LEGACIES AND UPSTARTS IN ECOLOGICAL RESTORATION IN THE MIDWEST

Photo Credit: Molly FiField Murray University of Wisconsin Regents

SECOND MIDWEST-GREAT LAKES SER CHAPTER MEETING

April 9 to 10, 2010 University of Wisconsin-Madison Arboretum

ABSTRACT BOOK

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MIDWEST-GREAT LAKES CHAPTER
SOCIETY FOR ECOLOGICAL
SER RESTORATION INTERNATIONAL

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PREFACE

The Second Annual Midwest-Great Lakes Society for Ecological Restoration (SER) Chapter Meeting was held April 9 to 10, 2010 at the University of Wisconsin-Madison Arboretum. This was a very special event because it marked the second gathering of the Midwest-Great Lakes SER Chapter and it was also part of the University of Wisconsin-Madison Arboretum's 75th Anniversary celebration. Given that the meeting site is considered to be the birthplace of ecological restoration and the Chapter is a newcomer to the region we adopted the meeting theme "Legacies and Upstarts in Ecological Restoration". Restoration projects are implemented as a result of historic degradation, current environmental problems, emerging environmental threats, or a combination of these factors. Thus, the meeting theme also provided an opportunity to explore how past restoration efforts influenced the present environment and how present restoration efforts will shape the future environment of the midwestern United States. We had 130 attendees from 12 states (Ohio, Indiana, Michigan, Illinois, Wisconsin, Minnesota, New York, Kentucky, Iowa, Missouri, Mississippi, and California) in attendance. Meeting attendees represented their respective academic institutions (44%), private companies (28%), nonprofit groups (17%), and county, state, and federal agencies (11%). Our scientific program consisted of a keynote presentation, two plenary sessions, two workshops, one poster session containing 15 poster presentations, six contributed oral presentation sessions encompassing 36 oral presentations, and tours of the University of Wisconsin-Madison Arboretum. Additional meeting events included: 1) a sponsorship reception held in conjunction with the poster session; 2) the annual Chapter business meeting; 3) an awards ceremony that recognized the Best Student Poster Award and the Student Presenter Who Traveled the Farthest Award; and 4) a report from the Midwest U.S./Canada Representative on the SER Board of Directors. This abstract book contains the abstracts from all meeting presentations and workshops.

ACKNOWLEDGEMENTS

We are grateful for the support provided by our generous meeting sponsors (University of Wisconsin-Madison Arboretum, Genesis Nursery, Stantec Consulting, Applied Ecological Services, ENVIRON International Corporation, Prairie Restorations Inc., JFNew, The Nature Conservancy, Seiler Instrument, Botham Vineyards, and Ecological Restoration Services). We thank other members of Board of Directors (Cody Fleece, Pamela Rice, Bob Grese, Cara Hardesty, Jason Husveth, Anne Remek-Kominowski, John Shuey, Geoff Morris, and Bob Barr) for assisting the Annual Meeting Committee in organizing and holding the meeting. Steve Glass, Susan Halverson, Kevin McSweeney, and the other staff at the University of Wisconsin-Madison Arboretum also assisted the Chapter's Annual Meeting Committee with planning and onsite preparations. Hua Chen, Bob Grese, Dan Larkin, and John Shuey served as judges for the Best Student Poster Presentation Award. Assistance with set up and registration was provided by David Benson, Katie Martin, Belynda Smiley, Eric Bird, and Benjamin Van Thiel. We are also thankful for the participation of all presenters, moderators, tour leaders, volunteers, and attendees for making our second Annual Chapter meeting a success.

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KEYNOTE PRESENTATION ABSTRACT

Zedler, J. Restoration targets are changing. University of Wisconsin-Madison, Madison, Wisconsin.

Much has been said about what our ecological restoration targets should and should not be, but no one asked my opinion until SER-MWGL requested this talk. With a wealth of literature available and no time to read it, my review of historical, current, and futuristic restoration targets promises to be superficial, biased, and limited to personal experience. But preliminary data indicate that if the after-dinner time slot is also an after-drinking slot, few will notice. To test the hypothesis that targets are changing, I will talk and show slides, including words, graphs and photos, aiming to keep most of the audience awake most of the time. All those who snooze all of the time will be unlikely to ask appropriate questions, although their comments will still be welcome at this festive occasion, namely, the emergence of a new SER chapter and visit to the birthplace of restoration ecology. Readers of this abstract who would like to contribute advance opinions about how targets are changing are invited to use my email address. If I don't get help in advance, I might need to call for input at the banquet, and wouldn't that be embarrassing for those who aren't so alert after a fulfilling Wisconsin meal? I look forward to this occasion, which is part of the Arboretum's 75th anniversary celebration! Please come and enjoy!

** Dr. Zedler's keynote presentation was given after dinner on Friday evening. Following the meeting she compiled the ideas and information presented in her presentation within a University of Wisconsin-Madison Arboretum Leaflet (Arboretum Leaflet 21). The leaflet is available as a pdf file at http://uwarboretum.org/research; http://www.botany.wisc.edu/zedler/leaflets.html; and http://www.ser.org/mwgl/meetings.asp*

PLENARY SESSION ABSTRACTS

Iliff, J. [1], T. Hogrefe [2], A. McGovern [3], and K. Rodriguez [4]. Great Lakes Restoration Initiative: Best practices for developing strong "shovel ready" habitat restoration proposals. [1]National Oceanic and Atmospheric Administration, Silver Spring, Maryland. [2] National Fish and Wildlife Foundation, Ft. Snelling, Minnesota. [3] U.S. Fish and Wildlife Service, Chicago, Illinois. [4] U.S. Environmental Protection Agency, Chicago, Illinois.

In these difficult economic times receiving notice that a proposal for a critical project will not be funded is at best a terrible disappointment. What did the funder see about your proposal that caused it to end up in the do not fund pile? What does a successful proposal look like? From a funder's point of view, the proposal is the funder's window to your world—the problem you want to resolve, the place you are restoring, the activities you will be doing, and the people who do the work. The story you tell in several pages needs to engage and inspire trust and confidence in your ability to assess a problem and fix it. An opportunity for grant funding through the Great Lakes Restoration Initiative is underway—you need to be ready with a well written, well directed proposal. In this session a panel of funders from the National Oceanic and Atmospheric Administration, National Fish and Wildlife Foundation, U.S. Fish and Wildlife Service, and U.S. Environmental Protection Agency will bring you up-to-date on the Great Lakes Restoration Initiative and a number of grant opportunities that are available as well as give you advice on writing a great grant proposal—not fair, not adequate, but great! The people on this panel have years of reading thousands of grant proposals and this expertise will be distilled into a helpful session.

McSweeney, K., M. Wegener, C. Bauer-Armstrong, and R. Hall. University of Wisconsin-Madison Arboretum Plenary Session. University of Wisconsin-Madison Arboretum, Madison, Wisconsin.

This special plenary session consisted of three presentations devoted to the history, land use analyses, and educational outreach program of the University of Wisconsin-Madison Arboretum. The Arboretum since its beginning in 1934 has been devoted to the reestablishment of historic landscapes and has continued its efforts to restore and create habitats on Arboretum lands. As a result it contains a collection of the oldest and most varied collection of restored communities as well as a collection of flowering trees, shrubs, and lilacs. Examination of historical and current aerial photography, GIS data, and research/monitoring information and the subsequent development of maps with this information reveals the volunteer efforts, physiographic information, research activity, stormwater hydrology, and burn history of the Arboretum. Additionally, Arboretum staff have recently developed an interactive map as a way of sharing their diverse spatial data with the public and enabling the public to contribute their insights and photographs. Educational outreach efforts at the Arboretum include their participation in the Earth Partnership for Schools (EPS) and the Restoration Education Science Training and Outreach for Regional Educators (RESTORE) programs. EPS is a teacher professional development program enhancing teaching and student learning through restoring native ecosystems on school grounds. RESTORE focuses on training teams from other parts of the United States to bring EPS back to their home regions. For example, the Great Lakes RESTORE Earth Partnership focuses on watersheds and water quality issues as a basis for restoring native plantings and building rain gardens in the Great Lakes region. In conclusion, the plenary session highlights how the current activities of the Arboretum support its efforts in advancing the science of restoration ecology and the practice of ecological restoration.

WORKSHOP ABSTRACTS

Brush, L. [1] and S. Apfelbaum [2]. High-resolution multi-spectral aerial imaging as a tool for restoration planning. [1]Stewardship Network, Ann Arbor, Michigan. [2] Applied Ecological Services, Brodhead, Wisconsin

Using specialized aircraft, state-of-the-art digital photography equipment and high-powered data management technology, multispectral aerial imagery can provide very-high-resolution digital photographs of large land areas quickly and cost-effectively. Multi-spectral imaging can assist with other tasks such as: 1) very-high-resolution measurements of habitat conditions; 2) identifying the presence and extent of invasive species, native plants, and threatened plant species; 3) helping evaluate the effectiveness of invasive species control efforts; 4) identifying drain-tile fields for mapping required by hydrology restoration initiatives; 5) tracking point- and non-point source contaminant entries in wetlands, streams and coastal areas; 6) documenting baseline conditions of key natural areas as part of monitoring restoration and management performance; and 7) informing restoration and management planning by enabling comparison of the conditions of known quality and/or degraded sites, including but not limited to Areas of Concern (AOC). Aerial photography can be done at reasonable costs to provide very relevant and extraordinarily detailed data to assist land trusts, governmental units, private property owners, and businesses in managing their lands and any easements they may hold. New advances in software and hardware associated with aerial photography can provide such data very efficiently. The opportunities for using these advances to assist in managing natural lands is just beginning to be explored, but already many new applications have been developed.

Peyton, S. How to design natural channels using principles of geomorphology. Stantec Consulting, Cincinnati, Ohio.

The design of streams using natural channel design methods is a complex process relying heavily on the use of field measurements. In order to properly design a stream, the designer must understand and measure geomorphic parameters within the project reach, have a thorough understanding of the watershed, and must verify that the designed stream will transport sediment without significant aggradation or downcutting of the existing channel bed. A popular method for designing natural stream channels consists of measuring geomorphic parameters from a reference reach and then applying the reference reach parameters to the design reach through the use of dimensionless ratios. This course will provide an overview of stream restoration and will focus on the procedures necessary to design a stream using Natural Channel Design techniques. Participants will: 1) learn the basic design process for developing a natural channel design using a geomorphic approach; 2) develop an understanding of how to identify streams with high restoration potential that will be cost effective to restore; 3) learn how to manage a stream restoration design and what deliverables are necessary to ensure that proper design techniques were followed; and 4) learn how to reduce project costs, while increasing stream function and diversity. The workshop will review basic geomorphic principles, discuss stream classification and channel evolution models, describe diagnostic studies and design processes, and illustrate common stream restoration techniques.

POSTER PRESENTATION ABSTRACTS (ALPHABETIC)

Benson, David P.* The effects of restoring an historic restoration. Marian University, Indianapolis, Indiana. Email: dbenson@marian.edu

The property at the Marian University EcoLab was a farm field "restored" in 1912 with native plants in ecologically sensible locations by Jens Jensen in bluff, riparian, wetland, and lowland forest habitats. This early ecological restoration was without management from 1929 to 2000 and became dominated by bush honeysuckle and a suite of other invasives. Beginning in 2000, Marian University began an historic and environmental restoration of the site. In an effort to assess the effects of this restoration, springtime surveys of vegetation and breeding birds were conducted. Native plant species diversity and coverage increased in the lowland forest and the bluff habitat, but not in wetland areas. In eight years of 13 point counts, 60 potentially breeding bird species including two flyover species were observed. Of those 60 bird species, 15 were identified as species of regional concern by Partners in Flight. The most common species documented were Northern Cardinal (11.76%), Red-winged Blackbird (5.95%), and Song Sparrow (5.95%), and Baltimore Oriole (5.81%). There were trends toward increasing number of species, increasing number of listed species, individuals, and individuals of listed species with statistically significant increases in the number of listed species and individuals of listed species through 2007. Yellow-throated Warbler, Warbling Vireo, Red-Winged Blackbird significantly increased in number on the site as did the listed Great-crested Flycatcher and Blue-grey Gnatcatcher. American Goldfinch numbers declined. Both vegetation and birds appear to be responding to the contemporary restoration of this historic restoration.

