4/3/2019 DRAFT – ABSTRACT BOOK

11th SER MIDWEST-GREAT LAKES CHAPTER MEETING

April 12 to April 14, 2019

Central College, Pella, Iowa

SER MIDWEST GREAT LAKES SOCIETY FOR ECOLOGICAL RESTORATION

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MEETING HOST

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KEYNOTE PRESENTATION ABSTRACT

Jackson, Laura L.*. **Ecological restoration and rapid anthropogenic change: the tallgrass prairie of the future.** University of Northern Iowa Tallgrass Prairie Center, Cedar Falls, Iowa. Email: laura.l.jackson@uni.edu

The Midwest tallgrass prairie ecosystem is possibly the most highly altered landscape on the planet. It also holds a special significance for ecological restoration because is considered the birthplace of this professional discipline. The field of ecological restoration is at a crossroads as we cope with the accelerating consequences of climate change and other widespread anthropogenic forces. Can ecological restoration remain a relevant goal in a warming world, and what would the restored tallgrass prairie of the future look like? To protect and restore some authentic version of this ecosystem for current and future generations, we will need more practitioners, scientists, students, and passionate volunteers. Additionally, future restoration efforts will be dependent on recruiting more allies from outside our traditional spheres.

MEETING HOST PLENARY SESSION ABSTRACT

Benedict, Russell A.*. **Small college – big project: the first seven years of the Prairies For Agriculture Project.** Central College, Pella, Iowa. E-mail: benedictr@central.edu

Tallgrass Prairie is a critically endangered ecosystem in the United States. It is so rare that most Midwesterners have no emotional connection to it. The Prairies for Agriculture Project is a long-term endeavor that is examining potential benefits of prairie in the human landscape. Using over 350 plots planted with different mixes of vegetation, we are testing whether prairie plants provide more benefits than the non-native species commonly grown on un-farmable sites in the agricultural landscape. We also are testing whether increasing the diversity of prairie plantings increases the benefits provided by planting native prairie plants. Lastly, our research project also provides an unparalleled educational opportunity for undergraduate students at Central College. In this plenary session, conducted (weather permitting) at our site between Pella and Knoxville, Iowa, we will have a "posters in the prairie" presentation to describe research conducted during the first seven years of the project. This research, conducted by one or two faculty members together with teams of undergraduates, has covered topics ranging from prairie planting techniques, the impact of drought, the importance of individual plant species for monarchs and native bees, and the likelihood of establishment of commonly used prairie plants in new plantings.

MEETING HOST PLENARY SESSION PRESENTATION ABSTRACTS

Benedict, Russ*, Emma Clodfelter, Savanna Henning, Carly Klavins, Tyler Pfaltzgraff, and Jack Sytsma. **Prairie plants used for foraging by monarch butterflies.** Central College, Pella, Iowa. Email: benedictr@central.edu

Monarch butterfly numbers have declined dramatically in recent years for several reasons. To reverse these losses, landowners are encouraged to plant prairies and other habitats suitable for monarchs. This project examined which prairie plants are preferred by adult monarchs for feeding. We followed foraging adult butterflies and flagged plants used for feeding; only insects seen probing the flower with the proboscis were counted. We then recorded data on the focal plant and counted all flowers within a 5 m radius around the focal plant to determine flower availability. In June and July, monarch butterflies sought out particular

plants, especially those in the milkweed and sunflower families, often ignoring other nearby species that were more abundant. Furthermore, non-native plants were not used frequently in June but were used in proportion to their abundance in July. Data collected during August and September, including from butterflies during the migration period, will be presented. Collectively our data sheds light on which species of prairie plants most benefit foraging adult monarchs in southern Iowa.

Chipps, Austin*[2], Rachel Heatwole[4], Evelyn Kammeyer[1], Alex Mandi[3], Jack Sytsma[1], and Russ Benedict[1]. **The impact of increasing plant richness on pollinator use in tallgrass prairie.** [1]Central College, Pella, Iowa. [2]Texas Christian University, Fort Worth, Texas. [3]Nova Southeastern University, Dania Beach, Florida. 4 Secret Woods Nature Center, Broward County, Florida. Email: a.chipps@tcu.edu

Pollinators play a vital role in facilitating reproduction for many agricultural and wild plants. Our research plots located near Pella, Iowa, were seeded in fall 2011 and spring 2012 as part of a larger project examining impacts of increasing plant richness on ecosystem services. Bees were visually counted monthly in 2017 from May to September in plots of tallgrass prairie varying in plant richness to investigate the impact of plant richness on bulk numbers of pollinators. During our observations, insects were visually separated into categories: *Bombus* spp., *Apis mellifera*, "native bee," etc. Observations of pollinator activity were made in plots of low, moderate, and high plant species richness as well as plots containing only smooth brome (*Bromus inermis*) or Indiangrass (*Sorghastrum nutans*). All plots were located in the same 5.7 hectare research site. Plots containing only grasses seldom were used by pollinators. Comparing the three richness treatments, pollinator use varied by month and showed no consistent pattern. However, high richness plots did not support greater numbers of pollinators. All prairie treatments supported more pollinator activity than grass-only plots. An important limitation to our study is that the close proximity of all of our plots to each other may have increased use of low richness plants by pollinators. If this is true, it raises the possibility that large, low diversity prairie plantings can be seeded with isolated patches of high species richness, thus simultaneously reducing costs of seed while still benefitting pollinators. This possibility warrants further research.

Riebkes Clough, Jessica*[2], Sean Robbins*[3], Jordan Drake[1], Ashley Oblander[4], Abby Saladino[1], Olivia Schouten[5], and Russ Benedict[1]. **Impact of early mowing on prairie reconstruction in drought conditions.** [1]Central College, Pella, Iowa. [2]Iowa Natural Heritage Foundation, Des Moines, Iowa. [3]Lifeserve Blood Center, Ames, Iowa. [4]The Nature Conservancy, Letts, Iowa. [5]The Nature Conservancy, Wood River, Nebraska. Email: jclough@inhf.org; slrobbins2992@gmail.com

Mowing is used early in prairie reconstructions to reduce competition between prairie seedlings and weeds. Our research plots located near Pella, Iowa were seeded in fall 2011 or spring 2012 as part of a larger project examining impacts of increasing diversity on ecosystem services. Drought prevailed during the first two years of growth. To quantify establishment, we counted plants in one meter^2 frames. The impact of mowing was weak and varied somewhat by planting season. For broad measures of establishment (cover of native species, number of species, number of total individuals), mowing had no significant impact when data for fall and spring plots were combined. However, fall and spring-planted plots responded differently in the number of species per plot, as mowing was beneficial in spring but not in fall. Overall, our results are inconsistent with previous findings on the benefits of mowing, possibly as a result of drought conditions. While early mowing is advisable in most cases, our data suggest that there may be situations, such as in drought, where the decision to mow should be based on the density of non-native annuals that compete with prairie seedlings.

Mena, Paulina*, Will Daniels, Parker Hill, Sarah Casterline, Ben Turnley, and Russ Benedict. **Voted most popular: which prairie plants attract the greatest number and diversity of native bees.** Central College, Pella, Iowa. Email: menap@central.edu

Bees provide essential pollination services to both wild plants and crop species. Therefore, they are not only vital for conservation but also have enormous economic importance. Although much of the past research has focused on the honeybee, this is a non-native generalist species and, therefore, not always the most effective pollinator. On the other hand, it is estimated that there are approximately 4000 species of native bees in North America. Many of these are specialist or capable of buzz pollination, making them better pollinators of both native species and crops. This means that efforts aimed to conserve native bees would help to both preserve natural ecosystems and increase crop yields. This study is documenting which of the native prairie plants commonly used in restorations attract the highest numbers and diversity of native bees. During each sampling period, we first determined which plants were flowering in our research plots near Pella, Iowa. We then examined 150 plants of each species in the morning and in the afternoon, in standardized weather conditions. By working in a team, we were able to sample all plants flowering at a given time within a two to four-day period. We conducted sampling multiple times during the growing season of 2018, from early June to mid-September. At each plant, we moved slowly to minimize disturbance and caught all bees possible using aerial sweep nets. Data also was collected on missed bees or plants with no visitors present. Data will be presented on which species of plants hosted the greatest number and diversity of bees. With this information, practitioners will have better knowledge of which species to plant to provide the most benefit for bees in southern Iowa.

Moss, Zachary*[2], Alex Mandi[3], Evelyn Kammeyer[1], Katelyn Miner[1], Dane Salow[1], and Russ Benedict[1]. **Plant bullies: assessing the aggressiveness of species used in prairie reconstructions.** [1]Central College, Pella, Iowa. [2]Hubbell Realty Company, West Des Moines, Iowa. [3]Nova Southeastern University, Dania Beach, Florida. Email: ztmoss1@gmail.com

The Prairies for Agriculture project is examining the benefits of incorporating tallgrass prairie into the agricultural landscape via prairie restorations in un-farmable areas. As part of this long-term project, we assessed aggressiveness of 64 species of plants seeded into our research plots, each measuring 9 X 9 meters and surrounded by a two meter-wide mowed buffer. We recorded presence / absence and estimated abundance of each species in 31 un-planted plots interspersed among seeded plots. Five species that we seeded, Black-eyed Susan (*Rudbeckia hirta*), False Sunflower (*Heliopsis helianthoides*), Partridge Pea (*Chamaecrista fasciculata*), Sawtooth Sunflower (*Helianthus grosseserratus*), and Tall Boneset (*Eupatorium altissimum*) were the most aggressive, appearing in at least 80% of un-planted plots. Additionally, two species that we did not plant but that are abundant in the area, Canada/Tall Goldenrod (*Solidago canadensis*/*altissima*) and Old-field Aster (*Symphyotrichum pilosum*), were present in 100% of un-planted plots with very high abundance. We also conducted these same counts in six plots that were planted with five species of prairie grasses but no forbs, and the results were very similar. This knowledge can assist future prairie reconstructions by identifying which species are most likely to spread beyond areas where they are planted. But given the valuable functions performed by these species, they are important to include in reconstructions. Therefore, future work will address reducing the quantity of seed of these species in plantings and delaying their seeding for one or two years while other plants get established.

Oblander, Ashley*[2], Gabrielle Wilson*[3], Austin Boldt[1], Jordan Drake[1], Jessica Riebkes Clough[4], Sean Robbins[5], Abby Saladino[1], Olivia Schouten[6] and Russ Benedict[1]. **Impact of season of planting on prairie reconstruction in drought conditions.** [1]Central College, Pella, Iowa. [2]The Nature Conservancy, Letts, Iowa. [3]Iowa State University College of Veterinary Medicine, Ames, Iowa. [4]Iowa Natural Heritage Foundation, Des Moines, Iowa. [5]Lifeserve Blood Center, Ames, Iowa. [6]The Nature Conservancy, Wood River, Nebraska. Email: ashley.oblander@tnc.org; wilsong2@central.edu

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

Pfaltzgraff, Tyler*, Emma Clodfelter, Savanna Henning, Carly Klavins, Jack Sytsma, and Russ Benedict. **Impact of drought on a newly planted prairie.** Central College, Pella, Iowa. Email: Pfaltzgrafft1@central.edu

The accumulation of atmospheric greenhouse gases has resulted in increasing severity of weather in the Midwest, and droughts are expected to become more common. We studied the impact of drought on newly planted prairies by watering half of recently seeded prairie plots during drought conditions in 2017 and 2018 and counting plants on the watered and un-watered sides. Drought had a substantial negative impact on low richness plantings, affecting all parameters we measured. But high richness plantings showed less of a difference between the watered and non-watered sides. In fact, the un-watered side of high richness plots fared better for two variables than the watered side of low richness plots. Based on our work, drought will affect new prairie plantings, but it may be possible to reduce that impact by using high diversity seed mixes.

Roush, Stephanie*[1], Olivia Schouten*[2], Austin Boldt[1], Jordan Drake[1], Ashley Oblander[4], Jessica Riebkes Clough[3], Sean Robbins[5], Abby Saladino[1], Gabrielle Wilson[6], and Russ Benedict[1]. **Winners and losers: plant establishment during prairie reconstruction in drought conditions.** [1]Central College, Pella, Iowa. [2]The Nature Conservancy, Wood River, Nebraska. [3]Iowa Natural Heritage Foundation, Des Moines, Iowa. [4]The Nature Conservancy, Letts, Iowa. [5]LifeServe Blood Center, Ames, Iowa. [6]Iowa State University College of Veterinary Medicine, Ames, Iowa. Email: griffiths1@central.edu; olivia.schouten@gmail.com

This work is part of the Prairies For Agriculture Project (PFA), a long term study that seeks to benefit humans and nature by incorporating diverse prairie plantings into the agricultural landscape. The early stages of the PFA were impacted by drought, which appeared to slow establishment of some species. This study quantified establishment of prairie plants during the first four years of reconstruction; the first two of these were in drought conditions. The species planted differed widely in establishment success, with six species being 100% successful and eleven failing completely. Comparing our results to other research, we identified species that often succeed early in prairie restorations but did not establish well at our site. These plants, some of which are important in Tallgrass Prairies, include Big Bluestem (*Andropogon gerardii*), Canada Wildrye (*Elymus canadensis*), Yellow Coneflower (*Ratibida pinnata*), Illinois Bundleflower (*Desmanthus illinoensis*), and White Prairie Clover (*Dalea candida*). Drought is a possible explanation for the low success of these species at our site. On the other hand, several plants in our plots established better than expected based on other research, including Prairie Cinquefoil (*Potentilla arguta*), Smooth Blue Aster (*Symphyotrichum laeve*), New England Aster (*S. novae-angliae*), Golden Alexander (*Zizia aurea*), and Tall Coreopsis (*Coreopsis tripteris*), possibly because they are tolerant of dry conditions and benefitted from a lack of competitors. Lastly, some species established well and spread into adjacent plots. This topic is covered in another poster.

POLLINATOR HABITAT RESTORATION PLENARY SESSION ABSTRACT

Holzheuer, Martha. **Pollinator habitat restoration at multiple spatial scales.** Environmental Consulting & Technology, Inc., Bay City, Michigan. Email: mholzheuer@ectinc.com

Global populations of many invertebrate pollinators are in serious decline, and scientists and stakeholders alike are calling for an "All Hands on Deck" approach to restoring habitat for these taxa. Our objective for this plenary session is to highlight pollinator habitat restoration efforts at spatial scales ranging from regionally across the Midwestern United States to locally within Iowa communities. Professionals with extensive experience designing, implementing, and managing pollinator habitats in working agricultural, active transportation, and multiuse recreational landscapes will share their perspectives on important pollinator life history traits, design and best management practices, and initiatives and funding sources related to pollinator habitat restoration.

POLLINATOR HABITAT RESTORATION PLENARY SESSION PRESENTATION ABSTRACTS

Foltz Jordan, Sarah. **Using pollinator life history to inform habitat design and management.** The Xerces Society, Duluth, Minnesota. Email: sarah.foltz@xerces.org

I will summarize the current status and life history of a variety of native bees and other pollinators, with an emphasis on translating the specific foraging, nesting, and overwintering needs of these animals into larger scale habitat creation and management. Pollinator monitoring using non-lethal (observation-based) methods will also be discussed, and regional project examples will be used during the presentation to further illustrate the main concepts.

Godbold, Seana. **Pollinator habitat restoration and creation along Iowa's highways and roadsides.** Iowa Department of Transportation, Ames, Iowa. Email: Seana.Godbold@iowadot.us

I will outline the three-decade history of pollinator habitat restoration and creation within road rights-of-way across Iowa. Additionally, I will also discuss the concept of Integrated Roadside Vegetation Management (IRVM) and how this innovative program is implemented along federal and state highways through the coordination of the Iowa Department of Transportation (IDOT), and IDOT's Living Roadway Trust Fund, which is a competitive grant program for IRVM projects in Iowa. More than 202 km^2 of federal, state, county, and city roadsides in Iowa have been planted to native grasses, wildflowers, and other select vegetation types. I will also share challenges unique to pollinator habitat restoration in roadsides and the important lessons learned from IDOTs efforts within Iowa.

Kellogg, Dana. **Creating a successful public/private partnership to establish pollinator habitat.** Linn County Conservation Department, Toddville, Iowa. Email: Dana.Kellogg@linncounty.org

My presentation will discuss how to create successful public/private partnerships to establish pollinator habitat, while navigating related politics. I will highlight within the presentation an overview of how Linn County and the Cities of Cedar Rapids and Marion worked with the Monarch Research Project to create and implement the 1,000 Acre Pollinator Initiative. I will also present an overview of how to creatively integrate native plant design within public parks and landscapes and how this program could be used as a model that others could replicate or scale to their own communities. Additionally, I will summarize the challenges and lessons learned on implementation of the 1,000 Acre Pollinator Initiative program and key planting and maintenance aspects that need to be considered in creating pollinator habitat.

WORKSHOP ABSTRACTS

Fevold, Brick M.[1], Craig Palmer[1], Adam Bucher[1], and Louis Blume[2]. **Employing innovative quality assurance strategies in ecological restoration – a workshop on best practices in conducting quality control field checks during restoration monitoring.** [1]CSRA, a GDIT Company, Alexandria, Virginia, [2]U.S. Environmental Protection Agency, Chicago, Illinois. BF Email: brick.fevold@gdit.com; CP Email: craig.j.palmer@gdit.com; AB Email: adam.bucher@gdit.com; LB Email: blume.louis@epa.gov

Have you ever questioned the reliability of your monitoring data? (Be honest!). In ecological restoration projects, reliable data are needed to accurately assess ecosystem conditions, track progress toward stated restoration goals, determine the effectiveness of restoration practices, and provide evidence of restoration success. However, restoration projects often lack sufficient quality control (QC) assessment necessary to estimate uncertainty and facilitate the collection of data of acceptable quality to support sound decision making. In this workshop, we will share applied QC strategies for assessing, improving, and documenting the quality of ecological data. Participants will be invited to engage with the speakers, and each other, in creative exercises demonstrating the concepts and applications of QC field-check procedures. Quality control field checks are an essential component to any monitoring program and can provide the empirical data necessary to estimate uncertainty and evaluate conformance with established data quality acceptance criteria. Participants will gain an understanding of quality assurance best practices relevant to restoration project monitoring. A compendium of the presentations, exercises, and recommended resources will be made available to all participants. Guidance presented in this training opportunity is based on the results

of interagency collaboration and published resources. Funding is provided by the U.S. EPA Great Lakes National Program Office and the Great Lakes Restoration Initiative.

