

NAC 2022

Tuesday, September 6, 2022 3:15pm - 4:30pm

Climate Change Harbor Ballroom Rm 303-305

Seed Sourcing Strategies Under Climate Change: a review of the current literature

Topic: Native plant materials in restoration/rehabilitation

Pati Vitt
The Xerces Society

Rebecca Barak, Chicago Botanic Garden;
Anna Braum, The Wetlands Initiative;
Jessamine Finch, The Native Plant Trust;
Stephanie Frischie, The Xerces Society;
Izabella Redlinski, Forest Preserve District of Cook County;
Pati Vitt, Lake County Forest Preserve District

Like many places, the Great Lakes region of the midwestern US is predicted to experience increased air temperatures between 3 ± 1 °C and 5.0 ± 1.2 °C by the end of the century. Increases in winter and spring precipitation of up to 20% to 30% are projected for this region, but future summer and fall patterns remain uncertain. The severity and frequency of heavy rain events will increase, leading to increased flooding, and regionally the number of summer days with very high temperatures is expected to increase. As a result, the challenges associated with managing and restoring natural habitats will become increasingly complex. A primary consideration in undertaking management decisions to ensure the climate resiliency of native habitats, and the rare species that inhabit them, is the sourcing of propagules for restoration, reforestation and rare species reintroduction efforts.

In order to understand the current state of the science with regard to seed sourcing under climate change, we have undertaken a comprehensive review of the literature. To compile a list of papers that test seed sourcing strategies, we conducted a total of 9 searches on Web of Science using combinations of keywords including 'seed sourcing', 'restoration' and 'climate change.' From an initial result of 2442 unique titles, we used a systematic process to identify a total of 174 papers that were included in the full text review. Of these, 70.5% focused on a single taxon, and the vast majority of the experiments were conducted on trees (71.9%), while only 21 looked at how climate might influence the performance of an herbaceous species and 19 of a graminoid species. Experiments were conducted on propagules collected as seeds (30.9%) or implemented at the seedling/sapling stage (38.1%), while 17.3% of the experiments explicitly included both critical life history stages. The majority of the studies were conducted as field trials, with 46% conducted in a common garden setting, 36.7% conducted a multi-site provenance performance trial, while a small majority of these field trials implemented a full reciprocal transplant design.

We will present a synthesis of the literature to provide insight into common traits that influence performance that should be under consideration during the seed mix design phase of a restoration, during the sourcing phase of a reforestation effort, or that may influence the success of a species recovery or reintroduction program.

Ecological consequences of an extreme out-of-season flood on the Faville Prairie, Jefferson County, WI.

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Paul Zedler

UW-Madison, Nelson Institute

Brad Herrick
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Cooper Rosin
UW - Madison, Nelson Institute

Of special importance in this time of looming climate change, is the need to consider if changes in disturbance regimes might imperil the reservoirs of native biodiversity that the natural remnants contain. Changes in the frequency of occurrence of extreme events are of special concern. In this study we assessed the short-term effects of an extreme flooding event on the Faville Prairie State Natural Area. This site, a property managed by the University of Wisconsin at Madison Arboretum lies in Jefferson Co, WI and is bordered by the Crawfish River. It supports a diverse vegetation across complex microtopography. It ranges from mesic to wet-mesic prairie and transitions to a lower elevation area of wetland adjacent to the Crawfish River. In June of 2008 a flood of unprecedented extent and duration was caused by an anomalous incident of extreme precipitation. The existence of a comprehensive sample of the vegetation of permanently marked points in 1978-79 provided an opportunity to compare the post-flood condition to a sample taken when no flood of this size or that had occurred this late in the growing season had been recorded in the previous 80 years. We found that the flood was responsible for significant changes in the occurrence of the constituent species. Of most concern was the near extinction of native prairie species of conservation value. Other prairie species survived the flooding with their frequency of occurrence and spatial distribution little altered. Some species increased in occurrence, largely those associated with wet-mesic prairies or wetlands and therefore presumably tolerant of inundation and saturated soils. This short term acute disturbance was overlaid on pattern of invasion woody plants and alien species or, in the case of *Phalaris arundinaceae*, an alien invasive strain, that has been in progress since the reserve was established in the 1940s. Evidence suggests that the vegetation has considerable resilience and is recovering over much of the prairie. Therefore, if this extreme flood remains as infrequent as historical data suggests it might, flooding will not pose a serious threat. But the historical pattern has permitted the expansion of invasive species and did little to slow the increase in native shrubs and trees. If these trends continue, even if the optimistic assumption of the capacity of native prairie species to recover holds, active management to push back against the alien invasion will probably be required.

A menu of adaptation strategies and approaches for Great Lakes coastal ecosystems

Topic: Protecting and managing natural areas for climate resilience

Kristen Schmitt
Northern Institute of Applied Climate Science

Danielle Shannon
Northern Institute of Applied Climate Science

Throughout the Great Lakes region, climate change is impacting our coastal ecosystems, for example through increasingly severe storms and precipitation, rapid water level changes, and coastal erosion. Natural resources practitioners are facing decisions about how to help coastal ecosystems adapt to these changes, while also working to restore coastal functions disrupted by past disturbance. The U.S. Fish and Wildlife Service and the Northern Institute of Applied Climate Science convened regional managers and scientists to develop a menu of climate adaptation strategies and approaches for Great Lakes coastal ecosystems. This presentation will describe the menu and how it can be used to intentionally consider climate change in coastal management projects. We will highlight examples of pilot projects that have applied adaptation strategies to their work, including a project focused on marsh bird habitat restoration in Allouez Bay, WI.

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Ecological Monitoring Status and Trends

Long-Term Monitoring of Breeding Bird Populations at Crow's Nest Natural Area Preserve, Virginia

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Michael Lott

Virginia Department of Conservation and Recreation

Bird populations across North America have suffered tremendous declines in the past 50 years with an estimated loss of nearly three billion birds. Reasons for this decline include habitat loss, insect population decline and climate change. Crow's Nest Natural Area Preserve (CNNAP) in Stafford County – owned and managed by the Virginia Department of Conservation and Recreation (VCDR) – protects one of the largest contiguous occurrences of mature hardwood forests remaining in the coastal plain of Virginia. In addition, approximately 900 acres of tidal and non-tidal wetlands are located throughout the preserve. The varied habitats at CNNAP support a number of bird species of conservation concern as identified by the U.S. Fish and Wildlife Service and Partners in Flight, including king rail (*Rallus elegans*), red-headed woodpecker (*Melanerpes erythrocephalus*), wood thrush (*Hylocichla mustelina*), prothonotary warbler (*Protonotaria citrea*) and Kentucky warbler (*Geothlypis Formosa*) as well as additional species identified by the Virginia Department of Wildlife Resources. Beginning in 2014, staff with the VDCR with the assistance of volunteers have completed an annual breeding bird survey at CNNAP. Sixty-eight monitoring points were randomly chosen across the preserve and were stratified by plant community type. An additional 10 monitoring points are located along a tidal section of Accokeek Creek and are sampled by canoe. A ten-minute point count is completed twice annually at each point between May 28 and July 15. The long term goal of the program is to monitor how habitat changes associated with climate change and invasive species may affect bird populations across the preserve. For example, loss of ash (*Fraxinus* spp.) trees associated with the emerald ash borer (*Agrilus planipennis*) invasion has dramatically altered bottomland hardwood forests and tidal hardwood swamps across the preserve. In addition, visitation at CNNAP increased dramatically during the pandemic, and data from the program may provide insight into how and if increases in visitation have affected breeding bird populations. Finally, data from the program will inform management decisions as VDCR staff plan for new trails and associated infrastructure in the future. This presentation will summarize trends observed to date.

Ptilinum nodosum monitoring: tracking population fluctuations and trends of a rare plant with 35 years of creek walking

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Deborah Landau

The Nature Conservancy (MD/DC chapter)

The population of the federally endangered *Harperella* in Maryland is restricted to two creeks, one of which has been monitored nearly continuously since 1988. Monitoring involves walking several miles of a stretch of Sideling Hill Creek every August. While plant numbers have fluctuated from year-to-year, the population has, overall, remained relatively stable, and individual stands are persistent. However, bloom times appear to be occurring earlier, and flooding events more frequent, potentially jeopardizing the continued monitoring of this population, and perhaps the plant itself.

Three decades of dune vegetation change along successional and latitudinal gradients among 3 Great Lakes national parks

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Noel Pavlovic

U.S. Geological Survey

A. Kathryn McEachern

U.S. Geological Survey

Joseph Deas

U.S. Geological Survey

Since the late 1800's, coastal dune vegetation has been recognized as dynamic due to the opposing forces of shoreline processes and plant succession. While Great Lakes water level changes are known to be quasi-periodic at 35- and 150-year intervals and to drive coastal sand dune dynamics, little is known about the rates of vegetation succession at decadal intervals in the coastal dunes. Rates of dune succession are important for conserving endangered species that inhabit Great Lakes sand dunes such as the federally threatened, Pitcher's thistle (*Cirsium pitcheri*). We used vegetation data collected in 1989-1990, 2008 and 2018 at Pitcher's thistle demography sites at Indiana Dunes National Park, and Pictured Rocks and Sleeping Bear Dunes National Lakeshores, to examine vegetation change over approximately 30 years timespan across a latitudinal gradient. Sites within each park were situated among different successional stages to understand how plant cover influenced Pitcher's thistle. Sampling grids with four-by-four-meter cells were superimposed over demography plots that ranged from 0.03 to 0.01 hectare in area, depending on thistle density. A 1-meter radius plot was placed at each grid intersection and the identity and cover of each plant species was recorded. We analyzed plot-and site-level vegetation change using multivariate techniques and a novel successional index, and related vegetation dynamics to landscape context and change metrics. Vegetation composition varied latitudinally among the parks. We found that vegetation change varied with coastal context and successional stage at initial sampling. Late successional plots accumulated species over time but were static relative to the abundance of dominating grasses. We discuss our results in the context of Great Lakes dune conservation and implications for rare plant restoration and viability in the context of climate change.

Using LiDAR for Long-Term Monitoring of Restored Prairies

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Karli Cich

Shakopee Mdewakanton Sioux Community

Monitoring ecosystems at the landscape scale often utilizes the help of spatial data. Utilizing LiDAR point-cloud data and digital elevation models (DEM) can help understand the changes occurring at a smaller scale without relying on ground-based surveys. Long-term monitoring can be challenging with incomplete or nonexistent data to help understand how a landscape has changed over time. With many states conducting LiDAR flight surveys every decade, utilizing this data in a meaningful way can help with future management and conservation goals. In this research, the goal is to track changes in microtopography between 2011 and 2021 using LiDAR-derived elevation data in restored prairies. Often restoration of tallgrass prairie is done on previously farmed land, with tractors and implements removing natural microtopography from the landscape. This research compares microtopography in four land-uses, including soybean/cornfields, fallow fields, newly restored prairies, and older restored prairies. Another aspect is to understand the relationship between microtopography with plant diversity in newly restored prairies and older restored prairies-finally, a comparison of the same sites using 2011 elevation data to 2021 elevation data. Plant diversity was collected using the Prairie Reconstruction Monitoring Protocols. Elevation data collection for 2011 and 2021 used a UAV-mounted LiDAR system to generate DEMs. Older prairies, restored in the 2000s, showed higher variability in microtopography than new prairies, fallow fields, or corn/soybean fields. Prairies that have higher vegetation diversity also had more variability in microtopography. Thus, recovering natural microtopography from previous farming practices takes both time and plant species diversity. Since LiDAR data is publicly available, land managers can use this approach to get quick, accurate, and cost-effective assessments of prairies.

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Outreach: Virtual Connections

@bullrunmountains: Digitally Connecting the World to an Intellectual and Spiritual Sanctuary.

Topic: Outreach: cutting edge education, volunteer stewardship, citizen science and social media

Joseph Villari

Virginia Outdoors Foundation

The Virginia Outdoors Foundation owns and manages a 2,500 acre preserve that sits just thirty-five miles outside of Washington, DC. In 2002, this mountainous land holding became a state-designated Natural Area Preserve set to permanently protect its significant natural and cultural holdings. Now a naturally rewilded wilderness area that protects eleven distinct plant communities and a rich geologic history, the preserve is also home to a diversely peopled past that is known by its many prehistoric sites, homestead ruins, and burial grounds. Operated as a living laboratory and open-air museum, this public space serves as a unique and hopeful resource to the surrounding human communities. The last few years of punctuated equilibrium included the introduction of our preserve into the digital space. Unlike most public outdoor spaces, we engage with our communities not as a recreational hiking destination, but as a place to engage in intellectual and spiritual pursuits. We connect people to place utilizing science, art, and history – encouraging them to explore and discover in a thoughtful way that is less impactful on the resources that we collectively steward. Our focus on outreach relies heavily on social media (through Facebook, Instagram, and iNaturalist), informal education, and citizen science programs that aim to renew or improve ecological and societal awareness, mindfulness, and a greater sense of community in all of those that we serve.

Communicating the importance of natural areas

Topic: Outreach: cutting edge education, volunteer stewardship, citizen science and social media

Kelly Randall

Minnesota Department of Natural Resources

Minnesota's Scientific and Natural Area Program outreach strives to engage people in understanding the importance of natural areas. This outreach seeks to communicate an understanding and stewardship of, as well as interactions with, these areas. The long-term objective is support and involvement in the conservation of natural areas by the people of Minnesota.

This presentation will cover the basic and enhanced communication tools the Minnesota Scientific and Natural Areas uses for outreach. Tools include program web pages, centralized email account, social media, as well as newsletters, printed materials, and interpretation. It will also highlight two forms of communication that have had surprising engagement and participation, a program sticker and a bioblitz series. This presentation will rely on links to several of these tools to illustrate them in action. Some materials will be available for attendees to take with them as well. Rather than focus on the number of web pages, social media followers, or brochures printed this presentation will explain how this work is done, as well as who is responsible for it. This will give attendees ideas for how they might also do this work or prompt them to share outreach tools they use to communicate to their audience.

Lessons learned from optimizing visitor communication efforts in augmented and virtual reality

Topic: Developing technologies and apps: what to consider in creating or using

Ingrid Schneider

University of Minnesota

In our 'virtual century' (Anderson, 2020), natural resource agencies have increasingly offered 'virtual' tours, online educational opportunities and planning sessions. The number and type of such offerings expanded exponentially in 2020 due to the SARS-2- Coronavirus. Moving forward, questions remain as to if and how to retain or redevelop such offerings. Adopted extensively in other industries, advanced information communication technologies (ICT) like augmented reality (AR) and virtual reality (VR) offer significant opportunities in natural resource management and nature-based tourism (Smith, 2017). Benefits include potential cost reductions, service improvements, and effective and expanded natural resource education in an era of ever-decreasing budgets. However, effective development of advanced ICT takes time, expertise, equipment, and iterative feedback.

An 18-month collaborative development process engaged best practices, stakeholder involvement, and multimedia teams to create and test engaging visitor education about if and how to manage forests impacted by emerald ash borer (*Agilus planipennis* Fairmaire), one of the most destructive terrestrial pests ever (Herms et al. 2014). The selected management approaches followed common forestry practices: doing nothing, select harvest with planted

trees, select harvest with natural regeneration and complete harvest with natural regeneration. Identical messaging was tested in photo and text format, (AR) and (VR) among more than 300 state park visitors at three parks.

Our research development and implementation process included: selection and management of a multi-agency advisory group; multiple focus groups to understand visitor perceptions of forest management in response to EAB; iterative message development and refinement to address visitor questions and concerns identified in the focus groups; message testing with experts and consumers; and visual and acoustic media creation and acquisition to optimize experimental educational resources across messaging platforms.

Development lessons included: those related to language use both within and across content expert teams as well as between experts and the public; best practice optimization across written, verbal and visual presentation; as well as technology integration across development platforms including apps and hardware. Our experiment implementation process included pre-testing, safety protocol development, and resource allocation to minimize time-per questionnaire. Implementation lessons included the importance of detailed instructions, focus time and space for visitors to complete the questionnaires, opportunities to devote hardware to the applications, and patience. In sum, the opportunities in advanced ICT are promising, and avoiding a variety of pitfalls can optimize the experience and outcomes.

Coauthors Ingrid Schneider, Angela Gupta, Bobbi Donovan, Elena Tsakasis, Ella Weber, Marcella Windmuller-Campione, Matt Russell, Brett Rannow

Wild Spotter - engaging the public to report invasive species on public lands

Topic: Outreach: cutting edge education, volunteer stewardship, citizen science and social media

Rebekah Wallace
University of Georgia

Wild Spotter aims to build citizen science volunteer capacity to protect America's wild places from harmful invasive plants, vertebrates, invertebrates, microbes, algae, and fungi that outcompete our nation's native species and threaten the biodiversity and health of every aquatic and terrestrial ecosystem. America's wild places are home to beauty, diversity, and reflection, yet they are under attack from aquatic and terrestrial invasive species. One of the goals of Wild Spotter is to help raise public awareness about the threat of these non-native invaders, and provide fast and simple steps the public can take to prevent them from spreading into new areas. nationwide inventory of invasive species in America's natural areas. You can help us fight back against harmful invaders by becoming a Wild Spotter volunteer or partner. By downloading the FREE Wild Spotter Mobile App on your smartphone, you can quickly and easily collect vital data on these invasions: location, extent, and impact - all while you are enjoying the great outdoors. The data you collect while you are visiting America's wild places will help management teams create more effective strategies to prevent and control invasive species and restore the areas they impact. By reporting data through the FREE Wild Spotter Mobile App, you will be helping to protect recreational activities, such as hiking, camping, fishing, hunting, climbing as well as clean water, abundant wildlife, and all the other benefits of these wonderful wild places.

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Prescribed Disturbance

A Tale of Grazing and Fire: Beta Diversity and Niche Availability in a Working Landscape

Topic: Prescribed disturbance: haying, grazing, fire, logging

Esben Kjaer
North Dakota State University

Esben L. Kjaer, Ryan F. Limb, Benjamin Geaumont, Jason P. Harmon, Torre J. Hovick, Kevin Sedivec

Historic vegetation heterogeneity, once inherent to the Great Plains, has now been reduced due to fire suppression,

invasion of exotic grasses, and altered grazing regimes. Homogenization has decreased biodiversity and facilitated non-native species establishment and invasion. It is possible to restore some of this lost heterogeneity through the interaction of burning and grazing (patch-burn grazing) and has been shown to positively influence biodiversity. However, in some regions of the Great Plains, the use of fire is not always practical due to extreme climatic variation or cultural aversion to prescribed fire, leading to a need for alternative ways to create structural heterogeneity that positively impacts biodiversity. To examine an alternative way to create structural heterogeneity, we utilized pastures managed with either patch-burn grazing, season-long grazing, or a modified twice-over rest-rotational grazing system (MTORG). MTORG mimics the structural heterogeneity of patch-burn grazing by restricting domestic herbivore movement, allowing them to graze paddocks with different intensities utilizing fencing rather than attracting them with fire. We sampled plant community composition in each pasture for five years to assess the spatial variation in species composition (beta diversity and vegetation patch size) and niche availability of each management practice. We found that pastures managed with patch-burn grazing had higher beta diversity across years than season-long grazing or MTORG. On average, patch-burn pastures had smaller patches with higher species turnover and less spatial variation (7.2 meters across) than either MTORG pastures or season-long pastures (7.4 meters). Also, the niche availability of patch-burn pastures was equal to or greater than that of MTORG pastures (and was likely dependent on growing season moisture) and both had greater niche availability than season-long pastures. A severe drought helped to equalize differences in patch size in years four and five, and led to more niche availability in MTORG pastures than either patch-burn or season-long pastures in year five. These results suggest that while a modified twice-over rest-rotational grazing system might create more variation in species composition (beta diversity) than season-long grazing. Patch-burn grazing creates a more heterogeneous landscape with smaller, more varied, and stable vegetation patches and greater niche availability than other management strategies. Increased heterogeneity and niche availability from patch-burn grazing should also increase diversity across trophic levels in grasslands. Future management plans should incorporate patch-burn grazing over a system designed to mimic patch-burn grazing to enhance grassland heterogeneity and biodiversity.

Breeding Bird Nesting Abundance and Nest Success in a Modified Twice-Over Rest-Rotation Grazing System

Topic: Prescribed disturbance: haying, grazing, fire, logging

Justin Clarke
North Dakota State University

Co-Authors: Torre Hovick, Kevin Sedivec, Ryan Limb, Ben Geaumont, Jason Harmon.