Blersch, Stacey S.*[1], Bernadette Clabeaux[2], Nathan Drag[3], Robert Earle[4], Michael Habberfield[5], Shannon Seneca[1], David M. Blersch[1], and Alan Rabideau[1.] Interdisciplinary education for restoration planning: a practicum exercise to develop restoration options for remnant oxbow wetlands in Buffalo, New York. [1] Department of Civil, Structural and Environmental Engineering, State University of New York at Buffalo, Buffalo, New York. [2] Department of Biology, State University of New York at Buffalo, Buffalo, New York. [3] Department of American Studies, State University of New York at Buffalo, Buffalo, New York. [4] Department of Philosophy, State University of New York at Buffalo, Buffalo, New York. [5] Department of Geography, State University of New York at Buffalo, Buffalo, New York. Email: sblersch@buffalo.edu

The student experience in the Ecosystem Restoration through Interdisciplinary Exchange (ERIE) Program, an interdisciplinary Ph.D. program in ecological restoration at the University at Buffalo (UB), culminates with the *Ecosystem Restoration Practicum* in which trainees collaborate on an interdisciplinary restoration initiative. In 2009, the ERIE Practicum developed a habitat restoration plan for a 28-acre oxbow wetland on Buffalo Creek in West Seneca, NY, a regionally-rare riparian environment of legacy value to the heavily industrialized Buffalo River watershed impacted heavily through historical development of the region. The project involved researching options for enhancement of existing habitats, modification of hydrological functions, management of invasive species, and community involvement at the site. Working with the sponsor Buffalo-Niagara Riverkeeper organization, the ERIE project team developed interim deliverables as part of the plan formulation processes, including a strengths, weaknesses, opportunities, threats (SWOT) analysis of the site, reports and presentations to community representatives, and a comprehensive restoration plan based upon field and GIS analyses. Overcoming the difficulties of interdisciplinary group work was facilitated by centering on an agreeable working definition of *ecological restoration*, and SER's basic definition of restoration as "the process of assisting the recovery of an ecosystem that has been

degraded, damaged, or destroyed" helped guide interdisciplinary communication. In addition to recommending restoration alternatives for hydrological modifications and invasive species management at the site, the ERIE team recommended that a technical workgroup be established for regional monitoring of the remaining wetland complexes in western New York.

Cigan, Paul W. * The role of university-based conservation organizations in environmental monitoring and community outreach: a case study in Karner blue butterfly habitat restoration. College of Natural Resources, University of Wisconsin-Stevens Point, Stevens Point, Wisconsin. Email: pciga971@uwsp.edu

University-based conservation organizations can play a duel role in community-based restoration. Often provided with steady membership, institutional funding, faculty expertise, field equipment, and laboratory space, such organizations can positively contribute to local restoration efforts by (a) collecting and providing citizen environmental monitoring data to natural resource professionals and (b) developing and conducting community outreach programs aimed to draw support for restoration efforts on private lands within the local community. Here, I present a case-study using the University of Wisconsin-Stevens Point Chapter of the Society for Ecological Restoration's two-year running Karner blue butterfly (*Lycaeides melissa samuelis*) habitat restoration project. Outlined is the group's approach to (a) acquiring external funding, (b) developing an environmental monitoring program, and (c) conducting an annual community outreach program. Previous successes and failures are evaluated using an internal review informed by interviews with project managers and stakeholders. Lastly, suggestions are offered regarding improvement of monitoring protocol and outreach programming.

Glass, Steve*, Mrill Ingram, Mark Wegener, Marian Farrior, and Brad Herrick. The worms, the plants, and the people – incorporating human impacts into restoration planning at the University of Wisconsin Arboretum. University of Wisconsin-Madison Arboretum, Madison, Wisconsin. Email: sbglass@uwarb.wisc.edu

Recent research on invasive synergies or "invasional meltdown" demands new approaches that incorporate anthropogenic influences into ecological restoration and land management. A growing number of studies support the idea that the robust persistence of undesired European buckthorn in many areas in the Midwest, even where its eradication has been a major objective, may be due in part to the presence of non-native earthworms. European earthworms, brought to southern Wisconsin by settlers, are implicated in consuming leaf litter and altering the soil chemistry and nutrient cycling on the forest floor in ways that promote conditions favoring invading plants, such as European buckthorn, and also inhibiting the reproduction of native plants. The idea of synergistic invasions and their legacy effects, not to mention the notion of an underground, and therefore mostly invisible, invasive species that enjoys a general reputation as a friend to the soil, offers a whole new set of challenges – and opportunities -- for land management and restoration efforts at the (UW) University of Wisconsin-Madison Arboretum (and elsewhere). We also see nonnative earthworm introduction as but one example of numerous human impacts on the ecology of the UW-Arboretum. Resilient restoration planning requires that these anthropogenic influences be taken into account in establishing restoration goals and management practices.

Grabowski, Paul*, Geoffrey Morris, and Justin Borevitz. Genetic diversity of grasses in natural and restored habitats. University of Chicago, Chicago, Illinois. Email: grabowsp@uchicago.edu

Genetic diversity is an important component of ecological restorations as it results in greater diversity in physical traits, providing potential for local adaptation within the restoration as well as the conservation of rare varieties. Characterizing genetic diversity has been difficult in the past, but with second-generation sequencing technology, we can now combine affordable sequencing with field experiments to address the role of genetic diversity on landscapes and on ecological restorations. Switchgrass (*Panicum virgatum*) lives in a variety of very different habitats in coastal sand dune ecosystems. We are using automated weather stations at ecological transition zones to characterize the microhabitats inhabited by switchgrass in Indiana Dunes State Park. By using reconstructed habitats for reciprocal transplants, we will test for local adaptation of switchgrass to these habitats. And we are using second-generation sequencing to test how much diversity exists within the same switchgrass population and how the diversity affects the population's ability to live in many different habitats. Genetic diversity likely plays a role in habitat reconstruction success, as well. The conditions of a habitat reconstruction are unpredictable and the establishment of the reconstruction may be increased by starting with high genetic diversity. We are testing this with little bluestem (*Schizachyrium scoparium*) in a prairie restoration in collaboration with the Chicago Park District. Little bluestem seed from three local suppliers was planted to compare establishment success with the amount of starting genetic diversity.

Kellerhals, Doyn M.*[1] and Michael J. Lemke [1, 2] Bacterial communities change on decomposing Silver Maple (*Acer saccharinum*) leaves from three Illinois River floodplain habitats. [1] Biology Department and [2] The Therkildsen Field Station at Emiquon, University of Illinois at Springfield, Springfield, Illinois. Email: dkell1@uis.edu

Leaf decomposition occurs in an orderly manner in which more labile compounds (i.e., amino acids, simple carbohydrates) are used or lost before the more recalcitrant substances (i.e., humic substances, lignin). The objective of this study was to monitor change in bacterial species on maple leaves beginning with leaf buds and following changes on mature leaves and through decomposition. Changes in one group of leaves were monitored during and after annual flooding. Leaves were collected over a 21-month period beginning April 2002. Bacterial communities were examined at the bud stage, at the mature leaf stage, and on samples collected at six to 10 week intervals after leaf fall. For the last category, 1.5g of maple leaves were placed in fiberglass mesh leaf bags (n = 3) and placed in three locations: floodplain, river, and upland forest. Change in organic mass (AFDM) was nearly twice as much in leaves exposed to flood water (70.1%) than for those not wetted by flood waters (36.0%). DNA extraction, followed by purification on Sephadex G-200 columns, was completed to amplify 16S rDNA in the bacteria. The resulting amplicons were separated by Denaturing Gradient Gel Electrophoresis (DGGE; 8% acrylamide, 30-70% denaturing gradient). Initial results detected 10 bands in the summer, mature leaf samples. We expect diversity in bacterial communities to increase initially after leaf fall, decrease as leaves become more decomposed, and for introduction of new communities to occur after leaf fall and flooding. The microbial community changes during decomposition are likely due to leaf substrate changes.

Kingsbury, Judith A.*, Marian Farrior, and Molly F. Murray. The evolution of an ecological restoration volunteer program. University of Wisconsin-Madison Arboretum, Madison, Wisconsin. Email: jakingsb@wisc.edu

The University of Wisconsin-Madison Arboretum volunteer program is a complex community providing niches from low levels to high levels of engagement and commitment, and fulfilling a variety of social and ecological functions. We have learned that volunteers come to us with different needs, motivations, values and perspectives. The Arboretum also has multiple institutional needs and values. We have found that providing an array of ecological restoration volunteer opportunities enables us to better meet the needs of the institution and the community of volunteers. Our volunteer program has evolved from sporadic tree planting events by University of Wisconsin-Madison students in the 1940s to today's more formal and structured program which includes drop-in ecological work parties, the propagation and planting crew, native plant gardens assistants, the habitat restoration team, and the earth partnership team leaders. The volunteer program increases community involvement, provides education to volunteers, fosters the land ethic, and increases the labor force available to do ecological restoration. Looking to the future, we must continue to adapt to demographic, institutional, cultural, and ecosystem changes.

Lemke, A. Maria.*[1], Krista G. Kirkham[1], Tim T. Lindenbaum[1], William L. Perry[2], Elias G. Bekele[3], Yanqing Lian[3], Michael P. Wallace[4], David A. Kovacic[4]. Evaluating practices to mitigate nutrient transport in a tile-drained subwatershed of the Mackinaw River, Illinois. [1] The Nature Conservancy, Peoria, Illinois. [2] Illinois State University, Normal, Illinois. [3] Illinois State Water Survey, Champaign, Illinois. [4] University of Illinois, Champaign, Illinois. Email: mlemke@tnc.org

We evaluated effectiveness of outreach on implementation of best management practices (BMPs) and water quality improvement in experimental versus reference subwatersheds (4,000 ha) of the Mackinaw River. Land use was >80% row crop agriculture with extensive subsurface tile drainage. Outreach significantly increased implementation rates of grassed waterways, stream buffers, and strip-tillage throughout the experimental subwatershed. Seven years of monitoring revealed no significant changes in nutrients, total suspended solids, or hydrologic variables. Results suggest that BMPs implemented during this study were bypassed by subsurface drainage tiles. We are currently testing the effectiveness of intercepting tile water using wetlands to reduce nutrient exports. Specific questions include: (1) watershed to wetland area ratio needed for wetlands to effectively retain tile water and reduce nutrients and (2) optimum placement of wetlands on the landscape. We constructed three experimental wetland systems, each with 3 consecutive wetland cells that represent a wetland to watershed ratio of 3%, 6% and 9% per wetland system. Monitors measure water volume and nutrients as tile water flows through the wetland systems. Preliminary results suggest that wetland to watershed ratios of 3%, 6% and 9% will remove 21%, 41%, and 53% of nitrate nitrogen, respectively, and 52%, 68%, and 72% of orthophosphorus, respectively. Illinois State Water Survey is developing a hydrologic model to target where conservation practices will be most effective in the watershed. We will begin testing this model in our paired watershed sites in 2010. Additionally, we will coordinate teams of local farmers to assist in outreach efforts.