Foltz Jordan, Sarah* and Sarah Nizzi*. **On-farm pollinator habitat restoration using organic site preparation methods.** Xerces Society, Duluth, Minnesota. SJF Email: sarah.foltz@xerces.org; SN Email: sarah.nizzi@xerces.org

There is growing interest from both farmers and restorationists in wildflower establishment using organic (herbicide-free) site preparation methods. This workshop will provide an overview of seven organic site prep approaches (solarization, smother cropping, sheet mulching, repeated shallow cultivation, soil inversion, organic herbicides, and sod removal), including our successes and failures from a series of trials across the Midwest that were conducted mostly on farmlands. We will also cover a wide variety of exciting on-farm habitat installation options for farmers and conservation planners, including beetle banks, insectary strips, native flowering hedgerows, and more. Strategies for protecting pollinator habitat from pesticide drift will also be shared in the form of stories from farmers we have worked with in Minnesota and elsewhere. We will conclude the workshop with an overview of farm-bill and other relevant programs for pollinator conservation.

Mena, Paulina A.*. **Introduction to identification of bees found within the Midwest.** Central College, Pella, Iowa. Email: menap@central.edu

This workshop will provide participants with an introduction to identifying bees to genus. It will consist of two parts. The first part of the workshop will consist of a general overview of bee families and highlighting distinguishing characteristics. The second part of the workshop will consist of learning how to identify bees using the Michener, McGinley, and Danforth genera of the North and Central America key. Participants will become familiar with diagnostic characters used in the key. Participants will be using bees collected from central Iowa and therefore it will be particularly useful for those interested in bees of the Midwest.

SYMPOSIA ABSTRACTS

Innovative Science Communication to Build Connections in Restorations Symposium Abstract

Quiram, Gina. **Innovative science communication to build connections in restorations.** Minnesota Department of Natural Resources, St. Paul, Minnesota. Email: Gina.Quiram@state.mn.us

In a world with growing populations, changing climates, and increasing pressures on our natural landscapes, maintaining and increasing support for ecological restoration is critical. Every year we learn more about the science behind restoring and enhancing natural systems to help us face these challenges. The problem is, restoration is truly an interdisciplinary endeavor that requires support from a lot of people and scientists have a reputation for being really bad communicators. While peer-reviewed publications and conference presentations are invaluable and necessary ways for scientists to share their findings with others, more and more restoration scientists are finding value in innovative science communication. The community of stakeholders involved in, and benefited by, ecological restorations is diverse and not everyone has a science background. As restoration scientists, the ball is in our court to work to communicate the value of our work

and the science behind it. By effectively engaging a variety of audiences we can build connections among everyone who impacts or is impacted by ecological restorations. The speakers in this session have been using targeted and creative communication to reach the broad audiences including policy makers, funders, regulatory agencies, public land users, partners, and future practitioners. The speakers will share the successes and challenges they have experienced in pushing boundaries to communicate science as a way to build connections and support for restorations.

Innovative Science Communication to Build Connections in Restorations Symposium Presentation Abstracts

Benage, Megan M.*. **The Prairie Pod bears fruit: challenges and successes of communicating science through podcasts.** Minnesota Department of Natural Resources, New Ulm, Minnesota. Email: megan.benage@state.mn.us

Podcasts are a relatively new frontier in communication—especially for government agencies. To make a 45-minute long broadcast interesting and engaging to a wide-ranging audience is no easy feat. It takes creativity and a strong focus to develop content that is both engaging and useful to listeners. It's about storytelling instead of lecturing and we feel we've achieved the right balance of fun and fact in this science-based podcast series, called the Prairie Pod. We knew we wouldn't be able to reach everyone engaged in prairie work through field days and education events alone. So, we needed a different way to communicate science surrounding prairie conservation, restoration, and management, thus the Prairie Pod was born. Each episode covers a prairie-focused topic, and offers insights on related literature and places to explore Minnesota's beautiful prairies and other amazing natural areas. We also wanted to work underneath the Minnesota Prairie Conservation Plan to connect and engage the prairie conservation partnership and because our main audience comes from those doing work underneath the umbrella of this plan. Our main topics include: protection, restoration, and enhancement of prairie and wetlands habitats. This presentation will cover how we got started, why we feel we're communicating effectively, and tips and tricks on how to start your own science-based podcast!

Benedict, Russ*. **Preparing undergraduate students for careers in restoration and conservation: the necessity of a multi-faceted approach.** Central College, Pella, Iowa. Email: benedictr@central.edu

Undergraduate education represents a specialized and multi-faceted form of communication carried out over an extended period of time. This presentation, geared for current or future educators or others interested in education, will summarize key features built into the four-year educational plan for students at Central College heading towards careers in the ecological restoration / conservation biology fields. Over the past decades, we have trained many students who now work as consultants, professors, naturalists, and biologists for NGOs and government agencies. Through many conversations with alumni and with their employers, we have learned that content gained in classrooms represents only a small fraction of the educational needs of a person hoping for a career in these fields. Other vital components of this training happen in the classroom, on fieldtrips, and during many one-on-one conversations in offices, halls, vans, forests, and prairies. Examples of these vital components include the importance of understanding the process of science, further building a love of nature, the absolute necessity of effective communication skills, and the vital need for "real world" experiences such as internships, volunteering, etc. Following the presentation, we will spend several minutes in open discussion to brainstorm other important considerations when training future restoration and conservation professionals.

Blume, Louis J.[1]*, Molly M. Amos[2], Craig J. Palmer[2], Brick Fevold[2], Judith Schofield[2], and Adam Bucher[2]. **Communication and collaboration supporting restoration outcomes of the US EPA's Great Lakes National Program Office.** [1]U.S. Environmental Protection Agency, Chicago, Illinois. [2]General Dynamics Information Technology, Alexandria, Virginia. Email: blume.louis@epa.gov

The U.S. Environmental Protection Agency's Great Lakes National Program Office (GLNPO) has taken a lead role with the implementation of the Great Lakes Restoration Initiative (GLRI) since its inception in 2010. Team members of GLNPO's Quality Assurance (QA) Program recognized the importance of communication and coordination between all GLRI partners to assist with the success of the GLRI. The overall goal has been to foster a collaborative environment to share quality concepts, practices, guidance, methods, and tools to ultimately improve ecological restoration projects funded by GLRI. GLNPO has promoted communication and collaboration efforts by 1) creating a knowledge base of information, 2) providing training sessions on quality assurance strategies to support environmental projects, 3) investing in QA Leads in various organizations, 4) developing multiple workgroups designed to support the greater research community, 5) hosting a monthly webinar series providing restoration practitioners with an opportunity to share innovative restoration approaches (these webinars are approved for continuing education credit for SER's CERP program), 6) developing a guidance document and other tools to encourage QA best practices for the collection of reliable ecological restoration data. This presentation will detail the efforts conducted to date to support the implementation of the GLRI across many agencies and organizations through communication and collaboration. As Henry Ford said "Coming together is a beginning. Keeping together is progress. Working together is success."

Maier, Craig*. **Designing a field day to be more than a day in the field.** Tallgrass Prairie & Oak Savanna Fire Science Consortium, Madison, Wisconsin. Email: tpos.firescience@gmail.com

New science, new management challenges, and innovative management practices continue to emerge, and field days, workshops, and other field-based learning activities can be vital to the exchange of knowledge. Five years of experience organizing field-based learning activities for groups from 5 people to 80 participants has provided me with many experiences to reflect upon and learn from. As a former land steward turned program coordinator, I learned as I went and discovered en route that a little structure can go a long way. My current field day planning framework draws on science-based information from the discipline of adult education, my experiences from field days across the upper Midwest, as well as from a pool of knowledge shared by fellow fire science exchange staff and other outreach specialists. A few key lessons include: 1) identify your potential audience and their information needs; 2) use this understanding to define a handful of learning objectives; 3) focus the field day agenda on meeting those learning objectives; 4) market the activity to your desired audience; 5) be sure to conduct a post-event assessment; and 6) review the entire process with the planning team. I'll discuss the value of sending out surveys prior to and after your field day, as well as simple—and free!—tools available to use. There are also simple activities you can lead at the end of an event to assess what participants learned (or didn't). If you are a student, researcher, or practitioner interested in hosting a field day for the first, this information can help you avoid re-inventing the wheel. If you're a more seasoned field day host, the symposium Q and A will provide an opportunity to share your experiences and ideas and continue to improve ecological restoration field days.

Quiram, Gina L.* and Wade A. Johnson. **Communicating restoration outcomes to diverse audiences: thinking beyond practitioners.** Minnesota Department of Natural Resources, St Paul, Minnesota. Email: gina.quiram@state.mn.us

In 2008 the Clean Water, Land and Legacy Amendment was passed in Minnesota. This Amendment provides significant funding for restoration activities in the State for 25 years. Since 2008 more than 4,000

restoration projects have been completed with Legacy funds. In 2011 a requirement was added to evaluate habitat restoration projects funded by the Legacy Amendment. The goal of the Restoration Evaluation Program is to improve the quality of restorations throughout the State. The Minnesota Board of Water and Soil Resources and Department of Natural Resources are tasked with coordinating a panel of experts to evaluate restorations. To do this, program staff organize third party reviews of restorations relative to the law, current science and stated goals of the projects. To date we have done 146 evaluations of wetland, prairie, forest, river, stream and lakeshore restorations. Based on findings from the first six years of evaluations, the panel has made six recommendations for improving restoration practice. To get these recommendations to translate to improvements in restoration practice, program staff work to communicate with all stakeholders involved in restoration. Using targeted, plain language, and accessible communications to engage with practitioners, agency staff, councils and trainees, we are working to promote the science and practice of high quality restorations.

Working Lands: An Innovative Framework to Expand and Improve Ecological Restoration in the Midwest Symposium Abstract

Thomforde, Stephen. **Working lands: innovative framework to expand and improve ecological restoration in the Midwest.** Prairie Restorations Inc., Northfield, Minnesota. Email: sthomforde@prairieresto.com

Ecological restoration has become exponentially more common over the past decade. However, continual expansion of restoration is limited by available land and financial resources. Concepts of "working lands" have recently emerged as a means to expand restoration, primarily by off-setting installation and management costs while at the same time providing quantifiable and qualitative ecological services such as food production and soil-building. In theory, working lands can increase ecological integrity, diversity, ecosystem function and service while providing incentives for both private and public restoration projects. This symposium begins by introducing scientific concepts that validate working land initiatives (i.e., disturbance, keystone species, connectivity, nutrient regulation, ecosystem function and service) in ways that suggest all large-scale grassland-savanna restorations require work, aka resistance, to maximize ecological integrity. These concepts are reinforced via case studies of Midwest working-land restoration projects involving haying, grazing, and silviculture. Practitioners discuss designing native pastures, hayfields and businesses that benefit a variety wildlife, provide numerous ecosystem services, and achieve agricultural objectives. Presenters will also share research results related to the positive impacts of working lands to increase diversity and ecosystem services. Practitioners will also discuss current economic realities and potentials for future market-based conservation. The symposium ends with an audience discussion on working lands, obstacles and opportunities to benefit land, water, biodiversity, and agriculture communities, while suppling consumers with high quality products produced in restoration projects.

Working Lands: An Innovative Framework to Expand and Improve Ecological Restoration in the Midwest Symposium Presentation Abstracts

Thomforde, Stephen*. **Far from equilibrium dynamics and the science behind working lands.** Prairie Restorations Inc., Northfield, Minnesota. Email: sthomforde@prairieresto.com

This presentation exposes multiple ecological benefits associated with biomass harvest, e.g. grazing and haying, in grassland ecosystems. The title sums up a multitude of ecological principles associated with keystone herbivore disturbance in grassland systems that maintain diverse, highly functional, provisional and resilient native grasslands. A paleological introduction illuminates a significant coevolution between grassland plants and herbivores, whereby both became dependent upon one another. Concepts of landscape connectivity, nutrient regulation, and structural heterogeneity are used to expose how biomass harvest can promote biodiversity, nutrient regulation, and the production of ecosystem services. State transition models are used to model the loss of biomass harvest and subsequent declines in ecosystem integrity. Concluding points discuss two types of grazing for land managers to consider and also the potential for market based conservation.

Damm, Mary C*. **Plant responses to cattle grazing in tallgrass prairie reconstructions**. Prairie Quest Farm, McGregor, Iowa. Email: mary.damm@gmail.com

Grazing reconstructed prairies with cattle reduces aboveground plant biomass and litter accumulation thereby allowing more light to penetrate the plant canopy and aiding in the establishment of prairie seedlings. Grazing also results in trampling of plants. Trampling may be beneficial to species tolerant of such disturbance, but detrimental to species sensitive to grazing. Prairie species have different morphologies and seasonal development that affect the likelihood of a species benefiting from grazing. The different responses by plants to grazing activities can affect the species composition of a grazed versus a non-grazed prairie. From a review of the literature, I will describe the potential impact to different prairie warm- and cool-season grasses and clonal and non-clonal forbs by grazing with cattle.

MacSwain, Dan[1]*, and Sean Wickhem*[2]. **Obstacles and opportunities for haying prairie on metro lands.** [1]Washington County Natural Resources, Stillwater, Minnesota. [2]Landbridge Ecological, St. Paul, Minnesota. Email: Dan.MacSwain@co.washington.mn.us; sean@whr.mn

Haying is used as an alternative to prescribed burning and grazing, creates a marketable product, and has unlimited potential due to the availability of equipment and skill. Sean will present on his experience implementing prescription haying in two ways: one as a non-profit, where grant funding was used to contract with local farmers, the other as a for-profit restoration firm. Both models had their benefits and drawbacks. Although each haying project had different ecological objectives, the preliminary observations from both sites are promising. Objectives included increasing native biodiversity, imposing tighter control over nutrient cycling, and controlling non-native species. Challenges encountered included: perception, marketability of prairie hay, and timing. We are only just beginning to examine all the opportunities that prescription haying can provide as an effective ecological tool and profit generating endeavor. Additionally, we ask

can haying be used to benefit birds, pollinators and prairie plant diversity while connecting people to the land in a sustainable and mutual beneficial relationship? Dan will present on how haying is being used as a tool to restore prairie species diversity and structure this year on regional park land within Washington County, MN. These areas include grasslands with minimal floral resources for pollinators that range from warm season grass dominated prairie restorations to old field dominated by cool season grasses. Topics will include why it is being used on public land, outcomes sought, haying design including considerations on site selection and species consideration, how it is being set up with a Request for Quote (RFQ), monitoring and evaluation, supplemental seeding, and initial feedback received from local farmers.

Johnson, Kyle[1]* and Jake Langeslag[2]. **Obstacles and opportunities for goat grazing in afforesting lands.** [1]Diversity Landworks LLC., Freeburg, Minnesota. [2]Goat Dispatch LLC., Fairbault Minnesota. Email: diversitylandworks@gmail.com; jake@aquaeden.com

Two professional goat grazers describe their experiences in working on both public and private lands controlling undesirable species in afforested landscapes. This presentation describes the effectiveness on transitioning afforested lands back towards the grassland state, using goats as a form of biomimicry and substitute for historic grazing by elk, bison, and beaver. This presentation describes the basics for using livestock in ecological restoration of afforested landscapes, covering topics such as objectives, expectations, writing RFPs, common threats, outcomes, and public acceptance. This presentation will also cover the basics for starting an ecological livestock grazing business including equipment needs, breeds, and financial expectations.

Hawkanson, Karl[1]*, Kent Solberg[2], and Peter Allen[3]. **Building conservation grazing capacity: supply, demand, infrastructure and the business of ecological grazing.** [1]University of Minnesota Extension, Minneapolis, Minnesota. [2]Minnesota [3]Sustainable Farm Association Minneapolis, Minnesota. [3]Mastodon Valley Farms, Viroqua, Wisconsin. Email: khakanso@umn.edu; kent@sfa-mn.org; pclarkallen@gmail.com

Ability to restore the second trophic level in Midwest native grasslands is limited by infrastructure, lack of grazing animals, and knowledge for how to graze. Industrial agriculture has removed mega-herbivores from the landscape along with the infrastructure that allows grazing to occur. Likewise, local knowledge of grazing practices, such as how to construct and maintain grazing infrastructure, livestock husbandry, processing, and markets have also eroded. Restoring grazing to grasslands requires a strategic approach that encompasses all the aforementioned requirements. This presentation highlights grassroots efforts by several individuals and organizations dedicated to restoring the second trophic level in Midwest grassland ecosystems. These efforts include: 1. fostering grazing businesses specific to restoration work, 2. teaching infrastructure classes, 3. conducting research on ability to use grazing as a restoration tool, and 4. designing grazing plans to implement livestock grazing on state wildlife management lands. This presentation also includes a meta-analysis of grazing impacts on Midwest grassland ecosystems.

Overcoming Barriers to Ecological Restoration on Farms for Soil, Water, and Wildlife in the Upper Midwest Symposium Abstract

Jackson, Laura L. **Overcoming barriers to ecological restoration on farms for soil, water, and wildlife in the Upper Midwest.** University of Northern Iowa Tallgrass Prairie Center, Cedar Falls, Iowa. Email: laura.jackson@uni.edu

The almost complete conversion of diverse, deep-rooted perennial prairie vegetation to monocultures of row crops in the upper Midwest has resulted in soil loss, degradation of soil health, degradation of surface waters and the Gulf of Mexico, and increasing vulnerability to flooding, exacerbated by climate change. Even wildlife once considered well adapted to modern agriculture, such as grassland birds, monarch butterflies and wild bees, have suffered extended population declines. Ecological restoration can address these issues in a meaningful way, but not at a large enough scale to reverse these declines. The speakers present current efforts at different scales and different perspectives. An Iowa farmer describes how and why he decided to convert a small portion of his row crops fields to contour prairie strips. Data from the Science-based Trials of Row crops Integrated with Prairie Strips (STRIPS) project quantifies benefits of this practice for soil, water and wildlife that are disproportionate to the land area required, and relatively inexpensive. Research in eastern Iowa assesses the success and tests the cost effectiveness of the widely-adopted Pollinator Initiative of the Conservation Reserve Program, in the context of a highly volatile native seed market. Finally, Environmental Defense Fund, a multinational environmental organization confronts the special difficulties of reversing habitat loss of the Monarch butterfly, resulting from land use trends that are more a reflection of the global food system, than the choices of individual farmers.

