted vacant lots to restore the full spectrum of ecosystem services provided by the soil food webs. We hypothesize that the missing nematode trophic guilds along with associated soil organisms in the soil food web can be transplanted/reestablished using small soil cores (9 cm diameter, 5 cm deep) when coupled with specific organic amendments and minimized physical disturbance. Our experiments indicate that nematodes can spread out of the transplanted cores and colonize a 60 cm x 60 cm area within two weeks. Our goal now is to develop specific management regimes to sustain the transplanted missing elements of the soil food webs in vacant lot soils and restore soil health. Results from this study could eliminate the need for large-scale topsoil replacements in urban gardens and will pave the way for establishment of sustainable and safe urban food production systems.

Smiley Jr., Peter C.*[1], Robert B. Gillespie[2], Kathyrn E. Sanders[2], Kevin W. King[1], Douglas R. Smith[3], and Elizabeth Pappas[3]. **Similarities in fish-habitat relationships within channelized agricultural headwater streams in Ohio and Indiana**. [1]USDA Agricultural Research Service, Columbus, Ohio. [2]Indiana University-Purdue University Fort Wayne, Fort Wayne, Indiana, [3]USDA Agricultural Research Service, West Lafayette, Indiana. Email: rocky.smiley@ars.usda.gov

Channelized agricultural headwater streams are common throughout agricultural watersheds in the Midwestern United States. Understanding the fish-habitat relationships within these streams will provide information that can assist with developing restoration strategies for these degraded streams. We conducted fish community assessments within channelized agricultural headwater streams within the Upper Big Walnut Creek watershed, Ohio and Cedar Creek watershed, Indiana to address the following research questions: 1) do fish-habitat relationships differ between watersheds?; 2) what is the relative influence of riparian habitat, instream habitat, and water chemistry on fish communities?; and 3) what is the influence of watershed size on fish-habitat relationships? From spring 2006 to fall 2010 we collected fishes and measured riparian habitat, instream habitat, nutrients, pesticides, and physico-chemical variables from 14 sites in the Upper Big Walnut Creek and seven sites in Cedar Creek. We found that community structure is more strongly correlated with instream habitat than either riparian habitat or water chemistry. These fish-habitat relationships occur in both the Upper Big Walnut Creek and Cedar Creek watersheds, but examination of fish-habitat relationships within individual watersheds revealed some within-watershed differences. Only one of 20 fish community response variables was more strongly correlated with water chemistry in the Upper Big Walnut Creek watershed and six of 21 fish community response variables were more strongly correlated with water chemistry in the Cedar Creek watershed. We also observed interrelationships among instream habitat, watershed size, and fish communities within both watersheds that suggest the hydrological changes that occur with increasing watershed size are the underlying factor for the fish community changes that occur with increasing watershed size. Overall, our results suggest that restoration projects within channelized agricultural headwater streams in the Midwestern United States need to address physical habitat degradation to positively influence fish community structure.

Thieme, Jennfer L.*, Steve Woods, Lindsey Reinarz, and Michael Losey. **The role of partnerships in developing and implementing conservation at the landscape scale.** The Nature Conservancy, Swanton, Ohio. Email: jthieme@tnc.org

The Lakeplain Oak Openings is an ecologically diverse region spanning southeast Michigan and northwest Ohio. Its unique combination of geology and hydrology result in the presence of globally rare communities and species. However, industrial, urban, and agricultural growth have drastically degraded habitat within the region. Coordinated landscape-scale conservation has historically been impeded by state borders and the ecosystem's large regional span. In 2000, conservation partners formed the Green Ribbon Initiative (GRI) to work together in protecting habitat within the Oak Openings. The GRI identified the removal of invasive species, increased prescribed fire, and increased public awareness of the ecological value of the oak openings as key strategies to successful, measurable conservation. The Nature Conservancy (TNC) incorporated these strategies into recent conservation actions that were undertaken on behalf of GRI to improve habitat quality and build partnerships throughout the region. In 2012, the GRI created a GIS-based model to identify areas with high conservation and restoration potential, resulting in the development of 20 Priority Conservation Areas. TNC then targeted private and public landowners within these areas for outreach and restoration opportunities. Over 30 private landowners have signed management agreements and new partnerships with public agencies, such as townships, have developed. To date, restoration has occurred on over 1.0 km^2 within the region. Critical biological monitoring is underway to record the changes in vegetation, avifauna, insects, amphibians, and reptiles associated with restoration. The biological monitoring has already resulted in new state records and the documentation of threatened and endangered species. GRI partners are also developing coarse metrics to track and assess improvements in habitat structure on restored tracts. The continued coordination of conservation strategies and action through GRI will ensure large-scale, long-term restoration persists within the Oak Openings.

Umek, Lauren*[1], Liam Heneghan[2], and David Wise[3]. **The Chicago Wilderness Land Management Research Program, aka 100 Sites for 100 Years: developing an urban long-term restoration research program.** [1]Northwestern University and Chicago Botanic Garden, Chicago, Chicago, Illinois. [2]DePaul University, Chicago, Illinois. [3]University of Illinois at Chicago, Chicago, Illinois. Email: lumek@u.northwestern.edu

The Chicago Wilderness Land Management Research Program (CWLMRP), more affectionately referred to as 100 Sites for 100 Years, is a network of land managers, academic researchers, and restored and managed sites across the Chicago Wilderness region. The project is a cross-disciplinary research program connecting on-the-ground land management efforts across the region with cutting-edge ecological research. Since uninitiated in 2008, we have identified over 120 0.01 km^2 sites of woodland, savanna, and prairie remnants and restorations replicated on along a management gradient. These sites represent degraded/unmanaged, recently managed and long-term managed as well as high quality/reference sites. The goals of the project are to connect cutting-edge ecological research with land management practices in order to address key questions that contribute to our understanding of local ecosystems and the impacts of management activities on these organisms and processes and facilitate further collaboration and study within the region. Research to date has addressed plant community structure, soil aggregate formation, soil nutrient dynamics, earthworms, ground dwelling insect communities, native pollinator communities, and song bird communities on these sites. This presentation will review the history and development of the project and highlight some preliminary key findings.

Wise, Karen[1] and Matt Hils*[2]. **Eagle Creek Stream Restoration: partnerships for successful funding, design, and construction.** [1]Davey Resource Group, Kent, Ohio. [2]Hiram College, Hiram, Ohio. Email: karen.wise@davey.com

Hiram College in partnership with Western Reserve Land Conservancy obtained funding through the Ohio EPA Water Resource Restoration Sponsor Program to purchase 0.6 km^2 in Portage County, Ohio, including 1050 m length of Eagle Creek, portions of which have been degraded. Funding included the restoration of 497 m length of Eagle Creek and its floodplain. Self-forming and natural channel design restoration concepts were implemented. Construction was performed in 2012. This restoration project will ensure that when stream levels rise, overflow will enter the floodplain and sediment will be actively deposited. In addition, instream habitat features, such as riffle structures built from native stone, will provide important habitat for fish, macroinvertebrates, and other aquatic life. This presentation will reveal challenges encountered and successes achieved throughout the stream restoration project from the funding and design process to completion of construction.

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