Lemke, Michael J.*[1], A. Maria Lemke[2], Doug Blodgett[2,] Jennifer Clarke[1], and Keith Miller[1]. The Emiquon Preserve: restoration of an Illinois River Floodplain. [1] The University of Illinois Springfield's Therkildsen Field Station at Emiquon, Lewistown, Illinois. [2]The Nature Conservancy in Illinois, Lewistown, Illinois. Email: mlemk1@uis.edu

The Nature Conservancy identified the floodplain area of Emiquon, currently isolated from the Illinois River and its flood pulse, as a prime candidate for restoration. In 2007, the Nature Conservancy began converting Emiquon from row crop agriculture into a natural prairie, upland forest and shallow lake ecosystem. Restoration strategies were based on extensive planning with the eventual goal of reconnecting the floodplain to the Illinois River, thus restoring complex biogeochemical and hydrological functions to reestablish Emiquon's former biodiversity. The Emiquon restoration is unusually large (2700 ha) and in its first phase. The restoration is focused on key ecological attributes. Scientists from the Illinois State Water Survey developed hydrologic, hydraulic, and sedimentation computer models that helped the Nature Conservancy with management decisions. University of Illinois Springfield (UIS) has established the Therkildsen Field Station at Emiquon to help document the restoration, and to facilitate floodplain science research. UIS scientists have analyzed a decade of nutrient data on the Illinois River to detail the effect of backwater areas. Sampling in both connected and unconnected lakes in the region are yielding intriguing patterns of microbial presence and absence. The field station and its partners – The Nature Conservancy, Dickson Mounds Museum, and the U.S. Fish and Wildlife Service - host an annual science conference that features studies conducted by the Illinois Natural History Survey, the Illinois Department of Natural Resources, and others. The partners are cooperating in scientific and educational projects in and around Emiquon.

Martin, Katherine L.*[1], David M. Hix[2], and P. Charles Goebel[1]. Establishment of reference plant communities for forest ecosystems of the Unglaciated Allegheny Plateau. [1] School of Environment and Natural Resources, The Ohio State University, Columbus, Ohio. [2] School of Environment and Natural Resources, OARDC, The Ohio State University, Wooster, Ohio. Email: martin.1678@osu.edu

Much of the eastern United States is experiencing a period of afforestation and as these forests develop some may be more strongly influenced by anthropogenic legacies. Thus, in some landscapes, successional pathways may not be considered optimal for managers with objectives emphasizing natural heritage and biodiversity conservation. We investigated whether the Ironton Unit of the Wayne National Forest, located on the Unglaciated Allegheny Plateau of southeastern Ohio, could serve as a benchmark mature, second-growth forest landscape for natural heritage and native biological diversity. We placed particular emphasis on the integrity of the ground flora, especially the presence of species that are either dispersal-limited or characteristic of older forests of the ecoregion. Our multivariate analyses demonstrate that vegetation layers of the Ironton Unit are closely linked to both physiographic and soil variables. Furthermore, our structural equation model indicates the tree canopy is strongly influential in the development of the sapling and ground flora layers. In the ground flora, dispersal-limited and species indicative of older forests were driven by the same environmental gradients as the ground flora as a whole. The mature forest landscape of the Ironton Unit has achieved a stable composition and structure, driven by environmental gradients. In particular, the rich ground flora species indicate recovery from anthropogenic land use. Restoration of forest landscapes using Ironton as a benchmark may require an ecological forestry approach to direct successional processes. These treatments could be expanded to include timber harvest goals within this region that contains an active forest products industry.

Nyamai, Priscilla *[1], P. Charles Goebel[2], David M. Hix[1], and R. Gregory Corace, III[3]. Disturbance and environmental influences on regeneration layer dynamics of mixed-pine forest ecosystems of Upper Michigan, USA. [1] School of Environment and Natural Resources, The Ohio State University, Columbus, Ohio. [2] School of Environment and Natural Resources, OARDC, The Ohio State University, Wooster, Ohio. [3] Seney National Wildlife Refuge, U.S. Fish and Wildlife Service, Seney, Michigan. Email: nyamai.1@osu.edu.

Fire-dependent mixed-pine forest ecosystems once dominated large portions of the northern Great Lake States. In the late 1800s and early 1900s, these ecosystems were significantly altered by extensive logging, wildfires, and then fire suppression. These activities have shifted the development pathways of these forest ecosystems, which in turn has negatively affected the regeneration of red pine (*Pinus resinosa* Ait.) and eastern white pine (*Pinus strobus* L.). Understanding the influence of both natural and human disturbance on regeneration dynamics is critical before developing any specific restoration recommendations for these ecosystems. We compared the regeneration layer composition and structure among four land management/disturbance types (harvest+prescribed fire, harvest+natural fire, harvest, and reference conditions) nested within two landform types (sand ridges and outwash channels) in mixed-pine forest ecosystems of the Seney National Wildlife Refuge in eastern Upper Michigan. Ordination analyses suggest that the observed variation in regeneration layer composition is primarily associated with differences in fuel loading characteristics and past land-use history. Seedling densities of species relatively intolerant to fire (red maple *Acer rubrum* L.) were found to dominate areas with harvesting and prescribed fire use while red and eastern white pine seedling densities were highest in the reference, old-growth stands where there has been no harvesting and the fire regime most closely resembles the pre-EuroAmerican condition. These results will help refine models of forest development and improve strategies to restore these forest ecosystems.

Roos, Robert C.*[1], Todd A. Aschenbach [1], and Carolynn Henne [2]. A Michigan sand prairie restoration experiment: design and pre-restoration conditions. [1] Grand Valley State University, Allendale, Michigan. [2] United States Forest Service, Manistee, Michigan. Email: roosro@gvsu.edu

Michigan's sand prairie is a primary component of its historical oak-pine barrens ecosystem and has been all but eliminated in the state. Only a few attempts at restoring this ecosystem have been conducted. Sub-optimal restoration results in this and other ecosystem types have left the research community theorizing about possible ways to create more successful approaches to reestablishing the diversity and functional equivalency found in remnant plant communities. Our attempt at creating more successful restoration approach involves varying the seeding rates of native plant functional groups (early season forbs, late season forbs, legumes) in an effort to dictate species richness, diversity, productivity, and vegetative cover in a sand prairie restoration at the Chittenden Nursery in the Manistee Huron National Forest. Here we describe the overall experimental design of the project and provide baseline data on plant community composition and productivity. Results from this study will be used to elucidate the effects of variable seeding rates on plant community composition and overall restoration success.

Smiley, Peter C., Jr.* and Barry J. Allred. Differences in fish, amphibian, and reptile communities within wetlands created by an agricultural water recycling system in northwestern Ohio. USDA ARS Soil Drainage Research Unit, Columbus, Ohio. Email: rocky.smiley@ars.usda.gov

Establishment of a water recycling system known as the wetland-reservoir subirrigation system (WRSIS) results in the creation of wetlands adjacent to agricultural fields. Each WRSIS consists of one wetland designed to process agricultural chemicals (WRSIS wetlands) and one wetland to store subirrigation water (WRSIS reservoirs). Previous research within three WRSIS constructed in the Maumee River watershed in northwestern Ohio has examined the flora and fauna in WRSIS wetlands, but not WRSIS reservoirs. Our hypothesis was that the larger, deeper WRSIS reservoirs would have different aquatic vertebrate communities than the smaller, shallower WRSIS wetlands. Fishes, amphibians, and reptiles were sampled by seining, hoop netting, and gee minnow trapping in three WRSIS wetlands and three WRSIS reservoirs in June of 2006, 2007, and 2008. A blocked two factor ANOVA coupled with the Tukey test was used to determine if differences in community structure occurred between wetland types and years. No difference in species richness, abundance, or percent reptiles occurred between WRSIS wetlands and reservoirs. Percent amphibians was greater in WRSIS wetlands than reservoirs ($P < 0.05$) and percent fishes was greater in WRSIS reservoirs than wetlands ($P < 0.05$). Jaccard's similarity index scores ranged from 0 to 0.5 and indicated species composition was different between WRSIS wetlands and reservoirs. No differences in any response variable occurred among years. Our results suggest that the creation and restoration of different sized wetlands within agricultural watersheds may benefit wetland dependent vertebrates.

Steber, Aaron*. Kent Creek stream restoration, Rockford IL**.** JFNew and Associates, Inc., Verona, Wisconsin. Email: asteber@jfnew.com

The main branch of Kent Creek is a cold water tributary within Rockford's Lockwood Park. Kent Creek had severely eroded stream banks and in some places the streambanks were nearly vertical, and sloughing and depositing large amounts of sediment directly into the stream. JFNew stabilized approximately 1219 linear m of the creek by installing a combination of rock vortex weirs, single-wing deflectors, boulder clusters, LUNKER structures, and erosion control blankets. In addition, stream banks were stabilized through bank re-contouring, seeding, and stone toe protection. All these modifications will improve instream and riparian habitat, restore stream bank stability, support reintroduction of native plant species, and reduce sedimentation. With money left over from the initial stream work, JFNew also addressed a barrier to fish passage through a design-build approach. JFNew addressed this concern by removing a perched 36-inch diameter metal culvert and replacing it with a buried pipe arch. This installation gives fish access to upstream spawning habitat. JFNew coordinated the sizing, design, permit amendments, and installation of this culvert replacement. All of these habitat enhancements will improve the degraded system and the site now acts as a learning tool for the possibilities of stream restoration in a park setting for the community of Rockford.

Troxell, Christy* and Amy B. McEuen. Early assessment of composition and floristic integrity of tallgrass prairie restorations at the Emiquon Preserve, Illinois. Biology Department, University of Illinois at Springfield, Springfield, Illinois. Email: ctrox01s@uis.edu

The tallgrass prairie biome has been classified as critically-endangered due to widespread conversion, with approximately 55% of all tallgrass prairie flora currently listed as threatened. Prairie management and monitoring are important for restoration success, especially when in early restoration stages such as The Nature Conservancy-owned Emiquon Preserve. The purpose of this study was to determine overall floristic quality of five prairie restoration management units, to examine potential effects of seasonal burning, and to help develop key ecological attributes for tallgrass prairie units at Emiquon. Restoration units were established in spring 2007 using 81 species of native seed. Two N-S transects were set up in five tallgrass prairie units (three burned spring 2008 and two unburned). Each transect had ten $1m^2$ subplots. During summer 2008, 15 subplots were sampled within each unit. Of the 63 species found approximately 50% were seeded and 50% were recruited. Additionally approximately 75% of the plant species were native and 25% were nonnative. Within subplots, mean native richness ranged from 7.33 to 10.07 per $1m^2$ and nonnative mean richness was lower and ranged from 0.60 to 2.07. Differences in mean subplot native richness between units was not related to burn status (Complex Contrast, $t=1.73$, $p=0.089$). However, differences in the average subplot nonnative richness between burned and unburned units was related to burned status with burned units having higher nonnative invasion (Complex Contrast, $t=4.74$, $p<0.0005$). These preliminary results suggest that burning very early in restoration may have negative consequences in terms of increased risk of nonnative recruitment.