Overcoming Barriers to Ecological Restoration on Farms for Soil, Water, and Wildlife in the Upper Midwest Symposium Presentation Abstracts

O'Neal, Matthew*. **Prairie STRIPS improve soil and nutrient retention as well as increase wildlife habitat.** Iowa State University, Ames, Iowa. Email: niemi@iastate.edu

The Science-based Trials of Rowcrops Integrated with Prairie Strips (STRIPS) project aims to understand the value of prairie strips located within row crop agriculture. Phase I of the project involved a randomized incomplete block design, at Neal Smith National Wildlife Refuge, to compare fields with no prairie compared to fields with 10% and 20% prairie. Fields with prairie had major ecosystem benefits including reduced sediment and nutrient runoff and increased abundance of native plants, birds, and pollinators with an expected decrease in yield due to removal of row crop. Phase II of the project is currently ramping up and involves farmers across Iowa in a paired design where one field is randomly assigned prairie strips and the other field serves as a row crop control. We hope to understand how generalizable the results from Neal Smith are to farms across Iowa.

Meissen, Justin*. **From plan to planting: assessing outcomes in a large agricultural conservation program.** Tallgrass Prairie Center, University of Northern Iowa, Cedar Falls, Iowa. Email: justin.meissen@uni.edu

Many large conservation programs operating in agricultural landscapes such as the Conservation Reserve Program (CRP) strive to deliver particular ecosystem services in a cost-effective manner. Success hinges on dependable native seed supply and price, ecologically sound seed mix and management specifications, and reliability in implementing those specifications. From 2014-2018, the USDA funded the Pollinator Habitat Initiative (CP-42), a CRP practice designed primarily to improve pollinator forage. Using Iowa as a test case, we examined the implementation of the CP-42 practice and assessed several ecological and cost outcomes. We focused on 1) dynamics of the native seed market over the course of the program, 2) whether seed mix specifications could achieve greater cost-effectiveness by targeting multiple ecosystem benefits rather than maximizing single benefits, and 3) implementation and establishment success of 3yr old pollinator plantings. We used a variety of methods to address our questions including manipulative field experiments, farmer surveys, and observational studies. We found that the cost of native seed spiked in Iowa during the program as demand sharply increased. Seed mix quality also declined as prices rose. In an experiment assessing grass to forb ratios (an important specification of the CP-42 practice), we found diverse, site-appropriate seed mixes (1:1 grass to forbs) established well and supported pollinator forage plants while resisting weed invasion. Pollinator seed mixes (1:3 grass to forbs) supported pollinator forage plants but established poorly and were at risk of invasion by invasive perennial weeds. Implementation and establishment success for fields enrolled in CP-42 was mixed.

Sloan, Richard*. **Adding diversity to Iowa cropland.** Corn and Soy Farmer, Rowley, Iowa. Email: sloan_richard@yahoo.com

When grain prices boomed after he had farmed for 30 years, Dick Sloan's reaction was not to tear out the fences and plant the pastures. In 2012, he converted 4.5 acres of highly productive cropland to narrow strips of prairie within his contoured field. He learned of the practice when his local water quality work introduced him to early research from the STRIPS team at Iowa State University. Adding habitat for pollinators, pheasant, and quail was an attractive bonus. Lack of local experience can only be overcome with local action and it was time to strive for environmental services consistent with productive agriculture.

Wolfe, David*. **Monarch recovery: moving beyond the paradigm of incentive-based conservation on private lands.** Environmental Defense Fund, Austin, Texas. Email: dwolfe@edf.org

This presentation will focus on EDF's work to engage the agricultural community in monarch recovery. The scale of the Monarch conservation issue presents unprecedented challenges for conservationists. It's the widest ranging species we've ever attempted to work on. Its recovery will require that tens of thousands farmers essentially farm in a very different way. The Monarch issue is a symptom of a broader range of conservation issues related to farming – e.g. Gulf hypoxia. We have realized that this is a societal issue that will require nothing short of societal change in order to achieve success.

Incorporating Fire Research Into Land Management and Restoration Work Across the Midwest Symposium Abstract

Johnson, Yari[1] and Craig Maier[2]. **Incorporating fire research into land management and restoration work across the Midwest.** [1]University of Wisconsin-Platteville, Platteville, Wisconsin. , [2]Tallgrass Prairie and Oak Savanna Fire Science Consortium, Madison, Wisconsin. YJ Email: johnsony@uwplatt.edu; CM Email: cmaier.tpos.firescience@gmail.com

Land managers and restoration ecology practitioners across the Midwest have unanswered burning questions about when to burn, how to burn, and what can be achieved with burning. There are many opportunities to answer these questions using existing prescribed fire practices. Please join four experts from across the Midwest-Great Lakes region to discuss how current prescribed fire work can be used to help answer: (1) What is the best season to burn invasive species?; (2) How can burning benefit threatened and endangered species?; (3) What considerations are needed to incorporate research into existing prescribed fire practices?; and (4) How do we get more fire on the landscape to help restore fire-dependent ecosystems? Presenters will share examples of successful research. Attendees are encouraged to ponder whether there are opportunities to answer broader questions across the region by pooling data from prescribed fire activities.

Incorporating Fire Research Into Land Management and Restoration Work Across the Midwest Symposium Presentation Abstracts

Aschenbach, Todd A.*. **Restoration in Michigan: Integrating teaching, research, and management.** Grand Valley State University, Allendale, Michigan. Email: aschenbt@gvsu.edu

A holistic approach to restoration requires the integration of research and management. An essential element to both of these facets is education. Given that fire is a natural and necessary disturbance in fire-adapted ecosystems combined with the necessity of implementing prescribed fire in a safe and effective manner, appropriate training is particularly important in fire management. In this presentation, I will provide an overview of results from on-going research at the Newaygo Prairies Research Natural Area, Manistee National Forest, Michigan, where Carex pensylvanica, a native invasive sedge, dominates restoration sites. This experiment evaluates different management treatments using fire and herbicide singularly and in combination to reduce Carex pensylvanica dominance. I will also discuss an oak savanna restoration experiment that examines the impact of prescribed burn treatments on restoration success. Lastly, I will discuss how this research is integrated into training and education courses in an effort to better prepare restoration practitioners for the future.

Hill, Elizabeth*. **Lessons from prescribed fire research at the Conard Environmental Research Area.** Grinnell College, Grinnell, Iowa. Email: hilleliz@grinnell.edu.

Faculty and staff at Grinnell College's 365-acre field station, the Conard Environmental Research Area (CERA), first began using prescribed fire to conduct ecological restoration on reconstructed prairie and bur oak savanna in 1980. In 1997-98, three arrays of replicated experimental plots were developed at CERA: woodland dormant season burn/no-burn, reconstructed prairie spring/summer/fall burn, and reconstructed

prairie no burn/burn/mow, and have served as the primary site for student research and expression in introductory and upper-level Biology, Chemistry, Environmental Studies, and Studio Arts classes. Undergraduate students have taken part in the prescribed fire program through volunteering to implement the burns, monitoring the effects of fire seasonality and frequency, and communicating the results. Student research and learning outcomes are dependent on connecting safety, training, and curricular programing within the fire program.

Johnson, Yari*. **Incorporating prescribed fire research into land management at a regional comprehensive university.** University of Wisconsin-Platteville, Platteville, Wisconsin. Email: johnsony@uwplatt.edu

The Reclamation, Environment and Conservation program at the University of Wisconsin-Platteville has been educating students in the science, practice, and art of reclaiming and restoring degraded ecosystems since 1980. Natural areas on campus covering 85 hectares serve as both a living laboratory and refuge for many of the region's 189 imperiled species. Faculty and students have focused most of the land management and restoration efforts on two prairies. Restoration work began on Pioneer Prairie, which contains a small section (<0.5 hectare) of remnant prairie, in 1985 and on Rountree Prairie in 1998. Faculty have used Pioneer Prairie to study the effects of burn season and fire intensity on invasive bush honeysuckles (*Lonicera* spp.). In the past, Rountree Prairie has been used to demonstrate the efficacy of prescribed fire as a restoration and management tool to the campus and community. Current research in Rountree Prairie focuses on the interactions between prescribed fire, belowground microbiota, and flora. In addition to the management benefits, prescribed burns help train students and give them employable skills. The Nature Conservancy and the Wisconsin Department of Natural Resources also help train students in wildland fire techniques and provide additional opportunities for students to conduct prescribed burns.

McGowan-Stinski, Jack*. **Evaluating the success of restoration and management techniques for fire-dependent oak/pine barren sites in Michigan.** Lake States Fire Science Consortium, Grand Marais, Minnesota. Email: mcgowan-stinski.1@osu.edu

Beginning in 1999 The Nature Conservancy in Michigan began intensive restoration projects of fire-dependent oak/pine savanna and barrens systems. These oak/pine systems were moved from a restoration-phase to a maintenance-phase through a combination of: 1) development of new invasive and competitive species removal techniques (spotted knapweed [Centaurea maculosa], sweet clovers [Melilotus spp.], Pennsylvania sedge [Carex pensylvanica], etc.); 2) native plant re-introduction; 3) intensive monitoring of invasive species, rare species (Karner blue butterfly [Lycaeides melissa], Eastern box turtle [Terrapene carolina], etc.), and habitat monitoring (floristic quality assessments, photo-monitoring, etc.); and 4) re-introduction of prescribed fire in different seasons. Coarse-level metrics were developed to provide a quick means to track progress of restoration/maintenance and determine next management step(s) needed. We will explore the differing fire effects and fire behavior between growing season and dormant season burns (timing, intensity, severity, and frequency), smoke, phenology, and natural community response.

ORAL PRESENTATION ABSTRACTS - ALPHABETICAL ORDER

Albro, Sandra L.*. **Social considerations for use of native plants and nature-based design elements on urban vacant lots.** Holden Forests & Gardens, Cleveland, Ohio. Email: salbro@holdenfg.org

There is growing interest in native plants and nature-based design elements for urban landscapes due to the ecological benefits that they provide. Complaints and interventions from residents, government officials, and maintenance contractors, however, present continued challenges for their lasting use. In Great Lakes cities that have endured population loss and disinvestment, there are social considerations for use of these elements as part of low-impact development, green infrastructure, and restoration projects. An interdisciplinary project team will share lessons from an urban vacant land reuse project that combined stormwater best management practices and recreation in Gary, Indiana; Cleveland, Ohio; and Buffalo, New York ("Vacant to Vibrant"). Nine project sites contained distinct arrangements of native plants in rain gardens and decorative plantings, as well as bird/bat houses and nature-play design elements. An in-depth community engagement process, as well as collaboration with a variety of community, government, and organizational partners, spanned project planning, implementation, and maintenance phases over 5 years. Underappreciated social benefits of native plants include a lower potential for theft by residents or landscapers compared to many commonly cultivated plants and, sometimes, greater resilience to vandalism. If native plants are perceived to be too unattractive, though, they risk being uprooted or mown down. Limiting the number of species within individual plantings, and clustering species into rows or clumps, can make native plantings appear tidier to urban residents while reducing the burden on maintenance contractors. In urban neighborhoods where vacant lots and dumping are prevalent, nature-based design elements and repurposed materials must be approached carefully so as to not contribute to existing human health/wealth disparities. In urban areas more broadly, addressing common complaints will be important for growing wildlife habitat, green infrastructure, and natural areas within cities.

Allison, Stuart K.*. **Ecological restoration during a time of rapid environmental change: how do we keep up with a runaway train?** Knox College, Galesburg, Illinois. Email: sallison@knox.edu

One of the greatest challenges facing the practice of ecological restoration in the 21st Century is the rapid pace and global scale of current and projected environmental change. There are many sources for these changes to the environment – conversion of ecosystems to other types and uses, habitat fragmentation, declines in species populations, extinctions of species, the human assisted movement of species from their original ecosystem to new ecosystems on a global scale, pollution, and global climate change. Almost all of these changes are either directly or indirectly related to continuing growth and movement of the human population. Restorationists have been aware of these changes for many years but only recently have been able to fully grasp the rapidity and scale of environmental changes. Given our current understanding of the rapidity and ubiquity of environmental change, it becomes obvious that the goals and practice of ecological restoration must change in order to accommodate the shifting conditions on the ground. Ecological restoration must be conducted with an eye to the future, planning for ways for the restored site to adapt as the environment around it changes. Restoration can help us keep up with accelerating rates of change if we: 1)maintain biodiversity, ecosystem structure, composition and function; 2)reduce the effects of disturbance and environmental stress; and 3)nurture or create refugia, redundancy and connectivity among ecosystems. Broad-based, forward looking restoration will be vital tool as we respond to environmental change and prepare ecosystems for the future.

Appelgate, Seth R.*. **Results of converting non-native cool season grasslands to native pollinator habitat two years post planting in Iowa.** Iowa State University, Ames, Iowa. Email: sethapp@iastate.edu

Non-native cool season grasslands, which provide little pollinator value, are the dominant vegetation of field margins, livestock facilities, riparian landscapes, and older conservation program practices in Midwestern agricultural systems. The ISU Monarch Workgroup, as part of the Iowa Monarch Conservation Consortium, is conducting a four year study to examine practices for converting non-native cool season grasslands to native pollinator habitat. Herbicide suppression of existing perennial non-native cool season grasslands and subsequent planting of native pollinator habitat was carried out in 2016 at 43 research plots throughout Iowa. Plots are located in agricultural landscapes along field edges, in riparian zones, on top of bioreactors, and at pork production facilities. Average plot size is 0.4 acres. Original site vegetation ranged from unmanaged smooth brome grass to turf grass managed as a lawn. Residue removal such as mowing or baling occurred in the summer of 2016. Glyphosate was applied in late summer of 2016 and again in fall of 2016. Plots were seeded with a no-till prairie drill in November/December 2016 and mowed three times during the summer of 2017. Sites were surveyed prior to intervention and continue to be monitored to document changes in plant community and monarch utilization. Statistical analyses, qualitative analyses, and site photos demonstrate that all sites had strong perennial/biennial weed pressure through two years post-plant and overall native plant community establishment was low. In comparison, reports in the literature indicate corn/soybean transitions have much higher rates of establishment and lower weed pressure. Our results strongly suggest that site preparation (e.g. number of herbicide applications) must be considerably more intensive than a residue removal event followed by two glyphosate applications to convert non-native cool season grasslands to high quality pollinator habitat.

Clough, Jessica L.[1], Mark E. Sherrard*[2], and Laura L. Jackson[3]. **Supplemental seed increases native seedling establishment in roadside prairie restoration.** [1]Iowa Natural Heritage Foundation, Des Moines, Iowa. [2]University of Northern Iowa, Cedar Falls, Iowa. [3]Tallgrass Prairie Center, Cedar Falls, Iowa. Email: jclough@inhf.org

Tallgrass prairie restorations are plagued by high seed costs and low rates of seedling establishment. Many restorations suffer high rates of seed loss to granivores; yet to date, there are no established protocols to minimize their impact. In this study, we tested whether the application of supplemental (sacrificial) seed reduces native seed consumption and increases native seedling establishment in roadside prairie restoration. We applied supplemental birdseed to a random subset of research plots at three roadside prairie restoration sites and compared rates of seed consumption and early native seedling establishment between supplemental seed plots and control plots. All three roadside restorations were seeded in fall 2014, immediately following the first frost. To assess native seed consumption, we monitored rates of seed removal from "seed cards" during the first 14 days of the restorations. To assess early seedling establishment, we identified and counted all native seedlings in mid-July of the first restoration year. The application of supplemental seed did not reduce rates of seed consumption, which were very low during the early stages of these restorations, but did increase native seedling establishment. Native seedling establishment was approximately 37% higher in supplemental seed plots than in control plots across restoration sites. The application of supplemental seed may have increased seedling establishment by reducing consumption of native seed during winter and spring. Our results suggest that supplemental seed is a practical, inexpensive technique for increasing seedling establishment in roadside prairie restoration.

Davies G. Matt. **There's nothing standard about data standardization – asking the right questions when analyzing ecosystem change.** The Ohio State University, Columbus, Ohio. Email: davies.411@osu.edu

When assessing the effects of restoration, changes in ecosystem community composition are often described using complex multivariate statistical methods such as Permutational Multivariate Analysis of Variance (PERMANOVA) or Non-metric Multidimensional Scaling (NMDS). It is not unusual for ecologists to pre-treat their data prior to such analyses. This might include removing rare species that add "noise" or standardizing their data. Some statistical packages or functions may include some form of standardization as a default setting. The uncritical selection of data standardization approaches is concerning, not because any particular method is necessarily incorrect, but rather because different methods ask different ecological questions. If you're being naughty standardization allows you to fiddle with your data until you get the answer you want! I compared the effects of different standardization methods using data from fifteen experimental fires burnt on Scottish heathlands of different pre-fire ages. In these ecosystems differences in stand age are associated with variation in species-specific regeneration rates but little change in the suite of species present. The data was subjected to increasing levels of standardization: i) raw data; ii) standardization by species maximum cover; iii) standardization by species maximum then by plot total cover – so called "Wisconsin" double standardization; iv) conversion of cover data to presence/absence. Analysis via NMDS and PERMANOVA provided conflicting messages on the ecological and statistical significance of stand age. Analysis of raw data yielded significant differences in composition between stand ages but effect sizes declined with increasing standardization. The results demonstrate the need for ecologists to define appropriate standardization methods when setting research objectives and to tie their analytical methods to specific ecological questions.

Drobney, Pauline[1]*, Rebecca Esser[2], Amanda McColpin[1], Marissa Ahlering[3], Megan Benage[4], Daniel Cariveau[5], Paul Charland[6], Cami Dixon[7], Jessica Dowler[8], James Ellis[9], William Johnson[10], Diane Larson[5], Craig Maier[11], Justin Meissen[12], Tom Skilling[13], Benjamin Walker[14], Sara Vacek[15] and Karen Viste-Sparkman[1]. **Information is power to get from seeds to successful prairie: the Prairie Reconstruction Initiative.** [1]U.S. Fish and Wildlife Service, Prairie City, Iowa. [2]U.S. Fish and Wildlife Service, Detroit Lakes, Minnesota. [3]The Nature Conservancy, Moorehead, Minnesota. [4]Minnesota DNR, New Ulm, Minnesota. [5]U.S. Geological Survey, St. Paul, Minnesota. [6]USFWS, East Lansing, Michigan. [7]U.S. Fish and Wildlife Service, Woodworth, North Dakota. [8]USDA-Natural Resources Conservation Service, Britton, South Dakota. [9]Illinois Natural History Survey, Champaign, Illinois, [10]Iowa Department of Natural Resources, Lehigh, Iowa. [11]University of Wisconsin, Madison, Wisconsin. [12]University of Northern Iowa, Cedar Falls, Iowa. [13]U.S. Fish and Wildlife Service, Titonka, Iowa. [14]U.S. Fish and Wildlife Service, Erskine, Minnesota. [15]U.S. Fish and Wildlife Service, Morris, Minnesota. Email: pauline_drobney@fws.gov

Prairie reconstruction (establishing prairie from seed) is essential to meet conservation goals where prairie once dominated the landscape. This type of ecological restoration is frequently used to buffer or enlarge existing prairie remnants, build a semblance of historic prairie where it no longer exists, improve water quality or create habitat. Many conservation organizations and landowners attempt to reconstruct floristically diverse prairie, but through time, quality among such plantings can range from highly diverse, functional prairies to disappointingly weedy places with few native species. The question is why? To bridge knowledge gaps and cultivate ecological restoration connections, a network of researchers and practitioners from over 30 conservation organizations has joined forces in a group called the Prairie Reconstruction Initiative (PRI). PRI uses tools including the newly-released monitoring protocols and the reconstruction

and management database to improve collective learning and inform future decisions. Crowd-sourced data about land use history, planting methods and management actions through time are entered by site into the database. Analysis of monitoring data and reconstruction history will generate insights about what factors consistently lead to high quality results. PRI does not prescribe methods for prairie reconstruction, but rather seeks to learn about the efficacy of different approaches and share the knowledge generated by our work through a wide range of informational products and person-to-person interactions including publications, field days, webinars, workshops and discussion forums.