Grassland birds are one of the most threatened avian guilds, largely due to loss and mismanagement of grasslands. Current management negatively influences avian biodiversity by creating homogenous pastures through uniform grazing practices and altered or suppressed fire regimes. Restoring disturbance regimes including fire can be an effective way to create heterogeneity but, in many regions, a cultural aversion to fire requires creative management practices to restore heterogeneity. In 2018, we implemented a modified twice-over rest-rotation grazing (MTORG) system with varying grazing intensities of to create heterogeneity in vegetation structure. This system has four replicates that are split into quarters, referenced to as paddocks, based on percent utilization: heavy (60+ %), full (40-60%), moderate (20-40%), and rested (0%). We assessed paddock scale vegetation structure using three 25 meter transects within each paddock. We monitored nests every 2-4 days until the nest fledged or failed. We used the RMark interface to assess nest survival rates and used hierarchical modeling steps to assess the drivers of nest success. We found that the MTORG system achieved structural heterogeneity between paddocks. We found 437 nests belonging to 18 facultative and 6 obligate grassland birds. Nesting species richness was highest in the full and light treatments (18 and 19 respectively), and lowest in the heavy and rested treatments (10 and 12, respectively). Additionally, the light and full treatments each had approximately double the number of nests as the heavy and rested treatments. Overall apparent nest survival was 29% for all species combined. Our preliminary results show that variation in grazing intensity influences diversity in breeding bird nesting abundances and provides additional insights into the importance of heterogeneity in rangeland systems to manage for biodiversity.

Promoting Scots Pine Fire Regimes in Hemi-Boreal Forests: Navigating the complexity of landscapes amid constant change

Topic: Prescribed disturbance: haying, grazing, fire, logging

Charles Ruffner

School of Forestry and Horticulture

Fire is an important natural disturbance and a driver of hemi-boreal forest successional trajectories, structural complexity, and biodiversity. Understanding the historic fire regime is an important step towards managing resilient forests in the face of Constant Change. Focusing on Lithuania's hemi-boreal forests, we first mapped the potential natural fire regimes based on the relationship between site conditions, vegetation, and fire frequency using the ASIO model to reveal four fire frequency categories (Absent, Seldom, Intermittent and Often) in Lithuania. Secondly, we developed disturbance chronologies from the fire-prone forest landscape of southern Lithuania using dendrochronological methods.

In our first study, we sampled and cross-dated 132 Scots pine samples with fire scars from four rural dry forest stands ($n = 92$) and four peatland forest stands ($n = 40$), respectively. In total, the fire history analysis revealed 455 fire scars and 213 fire events during the period of 1742–2019. The Weibull median fire intervals were 2.7 years (range 1–34) for the dry forest types and 6.3 years (range 1–27) for the peatland forest types. Analysis pre- and post-1950 showed the Weibull median fire interval increased from 2.2 to 7.2 for the dry forest types but decreased from 6.2 to 5.2 for the peatland forest types. A superposed epoch analysis revealed significant precipitation fluxes prior to the fire events after 1950. Our model results show that 20% of Lithuania's forest falls within the Often fire frequency category. Within this category, 92% of these forests are Scots pine, which is a much desired species across forest industry. Additionally, the official fire records show an increase in fire events but decrease in burnt areas, highlighting efficient forest fire control measures.

Thus, through time, the Scots Pine forest landscape of southern Lithuania has been strongly shaped by both human and naturally induced fires quite similar to the red pine stands of North America. In our on-going fire history study, we have now expanded our sampling to include 5 more upland sites from which 184 fire scar samples were collected this recent spring. The integration of cultural influences on fire patterns highlights the interworkings of the processes driving historic regeneration patterns across similar ecosystems. Combining theory (the ASIO model) with the examination of biological archives can help us navigate the complexity of managing forest ecosystems amid constant change. As traditional forest management focused primarily on wood production has eliminated fire and effectively simplified many forest structures, we are now introducing educational programs to communicate the benefits and history of forest fires as well as adaptive management trials that use low-intensity prescribed burning of Scots pine stands to develop badly needed, multi-cohort stand structure to enhance forest resiliency in the face of changing climates. While our sampling scheme is small in Lithuania, we are modeling our efforts on those from Canada and the northern tier of the United States which has resulted in numerous advances regarding climatological and human driven influences on wildfire starts and propagation.

Co-authors: Michael Manton: Faculty of Forest Sciences and Ecology, Vytautas Magnus University, Kaunas, Lithuania

Brian Van Winkle: Idaho Tree-Ring Lab, University of Idaho, Moscow, ID

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Public/Private Conservation Partnerships

Minnesota Prairie Conservation Plan 2010-2022

Topic: Conservation partnerships

Stephen Chaplin

The Nature Conservancy

In 2008, Minnesota voters passed a constitutional amendment that increased the state sales tax to generate dedicated funding in part for habitat conservation. \$118.5 M was generated in 2021 and over \$1.2B total for habitat

conservation. The Minnesota Prairie Conservation Plan was created in 2010 by 11 conservation agencies and NGO's to influence how the funds would be spent. The plan calls for the protection of the approximately 250,000 acres of native prairie in Minnesota and identifies 28 large core areas that capture 77% of the native prairie, corridors that connect the cores, and habitat complexes along the corridors to provide stepping stones of habitat to facilitate movement. In its first 10 years, the Prairie Plan has focused resources on the core areas and corridors.

Minnesota Prairie Landowner Network: How Some Creative Thinking Created a Network of Support.

Topic: Conservation partnerships

Judy Schulte

Minnesota Department of Natural Resources

As implementation of the Minnesota Prairie Conservation Plan began and local teams of conservation professionals rallied to support the plan, it became clear that landowner engagement needed special attention. Especially since half of Minnesota's remaining native prairie is privately owned (~115,000 acres).

This prompted the creation of the Minnesota Prairie Landowner Network. The Network aims to connect prairie landowners to each other and anyone else that can provide help and support. It creates a way for members to learn and exchange with others that may not be within their own local community on innovative ideas, tried and true techniques, shared challenges, and new opportunities. Since we know not everyone engages the same way, the network is designed to connect on multiple levels (online, offline, and in-person).

Though this network is facilitated by prairie plan partners with many prairie professionals across the state participating, the goal is for the landowners to drive the conversation. To simply connect the dots between those managing prairies and hope this knowledge sharing will help us all along the way.

This presentation takes you through the challenges of reaching a scattered audience with a wide array of communication preferences, the creation of the network, the people helping make it a success, challenges encountered along the way, and goals for the future.

Native Prairie Bank: The Role of Conservation Easements in Protecting and Managing Minnesota's Natural Areas.

Topic: Conservation partnerships

Judy Schulte

Minnesota Department of Natural Resources

At the time of Public Land Survey (the mid-1800s and early 1900s) more than 18 million acres of prairie and savanna covered Minnesota. As of today, only about 235,000 acres (1.3%) of that native prairie remains and approximately half (~115,000 acres) is privately owned. In order to protect and support the on-going management of high-quality privately owned native prairie in Minnesota, the state's Native Prairie Bank Conservation Easement Program was established in 1987. This presentation will showcase Native Prairie Bank Conservation Easements, how they operate, how they fill a niche role within the Minnesota Scientific and Natural Areas Unit, and how the partnerships with landowners have expanded staff capabilities to execute native prairie management. Time will be given for open discussion on conservation easements and potential new initiatives to improve their effectiveness as a conservation tool.

Working Woods: Outreach to forest landowners through research, partnerships, and demonstrations

Topic: Outreach: cutting edge education, volunteer stewardship, citizen science and social media

Jessica Miller

Holden Forests & Gardens

Forested natural areas are extremely valuable inherently and economically in Ohio. However, conservation-minded management and applied research on protected or public lands only goes so far: Most forested natural areas-85% of the state's 8 million acres of woodland-are held in private ownership and therefore private stewardship. Unfortunately,

much of these forested natural areas have been mismanaged, misunderstood, and undervalued. Bad timber practices, development, or passive 'wait and see' approaches result in reduced or degraded ecosystem resilience, native biodiversity, and ultimately reduce the wealth, health, and life-quality of private landowners themselves. While studies have demonstrated the value of forest management, little research addresses specific regional (northeast Ohio) concerns and there is a great need for effective and accessible technical transfer to practitioners and landowners. Recent (2020) surveys have revealed that most Ohio private landowners do not have an active management plan for their woods, nor have they ever spoken to a natural resources or forestry professional regarding managing their property.

We embarked on an outreach and extension project centered around Working Woods, a 70-acre forest management demonstration at the Holden Arboretum in Kirtland, Ohio with the goal of changing the attitude towards conservation-based management and thus increasing the adoption of best management practices. Practitioners and the Ohio Department of Forestry are also able to use the site as a resource for the contingents they serve, bringing landowners and stakeholders to see the effects of management firsthand. In its first 3 years, this project has resulted in the engagement of many landowners who had no existing management plans or professional help, ultimately resulting in them seeking assistance and the adoption of management plans. Leveraging partnership, research, and on-the-ground demonstrations of forest conservation has resulted in positive change in Northeast Ohio private forest management.

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Stream and Water

Arkansas Stream Heritage Partnership positively impacts stream conservation in Arkansas by removing barriers

Topic: Conservation partnerships

Darrell Bowman

Arkansas Game and Fish Commission

Darrell Bowman¹, Kat Hoenke², Victoria Ruddle²

¹Arkansas Game and Fish Commission, No. 2 Natural Resources Drive, Little Rock, AR 72205

²Southeastern Aquatic Resource Partnership, <https://southeastaquatics.net/>

The Arkansas Stream Heritage Partnership (ASHP) formed in January of 2017 as the Southeastern Aquatic Resource Partnership (SARP) aquatic connectivity team for Arkansas in the Aquatic Connectivity Program. In true partnership fashion, this group has worked collectively as a consortium of cooperating individuals to do great things for conservation in Arkansas streams. The ASHP has fostered the focus on restoring streams through barrier removal among conservation and outdoor recreation communities in Arkansas and currently has 118 members on the Google Groups email list. Annual meetings for the membership have occurred each year in one form or another and recently, due to the pandemic, a virtual membership webinar workshop was conducted in 2022. A Google Drive folder was created and shared with the partnership as a central area to store and share information among the members. A project list set of spreadsheets are actively maintained and have recorded that at least eight barrier removal projects have been completed, another 18 projects are currently proposed and planned, and another 25 projects are listed as potential projects. Recently the team has created a goal-oriented approach to activate more member engagement in barrier removal, and four overall goals have been developed with input from the members.

Beavers in an Urban Natural Area

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Robert Loeb

The Pennsylvania State University

About 2000, American beaver (*Castor canadensis*) migrated to the Radnor Lake State Natural Area, Nashville, TN and formed resident populations. The beavers have progressively converted the forests along the feeder streams into marshy bottomlands. The beavers have created shoreline lodges and have constructed a network of canals and check dams. Beaver foraging occurs around the 34 ha lake on almost every species of tree, involving both tree and sapling stem diameter size classes. In 2014, foraging was observed to virtually stop at a roadway and significantly decreased beyond the wood chip trails that surround the lake indicating. Human placed pathways act as boundaries for beaver foraging. The patterns of beaver cutting will be presented across the research sites.

A raised bridge across a stream flood plain also blocked beaver cutting uphill of the bridge even though a dam has been maintained for years 30 meters below the bridge. The bridge was taken out in September 2021. The management goal in removing the bridge is to increase the amount of wetlands developed through beavers creating additional dams. This presentation also will review the progress that the beavers have made in cutting the forest uphill of the former bridge site since removal of the bridge.

Collaborators: Jesse Germeraad, Samuel King, Steve Ward, Paul Schauer, Brandon Jarrett, Matthew Bowling, Dameon Fontenot, and Will Brazill, Tennessee Natural Areas; James Helton, Aptim Consulting

How Natural Channel Design Approach Restores Unstable Streams: Stewart River Case Study

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Karl Koller

MN Dept. of Natural Resources

Presenter: Karl Koller, Regional Clean Water Legacy Specialist, MN Department of Natural Resources

Authors: Karl Koller (MN DNR), Ann Thompson (South Saint Louis Soil and Watershed Conservation District)

River and stream health are a reflection of the watershed in which they flow through and ultimately drain. Land use by humans has dramatically impacted hydrology and riparian communities around the world, both directly and indirectly. These impacts have destabilized streams, resulting in degraded habitat and poor water quality. A local example is historic large-scale logging in Northeastern Minnesota occurring over a century ago where streams remain unstable and evolving, despite regrowth of surrounding forests and riparian areas. There are many approaches to restore unstable streams. The method supported by the , called Natural Channel Design (NCD), focuses on restoring a stable channel form, recognizing the form of the channel directly affects the streams physical and ecological processes. It relies on collecting form data from a stable stream reach which is scaled and applied to the design. The basic concept of NCD will be described in this talk, along with the benefits, such as improved fish habitat, reduced erosion/sedimentation and improved resiliency for climate change. An example of a project completed in 2015, the Stewart River, will be shown. A follow-up talk will cover monitoring of the restoration to assess success and to learn how to improve design and construction methods.

Lessons Learned From Monitoring Stream Restoration Projects in NE Minnesota. Stewart River Case Study.

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Ann Thompson

South St. Louis Soil and Water Conservation District

The state of Minnesota spends millions of tax dollars each year on stream restoration and habitat enhancement projects. Many across the state are pushing for Natural Channel Design (NCD) methods to be used. As of now, there exists little information showing the benefits or the harm of differing restoration methods on the physical and ecological functions of stream systems. By increasing monitoring efforts, we can better understand the effects of various restoration projects and techniques on ecosystems. The lessons learned will enhance the ability of practitioners to adapt design and implementation techniques.

Stream restoration project monitoring is currently taking place on the Stewart River in Northeast Minnesota, to look at

the effects of NCD on a coldwater trout stream. Monitoring is occurring across water quality, hydrology, geomorphology, connectivity and biology (often referred to as the five components of stream health) with a diversity of data being collected. Strategies, techniques for gathering and analyzing data, and some results will be discussed. Influences this monitoring data has had on other restoration design and implementation will be shared. Restoration of stream systems is a complex field. Monitoring projects in detail and sharing these results with other practitioners will lead to improvement of existing techniques, a better understanding of these stream systems and ultimately, enhance the odds of successes in future projects.

Wednesday, September 7, 2022 10:30am - 11:50am

Conservation Partnerships and Land Protection Prioritization

An exploration of the vascular flora of Pine City Natural Area, Monroe Co., Arkansas, U.S.A.

Topic: Ecological monitoring: data management, storage, accessibility and use

Diana Soteropoulos

Arkansas Natural Heritage Commission Herbarium

Travis Marsico

Arkansas State University

Joe Ledvina

Arkansas Department of Transportation

The Mississippi Alluvial Plain (MAP) Ecoregion of eastern Arkansas has had >90% of its land area converted to agriculture and has historically been under-collected floristically, including the ecologically unique site, Pine City Natural Area (PCNA). Actively managed by the Arkansas Natural Heritage Commission, PCNA contains some of the last known saline barrens in the MAP and diverse, open loblolly pine-post oak flatwoods. This site is home to the only population of Red-cockaded Woodpeckers (RCW), a federally endangered bird, in the MAP Ecoregion. From 2018-2019, we conducted a vascular flora of PCNA and the surrounding area that documented 576 taxa, including 9 taxa of state conservation concern. In comparing the flora of PCNA to the known flora of the ten counties surrounding it, 27 taxa (4.7%) documented at PCNA had not been vouchered in the region, and 196 taxa (34.0%) are known from half or fewer of the surrounding MAP counties. The richness in the PCNA flora, in comparison to the broader MAP, demonstrates the need for continued ecological and floristic inventory in eastern Arkansas to find areas of high conservation value for protection, most of which persist as remnant grasslands in an agricultural landscape.

County Natural Heritage Inventories as Planning Tools for Natural Area Protection: A Case Study from Northwest Arkansas

Topic: Conservation partnerships

Theo Witsell

Arkansas Natural Heritage Commission

The Arkansas Natural Heritage Commission (ANHC) is conducting our first-ever County Natural Heritage Inventories (NHIs) in Benton and Washington counties in Northwest Arkansas. NHIs collect and compile information concerning the biodiversity of an area, with a special focus on rare species and habitats, exemplary natural communities, and intact landscapes, and provide this information in a unified, interpreted form digestible by a wide audience of stakeholders. NHI data come from many sources (remote sensing, field surveys, scientific literature, museum records, observation data by community scientists, etc.) and are vetted by the scientists and data managers of the ANHC. NHIs are tools to assist planners working at both the county and municipal levels, but the information they provide can be used by a variety of other stakeholders including, but not limited to, businesses, conservation agencies, developers, consultants, land managers, researchers, outdoor recreation enthusiasts, and those interested in natural history. In particular, NHI data will make it easier for planners to incorporate biodiversity information into their planning

processes, ensuring that development decisions protect or otherwise account for unique habitats, species of conservation concern, and other important natural features. Having a thorough NHI will also help guide land protection efforts toward areas that meet biodiversity conservation targets while also meeting recreational, cultural, and open space objectives.

The ANHC's NHIs are illustrated, written for a non-technical audience, and are designed to appeal to anyone with an interest in natural history. They have a unique structure and methodology with five main components or sections: 1) Summary of County Natural History and Ecology (up-to-date scientific information on the ecoregions and natural communities or habitats present in the county, their ecological history, and the abiotic factors that influence them), 2) Comprehensive Species Level Biodiversity Summary (vetted checklists for all major species groups, contributed by contracted subject matter experts), 3) Elements of Conservation Concern (more in-depth summaries of rare species and habitats), 4) Threats to Biodiversity, and 5) Sites of High Conservation Value (summaries giving detail on the most important sites and habitats needed to protect and manage to ensure the long-term viability of the county's biodiversity).

This presentation will give an overview of the NHIs and how they will be used by various stakeholders.

Healing Springs Natural Area: Rare Fish Species Drive Acquisition of a Natural Area in a Rapidly Urbanizing Landscape

Topic: Conservation partnerships

Dustin Lynch

Arkansas Natural Heritage Commission

Authors: Dustin Lynch (Arkansas Natural Heritage Commission), Justin Stroman (Arkansas Game and Fish Commission), Brian Wagner (Arkansas Game and Fish Commission), Mike Slay (The Nature Conservancy), and Theo Witsell (Arkansas Natural Heritage Commission)

Northwest Arkansas is a center of extraordinary biodiversity that is also one of the most rapidly urbanizing areas in the United States. Two of the most imperiled fish species in the region, the Arkansas Darter (*Etheostoma cragini*) and a currently undescribed narrow-range endemic species similar to the Least Darter (*Etheostoma* sp. cf. *microperca*) are found only at a handful of groundwater-fed sites in this landscape, where they are under constant threat from rapid urban development. Partnerships between several state agencies and others enabled acquisition and protection of the Arkansas Natural Heritage Commission's (ANHC's) Healing Springs Natural Area (HSNA), established in 2020. In addition to containing the most robust populations and best remaining habitats for both of these rare fish species, HSNA is home to several other species of concern, including other rare and endemic fishes, crayfishes, and plants. The Natural Area sits within the karst recharge of a population of federally threatened Ozark Cavefish (*Troglichthys rosae*) and includes a rare fen habitat. Additionally, the upland habitat at the site is being restored by ANHC and partners to oak savanna and woodland, a habitat type mostly lost in the region. While many of ANHC's 77 Natural Areas protect imperiled fish and other aquatic species of concern, the story of HSNA is somewhat unique – it is perhaps the only ANHC acquisition specifically driven by the presence of populations of rare fish species, which are often difficult to protect at this scale. The creation of HSNA is the result of years of tireless efforts by many dedicated individuals. But while HSNA now provides protection for this unique aquatic community, many threats still remain. It is crucial not only that further steps are taken to ensure protection of this site, but that other such sites in the region are conserved if this natural community and the remarkable species that are part of it are to persist.

Prioritizing protected-area sites when rare and listed plants are lacking

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Suneeti Jog

University of Illinois at Urbana-Champaign

Matt Finzel
University of Illinois at Urbana-Champaign

Jason Bried
University of Illinois at Urbana-Champaign

Land managers rightfully focus on species of conservation concern when prioritizing sites for protection and conservation management. However, what happens when sites contain few if any of those species, or if the species are confined to a small subset of the sites targeted for prioritization? Plants are a good focal point for this problem because local species pools usually contain many common species that are not listed. Managers could look beyond rarity, legal status, and individual species and prioritize sites using information from all species. We suggest using a combination of three local community metrics: floristic quality, taxonomic distinctness, and contribution to beta diversity. Ideally, highest priority sites would have (relatively) high floristic quality scores, high average taxonomic distinctness, and strong contribution to beta diversity, although in reality priority sites may excel in only one or two metrics. To demonstrate, we surveyed vascular plants across 13 wetlands in the Braidwood Sands Area preserve network, one of the best quality sand area remnants in Illinois. Out of 247 species observed, only one was state-endangered (*Viola blanda*) and five rare-listed (S2). Sites contained zero, one, or two of these species, making prioritization difficult. In contrast, site ranking based on the community metrics provided an informative prioritization that will help to strategize protection and management actions across this regionally unique wetlandscape.

Wednesday, September 7, 2022 10:30am - 11:50am

Ecological Monitoring Aimed at Improving Management

Everyone on the Same Page: The Prairie Reconstruction Initiative Monitoring Protocol

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Amanda McColpin
U.S. Fish and Wildlife Service

Authors: Amanda McColpin, Pauline Drobney, Diane Larson.