ORAL PRESENTATION ABSTRACTS (ALPHABETIC)

Appleman, Chadwick E. Restoring northern Indiana wetlands to benefit lakes. Davey Resource Group, Fort Wayne, Indiana. Email: chad.appleman@davey.com

More than 85 percent of Indiana's wetlands have been drained and/or filled since the 1800s, resulting in significant changes in northern Indiana lakes. Surface water once flowed more slowly across Northern Indiana through a mosaic of streams, wetlands, and lakes. Wetlands filling, draining, and fragmentation are apparent as revealed by historical data and accounts made by longtime residents of the region. Some consequences of these activities include reduced water quality, loss of aquatic habitats, lake water levels that fluctuate drastically, and lake flooding. These conditions will become more prevalent as additional natural land cover in watersheds is eliminated. Much effort is now focused on restoring wetlands in the upper reaches of watershed headwaters and along lake fringes. Restoring wetlands in watersheds is an effective way of mediating lake water fluctuations, improving water quality and habitat, and reducing invasive aquatic plant problems. In addition to an overview of northern Indiana's wetlands heritage and the benefits wetlands provide, this presentation will provide information on how to plan and complete wetlands restoration projects in watersheds. Specific information will include tools on how to locate suitable wetlands restoration areas, strategies for building partnerships with landowners, and funding programs available to cover costs associated with planning, designing, and restoring wetlands.

Bauman, Jenise M.*[1], Carolyn H. Keiffer[1], Brian C. McCarthy[2], and Shiv Hiremath[3]. Microbial interactions and their influence on establishing American chestnut (*Castanea dentata*) seedlings in Ohio coal mine reclamation. [1] Miami University Department of Botany Oxford, Ohio. [2] Ohio University, Athens, Ohio. [3] USDA Forest Service 359 Main Road, Delaware, Ohio. Email: baumanjm@muohio.edu

The objective of this study was to evaluate planting protocols that may aid in alleviating the arrested succession of non-native grasslands on reclaimed coal mines in central Ohio. American chestnut (*Castanea dentata*) and blight resistant hybrid chestnut (*C.dentata x C. mollissima*) were used to evaluate the effects of soil treatments on seedling growth and colonization of beneficial ectomycorrhizal (ECM) fungi on roots. Twelve-hundred chestnuts were planted among four soil treatments established on a reclaimed strip mine: 1) a control plot left undisturbed, 2) plots mechanically cross-ripped, 3) plots plowed and disked, and 4) plots ripped + plowed and disked. Two-hundred and forty seedlings representing all treatment types were selected for root sampling at the end of the first and second growing seasons. Mechanical soil treatments resulted in seedlings with significantly more ECM root tips and species richness when compared to the control plots ($P = 0.0001$ and 0.01, respectively). There were significant interactions between soil treatments and native ECM infection when comparing seedling height ($P = 0.008$) and basal diameter ($P = 0.03$). Chestnut seedlings with naturally colonized by ECM fungi had the greatest shoot production in the mechanically treated plots when compared to their non-ECM counterparts. Soil compaction, competition from non-native forbs, and the absence of ECM symbionts seem to act synergistically as mechanisms inhibiting seedling establishment. Employing methods of surface conditioning that alleviate compaction and competition while encouraging native ECM colonization and may be the catalyst required to facilitate the natural successional pathway into a closed canopy forest.

Bennett, Jim*, Charles Goebel, Eric Toman, David Hix, and Robyn Wilson. Developing a fire science network for the northern lake states. School of Environment and Natural Resources, The Ohio State University. Columbus, Ohio. Email: Bennett.361@osu.edu

In the northern Great Lake states, almost all federal and state resource management organizations are faced with the challenge of managing fire-dependent forest ecosystem types. Current forest conditions in Michigan, Wisconsin, and Minnesota suggest there is an increasing risk of major wildfires. Many stands are particularly vulnerable as a result of insect outbreaks, blowdowns, over-mature trees, or high stand densities. In addition, fires in the area do not have to travel far before they impact the human community. A recent review found that nearly all forests in the region are located within 25km of densely populated communities. Efforts to reduce hazardous fuel levels and restore these forest ecosystem types to more natural conditions are often complicated by the need to focus on multiple objectives, including wildlife habitat, commodity production, and recreational opportunities. Resource managers must balance these competing demands and incorporate emerging fire-science information as they design their restoration programs. This presentation displays interview and survey data of state, federal, and non-profit resource managers in the northern Great Lake states to explore the context of their forest restoration programs as well as their preferred communication approaches. Findings, thus, enable comparisons to be made across the region as well as between organizations and allow for the discussion of strategies for building, adapting, and sustaining successful restoration programs and improving the communication of emerging fire-science information throughout the northern Great Lake States region.

Bird, Eric J. and Young D. Choi. Development of a restored prairie vegetation in Taltree Arboretum, Valparaiso, Indiana. Department of Biological Sciences, Purdue University Calumet, Hammond, Indiana. Email: ejbird@calumet.purdue.edu

Most of the North American prairies that once spanned across much of the midwest was converted to farmland following early European settlement. There has recently been an increased effort in Indiana to convert agricultural land to a restored prairie ecosystem. Taltree Arboretum in Valparaiso, Indiana exemplifies this type of restoration with over 16 hectares of former agricultural land converted to a native prairie ecosystem. Portions of Taltree's land remains as un-restored old field, while other areas were sown with the seeds of native tallgrass prairie species in 1996, 1998, and 2000. According to our survey during 2008 to 2009, nearly 90% of the planted species occurred in 98 plots of the restored prairie. Also, our Detrended Correspondence Analysis ordination, based on the relative importance of 33 major species, clearly revealed a divergence of the restored prairie vegetation from the old field. However, its species composition has yet to reach its target. Particularly, a heavy dominance by grass species (e.g., *Andropogon geradi*), has deviated the vegetation trajectory to lower diversity (H') within the community. We speculate that such grass dominance is related to soil nitrogen availability.

Bolender, Ivette[1], and Suzanne Hoehne*[2] Big Creek Watershed stormwater management improvement, Cleveland, Ohio (Case Study). [1] Biohabitats, Inc. Great Lakes Bioregion, Cleveland, Ohio. [2] Biohabitats, Inc. Ohio River Bioregion, Louisville, Kentucky. Email: shoehne@biohabitats.com

Big Creek, a tributary of the Cuyahoga River, flows through a highly urbanized watersheds within Cuyahoga County. Non-point and point source pollution, stormwater volume, infrastructure impacts, land use development and practices, and daily activities have all impacted the Big Creek stream system. A 1999-2000 stormwater management study analyzed the stormwater drainage capacity of the Chevrolet Branch subwatershed of Big Creek and identified areas along the Chevrolet Branch with

reduced stream channel carrying capacity, property encroachments, and insufficient culvert capacity. As a result of this study, a multi-community, multi-agency project was developed that focused on three main watershed management components: road culvert/stream channel restoration, a diversion pipe, and a storage basin. The team of DLZ and Biohabitats was selected to complete the design and construction inspection. Biohabitats prepared stream channel restoration designs for 1372 linear meters along Chevrolet Branch. The primary goals were to stabilize channel banks, develop a riparian zone with native vegetation, and restore the stream's flow and sediment carrying capacity. The channel improvements were based on the application of natural channel design techniques within an urban context. This presentation will cover the challenges of designing and construction a restoration project in a highly urbanized area.

Bollinger, Paul *[1], Valerie Jakobi *[2] and Dennis Dreher[2]. Baseline data collection for the CICN dolomite prairie enhancement project, Will County, Illinois. [1] Bollinger Environmental, Inc., Downers Grove, Illinois. [2] Cowhey Gudmundson Leder, Ltd., Itasca, Illinois. Email: pbollinger@bollingerenvironmental.com

The nearly 81 ha CICN Dolomite Prairie Enhancement Project is an effort to restore a unique dolomite prairie ecosystem, which is considered "globally impaired" by the Nature Conservancy and has been identified as a high preservation-restoration priority by the Chicago Wilderness consortium. This project resulted from a nearby industrial development and instead of buying credits from a mitigation bank, several agencies recommended the unique approach of enhancing this habitat. This project will add acreage to this unique habitat type and improve biodiversity, which would otherwise continue to be degraded by invasive species and the lack of fire. Ongoing enhancement activities will consist of clearing invasive brush and herbaceous plant species and reintroducing fire. Our research consisted of collecting baseline data before enhancement activities so future success can be measured and to determine approximate presettlement conditions. Data were collected by reviewing available information and conducting on-site quantitative sampling of vegetation within 298 circular plots. Sampling included: trees (species, number, DBH and percent canopy coverage), shrubs (species and number of stems), and herbaceous species. On-site data was collected on a Handheld GPS using ArcPad software to create a GIS database and presentation quality maps. Based on historical reviews and sampling on-site dolomite prairie remnants, we determined that this area was mostly dominated by dry to wet dolomite prairie at presettlement times and has become dominated by invasive trees and shrubs within the last 60 years. Our target for post-enhancement activities includes native grasses and plants specifically adapted to dolomite prairies.

Carlson, Brian D.*[1], Doug Pearsall[2], Patrick Doran[2], Tina Hall[1], Jon Fosgitt[3]. Restoration of northern hardwood forests in the Two Hearted River Watershed of Michigan's Upper Peninsula. [1] The Nature Conservancy, Marquette, Michigan; [2] The Nature Conservancy, Lansing, Michigan; [3] Cold Springs Forestry, LLC., Au Train, Michigan. Email: bcarlson@tnc.org

The Nature Conservancy has identified the Two Hearted River watershed in the Upper Peninsula of Michigan as a priority landscape for conservation within the Great Lakes ecoregion due to its diverse and high quality terrestrial and aquatic systems. With the 2005 acquisition of more than 9308 ha, now known as the Two Hearted River Forest Reserve, the Conservancy has initiated a conservation strategy that includes sustainable timber harvesting. Due to decades of industrial timber harvest in upland hardwood forest on the property, most of this forest is lacking in the structural- and tree species-diversity that is typically found in unmanaged, older forests. In addition, stream habitats within the forested watershed have been degraded by poorly sized and improperly installed culverts along the

forest road network. Through an experimental approach to forest restoration, using income-generating timber sales, we are striving to accelerate the development of forest characteristics that are representative of late-seral stage forests. We are leveraging income from timber sales with public grants to restore stream connectivity and eliminate sediment sources by upgrading road-stream crossings. By combining ecological and economic goals we hope to demonstrate a financially sustainable model for restoration of degraded northern forest ecosystems.

Cavender, Nicole D*., Nina Sengupta, and Shana M. Byrd. "Back" to paradise? The Wilds, Cumberland, Ohio. Email: ncavender@thewilds.org

Situated in the Appalachian foothills, *the Wilds* is a 3,700 hectare center for conservation research and education located on reclaimed strip-mined land. Although once covered with mixed mesophytic forest, land-use changes and coal extraction has left the present landscape much altered. Today the view is one of vast openness and rolling hills. At first glance, it is a breathtaking site, but it is not until one takes a closer look that severe ecological disturbance is revealed. Loss of the native seed bank and microflora, severe soil compaction, low nutrients, and presence of invasive species all must be contended with while attempting restoration. In ecosystems that have been dramatically altered and have crossed the threshold of irreversibility, it becomes important to consider the landscape context. There are restrictions as to what can actually be achieved and how close historical references can be targeted. Since 2002, the Restoration Ecology team at *The Wilds* has focused on researching, managing, and creating functional landscapes that support local native wildlife, promote soil formation and provide social value. We will discuss restoration projects geared at pollinator improvement, targeted invasive plant management, forest restoration, native wildlife monitoring, large-scale high diversity grassland creation and its carbon sequestration potentials.