Francino, Sarah*, G. Matt Davies, Ron Powell, and Brad Bergefurd. **Pawpaw patch management as a tool to facilitate woodland restoration: effects of forest structure on fruit yield.** Ohio State University, Columbus, Ohio. Email: francino.1@osu.edu

Pawpaw, the largest and "most deliciousest" native fruit in Ohio, are most often found for sale in farmers markets or brewed into specialty craft beers. While the majority of pawpaw fruits used commercially are sourced from wild patches, larger cultivated plantings are currently being developed. Management of woodland pawpaw stands provides a potential income source for land owners and could offset some of the costs involved in forest management. Diversifying incomes while supporting forest management may facilitate vital restoration practices such as the removal of invasive species and thinning. Wild pawpaw patches in their natural state are low yielding and often produce small fruit, but in orchard settings the fruit can grow much larger in size, sometimes over one pound in weight. We aim to use this information to develop management strategies for market production of pawpaw from wild patches. Across five woodland sites we quantified how tree age, architecture, forest structure, and abiotic conditions control flowering effort and subsequent fruit production. Principal Components Analysis was used to investigate forest and pawpaw patch structure. Two openly grown patches revealed fruit production two to three orders of magnitude greater than patches in the forest sub-canopy. The first Principal Component (related to higher canopy stocking densities, greater basal area, and fewer pawpaw trees) was significantly correlated with reduced fruit production. The collected data has established a baseline for future stand manipulation practices to improve pawpaw patch production.

Glover, Rachael E.*[1], G. Matt Davies[1], and Rebecca M. Swab[2]. **Trait selection as a tool for restoration success on degraded prairie in Southeastern Ohio.** [1]The Ohio State University, Columbus, Ohio. [2]The Wilds, Cumberland, Ohio. Email: glover.194@osu.edu

Strip mining for coal in southern Ohio left a legacy of environmental issues, such as degraded and compacted soil, loss of the native seed bank, and the replacement of native deciduous forest with non-native cool-season grassland. This has resulted in the loss of important ecosystem services, such as quality habitat for wildlife and pollinators. Prairie offers one option for restoration of highly degraded landscapes where re-establishing pre-mining forest habitat is difficult. In 2016, we evaluated the species and functional composition of a restored prairie at the Wilds that had been left unmanaged for nearly a decade following its establishment in 2008. The 20-acre prairie originally aimed to evaluate biomass production following different combinations of fertilizer application, subsoiling, and six different seed mixes. Initial analyses have suggested that even after a decade, the site has maintained some of the original seeded prairie species, but many treatments remain or reverted to non-native dominated cool-season grassland. Statistical evaluation of these plots showed an effect of the initial seed mix on species composition. Subsequent research aims to use the site's previous design to test mechanisms involved with community assembly during restoration and specific controls on the establishment of native species. We designed a seed mix

composed of species with traits that converged or contrasted with the current abundance of different plant functional types. The mix was seeded into plots that had either been burned or mowed. We also seeded small plots with nine single species at high and low seeding rates. Establishment within single species plots was assessed in summer 2018. We propose that this trait-based approach to restoration can better inform management and seeding decisions and set degraded sites on a trajectory that improves their biodiversity and associated ecosystem services.

Grieser, Kevin A.*[1], Suzanne Hoehne[1], and Tom Denbow[1]. **Engineered log complexes: it's the wood that makes it good.** [1]Biohabitats, Cleveland, Ohio. Email: kgrieser@biohabitats.com

In 2018, the Biohabitats/Meadville Land Service Team worked with the Chagrin River Watershed Partners to install over 300 feet of engineered log complex to stabilize near vertical banks as high as 15 feet on the Chagrin River, a state designated Scenic River, in the Village of Hunting Valley, Ohio. The original concept presented in the RFP called for over 500 feet of rock toe and 6 rock bendway weir structures, but asked consultants to consider design techniques that could minimize the use of rock in the restoration. Traditional streambank stabilization projects have relied on hard-engineering techniques that are anything but wild and scenic. Fortunately, Nature offers an appealing alternative: large, woody debris, which can be used for engineered log complexes. This alternative to hard-engineering solutions like riprap and gabion baskets improves the resiliency of our rivers in a way that helps keep them scenic...while delivering added ecosystem benefits. The approach to this specific restoration utilized a technique very common in restoration work in the Pacific Northwest, but seldomly used in the Midwest. By using logs and rootwads to engineer a log complex along the eroding streambank, the project was not only able to stabilize the banks but provide aquatic habitat and an aesthetically appealing design in stark contrast to a rip-rap bank immediately downstream of the restoration reach. The design-build project was designed by Biohabitats, constructed by Meadville Land Service and funded in part through an Ohio EPA Section 319 grant. This presentation describes what engineered log complexes are, provides a recent local example, and demonstrates their superior benefits.

Herakovich, Heather* and Holly P. Jones. **The effects of bison reintroduction on the grassland bird community in tallgrass prairie.** Northern Illinois University, DeKalb, Illinois. Email: hherakovich@niu.edu

Tallgrass prairie has been converted to agriculture over the past century, making it one of the most threatened ecosystems globally. Agriculture conversion of prairie has severely fragmented the landscape and many grassland birds are now in decline and threatened with extirpation. Restoration projects have sought to increase the quality and size of prairie fragments, hypothetically increasing breeding habitat for grassland birds. Bison and other grazers are now being reintroduced to prairie restorations as a final step in a complete restoration to increase habitat heterogeneity. The goal of our study was to understand how tallgrass prairie restoration practices (recent bison reintroduction and prescribed fire) at Nachusa Grasslands influence bird community composition. We predicted these management techniques would alter the bird community to more disturbance tolerant species. We used remote sensing technology to record the communities in four plantings and two remnant sites (half with bison and half without) from 2016-2018. For the grassland birds recorded, bison presence influenced community composition and prescribed fire did not. However, the community within the bison sites did not change over time, suggesting the differences

are not from bison presence. Long-term research is needed to help understand how these restoration practices are influencing this higher trophic level and how they can be altered to help these declining species.

Holthuijzen, Wieteke A.*[1], Beth N. Flint[2], Jonathan H. Plissner[3], Kaylee J. Rosenberger [1], Coral A. Wolf[3], and Holly P. Jones[1]. **Fly on the wall: monitoring ecological impacts of invasive house mice (*Mus musculus*) on Midway Atoll National Wildlife Refuge via arthropod diversity.** [1]Northern Illinois University, DeKalb, Illinois. [2]U.S. Fish and Wildlife Service, Honolulu, Hawaii. [3]Island Conservation, Honolulu, Hawaii. Email: wholthuijzen@gmail.com

Midway Atoll National Wildlife Refuge is the world's largest albatross colony and provides globally significant breeding grounds for over 20 species totaling more than 3 million birds. However, since 2015, invasive house mice have attacked and depredated hundreds of adult breeding albatross. Efforts are underway to eradicate mice from Midway in the summer of 2019 but a critical uncertainty remains regarding island ecosystem response to such a conservation intervention. While most attention of invasive island mammals has focused on vertebrate impacts, very few studies have examined impacts on terrestrial arthropods and invertebrates. This eradication presents a key opportunity to implement a pre-/post-control study to understand invasive mouse influence on island ecosystems. Midway provides a unique experimental set-up since mice are present on Midway's Sand Island, but not on Eastern Island. We seek to document fluctuations in the community composition and abundance of terrestrial arthropods on Midway's islands before and after eradication. Arthropod communities are sampled via pitfall traps; captured arthropods are sorted to order and counted to determine occurrence frequency. A linear mixed effects model was developed to examine the effect of island (Sand versus Eastern) and habitat association (4 categories) on current (pre-eradication) arthropod diversity (using the Simpson diversity index as a proxy). Preliminary results indicate that arthropod diversity differs significantly between islands but not habitat associations. Non-metric multidimensional scaling results show strong grouping among Coleoptera, Collembola, and Hymenoptera orders on Eastern Island; although Sand Island has greater species richness, arthropod communities are dominated by the orders of Acari, Dermaptera, Diptera, and Isopoda. With the pending eradication of mice on Midway, it is important to predict "surprise effects" such as unexpected population irruptions of previously-suppressed taxa, which could support ongoing recovery efforts or present new challenges for ecological restoration of native island flora and fauna.

Kingsbury, Jo[1], G. Matt Davies[1], Chris Tonra[1] and Ross Macleod[2]. **Restoring tropical grasslands for biodiversity in Beni Bolivia - Understanding links between disturbance, habitats and birds across the cerrado-grassland gradient.** [1]The Ohio State University, Columbus Ohio. [2]Glasgow University, Glasgow, Scotland, UK. Email Kingsbury.20@buckeyemail.osu.edu

The structure and composition of savanna ecosystems is driven by complex interacting disturbance processes, including fire, flooding and grazing. Within the Beni Savanna Ecoregion of Bolivia, the distribution and habitat use of three key avian cerrado-grassland specialists, the cock-tailed tyrant, *Alectrurus tricolor,* black-masked finch, *Coryphaspiza melanotis,* and wedge-tailed grass-finch, *Emberiziodes herbicola,* were contrasted to explore how disturbance may influence habitat use. To establish species density estimates and allow inferences regarding distributional differences, we conducted distance sampling along line transects arranged systematically across the cerrado-grassland ecotone. Further,

vegetation structural surveys were carried out at locations where birds were observed and at a number of random locations along each transect. Finally, multivariate techniques were used to discern patterns of microhabitat use between species, specifically the importance of disturbance-sensitive habitat features. Our results indicate that: i) Cock-tailed tyrants specialize on specific disturbance-sensitive micro-habitats within the cerrado-grassland ecotone, while black-masked finch and wedge-tailed grass-finch are more generalistic but seem to track available food resources that may be influenced by the timing and severity of disturbance processes; and ii) Black-masked finch and cock-tailed tyrants may have greater sensitivity to grazing pressure and agricultural fire-management than the more common wedge-tailed grass-finch. Our results will help to inform conservation management protocols for protected areas in this region and help to develop more sustainable approaches to agriculture in the wider Beni.

Koziol, Liz[1,2,3], James D. Bever[1], and Timothy E. Crews[2]. **Native plant establishment and richness increases progressively with density of native AM fungal inocula in a Kansas prairie restoration.** [1]University of Kansas, Lawrence, Kansas. [2]The Land Institute, Salina, Kansas. [3] MycoBloom LLC, Lawrence, Kansas. Email: lizkoziol@ku.edu

The plant microbiome, including endophytes, mycorrhizal fungi, and beneficial soil bacteria can influence plant community health. As a result, there have been frequent calls to amend microbial communities within ecological restoration efforts. Within tallgrass prairies, mycorrhizal fungi are important microbes, as many plant species demonstrate positive growth responses to arbuscular mycorrhizal (AM) fungi. Although we have begun to identify key soil microbes to include in restorations, we are still optimizing the most effective application methods. Popular methods used to incorporate microbes into restoration include the "nurse plant" approach, where microbes are incorporated at transplanting on seedling roots, seed coats, and the broadcast approach, where inocula is incorporated via soil surface spreading sometimes followed by tillage or drilling. To date, comparisons across these inoculation methods are complicated by inoculum type and propagule density. The majority of studies incorporating broadcast inoculum apply non-native commercially available inocula at low application rates, whereas studies using the "nurse plant" method typically apply native inoculum at high inoculation rates. To test the application density of an AM fungal inoculum that might be required to produce positive restoration effects, we chose the broadcast application method and applied 8 different densities of a multispecies AM fungal inoculum derived from a native Kansas prairie. We distributed AM fungal inoculum via broadcasting and tilling and then overseeded with 50 prairie species. During the growing season, we that found greater application rates improved seeded richness and native plant abundance. However, this effect was only significant with the greatest application rates and not with those suggested by the commercial inoculum producers. We conclude that broadcasted native prairie AM fungal inoculum can improve restoration success when applied at sufficient inocula densities. The availability and expense of native AMF inocula, however, may limit the feasibility of this application approach in large scale restoration efforts.

Lamar, Sarah K.* and Charlyn G. Partridge. **Comparing germination success of invasive baby's breath (*Gypsophila paniculata*) found in distinct ecoregions.** Grand Valley State University, Muskegon, Michigan. Email: lamars@mail.gvsu.edu

Baby's breath (*Gypsophila paniculata*) was introduced to North America in the late 1800's as a garden ornamental and has since spread throughout much of the Midwest and parts of the Pacific Northwest, invading a diverse array of habitats. For instance, populations of baby's breath in Chelan, Washington grow in the harsh sagebrush steppe characteristic of the high desert, while populations growing in Petoskey, Michigan inhabit the quartz sand dune-shore along Lake Michigan. To understand how invasive baby's

breath populations can respond to these diverse regions, we investigated germination between populations growing in Chelan, WA and Petoskey, MI. Seeds were collected from both locations on the same day in August of 2018. A germination trial was conducted over the course of 14 days. In addition, we examined gene expression data collected from seedlings growing in these same populations in the summer of 2018. We found a statistically significant difference between the two populations' germination rates. Similarly, differentially expressed genes focused on those associated with circadian rhythms and flowering. Some of these changes may be associated with growing degree day differences between populations. This study helps bridge the gap between field research of invasive plant species and genetics. Results give managers and researchers a better understanding of how invasive species can adapt to novel environments, aiding in the construction of more targeted management strategies on the ground. As our climate changes and ecoregions shift and alter, understanding adaptation in invasive species is critical for long-term management success.

Lindholm, Sarah[1,2] and Amy McEuen*[1]. **Tallgrass prairie restoration at the Emiquon preserve: diverging floristic quality outcomes.** [1]University of Illinois Springfield, Springfield, Illinois, [2] Northwater Consulting, Springfield, Illinois. Email: amceu2@uis.edu

Longitudinal studies examining changes in floristic quality over time are rare given the challenge of collecting data over long time periods. We quantified the floristic quality of a reconstructed prairie in central Illinois, examining how quality changed since the reconstruction's initial seeding in 2007. In 2008 and 2016, species were sampled within 15, 1-m^2 plots distributed across two (interrupted-belt) transects, in each of five prairie sites (75 plots total). Floristic quality assessment indices were calculated at both plot and community (site scale); including floristic quality index (FQI), mean coefficient of conservatism ($\bar{C}$), mean coefficient of wetness ($\bar{W}$), total species richness (S), and native (N) and non-native species (I) richness. Results at the community level show indices differ among sites, with large ranges in FQI, $\bar{C}$, and N. Although there was no significant change in the average value of indices at the community level (n=5 sites) over time, there was a significant increase in variance over time for multiple indices. This suggests differences in restoration trajectories among the five sites despite the same initial seeding. At a small spatial scale (plot level) significant differences were found for averages of all variables among sites. Plot level results also indicated divergence in restoration trajectories, with two sites showing increases in floristic quality indices over time, and other sites showing a range of decreases. These site differences may be the result of differential flooding among sites over time. Our study agrees with previous longitudinal research suggesting that without too frequent and/or intense disturbance, floristic quality will increase over the first decade for prairie restorations in areas with an agricultural legacy. They also suggest that predicting restoration outcomes is difficult and that flexibility and creativity in management approaches will be required to restore resilient ecosystems.

Lowry, Jessie* and Angela Tague. **Iowa hunters: leading the way.** Blank Park Zoo, Des Moines, Iowa. Email: jrlowry@blankparkzoo.org

Bald eagles (BE) are a symbol of restoration success, rebounding from extirpation in the lower 48 to widespread populations today. Following restoration of key habitats and cessation of threats posed by DDT, BE are increasingly prevalent and enjoyed by the public and wildlife enthusiasts. However, there is an increasing understanding of mortality sources that garner public attention through preventable deaths, related to lead toxicity, an anthropogenic secondary stressor. Between 2004-2014, ~50% of 322 BE admitted to wildlife rehabilitators in Iowa had elevated blood lead levels. Research in Minnesota and elsewhere demonstrated that fragmented lead bullets in shot game carcasses (namely deer) are a primary exposure pathway. Considering the beneficial ecological impacts and popularity of hunting in Iowa, this campaign was developed to increase awareness of the importance of hunting with lead-free ammunition for ecological health of BE and other wildlife. The project's communication strategy builds upon hunters' tradition of conservation ethics and building relationships with hunters and hunting organizations through one-on-one interactions via innovative educational materials (including interactive displays), shooting demonstrations, incentivization for purchase of non-lead, and trainings for partnering organizations. A commitment to positive messaging, based on collaborations and voluntary use of non-lead, rather than advocating for bans, has increased understanding and trust between stakeholders, including some previously resistant to engagement. Sustainability and effectiveness of this campaign is demonstrated by the 45+ regional/national partnering organizations, backed by the zoo's audience (500,000) and survey results showing 77% of audience is likely to use non- lead in the future. Our positive approach provides a model for communicating the importance of maintaining restoration successes by engaging hunters as community leaders in generating and negotiating cultural change, ensuring BE and other wildlife will continue to thrive.

Mackert, Morgan M.* and Mary A. Harris. **An oasis in the desert: evaluating contour buffer and filter strips within agricultural fields as habitat for native bees in Iowa.** Iowa State University, Ames, Iowa. Email: mmackert@iastate.edu

An approach to mitigating the negative impacts of highly intensive agricultural practices on the surrounding landscape is the implementation of contour buffer and filter strips within agricultural fields. This study assessed the impact of such strips with varying plant diversities on the local native bee communities. Surveys of native bee communities were conducted at eleven sites throughout Iowa using multiple trap (bowl, blue vane, and emergence) and netting techniques as well as vegetation surveys to determine blooming plant species diversity within the strips at each site. After five years of surveys, we have determined a highly significant positive relationship between bee abundance and the blooming forb coverage within the strips. Additionally, bee species richness is positively correlated with the number of blooming forb and weed species present increased. Based on these results, it is clear that contour strips with greater blooming floral species diversity have the potential to offer quality habitat, which supports more highly diverse bee communities than areas of low plant diversity.