Reconstructing prairie (i.e., creating a prairie on former crop land) is essential to conservation goals throughout the prairie region, but how do we know if we're doing it as well as we could be? The Prairie Reconstruction Initiative (PRI), a collaboration among practitioners and researchers working to expand prairie reconstruction networks and improve reconstruction outcomes, developed a vegetation monitoring protocol for reconstructions that empowers users to recognize trends within a reconstruction and inform management decisions. The protocol consists of two complementary methods: nested frequency plots and a botanist-directed meandering walk. Each method yields different types of information and is appropriate for different kinds of analyses; however, they were designed to be used in tandem for a more complete picture of a reconstruction's condition. The nested frequency plots allow users to generate plant species frequency data to compare among sites and over time. The meandering walk allows users to generate a more complete species list than the randomly located nested plots and will provide a relatively quick overview of the floristic community. The PRI vegetation monitoring protocol allows assessment of the trajectory of a planting over time and provides data for objective analyses. Although the protocol can be used on its own, it was designed to complement the PRI Reconstruction and Management Database. This database allows land managers and reconstruction practitioners to systematically document their reconstruction site characteristics, site history, seed mix, planting methods, and ongoing management actions to better understand how these factors may influence the outcome of a planting. When analyzed in conjunction with planting and management history, monitoring data from numerous sites will build our collective skill faster, to the benefit of future prairie reconstructions.

Introduction and Early Results of the SPRUCE Experiment

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Randy Kolka
USDA Forest Service Northern Research Station

The SPRUCE experiment is an ambitious ecosystem-level experiment that is testing the response of high-carbon northern peatland ecosystems to increased temperatures and elevated carbon dioxide. The experiment is being conducted in a black spruce peatland in northern Minnesota at the USDA Forest Service's Marcell Experimental Forest (MEF). SPRUCE is supported by the US Department of Energy and is a collaboration between Oak Ridge National Lab, the USDA Forest Service and 100's of other scientists from across the globe. Northern peatlands are an ecosystem considered especially vulnerable to climate change and responses to warming and interactions with increased atmospheric CO₂ concentration are anticipated to have important feedbacks on global climate. SPRUCE is evaluating the response of the existing plant and soil communities to a range of warming levels from ambient to +9°C, with and without elevated CO₂, provided via large, open-top chambers. Belowground heating began in 2014, aboveground heating in 2015, and elevated CO₂ treatments commenced in June 2016. We anticipate running the experiment for 10 years. I will present an introduction to the MEF, and an overview and some of the early results of SPRUCE, including treatment effects on greenhouse gas production, soil processes, and the plant communities.

Riverscour Prairies of National Parks in Southern West Virginia: Monitoring and Restoration of a Threatened Plant

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Doug Manning
National Park Service

The riparian vegetation communities of New River Gorge National Park and Preserve, Gauley River National Recreation Area, and Bluestone National Scenic River represent some of the most biodiverse and rare flora within the parks. Globally rare plant communities and dozens of rare species occur along the rivers, particularly in areas which receive periodic scouring from flooding.

Riverscour prairies, one of the park's globally rare communities, support tall prairie grasses and heliophytic forbs on cobble bars along the Bluestone, New, Gauley, and Meadow Rivers. Scour during high water events maintains these cobble bars as open habitats. Without sufficient scour, woody plants can establish, shading the heliophytic forbs and grasses that characterize this rare community.

Given increasing stressors from changing climate, invasive species, and altered flow regimes, understanding how riverscour prairies are changing is increasingly important to their protection. Over the past decade, the National Park Service Inventory and Monitoring Program has monitored these dynamic prairies, revealing shifts in the abundance of native and invasive plants, as well as the encroachment of woody plants. As a result, park staff have treated invasive shrubs at targeted sites, as well as newly-detected invasive plants that were not previously known to occur in the parks.

Of particular concern in these parks is the federally listed Virginia spiraea (*Spiraea virginiana*) that thrives in riverscour habitats. Gauley River National Recreation Area contains the world's largest known population of Virginia spiraea; and it also occurs just upstream of the Bluestone National Scenic River. Over the next decade, the National Park Service plans to monitor, propagate, augment, and outplant Virginia spiraea in Bluestone National Scenic River and Gauley River National Recreation Area. The National Park Service will also work to improve habitat for extant Virginia spiraea through invasive plant removal and increasing light availability in riverscour habitats.

Upper Columbia United Tribes (UCUT) Wildlife Monitoring and Evaluation Program (UWMEP)

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Marc Gauthier
UCUT

The UCUT established the UCUT Wildlife Monitoring and Evaluation Program (UWMEP) by pooling their mitigation funding with the goal of conducting restoration monitoring and evaluation of mitigation properties on a regional scale. The UWMEP's goals include 1) meeting the monitoring and evaluation requirements of the BPA's mitigation agreements, and 2) supporting data-driven management of their mitigation properties. The Tribes involved include, the Spokane Tribe, the Kalispel Tribe and the Colville Confederated Tribes of Washington and the Coeur d' Alene Tribe and Kootenai Tribe of Idaho. Under the UWMEP approach, mitigation station monitoring rotates among the different Tribes' properties each year. Vegetation, avian, and amphibian data are collected and disseminated in annual reports and via a geo-spatial publicly accessible data base. Results and trends from data collected at mitigation stations inform adaptive management strategies. Results from several years of data collection are beginning to deliver trends and restoration success as compared to desired reference conditions.

Wednesday, September 7, 2022 10:30am - 11:50am

Outreach: Citizen Science and Volunteers

Building a Diverse and Equitable Volunteer Stewardship Network

Topic: Making connections with new audiences

Brooke Thureau

The Nature Conservancy (TNC), Illinois Chapter

Since 1983, The Nature Conservancy has reached beyond its preserve boundaries to empower volunteers through the Volunteer Stewardship Network (VSN). The VSN is a statewide program with the goal to support, promote and expand the role of volunteers working to protect and manage native landscapes in Illinois, through funding, training, and networking opportunities. The 130 groups and organizations that are part of the VSN include public agencies (Forest Preserve Districts, Conservation Districts, Park Districts), private organizations (land trusts) and non-profit organizations – all working with volunteers to restore and maintain sizeable natural areas and preserves. Though it has historically supported white groups working on larger natural areas, VSN staff are currently working to deepen engagement with organizations working directly with black, indigenous, people of color (BIPOC) and other historically underrepresented communities in community gardens and other native habitat pockets. In this presentation, I will speak about (1) the specific ways in which the VSN is engaging and supporting diverse communities; (2) the importance of diverse perspectives in conservation; (3) how the VSN is providing opportunities to its traditionally white members to expand their knowledge and understanding of diversity, equity, inclusion and justice (DEIJ) issues in volunteer stewardship and conservation; and (4) my privilege as a white person in this space and my willingness to listen and learn from diverse perspectives to help grow a diverse and equitable network. Additionally, participants will be invited to contribute to this important discussion around DEIJ in conservation.

Community Science as an Effective Approach to Bumble Bee Conservation

Topic: Outreach: cutting edge education, volunteer stewardship, citizen science and social media

Katie Lamke

Xerces Society

Rae Powers

The Xerces Society

Richard Hatfield

The Xerces Society

Bumble Bee Atlas projects are engaging thousands of community scientists to help track and conserve these valuable pollinators throughout the United States. In partnership with federal and state agencies, universities, and non-profit organizations, the Xerces Society is coordinating five Bumble Bee Atlas (BBA) projects: Pacific Northwest BBA (ID, OR, WA), Nebraska BBA, Missouri BBA, Minnesota BBA, California BBA, and the Great Plains BBA (KS, ND, SD).

Each BBA captures a region- or statewide understanding of bumble bee distribution and phenology.

Participants attend a workshop where they learn the sampling protocol, and how to submit data to Bumble Bee Watch. By engaging volunteers and providing educational workshops, BBAs are changing the patterns of data collection. These atlas projects are filling gaps where recent survey effort is lacking, and since they follow a standardized protocol, they also provide essential lack of detection information, useful for status assessments and conservation decision making. To date, over 3,000 participants have dedicated countless hours observing more than 43,000 bumble bee observations.

The data is helping to supplement species status assessments, refine best management practices, inform conservation practitioners and policy makers, and educate the general public. For example, the Pacific Northwest BBA and Nebraska BBAs have recently produced guidance documents and developed hands-on workshops for land managers. This guidance includes bumble bee species distribution maps, habitat associations, floral associations, and best management practices to maintain high quality bumble bee habitat.

This presentation will provide an overview of the Bumble Bee Atlas, detailing project inception and design, effort to date, and resulting products.

Conservation Leader Internship Program: A journey to supporting the next generation of diverse leaders in conservation

Topic: Outreach: cutting edge education, volunteer stewardship, citizen science and social media

Kim Elsenbroek

The Land Conservancy of McHenry County

Megan Oropeza

The Land Conservancy of McHenry County

Few scholarly programs provide the practical experience and hands-on training required to enter the field of conservation, outside of academia. However, the majority of jobs lie outside of the academy. Programs that provide quality training to a diverse group of young people are essential for the sustainability of our field and can be accomplished by a multitude of conservation organizations. The Conservation Leader Internship Program is a melting pot of several programs including but not limited to: The McNair Scholars Program, Research Rookies program, Research Enriched Academic Challenge (REACH), Saluki Scholars program, Research Experience for Undergraduates (REU) along with internships and work experiences with the Illinois Department of Natural Resources (IDNR), the National Park Service (NPS) and The Nature Conservancy (TNC). Each program provides a unique set of experiences that collectively prepare students to navigate their field in a professional manner. The Conservation Leader Internship Program (CLIP) combines all of that into one. CLIP is a paid summer internship that provides underserved, first generation and BIPOC youth with hands-on professional training in the field of conservation. Participants gain experience in areas such as: Plant identification, Land management, GIS/GPS training, Prescribed fire training, Herbicide use, Rare plant monitoring, Wildlife/Stream surveys, Sustainable farming techniques, Land preservation techniques, Field safety, Scientific research/Experimental design, Art in the natural world, Career development and Professional networking. Collectively, these skills give each participant a strong understanding of the field of conservation and serve as a springboard for a professional career in the field of conservation. Program success was measured by a series of reviews, check-ins, surveys, blog posts and skill tests throughout the entirety of the program. At the beginning/end of the program, students were given a survey which asks about various aspects of the conservation world from organizations and institutions to plant ID questions and invasive species management techniques; the pre/post program surveys were compared. During the inaugural year of CLIP students who entered the program with virtually no experience in the field of conservation, graduated the program feeling comfortable navigating the field as a professional. Graduates reported feelings of increased confidence, a strong understanding of the field of conservation and the ability to continue their journey in this profession.

Finding impact volunteers for stewardship work

Topic: Outreach: cutting edge education, volunteer stewardship, citizen science and social media

Jared Urban

Wisconsin DNR- State Natural Areas

Stewardship work is often infinite while funding is tight, therefore volunteer programs often play a role in making progress. However, these programs deal with constant change, making committed, consistent volunteers extremely valuable. One time and multiple time volunteers are easier to find but a common question is how do we find those who are able to lead projects and make real progress for our programs- the impact volunteers? Finding them can be challenging and at times feels impossibly hard while at other times it can appear quite easy. The Wisconsin State Natural Areas Volunteer Program had volunteers working at 55 different properties around the state and contributing over 6,700 hours in 2021. Stories and strategies of how impact volunteers were found will be shared as well as lessons learned along the way.

Wednesday, September 7, 2022 10:30am - 11:50am

Plant Community Restoration and Regeneration

Seed-Spec: A Native Seed Blend Development Tool

Topic: Native plant materials in restoration/rehabilitation

Brian Hays

Bamert Seed Company

Seed-Spec: A Native Seed Blend Development Tool

R.W. Cook * and G. Peacock 1

Abstract: Establishing native vegetation in any reclamation project can be a challenging task. The species and varieties that match the site must be identified and used to help ensure adequate establishment and persistence. Data exists to help project managers identify what species are native to a given area and commercially available, but can be cumbersome, not user friendly, and time consuming.

Bamert Seed Company has worked with Colorado State University to develop a web application to easily identify a project area of interest (AOI) and provide information on native species composition for the AOI. The tool will provide a list of commercially available species that correspond to the plants that grow natively in the AOI and intuitively walk the user through developing a site-specific native seed blend. The recommended seeding rate from NRCS will be used to calculate the pounds of pure live seed (PLS) that will be needed for the project. Users will have the ability to adjust the seeding rate based on their establishment objectives and seeding method they will be using. Having this tool will allow the reclamation specialist a timely way to determine the best blend for their AOI and get the seed blend to a vendor/seed dealer with knowledge that the species selected will work for their specific site. Rob will discuss the importance of native plants and the benefits they bring to reclamation projects such as adding biodiversity and improving soil health. He will discuss and present version 1 of the tool and ask attendees to provide input on what other functionality/data would be useful for their operations for version 2.

Additional Key Words: Biodiversity, Ecosystem Services, Revegetation, Reclamation, Species Selection

1. Rob W. Cook (*presenter), Director of Business Development, Bamert Seed Company, Muleshoe TX 79347, George Peacock, Research Associate, Object Modeling Systems Laboratory, Colorado State University, Fort Collins CO 80523

Sourcing seed for climate-adapted grassland restoration

Topic: Native plant materials in restoration/rehabilitation

Marissa Ahlering

The Nature Conservancy

Grassland restoration is an important climate adaptation strategy, and how we go about reconstructing those grasslands could have implications for long-term adaptability. Recommendations to diversify seed mixes to enhance genetic diversity and adaptability are now pervasive in the literature, but common practice often emphasizes the use of local seed for restoration. While local adaptation is an important consideration, it may also have its limitations. The goal of this project was to demonstrate the use of multiple-source seed mixes in grassland restorations and develop resources for sourcing seed. In 2019 we hired crews to map and collect seed from multiple regions across Minnesota, North Dakota and South Dakota. We used the seed collected to plant 918 acres of species and genetically diverse grasslands. We included at least 3 seed sources for all species in the seed mix for all 918 acres. As part of this effort, we also developed an online, shareable database to track the location of potential seed sources for hundreds of native grassland species. We mapped more than 31,100 populations of 327 species for possible future seed collection and planning of restorations. We also established two long-term experimental designs to test the influence of single versus multiple seed mixes on establishment success and long-term persistence of species and genetic diversity. These restorations have much greater genetic diversity than our typical restorations, and we plan to monitor success over time.

The role of plant-microbial interactions in ecological restoration

Topic: Native plant materials in restoration/rehabilitation

Jennifer Larson

USGS, Northern Prairie Wildlife Research Center

Laura Aldrich-Wolfe

North Dakota State University

Diane Larson

USGS, Northern Prairie Wildlife Research Center

With increasing efforts to restore grassland ecosystems, a primary goal is to create a habitat resilient to potential stressors, including those associated with a changing climate. The habitat reconstruction process often follows a top-down, plant-based approach, moving plant material as seed from outside of its place of origin to a new, often heavily degraded restoration site. However, we offer insight that restoration of plant-soil microbial interactions, namely plant-arbuscular mycorrhizal fungi (AMF) and plant-rhizobia, may increase the likelihood of successful plant establishment and persistence. Our recent work in Minnesota and Iowa indicated differences in AMF communities among remnant and reconstructed prairie sites. In the next phase of our research, we will determine if native prairie plant performance is enhanced when grown with AMF isolated from remnant prairie soils. By incorporating restoration of interactions in native grassland reconstructions, land managers may be able to create habitat that is able to withstand and respond to future climate uncertainties.

Jennifer L. Larson¹, Laura Aldrich-Wolfe², Sheri C. Huerd³, Nicholas R. Jordan⁴, Robert C. Venette⁵ Stefanie Vink^{6,7}, Diane L. Larson¹

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Wednesday, September 7, 2022 10:30am - 11:50am

Threatened and Endangered Species Roundtable

Wednesday, September 7, 2022 2:00pm - 3:30pm

Beetles and Butterflies

Do monarch butterflies benefit from managed early successional communities in the western Great Lakes?

Topic: Rare species/pollinator best management practices

Emma Keele

Indiana University of Pennsylvania

Monitoring for target and non-target associated species is essential to understand the effectiveness of wildlife habitat management. The monarch butterfly (*Danaus plexippus*) and Golden-winged Warbler (GWWA; *Vermivora chrysoptera*) are both target species of two USDA-NRCS working lands programs in the western Great Lakes. The Regional Conservation Partnership Program (RCPP) has managed early successional communities for Golden-winged Warblers in Minnesota and Wisconsin since 2015. Growing literature supports that early successional communities host abundant pollinator communities. Thus, monitoring habitat created through the RCPP-GWWA provides a valuable opportunity to understand potential benefits for monarchs, which it is estimated to have declined about 80% in the last 20+ years. The goal of this project is to assess how management for GWWA habitat through the RCPP benefits monarchs in the western Great Lakes. We followed a standard monarch monitoring protocol to survey 49 study sites in two early successional community types across northern Wisconsin and Minnesota during the summer of 2021. Additionally, we compared data from RCPP-GWWA sites with those specifically managed for pollinators. Monarch immatures, monarch adults, and milkweed were more abundant and prevalent at pollinator managed sites compared to RCPP-GWWA sites (all p-values 0.001). Although, GWWA sites still provided valuable habitat for monarchs (immature monarch or adult monarch detected at 57% of sites). Within RCPP-GWWA sites, the presence of immature monarchs, adult monarchs, and milkweed were associated with multiple landscape and within-site variables. Presence of immature monarchs was positively associated with percent area of pasture/hay ($\beta=1.234\pm0.440$) and herbaceous wetlands ($\beta=1.440\pm0.475$), but negatively associated mixed forests ($\beta=-0.768\pm0.418$) within the surrounding landscape. The presence of milkweed was also positively associated with pasture/hay ($\beta=1.088\pm0.418$) and herbaceous wetlands ($\beta=1.209\pm0.430$), but negatively associated with woody wetlands ($\beta=-0.752\pm0.401$) within the surrounding landscape. Presence of adult monarchs was positively associated with percent cover of small shrubs ($\beta=0.657\pm0.330$). Lastly, the presence of immature monarchs was positively associated with flowering plant prevalence ($\beta=0.885\pm0.359$) and flowering plant abundance ($\beta=1.136\pm0.408$). As milkweed density increased, immature monarch density increased (p-value 0.001), but there were no relationships with adult monarchs (p-value = 0.62). This study provides context for how well habitat management that targets a GWWA is augmenting monarch-specific conservation efforts in the region. Additionally, this project identified important landscape and within-site habitat variables that can be used to inform management recommendations to maximize habitat management outcomes for GWWA and monarchs in the western Great Lakes.

Monarch Butterfly (*Danaus plexippus* L.) Response to Variable Rangeland Grazing Strategies During Extreme Drought

Topic: Rare species/pollinator best management practices

Ellysa Johnson

North Dakota State University

Biodiversity continues to decline both at a local and global scale. A large contributor to this decline is land-use change towards agriculture and urbanization. However, North American rangelands present a unique opportunity for meeting human food demands, in the form of livestock production, while supporting conservation practices that enhance biodiversity. One specific example of conservation concern are Eastern migratory monarchs (*Danaus plexippus* L.)

due to their candidacy under the Endangered Species Act and cultural importance. In the last two decades, this population has declined by 80%, primarily due to land conversion to agriculture and the consequent use of herbicides that reduce their obligate milkweed (*Asclepias* spp.) host plants. Rangelands can potentially provide milkweed and forbs for nectar; however, it is unclear whether current management goals to maximize cattle production on such rangelands are compatible with monarch conservation. To determine the compatibility between these goals of production and conservation, we monitored adult and juvenile monarchs, milkweeds, and flowering forbs in North Dakota mixed-grass prairie rangelands and assessed their responses to three grazing management strategies: (1) modified twice-over rest-rotation grazing (MTORG), (2) patch-burn grazing (PBG), and (3) season-long grazing (SLG). During the monitoring period (Summer 2021), a substantial drought (classified as D3 and D4 by the U.S. Drought Monitor, or extreme to exceptional) occurred which influenced vegetation in each management strategy. In these conditions, we found that the MTORG management strategy had the highest abundances of all four response variables. Out of a total of 96 adults, 77 juveniles, 17,099 milkweed stems, and 69,778 flowering forbs, MTORG accounted for ~60% of observations of each group (53, 44, 11,044, and 39,173, respectively). Within MTORG, some areas were rested meaning they did not have cattle present. These areas seemed to act as a refuge for vegetation during the drought. Our results will continue in the summer of 2022 to compare monarch, milkweed, and forb responses under different growing season weather conditions. These findings could inform future monarch conservation and rangeland management, particularly under predicted climate change, by helping align human demands with those of wildlife.