Chen, Hua *. Changes in soil organic carbon storage in two restored wetlands in Illinois. University of Illinois Springfield, Illinois. Email: hchen40@uis.edu

Terrestrial ecosystems can play important role in carbon sequestration. Wetland loss for croplands results in a release of significant amount of carbon from soil organic matter into atmosphere. One way to mitigate the rising atmospheric carbon dioxide concentration is to increase carbon sequestration in terrestrial ecosystems. Wetland restoration from croplands has potential for carbon sequestration. My goal is to quantify how soil organic carbon (SOC) storage in two restored wetlands with various ages changes over time. The wetland restoration of Emiquon and Spunky Bottoms in Illinois was launched in 2007 and 1997, respectively. Soil samples were collected in the summer 2007 from both restored wetlands and one corn field. Average SOC concentration of the two restored wetlands increased while the average soil bulk density decreased with restoration ages. For the top 20 cm soil, the average SOC in Emiquon and Spunky Bottoms was 1.83% and 1.95% in comparison with an average of SOC of 1.04% in a corn field adjacent to Spunky Bottoms. For the same soil depth, soil bulk density of these two restored wetlands was 0.72 g/cm^3 and 0.67 g/cm^3. However, the average SOC storage of the top 20 cm soil in Emiquon and Spunky Bottoms was similar with a value of 26 Mg/ha. Average SOC storage in restored wetlands was greater than average SOC storage of 20.6 Mg/ha in the corn field. Our study suggests soils in restored wetlands have potential for carbon sequestration, but how methane emission in these two restored wetlands changes is unknown.

Cook, Daniel* and Geof Parish. Hydrological and habitat enhancement to a recharge area as a means of accomplishing wetland restoration, McMahon Woods Fen, Illinois. GRAEF, Milwaukee, Wisconsin. Email: dan.cook@graef-usa.com

Floodwaters are typically identified as problems when structures are impacted. They also impact existing sensitive ecosystems over long time periods. Open Lands is working with Cook County Forest Preserve District to resolve such an issue. Several alternative solutions will be presented along with active and proposed restorations. Part of the project includes stream restoration. McMahon Woods Forest Preserve in Cook County, Illinois is home to uncommon flora and fauna. A high quality six ha graminoid fen and sedge meadow is its centerpiece. Ephemeral rivulets emanate from the distal portion of the fen providing critical habitat for Hine's emerald dragonfly. Concern about the health of the fen and adjacent uplands, including the encroachment of invasive plants, degradation of habitat and physical landscapes, and stormwater influences, prompted ongoing ground water and vegetation studies. Significant changes in the fen and immediate recharge area were interpreted to result from degradation of plant communities and physical landscapes. A plan is currently underway to enhance the fen and recharge area. A stream and its watershed up-gradient of the fen is urbanized and degraded in its upper reaches and likely alters surface water quality, flood frequency, and flood magnitude. This stream floods into the fen, influencing fen water quality and contributing to erosion and sedimentation. Stopping floodwaters from entering the fen is a critical component to the long-term health of the fen. Habitat enhancements are anticipated to augment ecosystem functions and provide a landscape that enhances native habitats while providing buffer and recharge to the fen.

Gómez -Raboteaux, Nadilia N.* [1] and Robert C. Venette [2]. Reed canarygrass: earlier notions and future challenges. [1] University of Minnesota, Saint Paul, Minnesota. [2] US Forest Service Northern Research Station, Saint Paul, Minnesota. Email: gome0046@umn.edu

Reed canarygrass (*Phalaris arundinacea*) interferes with wetland and forest restoration. Earlier notions highlight European varieties as a source of invasive traits. Future challenges will require consensus among diverse stakeholders since reed canarygrass is a forage and potential biofuel crop. First, a comparison of greenhouse-grown cultivated and non-cultivated seed sources planted in mixtures of 10:90, 50:50, and 90:10 sand:clay-loam soil (vol:vol) showed similarities in the rate of tiller and rhizomes production; distance of tillers and rhizomes from the primary shoot; and biomass of shoots, roots and unemerged rhizomes 10 weeks after seed sow. Although greater growth was observed in higher soil:sand ratios, the magnitude of the difference depended on seed sources. Second, an expert elicitation approach was used to identify factors that govern reed canarygrass distribution. Experts (n=29) were asked whether 67 factors had a positive, neutral or negative effect on reed canary-grass distribution and abundance. A χ^2 test with a Bonferroni adjustment was used to identify consensus for factors affecting distribution (n=14) and abundance (n=17). High annual precipitation was likely to affect distribution ($p = 4.56 \times 10^{-4}$). Flooding depth of 1-3 inches ($p = 6.80 \times 10^{-4}$), shade ($p = 9.12 \times 10^{-4}$), lakeshore cover ($p = 2.75 \times 10^{-3}$), and low nitrogen (<10 ppm) ($p = 3.39 \times 10^{-3}$) were considered likely to affect abundance. Experts agreed that gravel, shade, low soil nitrogen, and <3 inches of soil moisture have negative effect on reed canary grass. Revising our understanding of reed canarygrass and involving diverse stakeholders in management decisions may increase restoration success.

Guen, Terry*. Next generation paradigms for ecological restoration: student GIS-based analysis and planning for Midewin National Tallgrass Prairie Site, Joliet, Illinois. Terry Guen Design Associates, Inc., & Illinois Institute of Chicago Program in Landscape Architecture, Chicago, Illinois. Email: tguen@tgda.net

The IIT/Midewin Studio provides ecological planning tools for the next generation of thinkers, and alerts them to engage with stewardship on design, policy and field levels. Training designers to engage stewardship as a mainstream activity includes study of local and regional historic cultural context, as related to native restoration communities and soil complexes. Such studies promise to innovate long term ecological restoration solutions, tied to compatible development. IIT design students were led through a 15 week study of the vast 7284 ha Midewin National Tallgrass study site. This program included general explanation of ecological systems, practical training in GIS mapping, and field visits to the Midewin site. Through map analysis of regional ecological, economic, and social factors, the students identified predominant site-based characteristics, which were used to synthesize a consensus set of site-based values upon which sustainable designs were drawn. Three representative projects are included in this presentation, varying in scale and range of student interest. The first, a 243 ha restoration parcel including iconic historic ammunitions bunkers, provides a visual, historic, and ecologically laid plan for scientific testing of native plant communities. The second proposes a regional transportation node within the Midewin property, located to provide cultural and wildlife connections. The third proposes a private agroforestry/farmstead on public land as a model for funding and stewarding 2.6 square km site parcels.

Hanberry, Brice *[1], Hong He[1], John Kabrick[2], Dan Dey[2], Brian Palik[3], and Shawn Fraver. Historical tree species distribution in the Laurentian Mixed Forest province of northeastern Minnesota. [1] School of Natural Resources, University of Missouri, Columbia, Missouri. [2] USDA Forest Service, Northern Research Station, Columbia, Missouri. [3] USDA Forest Service, Northern Research Station, Grand Rapids, Minnesota. Email: hanberryb@missouri.edu

Minnesota's forests changed after European settlement due in part to timber harvest, fire suppression, and conversion to agricultural and urban land use. Reconstruction of historical landscapes can provide a reference for restoration efforts, to support persistence of species adapted to historical conditions. Therefore, we used GIS (geographic information system) and statistical inference of General Land Office Surveys from 1847 to 1908 to spatially predict tree species composition and distribution of the Laurentian Mixed Forest province of northeastern Minnesota. For modeling and prediction, we used Random Forest, a nonlinear method that constructs many classification trees using different samples of both the data and the predictor variables. Relevant predictors included terrain characteristics and variables from the soil survey geographic (SSURGO) dataset. Modeling and prediction rates for 15 species or species groups were above 90%. Our predictions provide a spatial representation of historical forests, as a reference for future restoration.

Hansis, Robert D.*[1] and Jeremiah Yahn [2]. Wetlands exposed-floodplain restoration along the east branch of the Pecatonica River, Wisconsin. [1] Wisconsin Department of Natural Resources, Fitchburg, Wisconsin. [2] University of Wisconsin, Madison, Wisconsin. Email: robert.hansis@wisconsin.gov

At two 800 meter reaches of the East Branch of the Pecatonica River (10-12 sq km), the Wisconsin Chapter of The Nature Conservancy (TNC) restored the stream's floodplain by removing cultural sediment that had covered the native soil. The project strategy combined a strong science backing with experienced practitioners to successfully connect the stream with its floodplain and improve a range of

ecosystem services. Sediment is the major surface water impairment in southwest Wisconsin, with both upland and stored sediment as the primary sources. The Pecatonica River has typical high steep banks of beautiful dark soil that crumble easily into the water, particularly when the stream rises. This soil pollutes downstream portions of the Pecatonica, the Mississippi River and the Gulf of Mexico. Most of the removed soil has been put to beneficial uses such as landscaping, soil conservation practices and highway shoulder improvement. The project is set in the Military Ridge Prairie Heritage Area that contains a landscape-scale grassland management project, a vast distribution of spring creeks, and perhaps the upper midwest's largest concentration of grasslands. Early monitoring results show an increase in native plant diversity, a dramatic increase in the number and variety of reptiles and amphibians, stream channel narrowing and no major change to fish and aquatic invertebrates. The weather extremes during the monitoring period have prevented any meaningful conclusions about stream temperatures impacts.

Herrick, Bradley M.*[1], Stephen B. Glass[1], and Christopher J. Kucharik[2]. Climate change and ecological restoration at the University of Wisconsin-Madison Arboretum. [1] University of Wisconsin-Madison Arboretum, Madison, Wisconsin. [2] Department of Agronomy and Nelson Institute Center for Sustainability and the Global Environment, University of Wisconsin-Madison, Madison, Wisconsin. Email: bmherrick@uwarb.wisc.edu

We consider potential impacts of global climate change for restoration practitioners in Wisconsin through a discussion of restoration and land management at the University of Wisconsin–Madison Arboretum. Created to provide an outdoor research and teaching laboratory for university faculty, staff, and students, the Arboretum has been restoring and managing dynamic examples of the native plant communities of Wisconsin for 75 years. We discuss how climate change might influence historical restoration goals, as well as contemporary issues such as stormwater, extreme precipitation events, and changes in the effectiveness of restoration techniques.

Kapolka, Corey K.* and Neil W. MacDonald. First-year site preparation and hand pulling effects on spotted knapweed control on a knapweed-infested site in western Michigan. Grand Valley State University, Allendale, Michigan. Email: kapolkac@mail.gvsu.edu

Establishment of native plant communities on sites infested by spotted knapweed (*Centaurea maculosa* Lam.) requires the application of effective control measures. The objective of our study was to examine the first-year effects of mowing and herbicide (glyphosate, clopyralid) site preparation treatments combined with hand pulling on spotted knapweed control and native plant establishment on a knapweed-infested site in western Michigan. Initial mowing and herbicide treatments were applied to forty-eight 5-m × 5-m plots in the summer of 2008. In late March 2009, before spring germination of knapweed seed commenced, we collected seed bank samples from the upper 5 cm of soil on each plot. We seeded all plots with a mixture of native grasses and forbs in mid May 2009. We hand pulled bolted knapweed from selected plots in mid July 2009 and determined residual knapweed densities and native plant occurrence on all plots in late July 2009. All site preparation treatments began to reduce the knapweed seed bank, though first-year effects were not significant ($P = 0.10$). Both glyphosate and clopyralid herbicides substantially reduced mature spotted knapweed densities. Hand pulling effectively reduced mature knapweed densities to less than 0.5 m^{-2} on both mowed and glyphosate-treated plots. Hand pulling was unnecessary on clopyralid plots because mature knapweed were totally absent in 2009. Only clopyralid treatment, however, reduced juvenile and seedling knapweed densities significantly. Planted native warm-season grasses were present on all treatment combinations, but full development of a diverse native plant community is expected to take several years.