McNicoll, Molly*. **Herbaceous vegetation and European buckthorn (*Rhamnus cathartica*) response to prescribed fire in the early years of an oak woodland restoration.** Luther College, Decorah, Iowa. Email: mcnimo01@luther.edu

Midwestern woodlands invaded by woody shrubs and with long term fire suppression display low diversity understory vegetation compared to open oak woodlands. Management goals to restore diversity to low growing annuals and perennials typically aim to increase sunlight and reduce competition. Prescribed fire has the potential to top-kill European buckthorn (*Rhamnus cathartica*) and reduce the effects of competition, although this interaction has not been fully investigated experimentally. In an oak woodland in Northeast Iowa, we sampled areas that were 1) uninvaded or invaded by buckthorn, and 2) unburned or burned (fall burns 2015, 2016). We sampled herbaceous vegetation (x20 plots per treatment) along permanent transects over several years. In uninvaded areas, average herbaceous species richness and percent cover were greater in plots with prescribed fire than without. In invaded areas, average herbaceous species richness and cover were lower in burned than unburned plots. Average percent cover of buckthorn was lower in burned than unburned plots, although most commonly this reflected top-kill of buckthorn, rather than outright death of the invasive. In uninvaded areas, woodland floor vegetation may have the capacity to respond more quickly after fire, whereas this vegetation may be suppressed or absent in areas with a history of invasion. Attaining the restoration goals for this woodland will likely take multiple years of fire, but may also require additional removal of buckthorn and possible reintroduction of native herbaceous vegetation where it has been excluded.

Mohl, Emily K.*[1], Madeline Q. Johnson[1], Zoua Lor[1], Kate E. Noel[1], Jacqueline Nuzzo[1], Diane Vargas[1], and Sydney C. Povilaitis[2]. **Plasticity and population differentiation in common milkweed: implications for restoration.** [1]St. Olaf College, Northfield, Minnesota. [2]University of Texas. Austin, Texas. Email: mohl@stolaf.edu

In response to recent declines in monarch butterfly populations, conservation practitioners have engaged in widespread efforts to plant milkweeds, the sole food source for monarch caterpillars. Understanding patterns of population differentiation and local adaptation could inform milkweed restoration efforts by identifying regional differences among populations. To investigate these patterns across the range of common milkweed, one of the most important milkweed species for migrating monarch populations, we have established a coordinated research and education network including 30 institutions which participate in seed and data collection. Here, we report on geographic patterns of differentiation in milkweed growth and allocation traits among 16 populations in two separate greenhouse experiments which explicitly manipulated herbivory or damage to plants. Our results indicate that populations are differentiated for many traits, but that milkweed plants show plastic growth responses to herbivory and damage that generate more similar phenotypes. Consequently, herbivory may obscure or reduce population level differences for some traits observed in the field. If adaptive phenotypic plasticity reduces local adaptation in plants, then local sourcing of ecotypes for restoration may be less important than maximizing other goals. Nevertheless, transplant studies in the field should test for a potential role of other factors, like variable herbivory, to generate patterns of local adaptation.

Preville, Nicholas M.*. **The cart before the redhorse: examining habitat use of the threatened river redhorse (*Moxostoma carinatum*) to guide future management.** Grand Valley State University, Allendale, Michigan. Email: previlln@mail.gvsu.edu

The resiliency of our aquatic ecosystems hinges on our ability to protect the native species that reside there. The River Redhorse (*Moxostoma carinatum*) is one such example and populations have become low enough to warrant listing by the State of Michigan. Causes of decline include overfishing, habitat alteration, and lack of knowledge of basic life-history attributes including the use of non-spawning habitat. In order to aid its recovery, we implanted 15 individuals with radio transmitters and tracked their locations over the course of a summer. Tagged River Redhorse were found to move as far as 50 km down river following spawning and establish themselves in small home ranges between 0.04 and 0.12 km^2. The presence of mussels and snails, the River Redhorse's preferred food source, was the primary habitat characteristic selected for by tagged individuals and was documented at 79 percent of all tracked locations. The selection seen here presents a unique opportunity for future mussel restoration and provides insight into River Redhorse management. The recovery of the River Redhorse will likely depend on our ability to protect these newly discovered feeding areas as well as maintaining connectivity between distant populations. Future management should therefore focus on the protection of native mussels and snails and should attempt to maintain migration routes between spawning and summer habitats.

Rochefort, Line*[1], Stéphanie Lefebvre-Ruel[1], Sylvain Jutras[1], Daniel Campbell[2] , Marie-Claire Leblanc[1], and Pete Whittingdon[3]. **Ecohydrological connectivity gradients and their restoration on the periphery of extracted peatlands.** [1]Université Laval, Québec. [2]Birchbark Environmental Research, Ontario. [3]Brandon University, Manitoba. Email: line.rochefort@fsaa.ulaval.ca

The moss layer transfer technique is effective at restoring extracted peatland surfaces. However, remnant peatlands persist on the periphery of extracted surfaces. These remnant peatlands drop steeply to extracted surfaces, producing artificial ecotones that are more challenging to restore. We asked to what degree natural ecotones at undisturbed reference fens can act as models for the restoration of artificial ecotones around an extracted peatland, and whether management actions can ameliorate conditions in artificial ecotones. We compared changes in elevation, water table, peat and multiple vegetation characteristics between natural ecotones and unmanaged artificial ecotones in eastern Canada. We then clear-cut peripheral strips (20 m wide), completely filled perimeter canals and smoothed peripheral slopes around sections of the extracted surfaces to assess whether hydrological conditions improved. Without management, artificial ecotones are not good models of natural ecotones. The elevation gradient is steep, and water tables drop steeply within 8 m of blocked perimeter canals, with possible effects at 25 m. The consequent vegetation had denser tree saplings, faster tree growth, almost no moss cover and low moss species richness. After these management actions, water tables increased to within approximately 5 cm of those along natural ecotones. Future study is required to assess the extent of vegetation recovery, but these results hold promise for a more holistic rehabilitation of ecotones on the periphery of extracted peatland surfaces. We will then present an ecosystem scale-up study (over 7.5 ha) done in Manitoba, Canada. We show that it is possible to improve landscape connectivity, at the ecotone between natural peatlands and degraded peat extracted peatlands, with management actions. These actions in this experimental case did include clearcutting the edges of remnant peatlands, complete infilling of drainage canals and surface reprofiling which resulted in the improvement of hydrological conditions for peatland species establishment.

Schilling, Keith[1] , Keegan Kult[2] , Anthony Seeman[2] , Karen Wilke*[3],and Christopher Jones[1]. **Quantifying the multiple benefits of restored oxbows.** [1]Iowa Geological Survey, Iowa City, Iowa. [2]Iowa Soybean Association, Ankeny, Iowa. [3]The Nature Conservancy, Des Moines, Iowa. Email: kwilke@tnc.org

With growing concerns over the many environmental issues that the Midwest faces, conservation practices that provide multiple benefits are gaining momentum. Oxbow restorations are increasingly popular due to recent research showing incredible ecosystem services provided by them. Oxbows are natural floodplain features formed when a river cuts off a meander loop as it migrates within its floodplain. Natural oxbows are among the most biologically diverse aquatic systems in the world, but accumulation of sediment often fill the oxbows over time and the benefits they once provided cease. Degraded oxbows can be restored by removing the excess fill material. Annual fish surveys over the last 5 years identify that restored oxbows provide valuable year-round habitat for thousands of fish, representing 30 different fish species, including the federally endangered Topeka Shiner minnow. At least 54 species of birds were observed utilizing restored oxbow habitat as well. Restored oxbows that intercept tile water were found to remove an average of 42% of the nitrates that enter the oxbow. When water was given enough time in the oxbow, such as during dry weather conditions, nearly 100% of the nitrates were filtered out by the oxbow. Over 150 oxbows have been restored in the state of Iowa by willing landowners and the U.S. Fish and Wildlife Service, The Nature Conservancy, and the Iowa Soybean Association. However, there are tens of thousands of future potential restoration sites across the state, and likely similar opportunities exist across the Midwest. As a result, there is a great opportunity to scale up the adoption of this practice to improve water quality and wildlife habitat at a meaningful scale. This presentation will showcase results from recent research that quantified the multiple benefits that restored oxbows provide, while also giving guidelines for identifying and restoring oxbows across the upper Midwest.

Schneider, Rebecca[1] *, Stephen Morreale[1], Kirsten Kurtz[1], Erin Menzies[1], and Harold van Es[1], Li Changxiao[2], and Li Jian[3]. **Using coarse woody amendments to jump-start the restoration of severely degraded and desertified grassland soils.** [1]Cornell University, Ithaca, New York. [2]Southwest University, Chongqing, China. [3]Ningxia Forestry Institute, Yinchuan, China. Email: RLS11@cornell.edu

Temperate grasslands historically developed deep fertile mollisol soils, which formed the foundation of highly productive natural ecosystems in semi-arid regions receiving less than 500 mm precipitation annually. These grasslands were subsequently converted to agriculture, and centuries to millennia of poor farming practices have resulted in severe soil degradation. Erosion and desertification of the world's agricultural lands is a leading contributor to the global challenges and impending crises of food and water security. Strategies are needed for restoring these severely degraded systems. For the past several years, our team has been developing methods for jump-starting the revitalization of degraded soils in former grasslands. Through microcosm experiments and field plots studies conducted in Ningxia, China, in Mandan, North Dakota, and in Cornell University laboratories, we have demonstrated that incorporation of coarse wood chips into the surface 20 cm of soil can increase rainfall capture, maintain higher soil moisture contents, and reduce the number of days below permanent wilting point. Selection of more slowly decomposing wood species will maintain these benefits for decades. Addition of fertilizer and other components increased the growth and yield of wheat and alfalfa above levels in unamended soils. In 2017, soils were collected from five healthy, "relict" tallgrass prairies located in eastern Nebraska, and from adjacent agricultural fields. Comprehensive soil health analyses of the relict soil samples, and comparison with the adjacent ag soil, is being used to create an ideal reference soil profile that will guide our restoration designs for this type of prairie. Our next step will be to expand our sampling program into the drier, mixed and short grass prairies of the central northern Great Plains, in the Dakotas and Montana.

Slater, Julie M.*, and G. Matt Davies. **Hydrochemical gradients in Ohio's *Sphagnum*-dominated peatlands.** The Ohio State University, Columbus, Ohio. Email: slater.150@osu.edu

Peatlands are not common in temperate climates such as Ohio's, where they increase landscape diversity, act as important carbon stores, and provide habitat to many locally rare species. Spatial gradients in vegetation and hydrochemistry have been extensively studied in northern bogs but remain understudied in glacial peatlands at the southern extent of their range. Additionally, reference data is needed in order to set appropriate targets for the restoration of Ohio's peatlands. We investigated gradients in hydrology and hydrochemistry at nine *Sphagnum*-dominated peatlands in northeastern Ohio. Differences between sites explained a large proportion (28%) of the variation in hydrology and hydrochemistry, as compared to 11% of the variation in hydrology and hydrochemistry which was explained by dominant vegetation type. We examined four potential indicators of hydrology and water chemistry, accounting for between-site differences using mixed-effects modeling. Dominant vegetation type was the best indicator of water table level, water table level range, and phosphorus concentrations. Water table level, in turn, was the best indicator of pH, electrical conductivity, and calcium concentrations. Ecospatial zones – lagg, wooded zone, and open *Sphagnum* mat – were moderately good indicators of all considered measures of hydrology and hydrochemistry. Ecospatial zones were used to compare environmental conditions in Ohio's bogs to bogs worldwide, where specific species may not be useful indicators. Additionally, we examined the environmental conditions at Flatiron Lake Bog, comparing a relatively intact area to a degraded area where hydrological restoration has been attempted. The hydrochemistry of the degraded area was comparable to that of the intact swamp shrub zone, but its water table level range was significantly greater than within the entire intact area. Information on the historical conditions of the degraded area is not available, but if the intact area is to be used as a restoration target, further hydrological restoration is a priority.

Smiley Jr., Peter C.*[1], Tyler C. Wood[2], Robert B. Gillespie[3], Javier M. Gonzalez[4], and Kevin W. King[5]. **Restoration implications of the role of physical, chemical, and biotic factors on crayfish injuries in channelized agricultural headwater streams.** [1]USDA Agricultural Research Service, Columbus, Ohio. [2] Bowling Green State University, Bowling Green, Ohio. [3]Purdue University Fort Wayne, Fort Wayne, Indiana. [4] USDA Agricultural Research Service, West Lafayette, Indiana. Email: rocky.smiley@ars.usda.gov

Understanding the biota-habitat relationships within agricultural headwater streams in the Midwestern United States will provide information that can assist with developing restoration strategies for these streams. Crayfishes (Order Decapoda) are common inhabitants of agricultural headwater streams in the region. The frequency and severity of injuries within crayfish communities are indicators of levels of crayfish aggression, which is influenced by physical habitat conditions, stress, and crayfish density. Previous studies have not evaluated the determinants of crayfish injuries within agricultural headwater streams. We hypothesized that the frequency and severity of crayfish injuries within agricultural headwater streams would be more strongly influenced by physical habitat and water quality than crayfish density. We sampled crayfishes, documented the frequency and type of injuries, and measured instream habitat and water chemistry in 2014 and 2015 within agricultural headwater streams in northeastern Indiana, southern Michigan, and central Ohio. A linear mixed effect model analysis was conducted to determine if the mean number of injuries per individual, the proportion of injured individuals, the mean number of claw injuries, and the proportion of individuals with multiple injuries were more influenced by physical habitat quality, water quality, or crayfish density. The standardized coefficients from the linear mixed effect model

analyses indicated that the four crayfish injury variables were most strongly influenced by crayfish density. We also observed that the crayfish injury variables were positively correlated with crayfish density ($P < 0.001$) and physical habitat quality ($P < 0.05$). Our results suggested that within agricultural headwater streams in the Midwestern United States crayfish injuries will be most influenced by restoration practices that alter crayfish density and that crayfish injury response variables may not be effective indicators of physical habitat or water quality.

Thada, Adam R.[1]* and Robert T. Reber[2]. **Interseeding forbs in a grass-dominated prairie restoration in northeast Indiana: year six results.** [1]The Center at Donaldson, Donaldson, Indiana. [2]Taylor University, Upland, Indiana. E-mail: athada@poorhandmaids.org

Many tallgrass prairie restorations fail to match the level of floral diversity found in undisturbed prairie remnants. Restorations often become excessively dominated by warm-season grasses at the expense of forbs due to the lack of historical disturbance regimes. Interseeding new species often requires a disturbance mechanism to aid establishment of new plants. In April 2013, five native forb species were seeded into a restoration dominated by *Andropogon gerardii* (Big Bluestem). Test plots were treated either once or twice during the growing season with a grass-specific herbicide in order to examine effects of this disturbance on the dominance of *A. gerardii* and the establishment of interseeded forbs. Treatments were completed for the first three growing seasons. Plots were sampled again in year six (June 2018). Aerial coverage and above-ground biomass of *A. gerardii* was significantly lower in both once and twice-treated plots in comparison to control plots. The abundance and coverage of some species of interseeded forbs were also significantly greater in herbicide-treated plots, starting in year one and continuing through year six. Where other management options such as grazing or mowing are limited, grass-specific herbicide application could constitute a cost-effective tool for land managers interested in increasing floral diversity.

Thomforde, Stephen L*. **Terrestrial eutrophication and afforestation: innovative modeling of catastrophic transitions from open grassland-savanna to closed canopy woodlands.** Prairie Restorations Inc., Northfield, Minnesota. Email: sthomforde@prairieresto.com

A significant acreage of low-quality Midwest forests-woodlands represent a catastrophic, dysfunctional, non-provisional state compared to the historic open grassland-savanna condition. Quality is quantified as the vegetation's capacity to promote multitrophic food webs, impose strong control over nutrient flows, and provision ecosystem services; therefore, low quality forest-woodlands offer a classic example of an alternative, catastrophic, non-provisional state. Forest-woodland low-quality conditions are often attributed to unsustainable resource extraction, e.g. grazing and tree harvest, and current dominance and impacts of invasive species; however, this presentation provides evidence suggesting most low-quality forests-woodlands never were forest-woodlands and never will be forest-woodlands: the premise is false. Instead, low-quality and invaded forest-woodlands are symptomatic of a phenomenon modeled here as, "terrestrial eutrophication and afforestation" (TEA), a condition representative of catastrophic transitions from high-quality open grassland-savannas to low-quality afforested lands. Reinforcing TEA and the catastrophic state, are management regimes based on poorly developed narratives on forest-woodlands, that counterintuitively contribute to declines in ecological quality. By modeling TEA, this presentation: 1. provides an operational definition for forest-woodlands, 2. differentiates between forest-woodlands and grassland-savanna, 3. describes historic keystone assemblages and associated disturbance regimes that maintained open grassland-savanna, 4. models the loss of keystone species, processes and subsequent trophic cascade impacts on energy-flow, nutrient cycles, and biotic assemblages (plant assemblages), 5.

describes current TEA reinforcing mechanisms, and 6. illuminates restoration strategies based on the TEA framework.

POSTER PRESENTATION ABSTRACTS - ALPHABETICAL ORDER

Aby, Tessa M.*, Adam R. Warrix, and Jordan M. Marshall. **Soil transfer from a mesic prairie to conserve a native seed bank and control non-native plants.** Purdue University Fort Wayne, Fort Wayne, Indiana. Email: abytm01@pfw.edu

Non-native species colonize and can become dominant in managed ecosystems. Such species often invade disturbed areas, which are a common result of restoration or other management activities. In dredging open water bodies at Eagle Marsh Nature Preserve, artificial mounds were constructed with the soil removed. This movement of soil created a disturbance allowing the recruitment and colonization of non-native species. The purpose of this study was to quantify the effectiveness of transferring a native seed bank from a restored mesic prairie to the artificial mounds as a method of controlling non-native plant species, which was tested with greenhouse and field experimentation. Soil samples containing the seed bank were moved to a greenhouse to quantify plant emergence following different physical soil treatments. Prior to the field experiment, a plant survey of the mounds was conducted in July 2014. In October 2014, 144 m^3 of soil was transferred from the donor site to the recipient mounds. During the growing season immediately after the move (July 2015), native species diversity increased slightly while the diversity of invasive species decreased dramatically at the recipient location. After allowing establishment of the community (July 2017), both native and invasive species diversity increased dramatically – matching greenhouse values from the donor site before the transfer. Across all surveys, native species outnumber non-native species 2:1. While the soil transfer greatly decreased the number of non-native species immediately after transfer, after an additional 2-years there were more non-native species than before the transfer. Fortunately, a similar increase in native species did occur. The primary goal of this management was to move an existing native seed bank. Some benefits may arise from moving soil locally to transfer an established seed bank. However, such management may be facilitating colonization of non-native species.