Wednesday, September 7, 2022 2:00pm - 3:30pm

Ecological Monitoring Aimed at Improving Management - Continued

Invasive species are driving composition of Prairie Pothole Region wetlands

Topic: Invasive species: threats, prevention and management

Shawn Dekeyser
North Dakota State University

Breanna Kobiela
North Dakota State University

Seth Jones
North Dakota State University

Prairie pothole wetland plant communities are highly variable depending on hydrology, salinity, and anthropogenic disturbances in and around the wetland. The U.S. Fish and Wildlife Service (USFWS) has managed prairie potholes since the passing of the Duck Stamp Act in 1934, employing various management techniques in the subsequent decades. In 2020 and 2021 we conducted a regionwide assessment of prairie potholes on USFWS fee-title lands in North Dakota, South Dakota, and Montana to inform future prairie pothole management. While several of the included fee-title lands are remnant native prairie, most were cultivated in the past and reseeded into perennial grassland. Our goal was to determine the plant species exerting strong influences on wetland plant community composition throughout the region. We collected species-level cover data at 200 randomly selected wetland sites located on USFWS fee-title lands. We determined that relatively few sites accounted for most of the diversity in the region while most wetland sites had low diversity and high abundance of invasive species. We employed nonmetric multidimensional scaling and multi-response permutation procedure to explore wetland plant communities and identify species that appear to be 'driving' plant community composition. We found that invasive species, especially *Bromus inermis*, *Phalaris arundinacea*, and *Typha xglauca*, play major roles in USFWS-managed prairie potholes. In addition, native and reseeded plant communities possess distinct species compositions, largely due to the abundance of invasive species in reseeded areas. Our research has identified invasive species have not only become prevalent in the region, but are driving species composition, and pose a major threat to biological diversity. Despite land management efforts to convert past agricultural land into diverse, productive ecosystems, invasive species continue

to dominate these landscapes and are encroaching into native areas as well. Our results reveal a need to protect the remaining few 'biological hotspots' on these USFWS lands within the region, and implement native species restoration efforts on their land that was in agriculture in the past.

Long term monitoring of sun loving rare plants and high-quality grassland communities in natural areas across Kentucky

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Tara Littlefield

Office of Kentucky nature preserves

In Kentucky, over 65% of state listed rare plants are disturbance dependent, facultative to obligate heliophytes that occur in grassland systems ranging from xeric to obligate wetland conditions. This includes several federally listed plants and globally rare species and communities whose existence depends on science-based conservation methods and the development of best management practices. Many of these rare plants and communities are managed by conservation agencies that conduct various management techniques such as woody removal and prescribed fire to maintain more open habitat conditions. To conserve these natural areas, surveying, monitoring and research of management units is needed to assess trends and management effects on these rare communities and species. Collaborative efforts among land managers, botanists, and ecologists on high quality natural areas across the state has resulted in the development of a long-term monitoring program on high quality managed sites that tackles multiple facets of grassland conservation such as assessing management objectives, updated surveys and accurate mapping of rare species and communities, classifying reference high quality communities, assessing the floristic quality of management units over time, and monitoring trends of rare species. This talk will give an overview of the long-term monitoring program developed by the Office of Kentucky Nature Preserves, the state's natural area and natural heritage programs, for rare species and communities in these management intensive natural areas.

The Documentation and Exploration of Minnesota's Sprague Creek Peatland Scientific and Natural Area

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Scott Milburn

Midwest Natural Resources, Inc.

One of Minnesota's more unique Scientific and Natural Areas (SNAs), Sprague Creek Peatland SNA lies in northwest Minnesota along the Canadian border. This SNA is primarily forested peatland that includes string fen channels, a type of calcareous fen afforded special protection under Minnesota state law. The hydrology has been significantly altered by several significant ditch features, in place since 1910. The SNA will be undergoing hydrologic restoration as part of a larger hydrologic restoration of the historic Roseau Lake lakebed.

As part of the effort, botanical staff from Midwest Natural Resources collected baseline vegetation monitoring data within the SNA. The data will be used to gauge changes in community structure as hydrologic restoration takes place. This initial effort involved the mapping of current native plant communities, the establishment of monitoring plots and transects, and the documentation of rare plant populations. This talk will briefly discuss the proposed hydrologic restoration efforts. Additionally, the talk will examine changes in community structure as compared to historic boundaries, the various baseline data collection methods implemented, and a brief discussion on some of the more unique species that are found in this spectacular natural area.

Woody understory response to high moose browse pressure following apex predator decline

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Suzanne Sanders

National Park Service

Jessica Kirschbaum
National Park Service

Predators exert strong controls over forested ecosystems such that loss of these predators can result in broadscale adverse impacts. We examined changes in woody species abundance at Isle Royale National Park following nine-years of wolf decline. Here, moose and snowshoe hare are the dominant herbivores. Our study period followed six years of low moose abundance, then coincided with an escalation in moose density. We pooled tree species and modeled small sapling density between sampling periods and island locations. Next, using a novel approach, we asked whether the diameter distributions of key tree species differed between the two sampling events. Lastly, we tested whether abundance of key shrub taxa changed between the two sampling dates. We found little change in density of small saplings, pooled across species. Comparisons of diameter distributions showed partial recovery of trembling aspen, but not balsam fir, during the period of low moose browse pressure. Shrub population trajectories were surprising: nine of 20 key shrub taxa exhibited greater frequency of occurrence in 2019, following the moose irruption, while none declined. Besides impacts attributable to moose, we observed further indirect impacts from low predator abundance. Small saplings of both white spruce and black spruce, taxa that are unpalatable to moose, showed reduced abundance during the 2019 sampling event. We attribute this to a historically high spike in snowshoe hare abundance. We also note increased abundance of small saplings of black ash in the central section, likely a result of more standing water from increased beaver presence. The park initiated a wolf restoration program on the island in 2018; in the absence of a reproducing carnivore population, the relatively small perturbations we found here will likely intensify, causing more serious ecosystem-wide disruption.

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Ecological Monitoring Roundtable

Wednesday, September 7, 2022 2:00pm - 3:30pm

Outreach: Innovative Engagement

Can We Do Better Than the Seasonal Technician Model?

Topic: Making connections with new audiences

Chris Helzer
The Nature Conservancy

The hiring of seasonal technicians is a tried-and-true way to build experience for technicians and to hire cheap labor for employers. However, it is far from a perfect model for either the employer or employee. Because of a generous donor, The Nature Conservancy (TNC) in Nebraska has tested a different approach with their Claire M. Hubbard Young Leaders in Conservation Fellowship Program (Hubbard Fellowship) over the last 8 years. The Fellowship employs 2 people a year who are recent college graduates and provides them with a full-year of experience working for a conservation organization. Hubbard Fellows spend about half their time engaged in land stewardship work, but also help with research, outreach, strategic planning, volunteer management, and other aspects of TNC's work. They also choose an independent project, which allows them to pursue an interest of theirs while providing a tangible benefit to TNC. The program attracts a large number of highly qualified applicants each year. They are drawn by the unique combination offered by the Fellowship – a full year position with housing and salary/full benefits that provides broad training and experience. Applicants are not required to have extensive land stewardship experience but need to show that they can work outdoors and have demonstrated a passion for conservation. From the perspective of TNC Nebraska, the program has been a success because it has built capacity for stewardship and research while also providing new energy into our outreach, volunteer and other programs. Because it is a full-year Fellowship, there is a great ratio of training to productivity and because of the caliber of applicants, the productivity is of high quality. In addition, the demographic diversity of applicants for the Fellowship is much higher than for many technician jobs,

especially in terms of gender – skewing heavily toward female applicants. Fellows get a broad suite of training and experience in one position while being provided housing, health insurance, and reasonable pay. Not only can they take advantage of the opportunities provided, they are allowed to create their own as well, and pursue interests they might not otherwise have time or chances for. The Hubbard Fellowship is more expensive than a typical 3-to-6-month seasonal technician position. Providing both salary and full benefits adds to the cost, as does the longer tenure. However, the results have been rewarding, both in terms of organization capacity and the ability to strengthen and diversify the future leadership of conservation.

Engaging New Audiences in Old Spaces: Reigniting Interest in Minnesota's Scientific and Natural Areas

Topic: Outreach: cutting edge education, volunteer stewardship, citizen science and social media

Paula Comeau

North Dakota State College of Science/ MN DNR

Minnesota's (MN) Scientific and Natural Areas (SNA) in the Northwest Region of Minnesota hold some of the states' oldest and most pristine native prairie areas, but, despite their inherent natural beauty, visitation was limited to a small group of outdoor enthusiasts. About a decade ago, the MN Department of Natural Resources created a position to help diversify the patronage of these sites: the SNA Naturalist. The people holding these positions steadily worked towards raising awareness and access to SNAs, culminating in some of the highest visitations to the NW SNAs ever in 2019 (pre-pandemic) and demonstrating a strong come back in 2021. This success was achieved by targeting both typical and atypical nature enthusiasts. We maximized our audiences through outreach events by hosting birding events, guided hikes, and nontraditional outdoor opportunities. In addition to the regularly scheduled programs, we also reached out to non-traditional audiences for our traditional programming to encourage attendance in our fullest capacity.

Most notably the NW SNA Naturalist hosted two summer camps from a local university that worked to promote matriculation from tribal colleges and high schools to the two state universities in neighboring North Dakota. This relationship has brought both unique programming opportunities and unique audiences. North Dakota State University's Natural Resource Management (NRM) program has been key in SNA programming and has requested multiple events and opened them up to the public. Most recently the Bumble Bee hunt promoted by University of Minnesota. The inclusion of the public in these events provided more access to experts for questions and discussion regarding pollinator relationship to society, the value natural spaces as buffer areas between wildlife and humans, and the value of green spaces to mental health.

Despite the success of our more traditional programming, our non-traditional programming has introduced SNAs to the most diverse audiences. Most notably, our Tallgrass Prairie Meditation, "En Plein Aire" watercolor painting series, and the Prairie Photography series. These events offer two strong advantages 1) knowledgeable presenters to teach technique and 2) attraction to people beyond my typical audience. As the SNA program explores nontraditional outdoor programming, we are finding that alternative approaches allow people to engage with the outdoors in a context that they are comfortable in and create appreciation authentically through their own interests. In the end, it allows people to create value in the outdoors for themselves rather than having someone dictate the value to them.

From "elsewhere-nature" to "wonderful weeds": Biodiversity in cities is important to biodiversity everywhere

Topic: Public perception and attitude towards natural areas

Lea Johnson

Longwood Gardens

Urban people will decide how much of the diversity of life on Earth today will travel with us into the future. Experiences of nature shape perceptions and values that become decisions we make about land, species, and natural resources. Biodiversity in cities is necessary because billions of people experience only urban biodiversity. Yet the experience of urban biodiversity is a paradox.

On one hand, the growth of cities destroys native ecosystems, altering them beyond recognition as 'nature' to many people. As a result, there is a tendency to think of nature as something found elsewhere. This 'elsewhere-nature' is envisioned far from everyday life or in the distant past, accessible by travel or lost in history. Elsewhere-nature explains in part why proposals to restore biodiversity in cities are often met with skepticism â?? yet elsewhere-nature can be a source of joy, and a motivation to support work in places and on behalf of species that most people will never see with their own eyes.

At the same time, a city's patchwork of land uses and histories creates opportunities for some species, and despite urbanization's transformations forests continue growing, soils continue to form (with new parent materials), and evolution continues to unfold, while urban natural areas provide numerous benefits to people and provide experiences of nature. Increased awareness of urban nature has fueled enthusiasm for the biodiversity of everyday life, from children celebrating of urban birds to foragers searching parks and roadsides for wild foods. Weeds, seen in this light, become wonderful. This embrace of biodiversity in overlooked places has potential to deepen ecological sense of place and informs naturalistic approaches to landscape design. This positive view could help to diminish effects of nature deficit disorder and the extinction of experience of nature, particularly for children. Taken to its extreme, however, embracing an urban status quo for biodiversity could lower expectations for local and global biodiversity.

Both 'elsewhere-nature' and 'wonderful weeds' perspectives are engaged with biodiversity, yet one overlooks the nearby and the other looks out from a shifted baseline. From either view opportunities could be missed. Approaches spanning these perspectives are needed â?? and they are emerging across the globe. From native wildflower meadows in vacant lots to community stewardship of natural regeneration, and from designed habitats on built structures to restoration of urban old growth, all require creativity, flexibility, and community engagement for success.

Plant blindness represents the loss of cultural identity.

Topic: Public perception and attitude towards natural areas

Stacie Blue

North Dakota State University

Authors: Stacie Blue, Christina Hargiss, Jack Norland, and Shawn DeKeyser

Elders from the Turtle Mountain Band of Chippewa Indians (TMBCI) who have gathered plants within the region have seen the plant numbers reduced and species of plants disappear. Their statements of concern for the plants and their hope for increased plant diversity led to the development of the current research study. Increasing plant knowledge is vital to rebuilding and maintaining the diversity of vegetation within the forest, grassland, and wetland habitats. The present study used an online survey to assess citizens ability to identify plants that belong in wetland, grassland, and forest habitats in the area; names of plants; learn how citizens use plant features to find and identify plants; and where citizens gained their knowledge. The survey also gathered demographic data, which allowed authors to determine trends across different demographic groups including age and ethnicity. In total, 216 participants took the survey, the majority were female and 91% classified themselves as Native American or Alaska Native. Participants were readily able to identify forest and wetland plants correctly, but struggled distinguishing grassland plants from the other habitat types. They were most readily able to identify Chokecherry (*Prunus virginiana*) in the forest habitat, Wild Prairie Rose (*Rosa arkansana*) in the grassland habitat, and Water Milfoil (*Myriophyllum sibiricum*) in the wetland habitat. When identifying these plants, they typically used the common or local/tribal name to identify the plant. Information from this study will be used as a stepping stone for developing community education projects which may lead to establishing conservation areas for the benefit of native species in the different habitats. Beyond the local area, this information is useful to researchers and scientists working with plant blindness and seeking to understand how people see and identify plants and how this may change across demographic groups.

Wednesday, September 7, 2022 2:00pm - 3:30pm

Plant Community Restoration and Regeneration - Continued

Conservation potential of post-industrial sites on Chicago's southeast side

Topic: Flourishing habitats: how they got that way

Lauren Umek

Chicago Park District

Post-industrial sites are often considered to have no conservation value but frequently host considerable biodiversity, including rare and unique species. We hypothesize that spontaneous communities on brownfield sites in many cases constitute novel ecosystems that require unique methods of management. We explore this idea in the Calumet region on Chicago's southeast side, a landscape heavily impacted by the steel industry. A ubiquitous legacy of this industry, especially in former wetland areas, is slag, steel making waste that forms a hard gravel or pavement-like substrate. We set out to assess spontaneous communities on slag in several ways. For a regional view, we compiled iNaturalist observations on slag throughout the Calumet. In 2020 we established monitoring plots along a 600m transect in Big Marsh Park entirely on slag. We analyzed soil from these plots once and surveyed plant species present in two consecutive summers. Our goals were (1) to assess existing biodiversity and other ecosystem services in a self-assembled plant community and (2) to formulate specific restoration goals and strategies that encompass this existing novel ecosystem. Across the region, iNaturalist contributors observed 854 species of animals, plants, and fungi, including several species considered uncommon or conservative in the region. Slag soils are rocky with low organic matter, higher pH (avg 9.3), and higher heavy metals than other natural areas in the region. We found a positive correlation between plant cover and soil organic matter along the Big Marsh transect. We observed a characteristic suite of species found at Big Marsh and other slag sites that does not resemble plant communities found in other ecosystems in the region. We conclude that historical baselines are inappropriate in shaping specific restoration plans for these sites due to extensive habitat modification by the steel industry. Existing biodiversity suggests that current communities are novel ecosystems worthy of conservation. Restoration strategies should seek to build on this existing value. In pursuit of such strategies, future work will compare plant community composition at slag-dominated sites to habitat analogs like dolomite or gravel hill prairies.

Co-Authors: Alison Anastasio, Laura Merwin, cassi saari

Natural Regeneration-Soil Relationships in an Urban Natural Area Forest

Topic: Flourishing habitats: how they got that way

Robert Loeb

Penn State DuBois Campus

Flourishing natural regeneration of the native canopy species is key to achieving a sustainable urban natural area forest. The new urban natural area forest management protocol 'SAFE' (Soils Aliens Fire Exclosure) guides the process to flourishing natural regeneration through: soil treatments; alien species treatments; fire surveillance; and large herbivores exclosure fencing. The initial stage of the iterative research process for the SAFE protocol was implemented in the Good Woods, Haddington Forest, Cobbs Creek Park, Philadelphia, Pennsylvania. Two components of the SAFE protocol, fire and soils, were investigated for the seedlings and saplings of the seven canopy taxa growing in a loam and an extremely stony loam of the Manor soil series in the Good Woods. The basis of the research was comparisons of data collected before and after a fire in 2015 that was caused by arson. Prior to the fire, seedlings for *Carya* spp., *Prunus serotina*, *Quercus alba*, and *Quercus rubra* and *Q. velutina* as well as *Liriodendron tulipifera* saplings had larger populations in the loam than the extremely stony loam. Saplings for *Carya* spp., *Liriodendron tulipifera*, and *Prunus serotina* and seedlings for all seven canopy taxa had different size populations in the burned and unburned areas of both soils. Considered separately, the fire related sprouts had low survival rates four years after the fire. pH, phosphorus, potassium, magnesium, and calcium were deficient in the burned and unburned area of the loam and extremely stony loam except for phosphorus in the burned extremely stony loam. For the seedlings of all seven taxa, the negative binomial regression equations with the soil nutrients indicated fertilizer treatments to increase phosphorus, potassium, magnesium, and calcium would have no effect on natural regeneration. Increasing the pH would result in forest regeneration decreases for *Acer rubrum*, *Fraxinus americana*, and *Prunus serotina* but not the traditional canopy taxa *Carya* spp., *Liriodendron tulipifera*, *Quercus alba*, and *Quercus rubra* and *Q. velutina* as revealed by the regression variable estimates. Sulfur levels in burned and unburned areas of the loam and the extremely stony loam exceeded other urban natural areas and rural woodlands in

Pennsylvania. A nearby historical anthracite coal burning mill is thought to be the source of the high sulfur levels. Moving forward with the iterative research process of the SAFE Protocol in the Good Woods will involve examining seedling populations relationships with additional soil chemical elements and the effect of large herbivore exclusion on the seedling populations of the canopy tree species.

Oak survivability in micro-openings created in low quality woodland buffering an Indiana natural area.

Topic: Native plant materials in restoration/rehabilitation

Jamison Hutchins

Central Indiana Land Trust

Phillip Weldy

Central Indiana Land Trust

In 2015 Central Indiana Land Trust acquired the property that is now Betley Woods Preserve at Glacier's End. This area features high quality natural area with forest interior habitat that is important for a variety of migratory birds and species of state concern in Indiana. Part of this area, bordering the contiguous forest to the north, is a 19-acre agriculture field and 31 acres of low quality mid succession woodland. With the management priority here being interior forested habitat, it was desirable to restore the early succession woodland and field to buffer this habitat for the species that utilize it. The early succession woodland had a dense canopy of pioneer species and was deficient in oaks. We were told by state officials that oaks would not survive unless we cleared at least twenty acres. We decided to create micro-openings mimicking the gaps created by fallen trees and planting oaks in those gaps. All planted trees were three gallon potted *Quercus alba* with local genotype. To create the gaps, nearby woody vegetation was cleared and trees were girdled within a 16.6 foot radius from the planted oaks. As of the writing of this abstract, 44 out the 50 trees are alive, giving a current survivability at 88%. The size of the micro-openings are 0.02 acres or three powers of ten smaller than what we were advised. With the potential success of this tactic, it will be promising to replicate it in other woodlands as another management tool for facilitating diverse mature forest habitats. The benefits of more diverse mature forest habitats is particularly valuable in the face of changing climate as habitats with greater richness are postulated to have greater resilience to the negative effects of climate change.

Wednesday, September 7, 2022 3:45pm - 5:05pm

Ecological Monitoring: Data Management, Use and Research

Establishing Rapid Assessment Monitoring Protocols for Natural Communities in Missouri and Beyond

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Gina Beebe

University of Missouri

Mike Leahy

Missouri Department of Conservation

Kyle Steele

Mark Twain National Forest

Missouri has been a pioneer in the restoration and management of fire-adapted natural communities in the lower midwestern U.S. For example, some public lands in Missouri have had prescribed fire applied to the landscape for over 45 years. While Missouri has paved the way forward in modern management regimes, there is a lack of established and accessible monitoring protocol to track changes to natural communities following management such as fire or thinning. Monitoring options in Missouri are often limited to either broad, visual assessments that are quick and inexpensive but provide limited information, or highly intensive botanical surveys, such as Floristic Quality Assessments, that provide a wealth of botanical data but are limited by cost and botanical expertise.

The Community Health Index (CHI) can provide a middle-ground monitoring solution for managers to effectively track changes to natural communities over time. CHI is a rapid assessment monitoring protocol that uses a set of key ecological metrics to describe the integrity of a natural community. Metrics were designed to inform management decisions and identify target areas of restoration. Further, metrics information on landscape context, common indicator species and their associated coefficient of conservatism values, forest/woody vegetation structure, and magnitude of disturbances (e.g., invasive species, feral hog damage).