Kilmer, Susan E..* Legacy of small scale adaptations in large scale restorations: the effects of seed dormancy on species composition within a community. University of Wisconsin-Madison Arboretum, Madison, Wisconsin. Email: sekilmer@wisc.edu

Seed is programmed to germinate during favorable conditions which can impact what species are found within a community. Seed germination is regulated by dormancy, an adaptation to environmental change that prevents immediate germination until specific requirements are met. This adaptation prevents seeds from germinating during unfavorable conditions. Primary dormancy regulates when, where and under what conditions germination occurs. Secondary dormancy prevents an imbibed seed from germinating if conditions become unfavorable once primary dormancy is broken. Eight types of primary dormancy prevent immediate germination: physical, mechanical, inhibitor, morphological, physiological, intermediate, embryo and double. Additionally, there are three major types of seeds: recalcitrant, orthodox and long-lived seeds. Seed types combined with dormancy mechanisms affect germination and subsequently the species composition within a system. While changes in population can be explained by species density, dispersion, predation, seed rain, and the existing seed bank, the interaction between seeds and their environment plays a role in the subsequent community composition. Seed physiology and morphology individual species can influence population size and lead to different community compositions even on similar sites. An understanding of seed characteristics can inform restoration efforts and improve predictions when correlated with weather events over time.

Kobal, Scott N. *[1] and Wayne A. Lampa[2], Long-term monitoring of biodiversity under variable cover regimes. [1] Forest Preserve District of Du Page County, Wheaton, Illinois. [2] Conservation Design Forum, Elmhurst, Illinois. E-mail: skobal@dupageforest.com

Between 1979 and 1985 a total of 35 0.4-ha monitoring plots were established in wooded communities throughout Forest Preserves in Du Page County, Illinois to obtain information on the composition and structure of these areas and evaluate ecological changes taking place in this urbanized county – particularly in response to management practices. Tree demography sampling involved measuring and recording every tree greater than 8.9 cm DBH within the plots. General floral inventories, sampling of distribution and abundance of herbaceous and woody flora, and light values were also obtained. Management of plots ranges from no management to those that have been extensively managed with prescribed fire and selective tree removal. Data from tree demographics has shown that, although oaks, particularly white oak, dominate the canopy of most Du Page County woodlands, their relative importance value has steadily declined since the plots were established as mortality has increased and regeneration in the understory (10 to 20 cm DBH) has remained low. The understory and midstory of most plots is now primarily composed of shade tolerant species such as *Prunus serotina* Ehrh. (black cherry), *Acer saccharum* Marshall (sugar maple), *Ulmus americana* L. (American elm), and *Tilia americana* L. (basswood). Where management has occurred ambient light levels reaching the ground have increased which has led to an increase in floral diversity and ground cover along with increases in graminoid cover and an increase in the likelihood of oak regeneration.

Kozich, Andrew T.* Measures of successful wetland restoration: An examination of policies and ecology in northern Michigan. Michigan Technological University, Houghton, Michigan. Email: atkozich@mtu.edu

Michigan's wetlands are managed by the state's Department of Natural Resources and Environment (MDNRE). In accordance with the federal United States "No Net Loss" of wetlands objective, permitted wetland impacts are offset by the restoration or construction of other wetlands in a process known as wetland mitigation. However, the ecological quality of mitigation wetlands is often inferior to the natural wetlands they replace. This reduces the effectiveness of the "No Net Loss" policy. We examined mitigation wetlands and permit files in Michigan's Upper Peninsula for compliance with several MDNRE policies. Findings indicate that the MDNRE is not consistently enforcing annual site monitoring requirements. We also found higher than permitted invasive plant species levels. Additionally, about half of the mitigation wetlands' permits did not meet conservation easement requirements, rendering considerable wetland acreage vulnerable to future development. Although mitigation resulted in a net gain of Upper Peninsula wetland acreage, our findings suggest that substantial wetland functions and services have likely been lost through ineffective policy implementation.

Larkin, Daniel J.*[1,2], James F. Steffen[1], and Rachel M. Hesselink[1,3]. Effects of *Rhamnus cathartica* (common buckthorn) invasion and woodland restoration on plant diversity and carbon-storage services. [1] Chicago Botanic Garden, Glencoe, Illinois, [2] Northwestern University, Evanston, Illinois, [3] Calvin College, Grand Rapids, Michigan. Email: dlarkin@chicagobotanic.org

Rhamnus cathartica (common buckthorn) is invasive in many midwestern woodlands. Management decisions could be better informed through improved understanding of how buckthorn and its removal influence diversity and ecosystem services. For example, several factors suggest that buckthorn invasion may impair carbon (C) storage. Buckthorn thickets have depauperate understories, are fire-resistant and may generally have higher earthworm biomass and soil-nutrient concentrations. Lack of vegetation and fire could reduce C capture and transformation to recalcitrant forms, bare ground may promote C loss through erosion, and elevated earthworms and nutrients might increase CO_2 respiration. We compared community and environmental characteristics and C dynamics between a buckthorn-dominated stand and chronosequence of restored stands in a formerly grazed and buckthorn-dominated oak woodland (McDonald Woods, Glencoe IL). Restoration had begun 5 to 14 years prior and involved buckthorn control, seeding, and prescribed fire. Restored areas had ~2x higher plot-level species richness and vegetation cover ($P<0.0001$ for both) and 27x higher leaf-litter biomass ($P=0.0007$). The shady, unburned buckthorn stand had more bare ground ($P<0.0001$), moss ($P<0.0001$), and woody debris ($P=0.014$). Restored soils had 30% higher total soil-organic C (SOC, $P=0.014$) and 27% higher recalcitrant SOC ($P=0.024$). Soil erosion varied greatly but was weakly higher in buckthorn ($P=0.065$). CO_2 respiration differed between restored and buckthorn plots ($P=0.008$) but not consistently over time. We conclude that buckthorn invasion might impair and restoration might enhance the ability of woodlands to perform C-storage ecosystem services. This builds upon an already strong rationale for restoring buckthorn-invaded woodlands on biodiversity grounds.

Lawrence, Beth A.[*1], and Joy B. Zedler[1,2]. Restoring wetland structure and function: hydroperiod and nutrient manipulation accelerates tussock formation. [1] Department of Botany, University of Wisconsin-Madison, Madison, Wisconsin. [2] UW-Madison Arboretum, Madison, Wisconsin. Email: balawrence@wisc.edu

Restoration efforts would be aided by knowing how environmental factors influence *Carex stricta* tussock formation, as these structures enhance microtopography and support biodiversity. A three-year mesocosm experiment testing five hydroperiods determined that inundation accelerated tussock formation, while N+P addition (15 g N/m^2 + 0.37 g P/m^2) increased productivity. After two growing seasons, constant high water (+18 cm) produced tall tussocks (mean = 10.2 ± 1.3 cm; maximum = 16.6 cm), while constant low water (-18 cm) did not (mean = 2.2 ± 0.4 cm). Tussock height differences persisted in year three, but tussock volume continued to increase in response to increased inundation (time or depth) and nitrogen addition (high water, N+P addition: 3274 ± 376 cm^3; low water, control: 275 ± 38 cm^3). Young tussocks were predominantly composed of organic material (74 to 94% dry biomass) including leaf bases, fine roots and duff (56, 26 and 16%, respectively, averaged across hydroperiods), but only plants subjected to high water levels produced vertically oriented rhizomes and ascending shoot bases that are prevalent in field-collected tussocks. Tussocks grown in the wettest mesocosms approached the height of tussocks in southern Wisconsin sedge meadows (15.1 cm ± 0.2) and they were 32-73% as dense (biomass/volume), indicating an ability to accrue mass rapidly. Additionally, inundation promoted accumulation of carbon in tussocks (range: 163-394 g C/m^2). Thus, *Carex stricta* can be induced to form tussocks and accumulate carbon by manipulating hydroperiod. This species has high utility for restoring wetland microtopography and function.

Matthews, Jeffrey W.* and Greg Spyreas. Convergence and divergence in the successional trajectories of Illinois restored wetlands. Illinois Natural History Survey, University of Illinois, Champaign, Illinois. E-mail: matthews@inhs.illinois.edu

Policies that use habitat restoration or creation to offset the destruction of natural areas assume that restorations will eventually replace destroyed habitats because they progress reliably and predictably over time. However, restoration outcomes are often unpredictable because succession is contingent upon many, seemingly intractable, variables. To track the many paths restorations can take over time, we developed a framework for monitoring restorations that is based on two ideas from succession theory: *convergence* vs. *divergence* in species composition among restorations over time, and *progression* towards vs. *deviation* from an expected restoration goal. We compared plant species composition among 11 restored wetlands over time and between the restored wetlands and two sets of natural reference wetlands (23 high integrity wetlands and 23 low integrity wetlands). Over the first four years, restored wetlands that were initially similar to each other in species composition diverged, progressing towards different high integrity reference wetlands. Over longer time scales however (five to 11 years after restoration), restored wetlands deviated from the ideal trajectory and converged upon the species composition of low integrity wetlands, usually in conjunction with non-native species invasion. Framing restoration trajectories in terms of compositional convergence/divergence and progression towards/deviation from an acceptable range of restoration outcomes is useful for monitoring restoration progress, identifying constraints to success, and predicting restoration outcomes. Our results suggest that barriers in the present midwestern landscape, including exotic species invasion and the lack of native propagules, may limit long-term progression towards restoration goals and constrain wetland restoration to undesirable outcomes.

Morris, Geoffrey P.*[1], Paul Grabowski [1], Justin O. Borevitz [1], and R. Michael Miller [2], Julie D. Jastrow [2]. Effects of ecotypic diversity on establishment of reconstructed native grasslands and outputs of ecosystem services. [1] University of Chicago, Chicago, Illinois. [2] Argonne National Laboratory, Batavia, Illinois. Email: gmorris@uchicago.edu

Long-term studies of reconstructed native grasslands have shown that increasing biodiversity leads to greater primary production, soil carbon accumulation, and resilience to invasive species. However, there has been little study on whether increasing within-species diversity (i.e. genetic or ecotypic diversity) has similar benefits. This issue is increasingly important as the possibility of payments for ecosystem services and bioenergy production may offer new impetus for large-scale reconstruction of native grassland habitats. To address this question we established 200+ plots with varying numbers of switchgrass (*Panicum virgatum*) and big bluestem (*Andropogon gerardii*) varieties and other prairie species on a 5.4-ha site at Fermilab National Environmental Research Park in Batavia, IL. Over the past two years since establishment we have collected data on above- and below-ground biomass, soil carbon and nitrogen, and greenhouse gas fluxes. Above-ground biomass yields indicate that high-diversity mixtures generally had productivity equal to or greater than monocultures of USDA-recommended switchgrass cultivars. Since a simple count of ecotypes per plot does not necessarily reflect underlying genetic diversity we have also developed novel methods to quantify ecotype genetic diversity and relatedness using high-throughput genomics tools. These methods were specifically designed to be applicable even to species with no genetic resources (i.e. genome sequence or genetic markers), in hopes that they may be used widely to strengthen population genetic and evolutionary basis of ecological restoration. Our preliminary findings suggest that increasing the genetic and ecotypic diversity of seed is an effective, cost-neutral strategy for improving establishment and productivity in reconstructed grasslands.