Arneson, Jade R., Mathew E. Dornbush*, Kevin Fermanich, and Amy Carrozzino-Lyon. **Restoration of wild rice (*Zizania palustris* L.) at coastal wetlands in the Bay of Green Bay, Lake Michigan.** University of Wisconsin – Green Bay, Green Bay, Wisconsin. Email: arnejr01@uwgb.edu

The Bay of Green Bay is the world's largest freshwater estuary, and one of the most productive systems in the Great Lakes. However, the Bay and its watersheds have a long history of intensive use and modification, including loss of wetland habitat. Due to significant impairment of beneficial uses, including those affecting fish and wildlife habitats, the Lower Menominee River and the Lower Green Bay and Fox River were designated as Great Lakes Areas of Concern in the 1980s. Today, Ducks Unlimited, the University of Wisconsin – Green Bay, and conservation partners are working to improve coastal wetland habitat within this system. This poster describes an ongoing project to re-introduce northern wild rice (*Zizania palustris* L.) to these historically impaired and naturally dynamic coastal wetland systems. Several other near-shore habitat restoration studies are also ongoing, including land-based migratory waterfowl surveys, which compliment wild rice re-introduction efforts. This poster will focus on the 2018 monitoring efforts conducted within wild rice restoration areas, which occur along the west shore of the Bay, from Marinette, WI, south to the Lower Bay and east to Point au Sable. Preliminary results suggest that differences exist in wetland habitat quality and wild rice establishment across restoration sites, with initial analyses suggesting

that a series of factors such as exposure to the Bay, grazing, water quality, and aquatic vegetation are key factors affecting wild rice establishment. This project demonstrates that Great Lakes coastal wetland restoration efforts benefit from strong conservation partnerships among multiple agencies and organizations, as well as from science-based adaptive management.

Bano, Anila*, Nikita Daly*, Josephine Enos-Berlage, and Molly McNicoll. **Land Care! Making new connections to natural areas through summer camps for girls and college community outreach.** Luther College, Decorah, Iowa. Email: mcnimo01@luther.edu

Programs to engage youth and adults in outdoor activities can meet multiple goals simultaneously, including teaching science and fundamentals of restoration, while developing connections and comfort with natural areas. More time outdoors in nature can lead to lower stress levels, greater concentration, and greater engagement in land stewardship. Luther College and 4-H collaborators initiated a program to create 1) an outdoor project-based camp for girls, 2) an outreach program for adults, and 3) internships for college-age females. The camps specifically aim to reach girls with meaningful exposure to science through the lens of restoration and land stewardship. In particular, the program is designed to provide role models and opportunities for girls from rural communities that lack opportunities compared to urban centers. The outreach program provides organized events for adults to connect and explore local natural areas, including guided hikes, mindfulness walks, and a natural areas poetry competition. The camp and outreach program are being developed while two college-age females intern in hands-on restoration work, as well as developing and coordinating activities for the girls camps and outreach program. In addition, the focus on women and girls increases the scope of individuals involved and interested in natural areas restoration and conservation careers. The progress and goals of this two year project (2018-2020) will be presented and provide awareness of programs to increase connections to natural areas and restorations.

Brokaw, Julia*, Michelle Vohs*, Bethanne Bruninga-Socolar, and Daniel Cariveau. **Maximizing the potential and minimizing the cost of prairie seed mix design for wild bees.** University of Minnesota, St. Paul, Minnesota. Email: broka028@umn.edu

Prairie restoration is essential to conserve pollinators, especially wild bee species that are facing population declines from habitat loss and other environmental stressors. Enhancing foraging resources for bees by planting diverse seed mixes is a common, but expensive strategy to mitigate bee declines because many of the pollinator-friendly flower species are cost-prohibitive. For example, some pollinator-friendly mixes can cost over $1,000 per acre. Our research objectives are to determine how variation in seed mixes, such as seeding rate, wildflower species richness, and grass seeding density affect attractiveness of wild bees to different seed mixes. We chose these factors because land managers can decrease the species richness or density of the mix to lower the cost of seed mixes. However, to resist invasion by aggressive plants, the seed mix density may need to stay high. Because grass species are cheaper than most forb species, it is possible to lower the cost of a mix by lowering the density of forbs, but buffer the effects of invasion by increasing the amount of grass seed in the mix. In December 2018, we seeded 36 seed mix treatments and varied the seeding rate, forb species richness, and amount of grass in 288 plots. To evaluate the success and establishment of mixes for pollinators and their resistance to invasion by aggressive plants, we will measure sown plant establishment, floral plant traits (flower number, floral surface area, and frequency of sown species) and interactions between the plant and bee community. We will also compare the realized plant community with the seeded mix. To quantify the performance of these mixes to prescribed burning, half of these plots will be burned. Our data will help guide land managers when designing seed mixes that can be affordable and beneficial for wild bees.

Charland, Paul[1,3,4], John A. Harrington[2,3], Craig Maier[3]*, Jack McGowan-Stinski[4], and Jessica R. Miesel[4,5]. **Can we improve the potential for fire research to inform management decisions?** [1]U.S. Fish and Wildlife Service, Lansing, Michigan. [2]University of Wisconsin-Madison, Madison, Wisconsin. [3]Tallgrass Prairie and Oak Savanna Fire Science Consortium, Madison, Wisconsin. [4]Lake States Fire Science Consortium, Columbus, Ohio. [5]Michigan State University, East Lansing, Michigan. Email: tpos.firescience@gmail.com

Informed management decisions require long-term data on prescribed fire conditions and application to understand the possible effects on soils, vegetation, and wildlife. Improving data collection, analysis, and reporting can provide resources to increase the efficiency of achieving land manager objectives. Fire behavior and the resulting effects of a single burn can vary significantly based on environmental conditions, such as temperature, relative humidity, wind speed, and fuel state, such as loading and moisture content. The post-fire environment, including the number of days to a rain event after fire also has impact on erosion, vegetation, and wildlife. Over time spans of years to decades, prescribed fire application decisions including timing, frequency, ignition patterns and duration (for example, headfire vs. backfire), will influence fuels and cycle back to further influence fire behavior. However, environmental conditions, fire application decisions, fire behavior, and fire effects are not consistently collected or reported in research that includes fire as a treatment. By not collecting environmental and fuel data and key characteristics of the fire, research fails to adequately inform land managers and fire practitioners about which set or sets of conditions will maximize their potential to achieve objectives. Why haven't the data been included for many studies at sites that are managed with prescribed fire? Are there technical or logistical barriers to collecting these data, or does the gap in the literature occur due to lack of recognition that these data are critical to fire practitioners' conceptual models and management decisions? To ensure maximum applicability of research to fire practitioners, ecological restoration, and conservation, we propose collaboration between the research and management communities to: 1) identify relevant data to include in studies involving fire, and 2) identify mechanisms to ensure relevant fire data is collected, reported, and analyzed by the research community.

Curtis, Gabriel L.*, Darren J. Shoemaker*, and Robert B. Gillespie. **Influence of land use change on fish assemblages within channelized streams.** [1]Purdue University Fort Wayne, Fort Wayne, Indiana. Email: curtgl01@pfw.edu, shoedj01@pfw.edu

An important factor regarding habitat restoration is determining which environmental variables most critically impact aquatic communities, so managers may effectively focus their restoration efforts. One such variable is mean distance to nearest crop field. This variable can provide insight into how likely a stream is to be disrupted by agricultural activities. Here, we examine if that distance may have an influence on fish assemblages. Riparian habitat at these sites is typically adjacent to agricultural row crop a few meters from the water's edge. Agricultural activity such as plowing, driving, and harvesting can expose streams to runoff, erosion, organic wastes, and disrupt canopy cover. Our study area comprised three ditch sites along Cedar Creek in Waterloo, Indiana and one reference stream in Hillsdale County, Michigan, all within the St. Joseph River Watershed. Fish surveys were conducted along 125 meter transects. Across two years, we surveyed fish assemblages with electrofishing and seine netting, and measured distance from water's edge to crop field every 25 meters at each transect. We hypothesized that sites with greater distance would have a higher richness, evenness, and Shannon Diversity Index within fish communities. Mean distances to crop field were calculated for ditch sites (10.75 meters) and the reference site (1605.23 meters). Shannon Diversity, species evenness, and species richness were calculated for both ditch and reference sites, respectively: mean Shannon Diversity (1.82; 1.71), mean evenness (0.70; 0.66), and mean richness (13.5; 13.5). Preliminary analysis of these data suggest that fish assemblage metrics do not vary significantly

between ditch and reference sites, and do not appear to be influenced by distance to crop field. We propose that impacts on fish assemblages cannot be attributed to a single variable, and that future analyses should incorporate multiple variables to identify factors which most influence those communities.

Davis, Charles D. and G. Matt Davies*. **A physical and chemical stratigraphy of peat deposits in Flatiron Bog in northeast Ohio.** Ohio State University, Columbus, Ohio.
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As with other wetlands, peat bogs have the potential to support critical ecosystem processes and functions. They are especially unique due to their ability to store large amounts of atmospheric carbon in partly-decomposed plant matter (peat) as their primary productivity tends to exceed ambient rates of decomposition. Peat bogs in the Midwestern region of the United States have been seriously diminished. In Ohio, only around 2% of historical sites remain. Because of this, and their function as carbon sinks, it is important to understand: i) the carbon stocks held in Ohio's peat bogs as they could be vulnerable to loss under climate or land-use change; ii) patterns of greenhouse gas exchange within Ohio peatlands; and iii) current and long-term changes in those peat bog environments. Field and laboratory analysis for this research focused on Flatiron Bog situated in northeastern Ohio. In field, soil cores were extracted from 4 locations selected to represent the gradient of ecological and soil conditions found from the periphery to the core of the site. Peat depth measurements were taken from 16 locations at and along transects between the coring sites. Cores were then processed in lab into 2-cm subsamples to determine depth gradients in pH, electrical conductivity (EC), bulk density, % organic matter, % carbon, and humification. After analysis, we observed a depth gradient in all physical and chemical characteristics with increasingly deeper samples yielding increasingly humified (more completely decomposed) peat. This was paralleled by pH, EC, and bulk density. We also found that the influence from underlying mineral soils resulted in lower % organic matter and % carbon at deeper core sections. Insights gained by these analyses allowed us to estimate a total carbon stock held in the bog of 1.31×10^6 kg and to interpret on-going collection of carbon flux data.

Ernst, Adrienne R.*[1,2], Andrew L. Hipp[3], Renata Poulton-Kamakura[4], and Andrea Kramer[1]. **Going beyond richness: the effect of phylogenetic and functional diversity on invasion resistance**. [1]Chicago Botanic Garden, Glencoe, Illinois, [2]Northwestern University, Evanston, Illinois, [3]Morton Arboretum, Lisle, Illinois, [4]University of Chicago, Chicago, Illinois. Email:aernst@u.northwestern.edu

Invasive species control is a hurdle to the establishment of many restorations—managing invasion is either costly or time-consuming. My project examines how changing the native species composition may bolster resistance to invasive species and potentially decrease the resources allocated to their control. Previous work has shown that highly diverse native plant communities have decreased invasibility. However, this work has focused on species richness, or counting the number of species present, which treats all species equally. In doing so, species richness overlooks species identity and the characteristics of native species that determine how they compete with invasive species. This project investigates two types of diversity that account for species identity: functional diversity and phylogenetic diversity. Functional diversity measures the variety of traits and strategies present in a plant community while phylogenetic diversity measures how much of the evolutionary tree of life is present. Increasing either type of diversity should decrease the niche space available for an invader. In order to test this hypothesis, we studied invasion within experimentally restored prairie plots at the Morton Arboretum in Lisle, Illinois. The plots were all sown with 15 species but with varied levels of phylogenetic and functional diversity. This design allows us to test the effect of each type of diversity on invasion separately and in concert while holding species richness constant. Once the plots were established, species from the surrounding area colonized the plots. We measured aboveground biomass for each species in the plot to determine the degree of invasion in each plot.

Fevold, Brick M.*[1], Craig Palmer[1], Lynn Walters[1], Joan Cuddeback[1], Molly Middlebrook A.[1], Judith Schofield[1], and Louis Blume[2]. **Application of quality assurance and quality control principles to ecological restoration monitoring.** [1]CSRA, LLC – a General Dynamics Information Technology Company, Alexandria, Virginia. [2]U.S. Environmental Protection Agency, Chicago, Illinois. Email: brick.fevold@gdit.com

The assessment of ecological restoration success requires clearly articulated goals and objectives, and the ability to make informed decisions based on data that are reliable and of known quality. Project planners are encouraged to incorporate best practices that build-in effective quality assurance and quality control (QA/QC) procedures into project design, implementation, and assessment monitoring. Quality assurance is 'process-oriented' and supports strategic project planning and implementation. Quality control is 'product-oriented' with a focus on quality inspection and assessment, and is most effective when conducted within an adaptive management framework that supports decision-making throughout the project lifecycle. Quality control in ecological restoration monitoring includes the collection of re-measurement or QC data using one of several QC field check procedures designed to assess whether routine data are being collected within acceptable standards of accuracy, bias and precision. QC field checks are an essential component to any monitoring program providing the empirical data necessary to determine if data are of sufficient quality to assess whether the project objectives have been achieved. Content presented in this poster reflects guidance provide by the U.S. EPA Great Lakes National Program Office and the Interagency Ecological Restoration Quality Committee.

Gastreich, Karin R.*, and Laura Presler. **Diversity and abundance of wild bees in organic gardens versus restored and remnant prairies embedded in an urban matrix.** Avila University, Kansas City, Missouri. Email: gastreichkr@avila.edu

Native bees are fundamental components of natural and anthropogenic habitats, sustaining plant communities and agricultural crops through pollination services. Despite the importance of this group and its increasingly threatened status, it is remarkably understudied. In cooperation with the Missouri Department of Conservation (MDC), KC Parks, and KC Wildlands, we are monitoring bee diversity across different habitats in Kansas City, Missouri. As in many parts of the United States, the bees of Kansas City have not been well documented and are likely to be in decline. Scattered across the metropolitan area are prairie remnants and restoration sites connected by occasional public greenways and power line transects, as well as residential areas and urban gardens, that may provide high-quality bee habitat. A 2016 survey by the MDC found 89 wild bee species, including one species new to Missouri, in the prairie restoration and remnant sites where we currently work. In cooperation with MDC, we are following up on this survey to (1) establish a baseline for long-term monitoring of wild bee communities of Kansas City, (2) study the ecology and natural history of specific species of conservation interest, and (3) identify management practices to better support wild bees, particularly in prairie restoration areas. This past summer, we compared species abundance and diversity in organic urban gardens versus restored and remnant prairies within the urban/suburban matrix. Preliminary analysis indicates that while restored and remnant prairies had much higher numbers of individual bees, there was no difference in species richness or relative abundance when comparing garden versus prairie remnant and restoration sites. These results, along with the unique species cohorts found in each habitat type, suggest that prairie remnants, restoration sites, and even home gardens can play important, complementary roles in sustaining native bee communities within highly urbanized environments.

Grau-Andrés, Roger*, G. Matt Davies, Camilo Rey-Sánchez, and Julie Slater. **Bryophyte communities vary along environmental gradients in Ohio peat bogs.** [1]Ohio State University, Columbus, Ohio. Email: rogergrau@yahoo.es

Peatlands are subjected to increased pressure from environmental and land-use change, particularly in temperate regions such as the US Midwest. Bryophytes dominate the ground cover of peat bog ecosystems, and play a key role in their functioning. Therefore, effective management and restoration of degraded peat bogs requires good understanding of their bryophyte communities, and how these are shaped by environmental conditions. We monitored microhabitat characteristics (water level and its fluctuation, water quality, abundance of vascular vegetation, microtopography) alongside bryophyte communities in nine kettlehole peat bogs in Ohio (US). We found that the most important drivers of bryophyte community composition were water level, hydrochemistry (pH and electric conductivity, EC) and cover of vascular plants. With regard to these, locations in peat bogs formed three distinct groups: (i) locations with poor fen characteristics and evidence of influence from surrounding urban and agricultural land-use (above-ground water table, high pH and EC), with high abundance of cosmopolitan pleurocarpous mosses; (ii) locations with peat bog characteristics (shallow, below-ground water level, low pH and EC), associated with Sphagnum species; and (iii) drier areas with a high cover of shrubs and trees, and intermediate pH and EC. Bryophyte species richness was highest in sampling locations with peat bog characteristics, while within-group heterogeneity of bryophyte communities (beta-diversity) was similar across groups. Indicator species analysis showed that *Amblystegium serpens* was associated with poor fen conditions, while *Sphagnum fallax* and the liverwort *Cephalozia* sp. were indicators of bog conditions. By linking bryophyte community composition to key environmental gradients, this research can help land managers evaluate the state of peat bogs and identify areas of restoration or conservation priority. Further, our results can be used to predict how bryophyte communities in temperate peat bogs are likely to respond to projected environmental change.

Hogan, Katharine F.E.*, Wedin, David A., and Craig R. Allen. **Tallgrass prairie restorations and remnants: comparing communities and perceptions in southeast Nebraska.** University of Nebraska-Lincoln, Lincoln, Nebraska. Email: khogan4@unl.edu

Unique opportunities exist at the intersection of ecological restoration, research, education, and outdoor recreation within the highly urbanized and developed Great Plains. We are using tallgrass prairie restorations (the oldest planted in 2009) and remnants within the 2,000+ acre Prairie Corridor on Haines Branch greenways project outside Lincoln, Nebraska to investigate the effectiveness of prairie restorations at meeting different objectives given current practices. Specifically, we are investigating how different restoration methods (site preparation, seed mix, and management) assemble into communities of varying plant diversity and benefit to pollinators. We are investigating the question: How do differences between restorations and remnants impact available resources for pollinators? Across the Great Plains, ecological restoration is recognized as a viable way to restore plant communities and create wildlife habitat, while potentially providing myriad opportunities for public involvement and outreach. The benefits of native grasslands are as diverse as the methods for establishing them. In light of this diversity we discuss the question: Can we do better? Specifically, can we create diverse native grasslands with effective season-long pollinator habitat using common methods of restoration, and how do they compare to remnants? Can we use different seed mixes to achieve similar habitat objectives given common stakeholder constraints such as budget and seed availability? Results from 2017 indicate that, while the plant species composition of restorations is not converging on that of remnants, restorations have native floral diversity that is as high or higher than tallgrass remnants, and attract more native wild bees than nearby remnants. We discuss future research directions and impacts for working lands prairie management, environmental education, and public outreach.