Accessibility and standardization are two major goals of CHI. CHI protocols are designed for professionals with intermediate plant identification skills and include plants species that are generally identifiable across seasons while the rapid nature of these assessments allows large areas to be sampled in a short timeframe. Further, the collaborative nature of this project has allowed for standardization of the protocol to occur across agencies and states. Originally developed by the Missouri Department of Conservation and the Mark Twain National Forest and, CHI has partnered with NatureServe, the USFS Eastern Regional Office, and three other National Forests design and implement CHI protocols across Central Hardwood ecosystems. Widespread adoption of this protocol will fulfill agency monitoring requirements and facilitate educational opportunities for managers to identify components of healthy ecosystems and to effectively understand and monitor management effects on natural communities.

Monitoring Tree Species Alpha Diversity at Temporal and Spatial Scales Across Kentucky and Tennessee, USA

Topic: Ecological monitoring: effective/sustainable long-term status and trends

James Rosson Jr
USDA Forest Service

A change in species diversity levels is often cited as one way to assess ecosystem health. Of most urgent concern are declines in ecosystem diversity. These declines may be from natural causes (successional series shifts, insects, pathogens, fire, and weather) or attributed to human activity (population growth, urban expansion, land-use changes, pollution, habitat alteration or destruction, and unsustainable resource use). I undertook a study to assess tree species diversity levels across two hardwood-rich states, Kentucky and Tennessee, to see if there were changes in diversity across a time span of 10 years and to assess the differences in diversity among different state regions. I used the USDA Forest Service, Forest Inventory and Analysis (FIA) program data from forest surveys conducted in 2005 and 2015. There were approximately 2800 remeasured forest sample units in Kentucky and approximately 3600 sample units in Tennessee. The diversity metric applied was tree species richness (S) at the alpha level (also called point diversity); in this application it is the unique number of species on each sample unit, thus allowing the application of parametric statistics. On all sample units across each state, Kentucky had 114 tree species ≥ 2.54 cm dbh tallied in the 2005 forest survey and again in 2015; Tennessee had 134 tree species tallied in 2005 and 123 in 2015. In Kentucky, average (S) increased from 5.7 to 8.3 per sample unit between the two survey periods. For Tennessee, average (S) increased from 5.6 to 7.9. Both of these increases were statistically significant. This is good news for the forests of Kentucky and Tennessee, but caution needs to be observed because successional stage overlap may cause artificial spikes in species diversity. On the spatial scale, average (S) decreased (in general) from east to west in Tennessee (8.0 to 7.3, respectively) but showed a smaller difference in Kentucky (8.8 to 8.5, respectively). Tree species diversity is just one important forest health indicator for state-level forest monitoring. Studies such as this establish important baseline data for which to base future studies as surveys are conducted. These assessments of diversity trends will become an important element to consider when making decisions regarding conservation action or for resource planning in general.

NEON: Integrating open data and infrastructure with community science to better understand changing ecosystems

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Ashley Spink

National Ecological Observatory Network (NEON)

The National Ecological Observatory Network (NEON) is a continental-scale facility that collects long-term, open access, ecological data to better understand how ecosystems are changing across the United States. NEON will provide 30 years of data from over 80 ecologically diverse terrestrial and aquatic field sites, including five sites within the Great Lakes region. NEON collects data via field observations, ecological sample analyses, in situ instrumentation, and remote sensing. Researchers are using these data to address a variety of topics, such as biodiversity and biogeography, phenology, biogeochemistry, disease ecology, and hydrology. All samples and data collected by NEON are publicly available and can be accessed digitally through the NEON website. In addition to open data, NEON also provides many resources that support land managers, researchers, and educators, including sampling protocols, data skills training, and classroom-ready lesson plans. By providing free and open standardized data - along with data analysis tools, tutorials, and educational resources - NEON is engaged in the global effort to expand the scope of science and make scientific data access easier for all.

This presentation will introduce NEON's field sites in the Great Lakes region, as well as the resources for accessing and working with a variety of NEON data from across the country. It will also demonstrate how NEON's mission of open-access science goes above and beyond the data available on the web portal. Through partnerships with organizations like the Thriving Earth Exchange, that bring scientific expertise directly to local communities, collaborations with other large data collection networks such as EDDmapS, as well as the Observatory's Assignable Assets program, NEON is putting resources and data directly in the hands of the users.

Wednesday, September 7, 2022 3:45pm - 5:05pm

Illustrating the Impact of Natural Areas Through Storytelling

Fen Resilience in Southern Michigan: Mitchell's Satyr Butterfly Response to Habitat Management

Topic: Conservation partnerships

Ashley Cole-Wick

Michigan Natural Features Inventory

Courtney Ross

Michigan Natural Features Inventory

The federally endangered Mitchell's satyr butterfly (*Neonympha mitchellii mitchellii*) is one of the most geographically restricted butterflies in North America. In Michigan, this sedentary species inhabits prairie fens and tamarack swamps, where it is often found along streams, springs, and seeps. Feeding on sedges, such as *Carex stricta*, this butterfly prefers areas with abundant host plants and patches of native shrub cover. Michigan Natural Features Inventory (MNFI) has partnered with many organizations and agencies to better understand and protect the Mitchell's satyr since its listing in 1991, the same year that the Southwest Michigan Land Conservancy (SWMLC) was founded and immediately focused efforts on the conservation of this species. For over three decades MNFI has worked with SWMLC to monitor, understand, acquire, and manage sites occupied by this rare butterfly in southern Michigan. We employed ArcGIS StoryMaps to share the history of how one Mitchell's satyr site, Coldwater Fen Preserve, has been protected. We highlight the value of partnership, and the dynamic relationship between land management and research. This web-based application allows us to share this story through maps in the context of narrative text and other multimedia content. The saga includes wetland violations, prescribed burning, and a not-always-enjoyable game of 'whack-a-mole' between land management and butterfly occupancy. We share how rare species inventories have informed how SWMLC cares for the land, lessons learned, the value of collaboration, and the usefulness of StoryMaps to visualize multidimensional conservation stories. The origin and management of Coldwater Fen is a lesson in unraveling the complex ecology of one endangered species, and that dedication and responsive stewardship can result in successes.

The Geographic Approach for Conservation Communication

Topic: Making connections with new audiences

Sunny Fleming
Esri

It's more important than ever to communicate scientific concepts in ways that allow non-scientific stakeholders to understand, plan and take action upon. For environmental professionals tasked with stewarding and monitoring our most special places, effective communication is critical but can be challenging. Sensitive data needs to be protected. Scientific reports are difficult for non-academics to digest. So often, the fruits of our efforts end up in static paper reports or spreadsheets and are forgotten. Using modern web GIS, it's easier than ever to overcome these challenges and accelerate conservation efforts. Exploring examples from Colorado Natural Heritage, Montana DNR and South Carolina DNR, we will explore ways in which land managers are taking a geographic approach to tackle these challenges and effectively communicate with and engage stakeholders for conservation planning, citizen science and more.

Wednesday, September 7, 2022 3:45pm - 5:05pm

Innovative Management Techniques, Equipment and Labor

EDDMapS: Integrated platform and program for tracking invasive species management in North America

Topic: Invasive species: threats, prevention and management

Rebekah Wallace
University of Georgia

EDDMapS has been a resource for invasive species occurrence data since 2005. In this time, EDDMapS has grown from a citizen science database focused on invasive plant data in the southeast to an aggregate database soliciting data on all invasive species taxa and biological control agents across the US and into Canada. As technology has advanced, it has allowed for more features and tools to be developed and made available to EDDMapS' partners. Whereas previous iterations of the EDDMapS website and smartphone applications focused on regional needs and, thus, regional versions of each existed, we have now launched the new EDDMapS. EDDMapS is the unification of the regions into one collective. Instead of having many websites and apps that all do very similar functions, but were separate due to the available technology at time of creation, they can now be brought into one website and one app. Concurrent to this, the EDDMapS API has also been redesigned for improved performance, increased usability, and easier implementation with a broader user base. This will allow for easier and more precise data sharing among individual users and aggregate databases alike. EDDMapS also has new tools including EDDMapS Pro and ISMTrack for tracking management of populations over time.

Scanning the Horizon for the Future of Natural Areas in the Anthropocene

Topic: Innovative management techniques, equipment and labor

David Bengston
US Forest Service, Northern Research Station

Mike Dockry
University of Minnesota

We live in an age of accelerating and transformative change. According to some analysts, we may have reached an historic inflection point at which multiple mega-trends – such as climate change, biodiversity loss, technological disruption, and economic globalization – are accelerating and interacting simultaneously. Rapid social, technological, environmental, economic, and political change is the broad context for natural areas and their conservation in the

Anthropocene. How can natural areas professionals better navigate this increasingly turbulent future, in which business-as-usual thinking is no longer a viable strategy to protect and restore natural areas?

The Forest Futures Horizon Scanning Project of the US Forest Service is an effort to proactively deal with the increasing pace and complexity of change. Horizon scanning is a systematic process for identifying early signals of change in the external environment of an organization or field. The focus is on external change because professionals within a field are already aware of most internal developments through reading newsletters and journals, attending conferences, and interacting with colleagues. But a wide range of nascent external developments could affect natural areas in the future. These include emerging issues, trends, countertrends, broad driving forces, and 'wild cards' – low probability, high-impact events that unfold rapidly and could shape the future. Horizon scanning aims to be an early warning system to identify potential threats and opportunities and enable decision makers to plan accordingly and take timely action. The goal is to avoid being blindsided by unforeseen change and to be prepared for multiple futures. This presentation will 'look beyond the headlights' of natural areas conservation. We will introduce the Forest Futures Horizon Scanning project, delve into its database of 'scanning hits' for examples of signals of change that may be relevant for the future of natural areas conservation, and explore the implications of these potential game changers.

Wednesday, September 7, 2022 3:45pm - 5:05pm

Pollinators and Other Insects - Continued

Using photography to survey multiple groups of pollinating insects and plant associations

Topic: Rare species/pollinator best management practices

Angella Moorehouse

Illinois Nature Preserves Commission

Currently most pollinator surveys focus on a small group of pollinating insects such as butterflies or bees at the exclusion of wasps, beetles, flies, moths, true bugs, ants, and other insects that move pollen. This study was established to look at the entire group of flower-visiting insects as a community. From 2018-2021 pollinators and their plant associations were surveyed on 24 protected prairie, wetland, and forest natural areas in west-central Illinois with the use of photographic documentation. The use of photography allows for documentation without the time and resources required for collecting, handling, and identifying specimens. The goals of the survey were to establish baseline species lists of potential pollinators, determine flora associations, assess the impacts of invasive species, find specialist pollinators associated with rare community types, evaluate insect preference for high-quality remnants, and obtain new ideas to guide management for the benefit of the pollinating insect communities. Six sites were sampled each year, with the goal of surveying each site on a five-year rotation. Each site was surveyed every 1-2 months (April – September), for 60-90 minutes per visit following pre-established meandering transects. The majority (over 90%) over the insects documented were photographed and all were documented to species level or the lowest classification possible. Four years of surveys (24 sites) have identified about 642 potential pollinators on 242 species of plants. Bees were the most abundant group representing 35% of all individuals recorded with beetles at 18%, flies at 16%, and butterflies and moths at 15%. Nearly 87% of plants utilized by insects on these sites were native, however there was a definite preference for a small number of invasive plants. Most remnant sites with a wider diversity of native plants attracted a higher diversity of insect pollinators. Land cover analysis demonstrates that heavily degraded communities, as well as dense forests with few floral resources, had fewer insects as compared to grasslands and open or managed woodlands. Richness and abundance of insects on sites receiving high intensity management was slightly higher than sites with little or no management. Using land cover data to include the surrounding landscape may also help to determine preferred refugia size for sites managed with prescribed fire.

Relative importance of anthropogenic and environmental factors on occurrence of prairie-dependent insect species

Topic: Prescribed disturbance: haying, grazing, fire, logging

Valeria Trivellone

University of Illinois at Urbana-Champaign

Valeria Trivellone, Abigail Pagels, David N. Zaya, Thomas J Benson, Christopher H. Dietrich, Brenda Molano-Flores.
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Drivers of grassland biodiversity loss include anthropogenic disturbances such as habitat destruction, degradation, and fragmentation. In Illinois, government and non-government organizations spend considerable efforts in managing and protecting natural areas, yet some habitat-dependent insect species have declined dramatically over the past 20 years. For example, the prairie leafhopper, *Aflexia rubranura*, is considered extinct in at least 2 counties and currently recorded in only 3 counties in north-eastern Illinois. Our project focused on two groups of phytophagous insects in greatest conservation need (SGCN) listed in the Illinois Wildlife Action Plan, Hemiptera (i.e., leafhoppers, planthoppers, cicadas, froghoppers) and Lepidoptera (i.e., butterflies, skippers, and moths). During our three-year survey, we selected a subset of SGCN that are found mainly in grasslands and monitored their presence-absence across the State. We hypothesized that the presence of SGCN to be determined primarily by host plant availability, which is in turn structured by a diverse suite of anthropogenic and environmental factors. Our aim was to evaluate if the current management practices, aimed at maintaining and improving habitat quality/quantity of grasslands, have a positive effect on the prevalence of native plant species and insect SGCN. We used different regression algorithms to relate plant species occurrence and richness to anthropogenic and environmental predictors to define which factors best explain the distribution of single species and communities of both focal insects and their native host plants. Ultimately, we showed the influence of anthropogenic and environmental factors on habitat quality for prairie-dependent species and gained a better picture of the overall conservation status of these species.

Science to Support BLM Pollinator Management

Topic: Rare species/pollinator best management practices

Bruce Young
NatureServe

Monarchs have experienced recent catastrophic population crashes, and other insect pollinators have also suffered widespread declines. The Bureau of Land Management is the largest land manager in the western US, overlapping the California overwintering population of the monarch, the North American peak in bee diversity, and a diverse Lepidopteran fauna. To support decisions made by BLM's land managers to protect these valuable biodiversity resources, we identified key areas for on-the-ground management actions such as habitat restoration and enrichment as well as to inform regulatory review. Recognizing that monarchs tend to migrate along riparian and wetland corridors, we modeled likely migratory pathways across BLM lands. For bees and pollinating Lepidoptera, we identified species documented to occur in each BLM field district, as well as highlighting at-risk species, BLM Special Status Species, and state Species of Greatest Conservation Need. We also mapped associations of these pollinators with soil types and vegetation classes. The results detected areas of particular value for pollinator diversity that could be overlooked through traditional approaches that focus on, for example, at-risk vertebrates or federally listed species. Coauthor: Hannah Hyatt

Native bees, natural communities and host plants from 5-year survey of long-managed Missouri Ozark woodland landscapes

Topic: Rare species/pollinator best management practices

Ken McCarty
Missouri Department of Natural Resources

With a mission to preserve Missouri's natural landscapes, following four decades of ecological restoration and fire management across the most ecologically rich and representative Ozark woodland and glade landscapes and natural areas in Missouri State parks, a survey of bee species began in 2016. This survey has produced over 7,000 records of bee species with respective host plant, natural community and ecological land type association data. The survey included 20 Ozark and Ozark border landscape-scale parks, with eight being intensively sampled at 2-3 week intervals throughout the growing season and including several high quality designated Missouri Natural Areas. All

specimens were collected by net, at the flower.

This presentation profiles the results, describing the bee fauna recorded within the natural communities that comprise these native Ozark woodland/glade state park landscapes. Information is presented on bee species richness, and records of oligolectic, rare or conservative bees; the plants that attract large numbers of bee species, those that host rare or specialist bees, and the bees found on the conservative plants of Ozark woodland and glade ecosystems. Given that most collections were made within restored and fire-managed natural environments, comparisons will be made to bee abundance and richness in those parks or portions that have not been so managed.

The overall result is meant to provide a record of the bee community with host plant and natural community records, for the high quality oak woodland and glade landscapes that have been long preserved at the scale of large landscapes within Missouri State Parks; especially those in what is considered good to excellent ecological condition through restoration and fire management beginning in 1980's.

Wednesday, September 7, 2022 3:45pm - 5:05pm

Rare Plants

The past, present, and future of Minnesota's rare arctic relicts

Topic: Rare species/pollinator best management practices

Briana Gross

University of Minnesota Duluth

Julie Etterson

University of Minnesota Duluth

John Vallez

University of Minnesota Duluth

The rare arctic relict plant populations of Minnesota, found in the cool and moist microclimate produced along the cold waters of Lake Superior, face an uncertain future due to anthropogenic climate change. We used a combination of ecological and evolutionary approaches to examine the impacts of this warming threat across a north/south latitudinal range. Ecological niche modeling of Minnesota populations of *Pinguicula vulgaris*, *Euphrasia hudsoniana*, and *Primula mistissinica* show a drastic reduction in suitable habitat probability when a conservative future forecast climate model is applied. To investigate if these arctic relict communities have changed in the past two decades of warming, we selected nine Relevé survey sites with community composition data from 2000 and 2001 and resurvey them in 2019 and 2020. Large temporal turnover was observed across all sites over the last ~20 years, and southern sites, where warmer temperatures are recorded, showed an overall mean decrease in species richness. To understand patterns of selection across the latitudinal gradient that the populations span in Minnesota, we established plots at four sites and collected data for phenotypic selection analysis on the relicts *Pinguicula vulgaris*, *Euphrasia hudsoniana*, and *Primula mistissinica*. Reduced flowering was observed in southern most plots for all species, likely due to stress from recorded average summer temperatures nearly 2°C warmer than northern plots. Phenotypic selection analysis of *Pinguicula vulgaris*, the species most vulnerable to climactic changes according to environmental niche modeling, reveals differences in selection acting on flowering date between northern and southern populations. This suggests that the warm range edge populations are facing selective pressures that are novel and potentially extreme compared to more northern populations. These findings, in addition to future population viability analysis, aim to direct conservation efforts to prevent extirpation of these arctic relict communities in Minnesota.

Developing a Rare Plant Rescue Program for Minnesota

Topic: Rare species/pollinator best management practices

Carrie Taylor
Anoka Conservation District

Amanda Weise
Minnesota Landscape Arboretum

Amy Husveth
Critical Connections Ecological Services, Inc.

There are 179 plant species listed as threatened or endangered in Minnesota. By definition, these plants are rare and vulnerable to extirpation. Over the past three decades, hundreds of thousands of rare plants have been legally destroyed as a part of permitted development activities. In 2019, the MN DNR created a new permit option that allowed for the rescue of individual rare plants from permitted development footprints. This new permit provides an important opportunity to advance rare plant conservation in Minnesota and from this, the Rare Plant Rescue Program was formed. The program is focused on the 1.1 million-acre Anoka Sand Plain (ASP) of central Minnesota - a biodiversity hotspot and home to at least 59 species of rare plants. The ASP is situated close to the state's major metropolitan center and is under continual development pressure, therefore rare plant rescue opportunities are becoming increasingly frequent. The newly formed Rare Plant Rescue Program is a collaborative network with a common goal of rescuing, protecting, conserving, and expanding the collective knowledge of Minnesota's rare plant species. To date, this group with partners and volunteers has performed 5 permitted rescue events and supported conservation activities (seed banking and research) for 16 rare plant species.

The Race Against Plant Extinction

Topic: Conservation partnerships

Wesley Knapp
NatureServe

Coauthor: Amanda Eberly, NatureServe.

As we move through the Anthropocene the extinction rates of plants and animals are expected to increase. Unfortunately, little is known about the current extinction rates of most plants and animals. In 2021, I published work with a broad team of botanists to document and assess the extinct plants of the United States and Canada. I will present an update of these results and focus on ongoing work to prevent plant extinction. A critical evaluation of current conservation prioritization methods, as well as new methods, are required to prevent future plant extinctions. There are approximately 1,250 G1 plant species in the United States and Canada and current plant conservation funding is inadequate to address all these species simultaneously. Our previously published work determined that 64% of all extinct plants were species of extremely limited geographic ranges, called single-site endemics (SSE). Our current work is to identify species of one extant occurrence. This includes SSEs and plants of one known occurrence (OKO's). SSEs evolved and were only known from one location, whereas OKOs can include species that have declined to one occurrence. We at NatureServe have developed a method to identify OKO plants for prioritized conservation action. We will present an analysis of OKO species that will include in situ and ex situ measures. Lastly, collaborative efforts to preserve extinct in the wild (EW) plants and the premise of extinction gardens will be discussed.

Wednesday, September 7, 2022 4:00pm - 6:00pm

State Natural Areas Program Roundtable

Wednesday, September 7, 2022 5:00pm - 7:00pm

Poster Reception

20+ Years of the National Park Service's Invasive Plant Management Team Program

Topic: Invasive species: threats, prevention and management

Shea Bruscia
National Park Service

Brian Lockwood
National Park Service

T. Hogan¹, S. Bruscia², B. Lockwood²
¹National Park Service, Invasive Plant Program Manager
²National Park Service, Florida/Caribbean Invasive Plant Management Team

Abstract

The National Park Service's Exotic Plant Management Team (EPMT) program was created in 2000. The goal of this program was to enhance parks abilities to manage invasive plant species by having 'boots on the ground' in the parks, removing invasive plants and conducting surveys. After 20 years, the program decided to change the name from 'Exotic' to 'Invasive' to better reflect Executive Order 13751, which uses the term invasive in lieu of exotic and to coincide with what other invasive plant organizations have done. The teams are now known as Invasive Plant Management Teams, or IPMTs.