Peyton Scott D. [1]*, and Michael Enright [2]. Low dam removal on the Stillwater River at Englewood MetroPark. [1] Stantec Consulting Services Inc, Cincinnati, Ohio. [2] Five Rivers MetroParks, Dayton, Ohio. Email: scott.peyton@stantec.com

As a designated State Scenic River, much of the Stillwater River supports the Exceptional Warm Water Habitat use attainment classification. However, the Stillwater within and downstream of the 70+ year old low-head dam in Englewood Park was impaired by sediment-bound nutrients that accumulated behind the dam. The preliminary designs were based on extensive field efforts including sediment samples upstream and downstream of the dam, topographic and hydrographic surveys of the river and surrounding riparian areas. Field crews used boat mounted GPS and sonar equipment to accurately map the channel bed upstream of the dam. This data was used for pond depth characterizations and hydrodynamic numerical modeling of drawdown flows. Our design team analyzed the flow and sediment transport in the Stillwater River and the large wetlands within the park using one-dimensional and two-dimensional computer models of flow (HEC-RAS and SMS(FESWMS)) and RIVERMorph software for sediment transport capacity and natural channel design. The project began in 2004 and design of the first phase of removal was completed in 2007 with deconstruction following in 2008. The remainder of the dam was removed in 2009 and restoration of the river, river bank, and wetlands will be completed in 2010. Stantec continues to collaborate with Five Rivers MetroParks to monitor post-removal response. Monitoring elements include stream channel morphology, water quality, and vegetation communities. Ohio EPA is monitoring benthic macroinvertebrate and fish communities annually as part of the 319(h) grant program.

Peyton, Scott D.* Tributary to Mill Creek stream restoration. Stantec Consulting Services Inc, Cincinnati, Ohio. Email: scott.peyton@stantec.com

Over 701 m of stream in Highland Hills, Ohio has been restored for the City of Cleveland, the North East Ohio Regional Sewer District, and the Cuyahoga County Board of Health using natural channel design techniques. The design-build project utilized an Ohio EPA section 319(h) grant as the primary funding mechanism. The Tributary to Mill Creek runs through the Highland Hills Golf Course and has a highly urbanized watershed. The stream was channelized and its riparian buffer was eliminated for golf course construction and maintenance. Channelization resulted in stream down cutting and high rates of bank erosion indicative of Rosgen G and F stream types. The clear water discharge from the urbanized upstream watershed does not deliver sediment for the stream to transport and dissipate energy, which exacerbates and accelerates erosion problems in the stream. Poor water quality from sedimentation and overland pollutant washing and aquatic habitat degradation are the consequences of the stream and riparian area instability. Stantec restored the stream to a stable form using natural channel design techniques including 305 linear m of Priority I restoration and 396 linear m of Priority III restoration. Stream facets, riffles, runs, pools, and glides were added to the Tributary to diversify in-stream habitat. Stantec also added in-channel rock and wood structures to protect the newly constructed stream banks, add bed and facet variability, and provide grade control. The wood structures also added a mechanism for the food web to shift from primary to secondary production.

Phillips-Mao, Laura.* Garlic mustard (*Alliaria petiolata*) invasion & impacts: implications for management & restoration. University of Minnesota, Saint Paul, Minnesota. Email: phil0308@umn.edu

The degree to which invasive species drive or respond to environmental change has important implications for management and restoration. To determine whether the exotic herb garlic mustard (*Alliaria petiolata*) is causing or responding to declines in native species, I am investigating the effects of garlic mustard and its removal on native herbs, and the effects of native herbs on garlic mustard invasion in oak woodlands in Minnesota. To test garlic mustard's impact on herbs, I planted native species into invaded and non-invaded plots in which existing vegetation was either removed or left intact. Plant growth was measured over two years and analyzed with repeated measures ANCOVA using light level as a covariate. Native plant size did not differ across invasion or removal treatments, suggesting that garlic mustard may not have a strong impact on herb growth. To determine if native diversity affects garlic mustard's invasibility, I planted garlic mustard seeds into plots across a diversity continuum and measured establishment, survival, biomass and silique production. The effects of species richness and light levels on seed establishment were analyzed with a logistic normal model. While species richness had no effect on establishment, light levels had a significantly negative effect, potentially due to increased competition in high-light plots. If garlic mustard is not responsible for native herb decline, control efforts may fail to restore native diversity. However, if garlic mustard is responding to declines in native herbs, then restoring their abundance and diversity may decrease the vulnerability of woodlands to garlic mustard invasion.

Ramey, Justin D.* and Amy B. McEuen. Seed limitation in an establishing tall-grass prairie. University of Illinois Springfield, Springfield, Illinois. Email: jrame01s@uis.edu

Tallgrass prairie is one of the most highly disturbed and critically endangered ecosystems in the world. In response to this, tallgrass prairie reconstruction efforts are taking on the enormous challenge of finding ways to quickly develop resilient prairie ecosystems. This study will determine if a second

seed-sowing event at two newly-established prairie restoration sites can significantly influence native plant species richness and floristic quality. In the spring of 2008, four seed addition transects containing randomized sample plots were established at the Emiquon Preserve in Lewistown, Illinois. During the 2008 growing season, all plant species within plot locations were identified and percent covers were visually estimated. In August of 2008, 18 native prairie species were selected based on their individual coefficients of conservatism (C) and hand-sown in randomly selected transect plots. Plots were again censused during the 2009 growing season and changes between the 2008 and 2009 seasons will be statistically analyzed using the following response variables: floristic quality (FQI), mean C, native species richness (forbs and grasses only), woody plant richness, nonnative species richness and species abundance (percent cover) for the 18 native species sown. If it can be shown that seed limitation occurring early in the prairie reconstruction process significantly influences patterns of prairie species richness and floristic quality, then a second seed addition could provide a beneficial and expedient management method for future restoration and reconstruction prairie projects.

Richardson, John and Dan J. Salas*. Stream daylighting and restoration in the Indiana Dunes State Park and National Lakeshore. JFNew and Associates, Inc, Verona, Wisconsin. Email: dsalas@jfnew.com

JFNew, working with the Troyer Group, designed the project to restore 274 m of Dunes Creek and adjacent wetlands that had been under a parking lot since the 1930's. The project was implemented to improve water quality that flows from Dunes Creek into Lake Michigan at the public bathing beach. The park has experienced annual flooding and deterioration of the parking lots in recent years, increased maintenance costs of sand removal from dune migration, increasing bacterial contamination, and biotic impairment of the stream. These concerns lead to the removal of at least 0.4 ha of parking area and restoration of the stream channel, floodplain, and riparian wetlands. The Indiana Department of Natural Resources was awarded a Conservation and Native Landscaping Award for their restoration work of Dunes Creek at Indiana Dunes State Park. The award, sponsored by the U.S. Environmental Protection Agency and Chicago Wilderness, recognizes park districts, municipalities and corporations that make extensive and creative use of native landscaping to support native species, as well as support biodiversity and ecological restoration. This project was also awarded the Governor's Awards for Environmental Excellence in Indiana and an Engineering Excellence award from the Association of Conservation Engineers.

Russart, Brian*. Conservation amongst the concrete: building a natural areas program from the ground up within Wisconsin's largest gathering of humanity. University of Wisconsin Cooperative Extension & Milwaukee County Department of Parks, Recreation and Culture, Milwaukee, Wisconsin. Email: brian.russart@milwcnty.com

The mission of this natural areas program is blending Milwaukee County's diverse and unique natural areas with its culturally rich communities to preserve and nurture its natural heritage for current and future generations. With that is mind, this presentation is about the creative use of partnerships and how they have been developed to engage Wisconsin's largest community through the science and beauty of restoration ecology. In just two short years this newly reborn Natural Areas Program has developed 46 community partnerships consisting of universities, public schools, community groups, government agencies, NGO's, religious institutions, and corporations to assist with the management of the Milwaukee County Park's 4047 ha of natural areas and agricultural lands. These areas include upland and bottomland forest, fens, oak savanna, remnant wet prairie, shrub-carrs, open marsh, lagoons, pollinator gardens, and restored grasslands. These are resources that have been historically

molded by the influences of a great lake, Wisconsin's ecological tension zone, and over 150 years of European settlement. Many unique challenges present themselves in a county where the human element cannot be separated from the natural element, nor should it. The overriding goal is restoration and management of these natural resources, but another which is of equal importance is binding the citizens of Milwaukee County to their natural areas. In the process we are creating stewards, advocates, donors, and in effect a corps of restoration ecologists. This is a presentation on how to develop a successful restoration program and to engage a community for a greater good.

Ryndock, Jason A.*, Gail E. Stratton, and Marjorie M. Holland. The impact of woodland restoration on the spider community of an upland deciduous forest in northern Mississippi. University of Mississippi, Oxford, Mississippi. Email: jaryndoc@gmail.com

Decades of fire suppression have radically altered the uplands of northern Mississippi. Once blanketed by grassy open oak woodlands, this region is now experiencing mesophytic tree invasion, canopy closure, reduced oak regeneration, and herbaceous understory loss. In an attempt to reestablish historical conditions, experimental restoration has been initiated through thinning and prescribed burn treatments. Our research, part of a comprehensive monitoring effort, strived to determine the impact of woodland restoration on both habitat structure and spider community. We predicted that spider community composition of the treatment site would be markedly diverse, as well as intermediate between that of forest and field ecosystems, reflecting a transitional habitat structure. To test our predictions, habitat structure and spider community was sampled within four habitats located at the restoration site: fire-suppressed forest, moderately treated forest, intensely treated forest, and old field. The intense treatment was found to harbor the greatest spider diversity, but this value was only significantly greater than that of the old field. Although treatments resulted in architecture more typical of open habitats, the predicted transitional habitat structure failed to develop. There was a distinct difference observed between the spider communities of the old field and forested habitats. The treatments did, however, alter spider community composition in an alternative trajectory. Ordinations revealed that spider assemblages of the forested habitats existed on a spectrum, with the fire-suppressed forest and intense treatment communities situated at opposite ends. This study indicates that subjecting landscapes to a mosaic of fire regimes will likely enhance spider diversity.

Schrotenboer, Abbie A.* and Carolyn, M. Malmstrom. Bringing native plants into cultivation for restoration: An example of domesticating nature? Michigan State University, East Lansing, Michigan. Email: gosseli9@msu.edu

In choosing plant materials for restoration, it is considered useful to discern between plant populations of local and non-local origin, with the idea that locally-adapted plants may perform better. However, much less attention has been given to assessment of how plant materials have been shaped by the process of bringing them into cultivation for the restoration trade. Cultivation of native plants can serve as a valuable tool to increase seed availability for restoration, but selection pressures—deliberate or inadvertent--during cultivation can alter plant traits considerably. Some favored traits may be beneficial in some restoration settings while others may be undesirable. To assess how cultivation and selection of wild prairie grasses for restoration may affect their traits, we conducted a suite of field and greenhouse experiments on a spectrum of prairie grass populations that ranged from local wild types to highly selected, commercial cultivars. To compare growth traits in different environments, we established common gardens of *Andropogon gerardii* and *Schizachyrium scoparium* on two soil types (loamy and sandy soils). To investigate pathogen interactions, we inoculated different *Panicum virgatum* populations with a generalist virus pathogen, and we compared population susceptibility with

population growth traits. We found significant trait differences among populations of all grasses studied. The fastest growth was seen in highly selected populations, particularly on more fertile soils. In switchgrass, fast growth in highly selected populations was further associated with increased susceptibility to virus infection. These findings illustrate the growing extent of human influence on native plant communities.