Jensen, Deanne E.* and Robert B. Gillespie. **Influence of a lowhead dam on macroinvertebrate assemblages of an Indiana stream.** Purdue University Fort Wayne, Fort Wayne, Indiana. Email: zeppde01@pfw.edu

The presence of a lowhead dam has been shown to modify a stream's hydrogeomorphology, with increased siltation upstream and substrate scouring downstream. This shift in habitat structure may result in longitudinal differences in biological assemblages. Our objective was to provide preliminary qualitative data on macroinvertebrate assemblage diversity and habitat structure upstream and downstream of a lowhead dam traversing Cedar Creek in the St. Joseph River watershed of northeastern Indiana. This survey was developed in part to inform decisions regarding a dam removal project proposal. We predicted that macroinvertebrate diversity would be higher upstream of the lowhead dam compared to downstream as a result of variations in hydrogeomorphology and habitat availability. Macroinvertebrates were sampled within 50 meter reaches upstream and downstream via dip nets and Surber samplers. Hydrogeomorphological and habitat features were measured at three transects within each reach. The upstream reach had a greater mean depth (60.2 cm), a lower mean velocity (0.08 m/s), and higher abundance of fine sediments (75% sand/silt) compared to the downstream mean depth (56.5 cm), velocity (0.11 m/s) and substrate composition (70% sand/gravel). A Shannon Diversity Index calculated a H' value of 1.94 for the upstream reach versus a H' value of 2.46 for the downstream reach, indicating greater diversity in the downstream reach. Upstream assemblage evenness (0.58) was also lower compared to downstream evenness (0.77). These results are contrary to our prediction. However, the presence of a two-lane bridge in the upstream reach appears to have influenced available habitat and subsequent assemblages. Our results suggest that the lowhead dam within Cedar Creek has altered the physical and habitat characteristics of the stream, thereby contributing to differences in macroinvertebrate assemblage diversity above and below the dam. Further investigation is warranted to quantify the effects the lowhead dam has on instream habitat and macroinvertebrate community metrics.

McCarthy, Ryan L*, Julie M. Slater, and Don Radcliffe. **Buckeyes restore: challenges and design solutions for university-community collaborative restoration projects in urban environments.** The Ohio State University, Columbus, Ohio. Email: mccarthy.224@osu.edu

The Ohio State University student chapter of the Society for Ecological Restoration (SER-OSU) has partnered with the Friends of the Lower Olentangy Watershed (FLOW) to restore a 300 m strip of riparian vegetation along the Olentangy River on Ohio State University land. Collaborative restoration projects in urban environments present unique challenges in the design, implementation, and monitoring stages of the restoration. First, projects in urban areas involve multiple stakeholders with conflicting goals and objectives. Second, because of high nutrient loading and high propagule pressure from ubiquitous invasive species in the urban environment, restoration efforts in urban areas are particularly vulnerable to failure from reinvasion. Lastly, restoration of a stable community of woody vegetation requires long-term commitment. However, careful planning can mitigate each of these challenges. Our collaborative project aligns the objectives of reducing erosion and nutrient runoff into the river, the primary objective of FLOW, with the university's goal of reforesting vacant Ohio State land. Dense growth of *Lonicera maakii* and *Pyrus calleryana* both within and nearby the restoration site, along with nutrient input from upslope lawn, constrain what restoration efforts are likely to succeed. We designed a strategy of interplanting highly competitive native trees (*Populus deltoidies, Platanus occidentalis, Acer negundo*) with slower-growing species (*Quercus bicolor, Juglans nigra, Asimina triloba*) to resist reinvasion by woody exotics while also providing food resources for wildlife. Lastly, by partnering with a longstanding community organization, we can plan for long-term monitoring and management, while also leveraging the volunteer resources of the student community at Ohio State. Additionally, community partnership significantly defrayed the costs of this project, thanks to equipment and supplies provided by FLOW in addition to funding by Ohio

State. We present this collaborative student/community organization/university restoration project as a model for SER student chapters nationwide.

Michaels, Theo*. **On the edge of opportunity: understanding the role of soil microbes in structuring ecosystem edges in fragmented landscapes.** University of Kansas, Lawrence, Kansas. tmichaels@ku.edu.

Habitat fragmentation has resulted in a world made of ecological edges. These edges function as filters, active boundaries, and novel habitats. The plasticity of an edge, that is the directional spread, degradation, or stagnation these boundaries, may depend on the ecological edge type, how different edges are from one another, and time since disturbance. Edge effects have primary been studied from an aboveground perspective, with little attention on below ground factors, specifically microbial community structure and function. Because land use history has strong, but differential effects microbial dynamics, land use edges may alter critical ecosystem functions thereby enhancing or depressing adjacent systems. This research examines if microbial spread across edges is governed by the growth and dispersal strategies of individual microbial groups, the edaphic and biological environment of the adjacent system, or both. In this study we transplanted whole soil tallgrass prairie monoliths 1.5 m wide by 1.5 deep into three recipient sites along a land use trajectory (recently disked, abandoned and restored fields) to examine microbial structure and function across known edges. We collected soil cores from transects bisecting the monolith-recipient site edge to evaluate microbial community structure, extracellular enzyme activity, soil nutrients, organic matter and other soil characteristics. Using linear mixed effects models, our preliminary data reveals that microbial function across the edge depends on the type of edge created by the prairie monolith-land use interface of the recipient site. The edge of the disked field showed a directional functional change, whereas the abandoned field remained distinct, and the restored field was most similar to the monolith. Given feedbacks between soil microbes and their environment, understanding the role of soil microbes at ecosystem edges may illuminate the mechanisms shaping these ecological boundaries and have implications for managing habitat edges and restoration objectives in tallgrass prairie systems.

Nzombo, Jonathan N.*[1], Kate A. Sinnott*[1], and Laura E. Fischer Walter[2]. **Germination rates of *Carex* spp. seed after long-term storage.** [1]University of Northern Iowa, Cedar Falls, Iowa. [2]Tallgrass Prairie Center, Cedar Falls, Iowa. Emails: nzomboj@uni.edu, sinnottk@uni.edu

This study explores the germination rates of *Carex* spp. seed that has been in storage for five to ten years. The genus *Carex* is a group of ecologically important grass-like species that constitute up to 25% of the aboveground biomass in tallgrass prairies. In the early 2000s, seed production plots of 18 *Carex* species were established from remnant prairie seed at the Tallgrass Prairie Center in Cedar Falls, IA. Seed harvested from the *Carex* plots from 2009 to 2014 was made available for release to the native seed industry for commercial production, with the remainder stored in an onsite seed bank at 4°C and 45% humidity. As the seed harvested from these original plots ages in storage, it is likely that viability will decrease. The rate of decline in seed viability of many *Carex* species in dry storage is not well known, and is important for determining when seed lots need to be regenerated. Species under examination are *C. annectens, C. bebbii, C. bicknellii, C. brevior, C. cristatella, C. molesta, C. stricta, C. tribuloides,* and *C. vulpinoidea.* After removal from storage, seeds were placed in cold-moist stratification for 28 days. Four replicates of 100 seeds from each species were arranged on moistened blotter paper in germination boxes. They were then placed in a growth chamber set to 30/15°C corresponding to a light regime of 12 hours light/12 hours dark. The cumulative count of germinated normal seedlings was used as an indicator for the viability of the seed. This study is ongoing and preliminary results will be presented. By determining viability of seeds in storage,

we can better inform the stewardship of foundation seed banks and improve the availability of genetically diverse and regionally adapted *Carex* seed for restorations.

Palmer, Craig J.[1]*, Lynn Walters[1], Brick Fevold[1], Joan Cuddeback[1], Molly M. Amos[1], and Louis J. Blume[2]. **Quality control checklist for ecological restoration data collection activities.** [1]General Dynamics Information Technology, Alexandria, Virginia. [2]U.S. Environmental Protection Agency, Chicago, Illinois. Email: craig.j.palmer@gdit.com

Monitoring and assessment of restoration actions is essential to ensure the success of an ecological restoration project. Quality control (QC) efforts associated with these data collection activities are meant to provide assurance that those data are accurate and usable. QC efforts should include 1) establishing and maintaining good field practices; 2) establishing qualified quality assurance crews; 3) determining field QC strategies such as the type and frequency of field QC checks; and, 4) using and reporting field QC check results. These QC field efforts can be used to identify and correct data collection errors and address unforeseen problems. They are also useful to identify solutions to challenges encountered in the field, facilitate the evaluation of data quality, and promote continuous improvement.

Ramos, Robert J.* and Jim Bever. **Plant-soil feedbacks and their role in the maintenance of biodiversity.** University of Kansas, Lawrence, Kansas. Email: rjramos@ku.edu

The mechanisms contributing to the maintenance of species diversity remains a key area of interest in ecology, and it has implications for both our understanding of plant community dynamics and for resource management and restoration projects. Plant-soil interactions can provide a set of mechanisms that could be driving patterns of plant biodiversity. North American prairie systems are an ecosystem strongly shaped by arbuscular mychorrizal (AM) fungal mutualisms. Many studies have shown that the abundance of and the composition within AM fungal communities have significant impacts on prairie plant community composition. An area of particular concern is the effectiveness of restoration practices. Late successional prairie species do not establish well under conventional restoration practices, and previous studies have shown that responsiveness to AM fungi correlates more with successional stage than with phylogenetic relatedness. A greenhouse experiment was conducted measuring the changes of soil AM fungal composition associated with specific host plants through the use of next-gen sequencing for both unfertilized and phosphorus fertilized pots. This experiment was designed to evaluate the effect of host plant identity on AM fungal composition as well as those effects across phylogenetic relationships and life history characteristics. The differential AM fungal communities were then used as inocula in a test of plant species fitness impacts from their own soil community and those of their competitors. We are able to test the phylogenetic and life history characteristics impacts on these fitness relationships. Preliminary results show significant changes following phosphorus fertilization in the strength of plant soil feedback effects both across individual species and successional status.

Reding, Jordan M.[1]*, G. Matt Davies[1], and Robert Klips[1]. **The effects of rock climbing on bryophyte and lichen communities on exposed rock within the Red River Gorge, Kentucky.** [1]The Ohio State University, Columbus, Ohio. Email: jordreding@gmail.com

National Parks and Forests have been an integral part of outdoor recreation in America since their creation. Recently, rock climbing has been expanding rapidly within such areas but with largely undocumented impacts on rock face habitats and plant communities. Ecosystems existing on bare rock surfaces that have previously evolved with little direct impact from human activity are now hotspots for climbing related foot

(and hand!) traffic. This study quantified the human impact on bryophyte and lichen communities present on exposed and climbed rock faces within the Red River Gorge, Kentucky, one of the fastest growing rock climbing locations in the eastern United States. Within the Red River Gorge, sport climbing routes were randomly selected, and the lower, middle and upper sections of the route surveyed. Within each section, a climbed portion of rock, an unclimbed portion of rock, and the fringe space between the two were surveyed for lichen and bryophyte species. Early results suggest that rock climbing has a negative impact on the abundance of both bryophyte and lichen communities. However, impacts were not distributed evenly across the rock faces and different lichen functional types are affected to different degrees. Evidence also suggested that slope, aspect, and microtopographic variation have a significant impact on bryophyte and lichen community composition. Understanding these impacts is important if future management of rock climbing routes is to consider the potential for restoration and recovery of heavily impacted sites

Roseman, Edward F.[1]*, James Boase[2], Justin A. Chiotti[2], Robin DeBruyne[3], Richard Drouin[4,] Roger L. Knight[5,] and Todd Wills[6]. **Developing a science and monitoring strategy to guide recovery of fisheries habitats and populations in the St. Clair-Detroit River system.** [1]USGS Great Lakes Science Center, Ann Arbor, Michigan. [2]U.S. Fish and Wildlife Service, Grosse Isle, Michigan. [3]University of Toledo, Toledo, Ohio. [4]Ontario Ministry of Natural Resources and Forestry, London, Ontario. [5]Great Lakes Fishery Commission, Ann Arbor, Michigan. [6]Michigan Department of Natural Resources, Harrison Township, Michigan. Email: eroseman@usgs.gov

The St. Clair-Detroit River System (SCDRS) contains the St. Clair River, Lake St. Clair, and the Detroit River connecting Lake Huron to Lake Erie in the densely populated Detroit/Windsor metropolitan areas. Losses of fish habitat and other perturbations resulted in the designation of portions of the SCDRS as Great Lakes Areas of Concern with loss of fish habitat and degradation of fish populations identified as Beneficial Use Impairments. Efforts to remediate and delist this BUI have focused on restoring habitat for native fishes and overall aquatic ecosystem health. To date, investigations have focused on site-specific effectiveness of restored habitats with only a few long-term aquatic community assessments. While these investigations have done well to provide site-specific validation of the success of individual restoration projects, they lack a credible long-term measure of fish population trajectory in response to habitat improvements. As part of a collaborative initiative, we implemented a scientific strategy for coordinated research and monitoring that incorporates a long-term vision for ecosystem recovery to measure the response of the system to restoration. Our approach capitalizes on the collective impact concept to measure progress and make efficient use of resources available for restoration.

Schulte, Rainie* and Keith Summerville. **Effects of prairie enrichment on pollinator communities in Chichaqua Bottoms Greenbelt, Iowa.** Drake University, Des Moines, Iowa. Email: rainie.schulte@drake.edu

Chichaqua Bottoms Greenbelt is a 9000-acre nature preserve located in central Iowa. Chichaqua receives government funding to enhance and restore prairie habitat for the benefit of native wildlife. Few studies, however, have explicitly tested whether enhancing floristic diversity impacts ecosystem services. The purpose of this study was to test the hypothesis that increasing forb cover within prairie patches increases pollinator richness and diversifies community composition. To test this hypothesis, we selected eight prairie plots to sample butterfly and bumblebees. Plots were organized into four sets of geographically close pairs; each pair consisted of one enriched and one control prairie patch. Line transect surveys were established within at each plot and each transect was sampled once a week. To sample butterflies, the observer walked three parallel one hundred meter transects, located fifty meters from one another, in each direction. All individual butterflies observed were noted and any specimens that could not be identified on site were

captured and identified using a reference manual in the lab. T-tests demonstrated that prairie enrichment did not significantly affect the species richness or the total abundances of butterflies in the prairie plots. However, ordination revealed that increasing forb cover did attract significantly different communities of butterflies. A Mantel test determined that spatial proximity was not a significant determinant of community composition. These results suggest that rather than attracting more individuals or species per se, enriched prairies attract a unique subset of species of high conservation value (e.g., *Speyeria idalia; Danaus plexippus).*

Shuman, Tyler C.[1]*, Robert B. Gillespie[1], Peter C. Smiley Jr.[2], and Javier M. Gonzalez[3]. **What is the relative influence of bed sediment composition and water chemistry on aquatic macroinvertebrate metrics in agricultural headwater streams?** [1]Purdue University Fort Wayne, Fort Wayne, Indiana. [2]USDA-Agricultural Research Service, Columbus, Ohio. [3]USDA-Agricultural Research Service, West Lafayette, Indiana. Email: shumtc01@pfw.edu

Macroinvertebrates of channelized headwater streams in agricultural landscapes are exposed to pesticides and altered bed sediments. We hypothesized that macroinvertebrate assemblages inhabiting sediments with a low percentage of gravel and low organic content are less diverse than those with greater gravel and organic content. We further hypothesized that agricultural chemicals in the water column would have less influence on macroinvertebrate assemblages than bed sediment characteristics. We analyzed particle-size distribution, percent organic content, and agricultural chemical concentrations of three channelized headwater streams and one reference site. Water samples were collected weekly, sediment samples were collected three times from May-September, and macroinvertebrate assemblages were sampled twice. Taxon richness was significantly greater at the reference site (mean = 13; 11.33-14.67) than that at channelized sites (mean = 8.4; 7.00-10.67). The percent of sediments with particles greater than 16.0 mm (gravel) was significantly greater at the reference site (mean = 12.2%; 4.70-18.20 %) than that at channelized sites (mean = 2.53%; 0.00-10.33 %). However, organic content did not differ significantly between channelized (mean = 2.2%; 1.1-3.1 %) and reference (mean = 2.8%; 1.7-4.8%) streams. Additionally, mean total concentrations of pesticides did not differ between channelized sites (mean = 0.80 ppb; 0.10-2.06 ppb) and reference sites (mean = 0.07 ppb; 0.02-0.15 ppb). These data support the hypothesis that sites with greater gravel content in sediments have greater macroinvertebrate taxa richness. However, it appears that organic content of sediments had no influence on macroinvertebrate richness. Although, as predicted, pesticide concentrations in water were not associated with taxa richness, it is possible that pesticide concentrations in sediments could negatively influence the diversity of macroinvertebrate assemblages. Multivariate analyses of these independent variables and diversity metrics could determine the relative importance of physical and chemical sediment characteristics on macroinvertebrate diversity of channelized headwater streams.

Slater, Julie M.*, and G. Matt Davies. **Historical land use changes of Ohio's *Sphagnum*-dominated peatlands.** The Ohio State University, Columbus, Ohio. Email: slater.150@osu.edu

In peatlands, as in many other ecosystems, historical changes in land use have decreased the land's capacity to sustain important ecosystem services such as carbon storage, water quality improvement, and rare species habitat. In 1992, 98% of surveyed historical peatlands in Ohio no longer supported characteristic peatland vegetation, primarily due to the impact of agricultural activity. By updating this information and adding spatial data on current land use in Ohio's bogs, we can help prioritize peatland restoration efforts throughout the State. We assessed the usefulness of historical maps and literature in evaluating the current status of Ohio's historical *Sphagnum*-dominated peatlands (bogs). Historical literature was used to locate 42 Ohio bogs from a long list of 87 potential sites, and United States Geological Survey (USGS) maps provided information on historical wetland extent at 32 of these sites. Differences in mapping criteria and scale made

comparisons of peatland extent over time unreliable: mapped wetland extent increased at 8 of 15 examined basin bogs. Instead, a map of estimated early-1900s bog extent was created by selecting the largest mapped wetland area among the three time periods at the 32 bog sites, totaling 3,513 ha. With this synthesized map, we were able to examine current land use at historical bog sites using National Land Cover Database (NLCD). We found that 23% of mapped historical bog area is still classified as wetlands, 56% is classified as non-cultivated vegetation, and 44% is developed, cultivated, or dammed and flooded. In addition, large bogs appeared to be more susceptible to land use conversion than small basin bogs. These sites present a great opportunity for restoration of Ohio's historical peatlands.