In addition to invasive plant control, the teams engage to varying degrees, in other aspects of ecological restoration such as native seed collection, supporting education, outreach, prevention of seed or plant introductions, and restoring sites once invasive plants are controlled. Conducting early detection and rapid response (EDRR) to plants 'on the move' facilitates these efforts. By providing these services the IPMTs help protect and preserve some of the most important natural and cultural resources in the United States.

In 2000, the Florida/Caribbean IPMT (FLC IPMT) was one of the first teams to be created. This team serves 16 park units located in Florida, the Virgin Islands, and Puerto Rico. Unlike most other teams, the FLC IPMT operates using contracted crews. One example of success was a project at Salt River Bay National Historical Park and Ecological Preserve. The main targets for removal were African guinea grass (*Megathyrsus maximus*), tan-tan (*Leucaena leucocephala*), wild cotton (*Gossypium hirsutum*), ginger Thomas (*Tecoma stans*), and purple allamanda (*Cryptostegia grandiflora*). Staff from the FLCIPMT, the park, and contractors chemically and mechanically removed invasive plant species. Over 1000 native plants were then planted to keep the invasive population low. Shade structures were established and an irrigation system was installed to help the newly planted natives. With the continued efforts of all parties involved, this parcel of land was transformed from a degraded piece of land to a unique place for locals and tourists to visit. There is now a nature trail and a Marine Research and Education Center. In addition, there are unique archeological sites across the unit. Continual mechanical and chemical maintenance will be required for the foreseeable future.

Keywords: Invasive plants, Restoration, Florida, Caribbean

A Guide to Developing Monitoring and Adaptive Management Plans

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Brook Herman
USACE - Engineer Research and Development Center

Adaptive management is a tool for flexible decision-making that allows adjustments in management actions to be made as a result of obtaining more knowledge through monitoring. Monitoring and adaptive management are key elements in the successful execution of an ecosystem restoration project and yet there are very few published guidelines or standards for developing a monitoring and adaptive management plan (MAMP). The U.S. Army Corps of Engineers (USACE) is in the process of publishing a guide to developing monitoring and adaptive management plans

(Herman et. al. 2022). The USACE executes ecosystem restoration and mitigation projects across the nation in order to support the recovery of important habitats and the species that depend on them. This poster provides a brief overview of the main elements of a MAMP. The main takeaways is that the MAMP should be developed early in the planning process for an ecosystem restoration project and should be refined as more information is obtained. The MAMP should include descriptions of the monitoring objectives, project features or design considerations, management objectives (restoration success), success metrics and how data will be used to calculate metrics, trends triggering adaptive management actions, data management, reporting and communication. Monitoring and adaptive management plans are needed to track recovery of ecosystems in order to make informed management decisions and assess restoration success.

A Potential New Nemesis for Garlic Mustard? Exploring the Range and Impacts of a Newly Arrived Specialist Aphid

Topic: Invasive species: threats, prevention and management

Rebecah Troutman

Holden Forests & Gardens

In 2021 Holden Forests & Gardens (HF&G) staff working at the Holden Arboretum (HA) in Kirtland, Northeast Ohio observed damaged garlic mustard plants during routine garlic mustard (*Alliaria petiolata*) management activities. Damaged garlic mustard plants appeared to be infested with an unknown aphid not seen before. These plants exhibited twisted seed pods and puckered/wilted leaves. The observation was surprising as it is extremely rare to find garlic mustard plants with apparent damage from herbivory or disease. The affected plants were collected and the aphid was identified as *Liaphis alliariae*, a garlic mustard specialist native to Europe and previously unrecorded in the United States. Given the importance of controlling invasive garlic mustard, the novel nature of the newly discovered aphid, and the anecdotal evidence suggesting this species may negatively impact garlic mustard, the HA developed this research project with the goal to 1) determine the local distribution of the aphid and 2) quantify how this aphid is affecting growth and productivity of individual garlic mustard plants within northeast Ohio. In the summer of 2022, HF&G staff and citizen scientists determined the spatial distribution and other qualitative information regarding this aphid species using a smartphone application. This was paired with a study of how the aphid may be impacting individual plant condition, including growth and productivity. These data will aid in our understanding of how this aphid may be naturalizing and potentially serve as a future biocontrol agent for garlic mustard.

An App for Community Scientists Helping to Save Rare Plants

Topic: Developing technologies and apps: what to consider in creating or using

Katie Kucera

Plants of Concern (Chicago Botanic Garden)

Gretel Kiefer

Plants of Concern (Chicago Botanic Garden)

Plants of Concern is a community science rare plant monitoring program that operates in northeastern and southern Illinois, USA. Since 2001, the program has trained over 900 volunteer plant monitors to help collect demographic, GPS, threat, and management data on over 300 plants species that are state threatened, endangered, or rare in Illinois. In partnership with land-managing agencies, these data are analyzed and utilized to inform adaptive land management practices that aim to conserve rare plant populations. With the help of a generous foundation grant, Plants of Concern developed and launched online training modules plus mobile and web applications in 2021. These technology tools make the volunteer training and data collection, exchange, and analysis process more efficient and accessible. With these apps, volunteer monitors can access their Plants of Concern accounts and monitoring assignments from their smartphone or tablet devices and seamlessly collect and submit data. Land managers can view sites, monitored species, and see which staff and volunteers are signed up to monitor a species each year. Land managers can also download detailed monitoring report datasets for their own internal use. Plants of Concern staff have also enjoyed the ease of use of these tools, which have simplified volunteer engagement, database management, and monitoring assignment coordination tasks. These tech tools are available to other conservation

organizations who want to use the Plants of Concern monitoring protocol for rare plant monitoring. In the future, Plants of Concern hopes to share its apps with more organizations and to expand the functionality of its apps to accommodate more advanced GIS and data visualization features.

Bee community abundance, diversity, and resource use under various grazing regimes

Topic: Rare species/pollinator best management practices

Bethany Robertson
North Dakota State University

As the human population increasingly depends on rangelands to support agricultural and livestock production, there is a need to study bee community responses and resource use across rangeland management regimes. Approximately 35% of crops and 87% of flowering plants are pollinated by animals which includes honeybees and native bees. Therefore, these pollinators need to be protected, especially considering that many bee species are facing worldwide declines. In grasslands, including working rangelands, this decline may be mitigated with disturbance regimes such as burning and grazing that may potentially promote floral resources for bees. Our research objectives are to examine the abundances and diversity of bee species, as well as their floral use, in three grazing regimes: patch-burn grazing (PBG), season-long grazing (SLG), and a modified twice-over rotational grazing (MTORG). We carried out surveys in all three treatments, recorded bee species observed, and noted the plants they were found visiting. Preliminary results for 2021 suggest that 1) the greatest number of bees were found in MTORG regime (and then within the rested treatment of the MTORG regime) while the PBG regime had the fewest bees, 2) diversity of bee genera amongst the three treatments were similar despite differing abundances, and 3) a wide variety of floral resources are used by bees even in genera with low abundances. This research should give us insight into how different grazing management techniques may be used on rangelands to promote bee communities which, in turn, can benefit agricultural and livestock production.

Bridging sciences in insect research: Exploring socio-ecological relationships between humans and insect families

Topic: Conservation partnerships

Katherine Schneider
Michigan Technological University

Authors: Katherine E. Schneider, Valoree S. Gagnon, Tara L. Bal

The respectful inclusion of Traditional Ecological Knowledge (TEK) in research involves actively bridging knowledge systems between Western Scientific Knowledge (WSK) and TEK through practicing 'two-eyed seeing'. This is important because Michigan Technological University is on ancestral and contemporary homelands of Ojibwa people, centered within ceded territory of the 1842 Treaty. Bridging knowledge systems is not an integration but an acknowledgement that TEK and WSK are each integral and co-exist. The practice of two-eyed seeing in research means that each is relevant and contributes equitably to advancing sciences.

In speaking with Michael Waasegiizhig Price, a traditional knowledge holder and Ojibwemowin teacher, we explored relationships of Ojibwa people with Emerald Ash Borer (EAB, *Agrilus planipennis*, Coleoptera: Buprestidae). He shared that the Ojibwa do not have a name for EAB because interactions and established relationships with the species are needed before being named. EAB is still 'manidoons' or 'little spirit', the Ojibwa name for insects. Although EAB is known for their negative impacts to the tree genus *Fraxinus*, the Ojibwa hesitate to pass judgment without a relationship. This can be said about any organism that we do not take time to learn about, interact with, or observe to see how our actions impact them, learning how we are linked. Here, we understand that relationships are at the core of Indigenous teachings.

This work aims to examine the evolution of relationships between humans and insects. TEK regards invertebrates as sovereign beings with rights as our more than human relatives. The first way of knowing on these lands include Ojibwa relationships with other beings. This was followed by the attempted eradication of the Ojibwa relationship with the natural world, which we will examine through the lens of historical forest management policy regarding insects in the United States, particularly regarding certain beetle families (Coleoptera: Silphidae/Carabidae). This research will

include insights and interactions with Ojibwa knowledge holders on TEK regarding invertebrates and relationships to land and other beings, and how relationships have been affected by US policy. Two important questions underlying this research are: how are forest managers shifting towards sustainable management practices and biodiversity maintenance and restoration? How can the inclusion and equity of Indigenous knowledge be central in forest practices and planning going forward? The practical applications of this framework may be used to advocate for more inclusion of invertebrate biodiversity in conservation partnerships and develop questions needed for further understanding of our relationships.

Droning on about buffer benefits: Testing the efficacy of aerial imagery for motivating ranchers to restore streams

Topic: Protecting and managing natural areas for climate resilience

Sarah Woodbury
Utah State University

Sarah Klain
Utah State University

In the arid American West, climate change means increased variability in precipitation, higher summer temperatures, and longer droughts, which are likely to have major consequences for native species and ranching livelihoods. Riparian buffers in otherwise agricultural lands can help moderate stream temperatures and improve water quality. Fencing cattle away from streams and building alternative watering infrastructure promises to improve stream habitat. This research on engaging ranchers is motivated by environmental justice concerns involving the Northwestern Band of the Shoshone Nation. The Tribe wants to restore endemic species to their land in southern Idaho called Boa Ogoi, which is the site of the 1862 Bear River Massacre where over 400 Shoshone were killed. Highly degraded water quality from upstream agriculture poses a significant barrier to the Tribe's goals of stream and riparian habitat restoration.

This study seeks to understand and potentially overcome barriers to stream restoration among landowners upstream of Boa Ogoi. Landscape visualizations may help motivate conservation actions. They also help communicate natural resource management implications to diverse stakeholders. We conducted semi-structured interviews with ranchers in this watershed that incorporate aerial imagery from a small unmanned aerial system (sUAS, aka drone) showing the current state of the landowner's property along a creek that ultimately runs through Boa Ogoi. We compare these images with imagery processed with landscape visualization software (Visual Forester) demonstrating what the property could look like with riparian buffers, fencing, and alternative water infrastructure for cattle. This study seeks to learn the extent to which the use of aerial imagery 1) promotes engagement of landowners in dialogue about water quality downstream; and 2) influences pro-environmental behavioral intentions (i.e., building fences, establishing riparian buffers, installing alternative watering infrastructure). We hypothesize that using visualizations and identifying ways to defray costs will motivate landowners to adopt practices that support downstream water quality. Private landowners have crucial roles to play in contributing to the persistence and restoration of endemic species. We test an innovative method using custom tailored aerial imagery for engaging private landowners to improve water quality and climate resilience.

Co-authors: Sarah Woodbury, Sarah Klain, Ph.D.

Effect of agricultural chemicals on the germination of northern Great Plains native plants

Topic: Native plant materials in restoration/rehabilitation

Gabrielle Bolwerk
South Dakota State University

Authors: Gabi Bolwerk, Joshua Leffler, Lora Perkins

Prairies are valuable ecosystems that provide economic, ecological, genetic, recreational, and aesthetic benefits to the landscape such as ecological diversity, wildlife habitat, water storage, and erosion reduction. Between 2006 and 2011, about 1.3 million acres of grassland were converted to corn and soybean production in the Western Corn Belt. Ecological restoration is used to initiate or accelerate an ecosystem's recovery and is commonly practiced on lands that have been degraded or damaged due to human activities such as agriculture. Many seed-based restoration projects are not successful, potentially due to seeds failing to germinate. One reason seeds may fail to germinate is anthropogenic chemical use (specifically pre- and post-emergent herbicide) drifting from surrounding row-crop agriculture. Chemicals used in agriculture are abundant in the northern Great Plains and are moved via wind and water to soil adjacent to treated crop fields. Few ecological studies examine the effects of these chemicals on native seed germination. Our objective is to determine the effects of agricultural chemicals at different concentrations on the germination of native plant species. We will conduct germination trials using treatments of 2,4-D, Atrazine, Trifluralin, and Ivermectin at concentrations of 100%, 50%, 10%, 1%, 0.1%, and 0% of the recommended rate to assess the phytotoxicity of these chemicals at different concentrations; these concentrations represent the range of exposure seeds may experience at the edge and up to approximately 20 meters from the edge of an agricultural field. We will test these treatments on fourteen native plant species, which were selected with a spectrum of high to low establishment success so that we can observe the potential range of effects that chemical concentration may have. Elucidating species-specific response to chemicals could improve restoration outcomes where drift is likely. This information will be used to educate land managers and restoration practitioners on recommended species to use in restoration adjacent to crop fields to increase the success of seed-based restoration.

Highly diverse prairies retain some ecosystem services for pollinators despite experimental warming and drought

Topic: Protecting and managing natural areas for climate resilience

Maggie Anderson
University of Minnesota

Background/Question/Methods.

Climate change is a growing threat to the diversity and functioning of grassland ecosystems, as it is expected to increase average temperatures and exacerbate drought conditions in the Midwestern United States over the next century. Midwestern tallgrass prairies are especially important for conservation purposes, as they support a high diversity of flowering plant species which provide essential forage and habitat for native pollinators. However, there is evidence that the warmer and drier conditions under climate change will favor non-flowering warm-season grasses, causing them to outcompete native wildflowers and potentially decreasing the ability of prairies to provide the ecosystem services that support pollinators in the future. Despite this threat, little research to date has established a link between climate change and the abundance and diversity of flowering plant species. Here, we use a fully factorial warming and drought experiment to examine the effects of warming and drought treatments on biodiversity and flower abundance (pollinator forage) in a tallgrass prairie ecosystem at Cedar Creek Ecosystem Science Reserve in East Bethel, MN. We measured flower resources by counting flower head abundance in the plots every two weeks over the growing season and quantified plant diversity by harvesting, identifying, and weighing individual species biomass.

Results/Conclusions.

Experimental elevated warming had the strongest effect on the ability of prairies to provide flower resources, although both warming and drought determined the relationship between *Andropogon gerardii* (a warm-season grass) biomass and plant diversity. *A. gerardii* biomass increased significantly (nearly 2-fold) with both elevated warming ($P = 0.05$) and drought ($P = 0.05$). *A. gerardii* also contributed to a 3-fold increase in grass/forb biomass ratios under warming. Plant diversity declined significantly with increasing *A. gerardii* biomass ($P = 0.0001$) under warming, although not under drought ($P = 0.395$). There was also a strong positive correlation between plant diversity and the total flower count throughout the growing season under the combined effects of warming and drought treatments ($P = 0.05$). Overall, these results indicate that future climate change will likely favor warm-season grasses, which outcompete other native plants, thereby reducing the overall diversity of tallgrass prairies and the services that they can provide to pollinators in the future. This research indicates that highly diverse prairies may be better able to maintain some ecosystem services for pollinators under extreme hot and dry conditions, allowing for more effective conservation of prairies for

pollinators in the future.

Identifying bumble bee species and the flowering plants they visit through surveys using cell phone videos.

Topic: Rare species/pollinator best management practices

Diane Angell
St. Olaf College

Diane Angell, Isabel Istephanous, Elijah Johnson, Kenna Nguyen, Sandra Chu

Bumble bees are important pollinators of native plants and have direct economic impacts due to the pollinating services they provide to fruit and vegetable growers. Their large size and visibility also make them a charismatic species. Bumble bee populations have declined substantially in North America and one species, the rusty patched bumble bee (*Bombus affinis*), has recently been added to the endangered species list. Efforts are underway to determine the status of rusty patched bees and many other species in Minnesota and elsewhere. We surveyed both remnant and restored prairies in southern Minnesota, creating video clips using cell phones to identify bee species and the flowering plants they were visiting. Review of videos allowed bees to be identified by species and the uploading of a subset of screenshots from those videos to the citizen science website bumblebeewatch.org allowed observations to be confirmed and archived. Our goal was to provide a general understanding of which bumble bee species were found in each prairie, as well as which plants were visited by each species.

Every bumble bee observed during our 2 hour surveys was captured on video. We each of five prairies every ten days from the start of June to the middle of September, noting every plant observed flowering during each visit. During 90 hours of surveys, we recorded and identified over 2,300 individual bees of 10 different species including several rusty patched bumble bees. Brown belted bees (*B. griseocollis*) were by far the most common species and visited the greatest number of different flowering plants. Out of the more common species observed, the yellow bumble bee (*B. fervidus*), a long-tongued species, visited the fewest different species of flowering plants. While we noted over 150 species of plants flowering during our surveys, fewer than a third of those were visited by bumble bees. Bees disproportionately visited plants that were legumes relative to those that were not legumes and visited roughly equal proportions of those plants that were native compared to those that were introduced. The most commonly visited introduced species were legumes such as white and red clover. Out of all the visits bees made to flowers, the vast majority were visits to two plant species, purple prairie clover and bee balm. Surveys of bumble bees non-destructively by using cell phone videos can be practical and valuable and should be added to other survey techniques such as netting and bee bowls.

Implications of Forest Health Risk Factors: Geospatial Analysis of Sugar Maple Decline in the Upper Great Lakes

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Manuel Anderson
Michigan Technological University

Authors: Anderson, M., M. Brady, M. Jarvi, C. Webster, T. Bal.

Maple decline can rarely be attributed to a single causal agent and is rather recognized as a complex interaction of predisposing and contributing factors. Recent evidence suggests that environmental pressures on sugar maple (*Acer saccharum*) are growing due to shifting climate regimes, interacting edaphic factors, and novel pests and/or pest dynamics. Despite the complexity of factors, risk assessment maps for sugar maple decline rely on a limited number of landscape features. Many of the stands dominated by sugar maple are managed using selection silviculture and traditional stocking standards despite increasing evidence that these treatments may not foster adequate regeneration.

Sugar maple dieback and decline has been documented in the Upper Great Lakes region for the last fifteen years. In 2009-2012, 120 plots were established across the western Upper Peninsula of Michigan, northern Wisconsin, and

northeastern Minnesota to evaluate potential causal factors. Disturbance to the forest floor caused by invasive earthworms was the most highly correlated variable for maple dieback within plots. In 2021-2022, the same plots are being re-evaluated to document dieback patterns over time and examine relationships among variables. Other potentially related factors, such as the European fruit lecanium, *Parthenolecanium corni*, are being quantified. Additional risk factors associated with earthworm activity, such as distance to lakes, streams, and roads, and local deer densities, will be geospatially modeled.

The principal objectives of this follow-up study are to (1) apply a geospatial approach to enhance our understanding of additional factors associated with sugar maple dieback in the region and (2) propose strategies for sugar maple dieback risk assessment, including recommendations for the development of nuanced risk assessment maps that account for key factors. Our overall goal is to provide these tools for forest stewards to better navigate assessment and mitigation options when considering maple dieback and decline in the region.

Land management strategies in a post-industrial landscape on Chicago's southeast side

Topic: Innovative management techniques, equipment and labor

Lauren Umek

Chicago Park District

Marian R. Byrnes Park, a 135-acre public space on the southeast side of Chicago. This poster will demonstrate how industrial and residential waste has resulted in a combination of typical conservation challenges such as soil contamination and invasive species dominance, but also unique opportunities for conservation. Slag, a by-product of the steel industry is the dominant surface the wetland of this site, hindering planting efforts due to shallow soils. However, this impervious surface has also created an anthropogenic 'slag-wetland' with unique species assemblages of high conservation value. This historic use of the site and its immediate proximity to a neighborhood results in a need for careful ecological, social, recreational goals that meet the needs of the people as well as the ecological community of the region. This poster will explore the challenges and opportunities of managing this post-industrial site and how these efforts seek to engage the local community.