Sengupta, Nina*, Nicole D. Cavender, and Shana M. Byrd. Preparing to transition from a carbon-extracting past to a carbon-sequestering future through ecological restoration of high-diversity prairie on mine land. The Wilds, Cumberland, Ohio. Email: nsengupta@thewilds.org

It is estimated that there are >280,000 ha of previously surface mined land in Ohio that are either severely degraded or considered marginal land with very low productivity potential. Can such land be ecologically restored to host high diversity plant communities that can in turn provide habitat to wildlife and at the same time improve soil and sequester carbon addressing the issues of global climate change? At *the Wilds* located in Appalachian Ohio, a conservation-restoration team has initiated a research to establish high-diversity low-input prairie on reclaimed coal mine land. The initial research area of 8.5 ha is subdivided for various treatments to compare between different land preparations, land management practices, and between performances of single species and mixes of diverse prairie species with or without fertilizer treatments. We will discuss this ongoing research, which is in the process of being expanded to an additional 1400 ha and has the potential to sequester 4.4 metric ton of CO_2/ha/year through the root system and soil.

Shuey, John A.* Restoring the prairie barrens mosaic at Prairie Border/Tefft Savanna, Jasper County Indiana. The Nature Conservancy, Indianapolis, Indiana. Email: Jshuey@tnc.org

The landscape surrounding Jasper-Pulaski FWA was originally a complex mosaic of emergent wetlands, prairie and oak barrens (savanna). Today, most wet and mesic habitats are drained and farmed and most upland barrens are fire suppressed and converted to dense forest. TNC has initiated an aggressive restoration program designed to restore hydrologic and successional complexity adjacent to Tefft Savanna NP, which includes the highest quality oak barrens. The restorations will achieve several objectives including: restore wet and mesic graminoid communities; enhance breeding habitats for herptile communities; increase stopover habitat for sandhill cranes; structurally restore globally rare oak barrens habitats; and increase ecological resilience in anticipation of climate change. We hope to create a system that will serve as a reservoir of biodiversity into the foreseeable future. The restoration has proceeded in two phases. In 2003, we restored hydrology and planted 61 ha of emergent wetland, wet prairie, and mesic prairie. These are intensively managed with fire and herbicide to limit invasive species establishment. Animal response to the restoration has been encouraging. In 2010, we thinned 35 ha of oak barrens to ~60% canopy. Aggressive herbicide treatment and prescribed fire will limit shrubby re-growth and enhance herbaceous recovery. In conjunction with Purdue University and St. Joseph's College, we initialed a five year monitoring program to document changing herbaceous and woody communities, and habitat use by herptiles, butterflies, breeding birds, small mammals and selected game species. We plan to restore other key tracts and just purchased 65 ha that negatively impact hydrology.

Staskowski, Nicole K.* Restoration conversion of boreal forest wetlands in Superior, Wisconsin. JFNew and Associates, Inc., Verona, Wisconsin. Email: nstaskowski@jfnew.com

JFNew is in the third year of completing a 49-ha restoration project in compensation for forested wetland conversion impacts along a new transmission line in northwestern Wisconsin. The restoration project activities are three-fold: removal of aggressive woody species, planting of boreal forest tree specie, and monitoring to assess the success of conversion. The first two activities, the removal of aggressive woody species and planting of appropriate boreal forest species, are taking place over the first four years of the restoration. Woody vegetation that is targeted for control as part of this phase includes *Populus tremuloides*, *Alnus incana* and various *Salix* species. Woody removal activities include cut stump treatment, forestry mowing, and targeted, aquatic-approved herbicide treatment. Native boreal forest species are targeted for planting across the site. In the wetland areas planted species include *Picea mariana*, *Larix laricina* and *Thuja occidentalis* and in the upland islands these species include *Picea glauca*, *Pinus strobus*, *Abies balsamea* and *Thuja occidentalis*. Restoration work and monitoring began in 2008. The goal of the project is set the successional trajectory of the site to support an assemblage of boreal forest tree species within 10 years. This is largely measured by survival of trees and reduction of invasive species across the site. In addition to the boreal forest conversion monitoring, state listed plant monitoring is also required within the wetland areas. Populations of the state threatened *Petasites sagittatus* and *Salix planifolia* were identified and are being protected on the site.

Thomforde, Steve L.* and Peter C. Allen. Beyond community ecology: restoration focused on ecosystem function increases diversity and service as a model for the 21st century. University of Wisconsin, Madison, Wisconsin. Email: thomforde@wisc.edu

The current restoration narrative is focused on restoring historic plant communities where dominant species are expected to maintain desirable community configuration by resisting invasion. Historic community restoration is evaluated through subjective floristic quality and similarity indexes, and ecosystem function is expected to follow form. When ecosystem services are included in project goals, the focus on community ecology shifts to focus on ecosystem function, project performance is evaluated through empirical data including nutrient regulation, soil stabilization and water purification rates and community form follows function. This presentation provides a case study to demonstrate how restoration based on ecosystem service will improve ecosystem function, integrity and community diversity. The case study involves a 2009 project that employs a traditional resistant-engineering community-ecology restoration to stabilize a lake shoreline in Madison, WI. The resulting project displays poor recruitment of natives, is infested by aggressive species, erodes 640 tons of soil into the watershed, and provides no discernable ecosystem services. An alternative restoration narrative focused on ecosystem service that employs concepts of resilience and function is introduced. Design plans and management strategies that promote multiple provisioning, supporting and cultural services, while maintaining high levels of ecosystem integrity and diversity are discussed. Services restored under the alternative plan include nutrient regulation, soil stabilization, flood, wave, and ice scour attenuation, water infiltration and purification, food and biomass production, and recreational opportunities. Conclusive evidence supports shifting the current community ecology based restoration narrative to an ecosystem function and service based restoration narrative.

Ziegler, Peter.* Cross contour floodplain and wetland restorations restore self sustaining ecosystems. Wisconsin Waterfowl Association, Wales, Wisconsin. Email: wwawetlands@gmail.com

Floodplain/wetland restoration is receiving considerable attention in the midwest due to recent natural events. The ability to restore floodplain wetlands working as a natural process increases its effectiveness for both habitat and human impact. Existing ground features and subsurface features are key data in analysis for success. Ecosystem based restorations completed by Wisconsin Waterfowl Association in numerous wetland across Wisconsin provides evidence of success. Cross contour restoration never used prior to 2006 in Wisconsin proves to be an effective model to successful floodplain ecosystem restoration. The only two cross contour floodplain restorations in conjunction with an ecosystem based approach resulted in two restorations success projects in the driftless region of Wisconsin. Restorations resulted in improvements of native habitat for aquatic and terrestrial ecosystems and flood abatement providing long term low cost self sustaining ecosystems.

Ziegler, Peter.* Ecosystem based approach to wetland restorations that fit into the landscape. Wisconsin Waterfowl Association, Wales, Wisconsin. Email: wwawetlands@gmail.com

Wetlands are becoming more important everyday as we feel the effects of there loss influencing wildlife, flooding, water quality, and the financial impact to everyone. Over 20 years Wisconsin Waterfowl Association has completed thousands of acres of ecosystem based wetland restorations that show the ability to restore wetland function and impact the ecosystem long term without continued cost. Wisconsin Waterfowl Association approaches each restoration project with the ecosystem based approach looking at how restored wetlands fit into the landscape challenging traditional restoration practices. Sustainability in the design mimics historically what was present prior to European settlement and the natural function of all associated ecosystems (stream, floodplain, wetland, ground water seeps, and upland/hillside habitat). Results have shown increased habitat diversity is directly correlated with species diversity in self sustaining ecosystems relying on minimal continued maintenance. Thousands of acres of these wetland restorations provide landscape scale restorations influencing the ecosystem around them.


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Photos by Deanna Rokich

Restoration of a quarry in Perth, Australia through the partnership of Rocla Quarry Products and the Science Directorate of Kings Park and Botanic Garden.

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Kings Park Master Gardeners monitoring a site in Beenup, Australia

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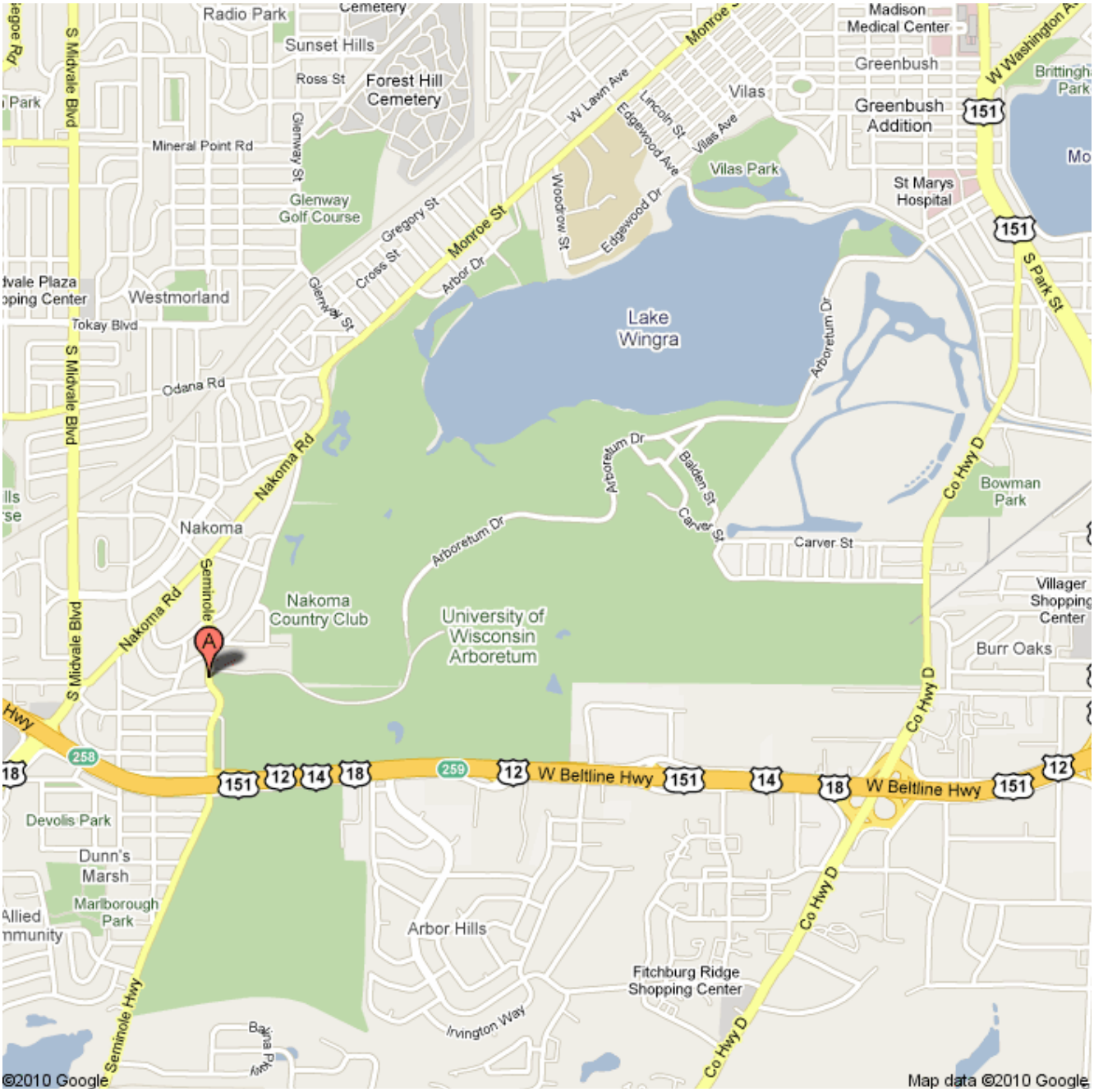

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