Stratman, Anna Jean*, Julie Rabe, and Cris G. Hochwender*. ***Oviposition preferences of Southern Indiana Danaus plexipus on local species of Asclepias.*** University of Evansville, Evansville, Indiana. AS Email: as673@evansville.edu; CH Email: ch81@evansville.edu

Flagship species serve an important educational purpose, generating public support for conservation goals beyond the needs of the specific species. Monarchs and milkweeds are an ideal system to engage the public because monarch populations are in decline and most people value monarch butterflies. We researched oviposition preferences of Southern Indiana monarch butterflies across four local species of milkweed to better understand and educate the local public about monarchs and their preferred host plant. Four native species in the study included: *Asclepias incarnata* (swamp milkweed), *A. tuberosa* (butterfly milkweed), *A. perennis* (thin-leaf milkweed), and *A. syriaca* (common milkweed). These plants included 67 common milkweeds, 38 butterfly milkweeds, 29 thin-leaf milkweeds, and 58 swamp milkweeds. Oviposition preference was tested using chi-squared. Although monarchs preferred swamp milkweed, with over 90% of the plants in the experiment being selected for oviposition by monarchs, over 50% of all species in the experiment were selected by monarchs suggesting that monarchs utilize all four local species of milkweed to rear offspring. Therefore, when educating the public about planting milkweed, advocates can suggest a variety of milkweed that may be more appealing to gardeners such as flower color and flowering duration. By encouraging the public to grow more milkweeds for monarchs, backyard gardeners may also begin to consider other native plants, and by extension, invest in the conservation goals of ecological restoration.

Struckhoff, Matthew A.*[1], Leslie K. Lueckenhoff[2], John S. Weber[3], and Michael J. Hooper[1]. **Facilitating post-contamination ecological restoration by integrating project planning, implementation, and monitoring.** [1]USGS Columbia Environmental Research Center, Columbia, Missouri. [2]Missouri Department of Natural Resources, Jefferson City, Missouri. [3]US Fish and Wildlife Service, Columbia, Missouri. Email: mstruckhoff@usgs.gov

The Little St. Francis River chat pile site in southeast Missouri is a historical lead and zinc mining waste site being remediated and restored as part of a Natural Resource Damage Assessment and Restoration settlement. To catalyze and improve restoration implementation at the 50 hectare site, we heeded calls from within the restoration ecology community to integrate restoration planning with long-term monitoring design. Site reconnaissance related coarse extant community types to potential restoration targets identified in USDA Ecological Site Descriptions to identify three broad goals: bottomland forest restoration on the remediated chat pile site, upland woodland habitat improvement, and invasive plant species reduction. Restoration monitoring was designed to quantify changes in plant community attributes relevant to these goals. Pre-restoration vegetation sampling quantified plant community composition, enabled refinement of restoration objectives and identification of management strategies appropriate for Ecological Site Descriptions and yielded maps to visualize baseline invasive species abundances and inform eradication planning. Continued invasive species sampling will enable rapid, map-based quantification of changes in abundance and identify locations where additional eradication efforts are needed. Long-term community

composition monitoring will relate restoration progress to specific restoration methodologies and inform adaptive management recommendations.

Troy, Jennifer L.* and Robert B. Gillespie. **Suspended solids, turbidity, instream habitat, and fishes in headwater streams.** Purdue University Fort Wayne, Fort Wayne, Indiana. Email: troyjl02@pfw.edu

Extensive agriculture in the Midwest United States has led to headwater streams being used as drainage ditches. These streams are subject to contaminants from fields, increased sedimentation, and degradation of natural habitat. Human induced alterations to the aquatic ecosystem have been shown to negatively impact the integrity of the aquatic stream community. Previous research has shown that instream habitat alteration better explained variation in fish-community metrics than water chemistry. However, these studies did not include suspended solids (TSS), which are considered a major freshwater contaminant. Our research attempts to better understand the impacts of total suspended solids to aquatic communities in an effort to provide important information to guide conservation efforts. Our study area included eight 125-meter sites among four headwater streams of the Cedar Creek watershed; two, 125-meter sites among two headwater streams of the Fish Creek watershed; one 125-meter site in a headwater stream of the St. Joseph River in Osseo, MI. Weekly water samples were collected and analyzed for total suspended solids, turbidity, and agrochemicals. Instream habitat, riparian habitat, and fish surveys were characterized. Turbidity values ranged from 1.4-281.6 NTU, with a median of 22.9 NTU. TSS values ranged from 3.2-81.6 mg/L, with a median of 16.6 mg/L. IBI scores ranged from 16-46, with a median site score of 32. Preliminary data suggest that total suspended solids and fish assemblage metrics are weakly correlated (r= -0.14: -0.49), but alone are not significant in explaining fish assemblages. Instream habitat, water chemistry, and landscape metrics best explained diversity (r^2=0.60) and evenness (r^2= 0.43). Instream habitat and water chemistry best explained species richness (r^2=0.56) and IBI (r^2= 0.55). Abundance was best explained by landscape, riparian and instream habitat metrics (r^2= 0.46). These results suggest that instream habitat metrics may be a stronger influence on fish assemblages than TSS.

Willoughby, Olivia* and Ai Wen. **Correlation between wild bee populations and vegetative resources in the Conservation Reserve Program pollinator habitat initiative plantings.** University of Northern Iowa, Cedar Falls, Iowa. Email: willougo@uni.edu

Habitat loss is one of the main factors that has attributed to a global decline in the wild bee population as well as many other pollinators. The Conservation Reserve Program Pollinator Habitat Initiative (CP-42) was established by the USDA as a way to provide long lasting and suitable habitat for bees and other pollinators. In 2018, we surveyed 28 CP-42 sites for vegetation density and floral resources; and of those sites, 8 were surveyed for bees using sweep net. We also surveyed the floral resources in each CP-42 planting. Preliminary results showed a strong positive relationship between wild bee density and diversity and the total floral resources in a field. However, there were no significant results produced when looking at only the sown floral resources and the total stem densities. These findings suggest that CP-42 plantings with a higher density and diversity of florals will support a larger and more diverse array of wild bees.

Wold, Susie*, Elizabeth Glennon, and Molly McNicoll. **Proposed restoration: replacing a reed canary grass meadow with a sedge grass meadow. What are the possibilities?** Luther College, Decorah, Iowa. Email: mcnimo01@luther.edu

Wetland restorations that result in high diversity native vegetation provide numerous benefits, including improved water quality and support for high diversity insect and bird communities. However, replacing invasive-dominated communities with native communities is difficult and well-intentioned restorations may be abandoned when either establishment of natives is unsuccessful or invasive species continue to dominate or reinvade the site. Deciding whether or not a restoration is attainable requires an assessment of the current site and probability of success. Luther College has proposed a native sedge meadow restoration in the floodplain of a perennial creek, a site currently dominated by reed canary grass (*Phalaris arundinacea*). We established a baseline for the hydrology, existing vegetation, and seedbank of the restoration site to assess and plan the components of this restoration. A summary of the initial site assessment will be presented, as well as current restoration plans being considered and the benefits and drawbacks of different management options.

Zuelke, Amanda* and Rebecca K. Tonietto. **The effects of phylogenetic and functional diversity of eastern tallgrass prairie species on bee abundance and diversity.** University of Michigan – Flint, Flint, Michigan. Email: azuelke@umflint.edu

Worldwide, pollinators have been subjected to pesticides, parasites, and loss of habitat due to the conversion of wild areas to urban and farm lands. However, some anthropogenically altered and developed lands are being converted back to the pre-settlement ecosystem through habitat restoration and management. Typically, restoration successes are measured using plant-based outcomes, increasingly incorporating metrics of functional and phylogenetic diversity. Yet, bees responses to plant communities optimizing around different metrics of diversity are not well understood. For this project, we utilized The Prairie Plot Experiment at the Morton Arboretum in Lisle, Illinois. The research site is comprised of 437 4-m^2 plots planted in 2016 based on varying levels of phylogenetic and functional diversity incorporating 127 plants native to the eastern tallgrass prairie and savanna. We conducted three pollinator observation rounds throughout the summer of 2018 at 69 of the plots. During observation periods bees were recorded to the genus level and noted of how many flowers each bee visited. Throughout our observational periods we also conducted vegetation surveys and recorded ground cover and blooming species. Preliminary results suggest that a higher diversity of bees visited the plots that were monocultures and that *Bombus spp.* was the species with the highest number of individual flower visits, while *Dialictus spp.* visited the most plots.

FIELD TRIP ABSTRACTS

Viste-Sparkman, Karen*. **Prairie and savana restoration at the Neal Smith National Wildlife Refuge.** Neal Smith National Wildlife Refuge, Prairie City, Iowa. Email: karen_vistesparkman@fws.gov

This field trip will provide a guided tour of the Neal Smith National Wildlife Refuge, which is located about 32 km east of Des Moines, Iowa. The U.S. Fish and Wildlife Service has been authorized to acquire 35 km^2 of land within the Walnut Creek watershed to reconstruct the tallgrass prairie ecosystem on former farmland. To date about 23 km^2 have been acquired. The refuge staff's management methods include prescribed fire, grazing, haying, tree removal, mowing, and invasive species treatment. Participants will have the opportunity to view prairie and savanna restoration and reconstructions that have been conducted in the past 28 years on this site. This field trip will be outdoors, so dress accordingly for weather and anticipated conditions.

DeCook, Mike*. **Restoration at the DeCook Bison Ranch.** DeCook Ranch, Lovilia, Iowa. Email: mdecook8@gmail.com

This field trip will provide a guided tour of the restoration efforts at the DeCook Bison Ranch, which is located about 41 km south of Pella, Iowa. The mission of the DeCook Ranch is to protect and restore wild nature and wildness, ecologically and aesthetically, on a profitable working ranch. Our goals are: 1) to provide permanent protection of our wild and natural land from development; 2) protect dark skies and natural quiet; 3) to protect native biodiversity, ecosystems, and ecological land health; and 4) produce native, healthy food with a perennial year-round natural grazing system. We will be talking about and looking at oak savannas, wetlands, prairie remnants, prairie reconstructions, and bison. We will demonstrate to participants that one does not have to change or destroy the natural world to make a living off the land and produce food which will benefit the complete web of life including us. This field trip will be outdoors, so dress accordingly for weather and anticipated conditions.

Schmidt, Ryan*. **Twenty-five years of oak savanna restoration at the Snyder Heritage Farm.** Iowa Natural Heritage Foundation, Des Moines, Iowa. Email: rschmidt@inhf.org

For over 25 years, Snyder Heritage Farm has been slowly transitioning from a traditional farm to a beautiful blend of prairie, oak savanna, woodland and wetlands. It is now a 0.6 km^2 natural area just north of the Des Moines metropolitan area. Snyder Heritage Farm, donated in 1991, is currently owned and stewarded by Iowa Natural Heritage Foundation. Since 1991, all but 0.03 km^2 of the former rowcrop fields and cattle pasture have been restored to native vegetation. The oak savanna area, which was perennially grazed by the former owners, now boasts a plethora of native grasses and wildflowers to complement the existing open-grown bur oak, white oak, red oak, and shagbark hickory. The savanna, although degraded at the time of the donation, does exhibit remnant plant species and nearly three decades of restoration has increased plant diversity across the site. Restoration practices have included removal of invasive woody vegetation, prescribed fire, and interseeding of native seed. Iowa Natural Heritage Foundation has learned that oak savanna restoration demands tremendous time and effort, as well as time to recover. The savanna at Snyder Heritage Farm continues to show signs of recovery and increased conservation value even after 25 years. Iowa Natural Heritage Foundation staff will provide participants with a guided tour of this site and will discuss the journey of this site's savanna restoration, lessons learned along the way, and their future restoration goals. This field trip will be outdoors, so dress accordingly for weather and anticipated conditions.

Youngquist, Tim*. **Marshall County Conservation Board Prairie STRIPS Project Site.** Iowa State University, Ames, Iowa. Email: timyoung@iastate.edu

This field trip will provide a guided tour of the STRIPS (Science-based Trials of Rowcrops Integrated with Prairie Strips) project site in Marshall County, Iowa. The STRIPS project is composed of a team of scientists, educators, farmers, and extension specialists working on the prairie strips farmland conservation practice. Over a decade of research shows that prairie strips are an affordable option for farmers and farm landowners seeking to garner multiple benefits. By strategically converting 10% of a crop field to diverse, native perennials farmers and farmland owners can reduce the amount of soil leaving their fields by 90% and the amount of nitrogen leaving their fields through surface runoff by up to 85%. Prairie strips also provide potential habitat for wildlife, including pollinators and other beneficial insects. This field trip will give attendees the opportunity to walk through first year prairie strips in a central Iowa crop field. Participants will be able to ask questions and discuss prairie strip management, design, benefits, current research findings, and more. Identification of prairie species, wildlife viewing, and a hike through the prairie strips will also be available to attendees. This field trip will be outdoors, so dress accordingly for weather and anticipated conditions.

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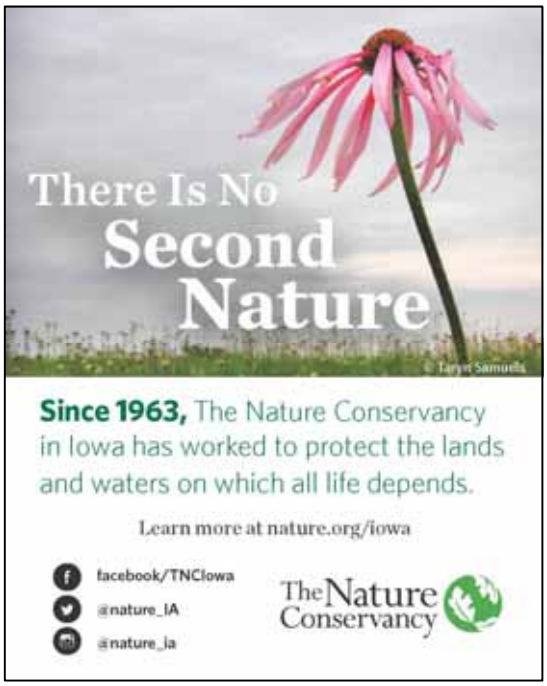
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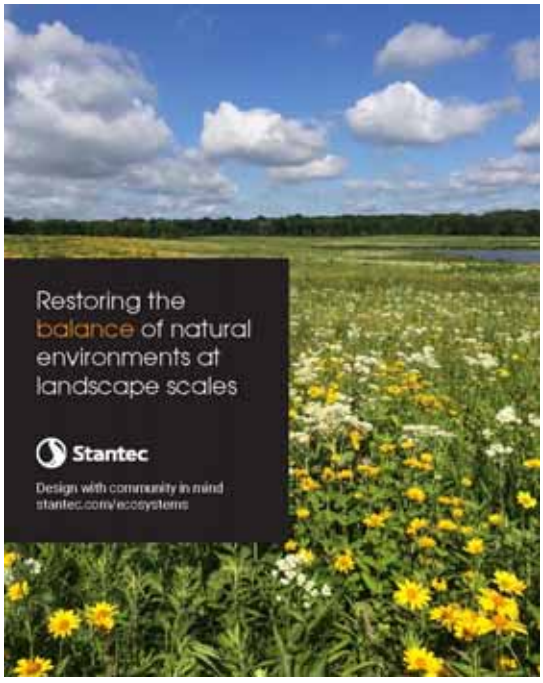
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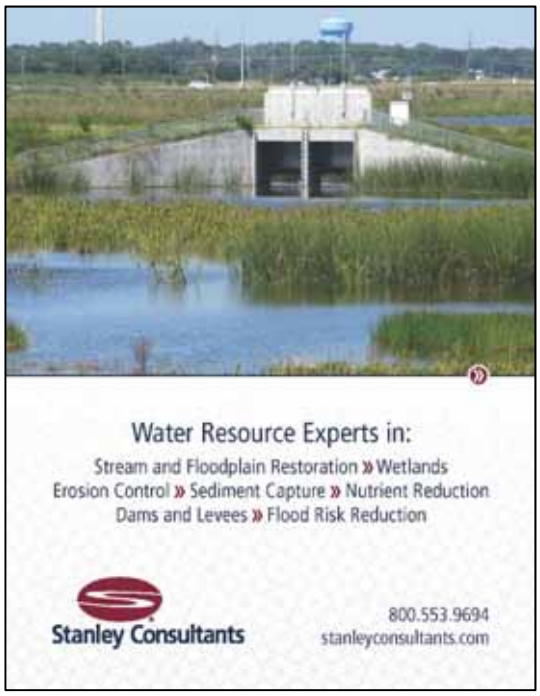
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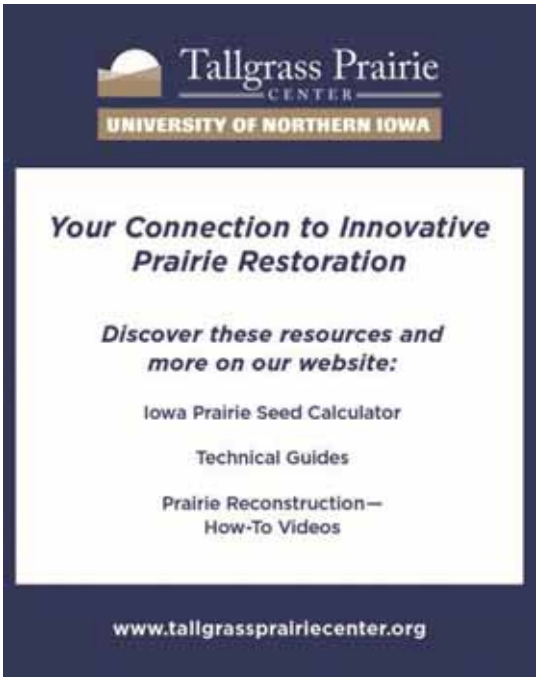
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Contributors: Luther Aadland, David P. Benson, Andrew F. Casper, Hua Chen, Joe DiMisa, Steve Glass, Heath M. Hagy, John A. Harrington, Neil Haugerud, Constance Hausman, Michael J. Lemke, Christian Lenhart, Jen Lyndall, Dan Shaw, John A. Shuey, Peter C. Smiley Jr., Daryl Smith