Co-author: Naureen Rana, Tony Troche

Land Use History Explains Depletion of Spring Ephemeral Communities

Topic: Flourishing habitats: how they got that way

Melissa Dopirak

Holden Forests and Gardens

Past land use is known to influence herbaceous communities presently inhabiting forests. Today, much of the eastern United States was previously cleared for agriculture and subsequently abandoned; left to convert back to forest. While these young forests tend to be less biodiverse, and often lack spring ephemerals, some can sustain communities of these forest wildflowers. Here we explore the legacies of prior land use on spring ephemeral communities across a forested landscape of varying land use histories. Specifically, we devised and conducted a spring ephemeral rapid assessment (SERA) survey to gauge the richness and composition of spring ephemeral communities, based on 15 disturbance-sensitive ephemeral species. Surveys were conducted within one-hectare plots across forests of varying land-use histories at the Holden Arboretum in northeastern Ohio. Using aerial imagery from 1937 and SERA data collected from 2016 through 2021, we explored the effects of previous land use on the presence and abundance of spring ephemerals. We find that areas that were forested in 1937 exhibited greater species richness and biodiversity than those that were disturbed. However, previously farmed areas can, in some instances, harbor healthy spring ephemeral populations. These areas tend to be in close spatial proximity to mature forest stands, suggesting slow spread of sensitive ephemeral species.

Loss of Wildfire ??? a 55 Year Sample of Forest Change

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Rebecca Marty

Minnesota Department of Natural Resources

Mark Fulton
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Fire dependent pine forests developed ~6000 years ago in north-central Minnesota as the climate stabilized following the end of the last glacial period. These forests were maintained by natural and anthropogenic fire until Europeans settled the area in the early 1900's. By the 1960's researchers were concerned that this fire suppression was causing adverse effects to the fire dependent forests. In 1964, Vilas Kurmis, from the U. of Minnesota, installed monumented sample sites for long-term monitoring of change in the upland forest communities of Itasca State Park, Clearwater Co, Minnesota. These sites have been re-sampled approximately every 10 years since.

Each site has eight plots made of five nested rings. The total diameter of each plot is 11.6m. The outer four rings are used for tree sampling, with dbh and species recorded. The inner circle also has the tree data collected, along with heights for smaller woody plants; estimated cover of forbs and small shrubs (like blueberries); and estimated total cover for broad categories such as trees, tree reproduction, shrubs, forbs, graminoids, mosses/lichens, rocks, etc.

Using the Minnesota DNR's native plant community classification, we compared sites from 1965 with the same sites in 2021, to explore community change. Natural processes of succession and periodic disturbance maintain forests in broad native plant community types. If those processes are interrupted, such as happened in Itasca State Park with the loss of fire, fire dependent communities are likely to become more mesic, and mesic hardwood communities are likely to continue to grow to a later successional stage.

Of the 30 sites, 18 were fire-dependent and 12 were mesic hardwood in 1965. Nine of the fire-dependent sites and only one of the mesic hardwood sites shifted toward more mesic conditions, so overall 10 sites shifted more mesic while 15 showed no shift, and the rest showed no clear trend. These patterns are consistent with our hypotheses that a disruption of fire processes would cause a mesic shift in the fire-dependent sites, and that mesic sites would remain mesic.

According to the classification used, the 30 sample sites had a mix of northern and central floristic affinities. The few sites that shifted floristic affinities showed no clear signal of shifts being due to lack of fire, climate change or other disturbances.

Mental Models and Demographic Impact on Plant Blindness

Topic: Public perception and attitude towards natural areas

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North Dakota State University

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In the last few decades, plant blindness, or a person's failure to recognize plants or their importance, has gained awareness in environmental education. Plant blindness can greatly affect one's ability to identify and understand plants and subsequently recognize their value in both natural and anthropogenic areas. A recent study assessed children's drawings to gain insight into plant blindness, as psychology research has shown that a third grader's plant knowledge should be similar to an adult novice who has not been taught to see more detail. The current study looks to expand on the children's drawings research and assess the adult population's ability to identify and see details in plants. Additionally, the adult population demographic information on race, ethnicity, culture, and where individuals gained their plant knowledge will be used to determine if there are differences among groups. The study population is

North Dakota college students at both public and private colleges, including tribal colleges across the state. Drawings from the study are being analyzed in the same ways as the third-grade drawings to determine how young adults' knowledge of plants compares. Additionally, data is being analyzed to determine where individuals are gaining their plant knowledge and if demographic factors impact their knowledge of plants. Results indicate that the study population demonstrates the symptoms of plant blindness. Information from this study will be useful to researchers and educators to determine where plant knowledge is gained and how that may change with demographic factors, which will provide insight into how to combat plant blindness in the future.

Natural Solutions: Development and Deployment of a Local Polypore as a Myco-biocontrol on Invasive Buckthorn Saplings

Topic: Invasive species: threats, prevention and management

Abraham Stone

Michigan Technological University

Stone, A., Dolinski, L., Webster, C., Bal, T.L., Resh, S.C.

Invasive buckthorns (*Rhamnus cathartica*, *Frangula alnus*) have established themselves as a prominent threat to ecosystems across the northeastern United States. Although efforts to eradicate buckthorn have been ongoing for several decades, few management practices provide a long-term solution in effectively removing well-established buckthorn colonies. While clear-cutting buckthorn stands removes large trees and temporarily opens the canopy, buckthorns often persist in the form of cut stem resprouts, young sapling proliferation, and germinating seed banks that, if not treated, lead to the reestablishment of the population. As a result, managing buckthorn requires a costly and laborious multi-year investment with repeated synthetic herbicide treatments. Forest health practitioners thus require a commercially-viable management technique that treats both mature and buckthorn regeneration while having low impact on native systems.

New research strongly supports the potential of a native fungus as a form of biocontrol: the silverleaf polypore, *Chondrostereum purpureum*. In Michigan, *C. purpureum* typically parasitizes *Prunus* and *Malus* spp, but also has exceptional host acceptance for buckthorn. In our recent trials, when directly applied to both girdled trees and freshly-cut stumps of buckthorn, *C. purpureum* demonstrated similar tree mortality and effectiveness at reducing resprouting as the herbicide glyphosate. Additionally, there was no statistically-significant difference between resprouting of both major invasive buckthorn species, indicating further potential for general invasive buckthorn application.

In the next steps of this research demonstration, we have explored ways to increase the efficiency of deployment potential by developing and testing a spray-based *C. purpureum* application on cut buckthorn sprouts. While previous research used a thick squeeze-bottle-applied gel, a thinner spray-based application of *C. purpureum* will emphasize ease of use, while aiming to maintain high rates of inoculation and sprout mitigation. Year one results of this trial spray application will be reported from multiple buckthorn invasion sites in Upper Michigan. Additionally, all native saplings growing within buckthorn sites will be monitored during treatments and trials to detect non-target *C. purpureum* impacts.

Our selected strain of *C. purpureum* was isolated and collected locally. Through the creation of novel 'myco-biocontrol' techniques, we seek to establish viable alternative methods to invasive species management that reduce usage of synthetic herbicides while providing commercial appeal. Data from this study directly applies to forest health specialists, invasive species managers, researchers, and a foray of industry practitioners with stakes in buckthorn management.

Perception, purpose, and pieces out of place: Deconstructing discourse on non-endemic earthworms

Topic: Invasive species: threats, prevention and management

Shelby Lane-Clark

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Co-authors: Valoree S. Gagnon, Tara L. Bal

Human activity across our planet has directly and indirectly led to the introduction and spread of countless species outside of their historical range. As globalization progresses, this phenomenon is becoming more frequent and the repercussions more apparent and extreme. Furthermore, anthropogenic climate change is extending and shifting ranges in ways not yet fully understood. Current discussion of introduced species in scientific literature, used to inform natural resource management practices, is heavily influenced by negative, militaristic, xenophobic language that implicates intent on the part of the organisms. This language normalizes damaging and destructive thinking, shifts responsibility, and enforces a negative relationship with these species that, from an ecological perspective, become the 'enemy' for roles they play in ecosystems for which they have evolved and come into being. Although out of place, the 'enemy,' as we may perceive them, are themselves living beings, performing their assigned duties. Holding this mindset damages our relationship and interactions with the natural world and our more-than-human kin with which we share it.

Earthworms are exceptional organisms, well-known as ecosystem engineers, and often perceived as partners in agriculture, as we have counted on them throughout history to nourish gardens and crops. This belief is commonly held in public spheres, which often leads to incredulity when those outside of ecological academia learn that earthworms were extirpated from northern regions of North America during the most recent glaciation. European earthworms were brought over by settlers during the colonization of North America through transportation of horticultural material and ship ballast. Today, they continue to be spread and new species introduced by human activity through land management, building of infrastructure, global trade, etc. Earthworms have cascading effects on ecosystems in which they are introduced. Disturbances to biogeochemical composition and processes within soil, wildlife and plant communities, and human health and economy have all been linked to non-endemic earthworm activity.

Changing how we think and talk about introduced species is an important first step, but we cannot stop there. Here, we will explore how, by deconstructing our perceptions and assumptions, we can build better practices in education and management, promoting understanding instead of biased or violent discourse. We hold responsibility for relocating innumerable species around the globe, as well as responsibility as environmental stewards to learn and acknowledge their impacts in their new environments, so that we can create informed solutions that are both respectful and effective in mitigating impacts.

Plant Species Associations in Native and Reconstructed Iowa Tallgrass Prairies

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Mary Damm

Prairie Quest Farm

The eastern tallgrass prairie is a highly diverse and endangered ecosystem. Tallgrass prairies have been planted across Midwestern states in an attempt to recreate the landscape nearly lost to agricultural conversion. Plant species richness and diversity and community composition differ between native and reconstructed prairies and at different spatial and temporal scales. In this study I asked which plant species are associated with one another in native and reconstructed prairies and how the associations differ or are the same among the prairies. In Iowa I sampled three native (Cayler Prairie, Hayden Prairie, Steele Prairie) and two reconstructed (Borlaug Farm, Lakeside Lab) tallgrass prairies. In each prairie, I established seven 70 cm x 70 cm (0.5 m²) plots stratified randomly in mesic prairie. I estimated plant cover using the point-intercept method. I measured plant canopy height and litter depth and sampled and weighed aboveground biomass and litter in each plot for community-associated variables. As part of a larger study, I collected soil samples for nutrient analyses. I analyzed plant species composition and community and soil variables with a nonmetric multidimensional scaling (NMS) ordination. In the ordination, Axis 1 differentiated the reconstructed prairies with cool-season (C3) grasses associated with the Borlaug Farm and warm-season (C4) grasses associated with Lakeside Lab. Axis 2 separated the native from reconstructed prairies with habitat conservative species *Amorpha canescens*, *Carex bicknellii*, *C. meadii*, *Helianthus rigidus*, and *Sporobolus heterolepis* associated with native prairies and less habitat specific *Monarda fistulosa* and *Elymus canadensis* associated with

reconstructions. Axis 3 separated the C4 grasses, *Sorghastrum nutans* and *Andropogon gerardii*. Litter depth correlated with axis 3, which could represent a burn gradient reflecting fire management of the native prairies. I suggested potential relevance of the plant associations to understanding plant community ecology in native prairies and to restoring prairie to the landscape.

Rehabilitating a *Lonicera maackii* dominated forest understory: Can native species plantings hold their ground?

Topic: Invasive species: threats, prevention and management

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Lonicera maackii is a highly invasive shrub that has successfully become the dominant understory woody plant in forests and woodlands throughout central Kentucky. Consequently, *L. maackii* negatively impacts the biodiversity and succession of natural forest ecosystems in Kentucky and surrounding region. The overall objectives of this study are 1) to evaluate if selected native species plantings may reduce or slow future *L. maackii* reinvasion in a central Kentucky (KY) forest understory; and 2) to determine if plant biodiversity increases in experimental areas where only *L. maackii* was removed compared to areas where *L. maackii* was removed and native species were planted. In spring 2019, a study was initiated as randomized complete block design with three replications whereby the following treatments were implemented: a) untreated control; b) *L. maackii* removal with 20% (v/v) glyphosate cut-stump application; and c) *L. maackii* removal with 20% (v/v) glyphosate cut-stump treatment followed by *Elymus* spp. seeding. As predicted, nearly two years after *L. maackii* removal and *Elymus* spp. seeding, *L. maackii* canopy cover was significantly lower ($P < 0.05$) in plots where it was removed/herbicide treated compared to untreated control plots. Moreover, *Elymus* cover averaged 50% or higher with slightly lower *L. maackii* cover compared to areas where only *L. maackii* was removed and herbicide treated (i.e., no *Elymus* seeding). Additionally, percent broadleaf plant cover was higher ($P < 0.05$) in *L. maackii* removal plots where *Elymus* was not seeded. These preliminary findings are encouraging whereby *L. maackii* removal (and herbicide) treatment followed by *Elymus* seeding may help mitigate the reinvasion of *L. maackii* to facilitate the recovery of both herbaceous and woody native plant communities in central KY forests once dominated by dense, and nearly impenetrable stands of *L. maackii*.

Reintroducing disturbance in midwestern landscapes to create healthy oak forests

Topic: Prescribed disturbance: haying, grazing, fire, logging

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Cincinnati Nature Center

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Many of our most impressive forests in the Midwest evolved with natural disturbances, such as fire and drought. However, urbanization and climate change have suppressed these natural disturbances, potentially destabilizing the forest community. Species that were once kept in check by natural disturbances are now outcompeting historically dominant species. For example, oak dominated forests are becoming dominated by earlier successional trees, such as maple. As maples begin to dominate the midstory canopy, the microclimate of the understory changes from open and xeric to closed and mesic- creating a positive feedback loop to further maple regeneration. This transition has the potential to drastically alter wildlife communities since dwindling oak numbers means habitat loss for hundreds of lepidoptera species and the decline of acorns, an invaluable winter food source for many mammals.

Additional disturbances that may be enhancing the transition from oak to maple dominated forests include the spread

of invasive species. Invasive species are strong competitors that often decrease native species abundance and diversity. Amur honeysuckle (*Lonicera maackii*) is an invasive woodland shrub that can quickly decrease species diversity by creating dense understory canopies and excreting allelopathic compounds. While allelopathy may hinder regeneration and sapling success of both oaks and maples, oaks are at greater disadvantage given the mesic conditions *L. maackii* creates.

Cincinnati Nature Center is a nearly 2000 acre nature preserve in Milford, Ohio interested in exploring best management practices in natural areas management, including re-instating disturbance as a natural management tool. For instance, practices such as prescribed woodland burns, forest thinning, and aggressive *L. maackii* removal could help return these forests to the more xeric conditions conducive to oak regeneration. To explore the most appropriate management practices, we implemented a common garden experiment to test Northern red oak's (*Quercus rubra*) response to shade, water availability, and exposure to *L. maackii*. Additionally, an experimental woodland burn is scheduled for Spring of 2022 to explore the impacts of burns on oak and maple regeneration. Early results of the common garden experiment suggest *L. maackii* is the greatest hindrance to oak growth and survival, implying management efforts should prioritize invasive removal over forest thinning. In particular, invasive removal should be focused in areas where mature oaks are producing seeds to make continued oak regeneration more likely.

Seeds of Success: Cultivating 20 Years of Plant Conservation

Topic: Native plant materials in restoration/rehabilitation

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Seeds of Success (SOS) is a national native seed collection program in the United States, led by the Bureau of Land Management (BLM) in partnership with the USDA Forest Service, U.S. Fish and Wildlife Service, USDA Agricultural Research Service and many non-federal partners. SOS is the first step in the native plant materials development process to increase the quality and quantity of native seed available for restoring and supporting resilient ecosystems. SOS collections of wildland native seed are used for seed research and development such as germination trials, common garden studies, and protocol establishment. Additional uses include germplasm conservation, seed production, and ecosystem restoration. Portions of each collection are also held in long-term storage facilities for conservation.

SOS was established in 2001 by the BLM and includes many partners, such as botanic gardens, arboreta, zoos, and municipalities. All SOS teams share a common protocol to coordinate seed collecting and species targeting efforts.

To date, SOS has made more than 26,000 native seed collections comprising 5,800 unique taxa from 43 states across the US. In 2015, BLM received a \$3.5 million mitigation award because of Hurricane Sandy to collect seed in coastal habitats from Virginia to Maine. Current SOS priorities include ecoregional programs in the Great Basin, Colorado Plateau, and Mojave Desert. Efforts are also underway to expand partnerships in the Southeastern U.S. to preserve the incredible plant biodiversity of the region.

Soil Seed Bank Composition of an Urban Canal Undergoing Hydrologic Change

Topic: Native plant materials in restoration/rehabilitation

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Soil seed banks, or the natural storage of seeds in the soil, in part determine how plant communities respond to disturbance and, by extension, shape post-disturbance ecological function. Our understanding of urban seed banks, especially in irrigation canals, is severely limited. Irrigation canals are common in semi-arid landscapes and have been shown to fulfill ecological functions similar to urban streams, yet are not often considered as an important habitat. A section of an urban canal in Denver, Colorado, is being repurposed to serve as green stormwater infrastructure. This change will increase the amount of water the canal receives annually. The response of the plant community to this hydrologic disturbance will depend on the composition of both the above-ground vegetation and the propagules in the soil. By uncovering what plant species have seeds in the soil, and then sorting those species into ecologically meaningful groups, we can investigate how the composition of the soil seed bank could shape plant community response in this urban canal set to shift toward a wetter hydrologic regime. Seeds from canal soil samples were germinated in a greenhouse and emerging seedlings were identified to uncover the species composition of the seed bank. We will compare seed bank composition to that of the aboveground vegetation using the Sørensen's similarity index to evaluate potential community response. We will also examine the composition of the seed bank through basic measures of biodiversity and through ecologically meaningful indicators-such as Wetland Indicator Status, native or introduced status, and Coefficients of Conservatism to understand what that community response will mean in terms of ecological function. We can use this information to gauge the resilience of this system and to assess the system's capacity to respond to disturbance from increased flooding. Practically, this allows us to make informed recommendations to the land managers regarding management and restoration practices of the canal.

Co-author: Dr. Christina Alba

Status of *Speyeria idalia* (Regal Fritillary) in Illinois: Data from three biological databases

Topic: Ecological monitoring: data management, storage, accessibility and use

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Abigail Pagels, Valeria Trivellone, Brenda Molano-Flores, David N. Zaya, Thomas J Benson, Christopher H. Dietrich

//Biological databases are fundamental tools to assess the status and trend of species in greatest conservation need and may support conservation actions. Data of presence/absence of species are typically accumulated in several different sources and biorepositories making the process of retrieving and summarizing the data more difficult. In Illinois, there are 171 Lepidopteran species listed as species in greatest conservation need or on the Watch List, one of them is the Regal Fritillary (*Speyeria idalia*). *Speyeria idalia* is a threatened species in Illinois with evidence suggesting population decline mostly due to loss of habitat quality and changes in land use. Our goal was to merge *S. idalia* presence data from three databases including the Illinois Department of Natural Resources (IDNR), the Illinois Natural History Survey (INHS) and iNaturalist to better understand the current status and trends of this insect of conservation concern. All records from databases were combined by defining a common set of minimum fields such as date seen, county, and coordinates. A total of 258 records of *S. idalia* presence were collected, 24 from INHS, 83 from iNaturalist and 151 from IDNR. There are records for almost every year from 1951 to 2021. Overall, 24 out of 102 Illinois counties have *S. idalia* recorded. The distribution of *S. idalia* is in the north and west region of the state. All records were for sightings of adults only, which indicates a gap in knowledge about the larval stage. We used correlation analysis to explore trends associated with this species. The combined database records show this species may be decreasing in its current range in Illinois. Further studies to define the habitat requirements for *S. idalia*, adults and larvae, are needed to better target conservation actions and management activities.

Stream Buffer Establishment in the Catalpa Creek Watershed, Oktibbeha County Mississippi

Topic: Native plant materials in restoration/rehabilitation

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Schauwecker T, Ramirez-Avila J, Baker B, Burger L, Czarnecki J, Johnson JC, and Chavarro L

The Redbud-Catalpa Creek watershed in north-central Mississippi is currently impaired for sediments. Headwaters in the watershed have been impacted by both urban and agricultural runoff. The development of a Water Resources Management Plan led to Clean Water Act Section 319 grant funding for best management practice (BMP) installation beginning in 2018. Two tributary stream buffers were included in the comprehensive set of BMPs installed over the following two years. Pre-BMP vegetation monitoring in the main channel of Catalpa Creek indicated greater than 40% invasive species cover in the shrub layer, and less than 15% total tree canopy with one-third of the tree canopy being non-native. Stream buffers were installed in a highly disturbed research area and in a severely gullied pasture. The objective of the buffers was to reduce non-point source impairments. The first buffer was a 70' grassland buffer, while the second was a 20' forest buffer at stream edge with a 25' grassland buffer extending to cattle-exclusion fencing at the edge of the buffer. Installation practices included application of herbicide prior to seeding with a Truax seed drill in the grassland buffers. Forest buffers included the installation of 1-year whips of 8 species of dominant trees and seeding an additional 13 species. Funds for the installation of a bioreactor system designed to remove phosphorus in gullies from pasture runoff were granted from the NRCS Conservation Innovation Grants program led to the installation of experimental plots in 2021. The main channel of the stream has very high concentrations of phosphorus and the presence of large algal populations. Monitoring of these plots for vegetation establishment using the grassland buffer seed mix and for the effectiveness of bioreactor phosphorus removal will continue through 2023.

The Art of Citizen Science: Engaging Undergraduates in Urban Habitat Restoration

Topic: Outreach: involving arts, literature and photography

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Stetson University

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Growing evidence points to the importance of small urban habitat fragments for maintaining biodiversity, especially of plants and arthropods. Less tangible benefits of urban fragments come from their accessibility to a diverse public. The Volusia Sandhill Ecosystem is a small restoration site located on our campus and used in course-related education and public outreach. Here we describe the inclusion of art in a brief, self-directed activity, in the form of a printed worksheet, designed to educate college students about native plants and their pollinators. Following a brief indoor activity outlined on the worksheet, students were instructed to move outdoors and prompted to count and classify pollinators visiting flowering native plants. The activity concluded with students choosing an artistic medium--such as sketching, photography, or videography--to reflect on observations. Most students stayed engaged during the 20 – 30 minutes required to complete the activity. Because they were not trained in insect identification, the quantitative data collected were not scientifically reliable, but the act of careful observation that was required to count insects resulted in artistic renderings that were thoughtful and accurately captioned. This and other public workshops linking science, nature, and art in the Volusia Sandhill have attracted diverse audiences that may not be reached through our more traditional science programming.

Toward accurate, easy-to-use indicators of grazing sustainability: a pilot analysis of simplified metrics

Topic: Prescribed disturbance: haying, grazing, fire, logging

Alison Long
The Nature Conservancy

Proper grazing and land management are necessary for rangeland health and functioning. Well-managed rangelands have various ecological and socioeconomic benefits and sustaining these benefits and avoiding or reversing rangeland degradation is critical.

Despite increasing efforts by ranchers, beef supply chains, and consumers to center sustainability, there remains a lack of consensus on simple, accurate indicators of sustainable cattle ranching operations. Twenty indicators were recently identified as common metrics for rangeland sustainability in the United States that could identify well-managed ranching, support adaptive management, and demonstrate sustainability and continuous improvement to retailers and the public. These 20 indicators were designed to detect change over time for management practices, are

common among many approaches, and/or are critical indicators for outcomes of common interest to diverse stakeholders. We selected two of these core indicators, bird diversity and plant productivity, and collected pilot data on preserves owned by The Nature Conservancy across Minnesota, North Dakota, and South Dakota to assess how well simplified metrics correlated with more complex, rigorous monitoring protocols. Simple methods that are easily accessible to ranchers and practitioners and that can accurately track management practices will allow for the advancement of biodiversity, water, climate, and social well-being outcomes in ranching operations as well as the clear communication of benefits to stakeholders and the public. Bird species richness and number of individuals observed on meandering walks were highly correlated with rigorous point count data. For plant productivity, grazing stick measurements, visual obstruction readings (VOR) collected via Robel pole, and vegetation biomass clippings were all significantly correlated with each other. Remotely sensed biomass estimates were lower than observed biomass but highly correlated. These pilot data demonstrate the potential for simplified metrics to accurately reflect more scientifically rigorous methods for evaluating management outcomes. However, further work must be done to determine whether these simplified metrics are sensitive enough to track change over time. Collecting data to evaluate other sustainability indicators and engaging with ranchers to further test these metrics are also important next steps.

(Co-authors: Marissa Ahlering, Eric Chien, Eric Hoff, Jonathan Eerkes, Jacob Anderson, Angela Miner, Joe Blastick, Mary Miller, Chris Gordon, Nancy Labbe, Matthew Graeve)

Wequiock Creek Natural Area: Reciprocal Values of Ecological and Cultural Restoration

Topic: Conservation partnerships

Bobbie Webster

University of Wisconsin Green Bay

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University of Wisconsin Green Bay

Ecological restoration in North America often aims to restore natural communities to a pre-settlement condition; many natural communities, including oak savanna, are a result of millennia of management by First Nations people. Ecological restoration planning tends to be led by white or non-Indigenous people with little recognition of the cultural and spiritual importance of these landscapes to people who have been displaced. Many in the restoration community are beginning to promote the reclamation of land, language, ceremony, food, medicines, and other important elements of First Nations culture.

The Cofrin Center for Biodiversity (CCB) at the University of Wisconsin Green Bay (UWGB) has partnered with the Northeast Wisconsin Land Trust and the Town of Scott to protect 76 acres of wetland, riparian woodland, and old field in a riparian corridor near the lower Green Bay coastal zone. The newly created Wequiock Creek Natural Area (WCNA) encompasses a significant archaeological site, upstream from a unique estuarine wetland complex in an adjacent coastal natural area.

We have initiated ecological restoration to re-establish plants, animals, and microorganisms of the Wequiock Creek corridor while simultaneously exploring how to restore and support the site's significance to Indigenous people. This poster explores ecological restoration efforts that simultaneously honor and promote a cultural context.

Current and continuing efforts include partners from UW-Sea Grant, UWGB First Nations Studies (FNS), and Menominee, Ho-Chunk and Oneida Nations. The research team includes a FNS graduate student who is developing educational materials, a list of local culturally important plants, and oral histories. Restoration planning includes an annual blessing that honors Indigenous communities' relationship with Mother Earth. Historical and current inventories of native plants, management of understory and woody invasive species, and restoration of natural drainage patterns are being implemented in consultation with an archaeologist who employs citizens of the Menominee Indian Tribe.

Other upcoming efforts include: writing a land management plan that address the significance of this land to the Menominee, Ho-Chunk, and Potawatomi people; establishment of a First Nations advisory council for long term

management; incorporating spaces for spiritual reflection and ceremonies; and setting guidelines for preserving the archeological and cultural heritage of this site. Outreach materials will include signage and educational resources that incorporate native languages and art. Restoration of natural features will emphasize 'kinship clusters' that are both ecologically and culturally appropriate. The managed landscape that we aim to restore incorporates not only native species and community dynamics, but also cultural influences that sustained the oak openings and woodlands found in this region prior to the 1800s.

Co-authors: Dr. Robert Howe, Stephanie Dodge

Where do they come from? Using microsatellite markers to infer range expansion patterns of *Juniperus virginiana*

Topic: Invasive species: threats, prevention and management

Hannah Hartman

Kent State University

Grasslands are considered one of the most imperiled ecosystems globally, partially due to woody encroachment. Lakeside Daisy Nature Preserve (LDNP) is a small grassland preserve on the coast of Lake Erie recently being encroached by the eastern red cedar (ERC). I am conducting this study to elucidate the pattern of range expansion of ERC into LDNP using genetic analysis. Range expansions may result from diffusion from the edge of the range or from long-distance dispersal events, i.e., seeds traveling far from their origin to establish a new area and spreading their range by diffusion after establishment. A few founding ERC trees were present in the preserve in the 1990s and have grown in number, becoming the most abundant woody species in the preserve. Therefore, if the encroachment of LDNP resulted from a single colonization event, the genetic diversity of the current ERC population should reflect the diversity of the founding trees established in the 1990s. Alternatively, the colonization of ERC may result from the arrival of multiple founding events and as a result, the first founders should not dominate the genetic diversity of the current ERC population.

I am investigating whether ERC's encroachment through LDNP resulted from seeds produced by the founder trees or seeds from neighboring populations arriving through long-distance dispersal. I am utilizing microsatellite markers to study the genetic diversity of the LDNP population since its establishment in the 1990s. My preliminary results revealed 64 alleles present in the 189 trees among the eight loci tested. The average number of alleles and number of effective alleles generally increased in younger generations compared to older generations and observed heterozygosity decreased slightly over time. Taken together, these results indicate that genetic diversity may be increasing in younger generations of ERC and that more than one founding event occurred in this population. My findings also revealed a division among individuals into two distinct groups based on their multi-locus genotype. Each of these groups includes representatives from all geographic locations on the preserve and all generations except for the youngest generation, which is contained to one of the groupings. It is unclear what is causing these groupings at this time.

Working Woods: Leveraging research, partnerships, and demonstrations to connect with forest landowners

Topic: Making connections with new audiences

Jessica Miller

Holden Forests & Gardens

Forested natural areas are extremely valuable inherently and economically in Ohio. However, conservation-minded management and applied research on protected or public lands only goes so far: Most forested natural areas-85% of the state's 8 million acres of woodland-are held in private ownership and therefore private stewardship. Unfortunately, much of these forested natural areas have been mismanaged, misunderstood, and undervalued. Bad timber practices, development, or passive 'wait and see' approaches result in reduced or degraded ecosystem resilience, native biodiversity, and ultimately reduce the wealth, health, and life-quality of private landowners themselves. While

studies have demonstrated the value of forest management, little research addresses specific regional (northeast Ohio) concerns and there is a great need for effective and accessible technical transfer to practitioners and landowners. Recent (2020) surveys have revealed that most Ohio private landowners do not have an active management plan for their woods, nor have they ever spoken to a natural resources or forestry professional regarding managing their property.

We embarked on an outreach and extension project centered around Working Woods, a 70-acre forest management demonstration at the Holden Arboretum in Kirtland, Ohio with the goal of changing the attitude towards conservation-based management and thus increasing the adoption of best management practices. Practitioners and the Ohio Department of Forestry are also able to use the site as a resource for the contingents they serve, bringing landowners and stakeholders to see the effects of management firsthand. In its first 3 years, this project has resulted in the engagement of many landowners who had no existing management plans or professional help, ultimately resulting in them seeking assistance and the adoption of management plans. Leveraging partnership, research, and on-the-ground demonstrations of forest conservation has resulted in positive change in Northeast Ohio private forest management.

Friday, September 9, 2022 8:30am - 11:10am

Conservation Detection Dogs: What they are and how they can help

Compassionate Conservation and Canines

Topic: Conservation partnerships

Kayla Fratt

K9 Conservationists

As "compassionate conservation" becomes increasingly well-known, it is important to remember that not all non-invasive sampling techniques are created equal. Factors such as study goals, target species, cost, and time investment are important for determining the right sampling technique or combination of techniques. In this talk, we will go over the comparisons and considerations between conservation detection dogs, camera traps, drones, thermal imaging, track plates, hair snares and more. We will also highlight ways in which combinations of these techniques can be leveraged to gather additional data. This talk will rely on published literature examining non-invasive sampling techniques as well as firsthand experience with both endangered species monitoring and invasive species mitigation efforts.

Developing Conservation Detection Dog Teams

Topic: Conservation partnerships

Jennifer Hartman

Rogue Detection Teams

Heath Smith

Rogue Detection Teams

Around the world, conservation detection dog teams (CDDT) are being deployed to assist researchers in locating data on a wide range of odors, from invasive to endangered species, viruses, illegal wildlife products, & many other cryptic odors.

With the increased adoption of the CDDT method in the science field, government agencies and conservation-minded organizations are seeking ways to further incorporate CDDTs into their internal operations, either as an 'in-house' program or specialized research project. Our presentation will provide experienced field-based advice on the CDDT method and guidelines for developing a successful CDDT.

One of the most crucial steps in developing a successful CDDT program is finding and teaching dogs & handlers, but

also considering their long-term care & well-being. Other important factors to consider before moving onto program development include conducting a proof-of-concept project with an established CDDT, securing funding or generating funder interest, and demonstrating the effectiveness of the CDDT method. The ultimate aim of any program should be to facilitate the positive and successful deployment of this unique methodology across a broad spectrum of species and ecosystems.

So, you think you want to use a conservation dog: A client's guide to selecting the right team for their project

Topic: Conservation partnerships

Laura Holder
Conservation Dogs Collective

Lindsay Hayward
Conservation Dogs Collective

Josephine Lock
Conservation Dogs Collective

The scientific literature has only recently begun exploring the effectiveness of conservation dogs and the factors that may contribute to their success or failure. This presentation will provide you with tools to help you decide if a conservation detection dog is the right choice for your project and help you to navigate through the questions to ask when selecting an appropriate conservation dog team for the task.

Plant Detection with Dogs on Neal Smith NWR: Dog's eye view

Topic: Conservation partnerships

Aimee Hurt
Working Dogs for Conservation

Working Dogs for Conservation (WD4C) first deployed dogs to find sericea lespedeza (*Lespedeza cuneata*) on Neal Smith National Wildlife Refuge in 2010 and has returned for six seasons since then. This was the first-time dogs had been trained to sniff-out *Lespedeza cuneata* and was among the very first operational uses of dogs to detect any plant species. Over the last decade, the use of dogs for plant detection has grown to dozens of invasive and native plants-both within WD4C's repertoire, and more importantly, worldwide-as many conservation dog practitioners are now involved in plant detection. From the perspective of the dog and training/handling practitioner, and through the lens of the decade of work at Neal Smith NWR, this presentation will discuss how the approach to training and deploying the dogs evolved over the years, varying degrees of success and challenges with sericea lespedeza and other plant targets, and what our experience with *Lespedeza cuneata* taught us that we now incorporate as best practices when we approach all new plant targets. This presentation is a companion piece to the previous presentation, but also stands alone with broad relevance for anyone working with-or considering working with-conservation dogs as either practitioner or manager.

Conservation Detection Dogs: Who, what, where, when, why, and how?

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Diane Larson
U.S. Geological Survey

Laura Holder
Conservation Dogs Collective

Dogs, with their keen olfactory sense, have been used to detect sparsely distributed, cryptic, and rare species for decades, and almost invariably prove more efficient and thorough when compared with other survey techniques.

Though most widely known for detecting evidence of birds and mammals (e.g., scat, carcass, fur), conservation detection dogs have been successfully deployed in the search for insects and plants, as well as fungi and bacteria.

Our objectives in this symposium are to describe the questions one might ask when considering use of conservation detection dogs. We will hear from individuals and/or organizations that train and deploy dog/handler teams to understand the criteria they use in deciding whether or not to undertake a task and the steps they take to both train the dogs and ensure the dogs' safety and welfare. Resource managers will report on their experiences using detection dogs for their projects, including benefits, caveats, and lessons learned.

Potential presenters and titles:

Presentation 1: What is a Conservation Detection Dog?

Presented by: Laura Holder, Conservation Dogs Collective;

Presentation 2: Compassionate Conservation and Canines,

Presented by: Kayla Fratt, K9 Conservationists, recorded;

Presentation 3: Developing Technologies and Applications,

Presented by: Jennifer Hartman or Heath Smith (TBD), Rogue Detection Teams, recorded;

Presentation 4: Plant Detection with Dogs on Neal Smith NWR: Management perspective,

Presented by: Karen Viste-Sparkman, U.S. Fish and Wildlife Service;

Presentation 5: Plant Detection with Dogs on Neal Smith NWR: Dog's eye view,

Presented by: Aimee Hurt, Working Dogs 4 Conservation;

Presentation 6: Detecting disappearing plants: rare cacti and orchids in the Southwestern U.S.,

Presented by: Lauralea Oliver, k9inSCENTive, LLC, recorded;

Presentation 7: Case Study-Developing an Invasive Plant Program,

Presented by: Kyoko Johnson, Conservation Dogs Hawai'i, recorded;

Presentation 8: Collaborating for Optimal Success,

Presented by: Lindsay Ware, Science Dogs of New England & Center for Wildlife Studies, recorded;

Presentation 9: What to ask when considering using a conservation detection dog team,

Presented by: Laura Holder / Lindsay Hayward, Conservation Dogs Collective.

Detecting disappearing plants: rare cacti and orchids in the Southwestern U.S.

Topic: Ecological monitoring: effective/sustainable long-term status and trends

Lauralea Oliver

k9inSCENTive, llc

Surveying for rare plants is often the most time-consuming and costly aspect of rare plant conservation. Rare plants by nature often occur in low numbers, may be sparsely scattered throughout an area, can be cryptically hidden amongst other vegetation, or are inherently small making detection difficult for humans that rely solely on vision. These attributes may lead to populations within a site to go undetected by human observers. Dogs, however, with their powerful sense of smell can greatly aid conservationists by performing surveys in a much more efficient manner thus requiring less human effort and resources.

The USFWS Recovery Plan for Pima pineapple cactus supports the idea of investigating the feasibility of alternative survey methodologies, specifically the use of detection dogs. There is potential habitat in both the United States and Mexico that have not been surveyed for the presence of *C. scheeri* var. *robustispina*. Additional and repeated surveys or monitoring are needed to confirm continued presence at known locations.

Another Arizona native and federally endangered plant species soon to benefit from the work of canines is *Spiranthes delitescens*, commonly known as lady's tresses. Surveys for this small, terrestrial orchid variety will be conducted through a partnership with k9inSCENTive, LLC and the Desert Botanical Garden with the support of the Arizona Department of Agriculture.

Collaborating for Optimal Success

Topic: Conservation partnerships

Lindsay Ware
Science Dogs of New England

Co-authors: Cheryl Frederick (Center for Wildlife Studies), Matthew Chatfield (University of Maine)

Research projects utilizing conservation dog services generally have a large collaborative component. A main reason for this is that researchers and scent detection professionals have different expertise and resources that must be integrated for the detection work to succeed. A partnership with an especially high level of collaboration was formed between Science Dogs of New England (SDNE) and the Maine Wood Turtle Project (MWTP) to assess the feasibility of incorporating canine scent detection into an existing long-term Wood Turtle (*Glyptemys insculpta*) research project. A short trial season was conducted in 2019 with an experienced detection dog. The trial indicated that further training and use of a detection dog would likely increase the number of Wood Turtles found, thus increasing the recapture rate and finding more unmarked individuals in a mark-recapture study. In 2020, a novice dog was incorporated into the project with the goal of developing a detailed assessment and documentation protocol for training a wood turtle detection dog. At the conclusion of the documented field training program, the dog was successful in finding telemetered wood turtles whose locations were unknown to the human participants at the time of searching. During deployment in the 2021 season, the dog found both non-telemetered and telemetered turtles in unknown locations, thereby contributing data to the mark-recapture study. The assessment and training processes developed laid the groundwork for other ongoing collaborative projects between SDNE and MWTP.

Conservation Detection Dogs: What they are and how they can help

Topic: Conservation partnerships

Laura Holder
Conservation Dogs Collective, Inc.

The use of dogs to assist in conservation efforts dates back as far as the 1890's. This presentation will explain what a conservation detection dog is and describe how they can assist with conservation work by providing examples of project applications. In addition, we'll discuss important factors if you're considering the use of a conservation dog team, the benefits over other survey methods, and how to set-up projects for success.

Friday, September 9, 2022 8:30am - 11:10am

Ecological Monitoring: MN Biological Survey

Friday, September 9, 2022 8:30am - 11:10am

How Disturbance Ecology Can Maximize Biodiversity and Ecological Integrity

How Disturbance Ecology Can Maximize Biological Diversity and Ecological Integrity in Natural Areas.

Topic: Prescribed disturbance: haying, grazing, fire, logging

Stephen Thomforde
Stantec Consulting Environmental Services

This symposium provides: 1) a framework for understanding disturbance ecology, 2) case studies for how to restore disturbance, and 3) scenarios for large scale restoration based on disturbance ecology. Our assumptions consider historic disturbance regimes maximized both biological diversity and ecological integrity; therefore, ecosystem management requires restoration of historic disturbance regimes. We start by exploring general principles associated with disturbance ecology including Keystone Species, Adaptive Cycles, and Resilience. Next, we model pre-Columbian disturbance regimes and associated benefits to ecosystem integrity, and contrast this model to post-

Eurovasion demise of historic disturbance regimes, resulting collapsed foodwebs, energy flows, and nutrient cycles that facilitate catastrophic transitions to lower quality states. We hypothesize many current threats to ecological integrity are legacy effects from losing key disturbance regimes. The symposium then shifts to application, providing case studies for planning and restoring disturbance regimes. Case studies focus on prescribed conservation grazing, haying, tree-editing, and indigenous fire. We hear from researchers layering tree-editing, burning, and grazing to mimic historic disturbances for savanna restoration, maintenance, and renewal. We hear about initiatives to reclassify many southeastern USA wooded landscapes as afforested grassland-savannas that catastrophically disappeared following the removal of herbivores and fire 400 years ago. A similar perspective is presented for western Europe, suggesting large herbivores are missing partners in restoration. This research challenges the current paradigm western Europe was forest while suggesting current lack of floral-faunal diversity corresponds to the demise of keystone herbivores. European rewilding strategies are introduced as a means to restore historic disturbance regimes. Another case study describes the barriers and bridges to bison restoration in Midwest exurbia, including planning, partnerships, funding, and implementation. A case study by Xerces highlights their work with grazers in native prairie for pollinator conservation. Yet another case study provides insight into Indigenous fire, how it differs from current fire regimes, and how we can modify current fire regimes to mimic indigenous burning. The symposium concludes by casting a future scenario of applied disturbance ecology that enhances existing natural areas and significantly expands restored ecosystems to the benefit of our land, water, and human communities. A question answer session concludes the symposium. Speakers, association, and titles include: Stephen Thomforde, Stantec: Disturbance ecology and application, Dwayne Estes, Southeastern Grassland Initiative: The ghost of southeastern grassland-savannas grazing ecosystems past, Frans Vera, University Groningen, Large herbivores as missing partners in restoration, Austin Yantes, University Minnesota, Layering disturbances, Ray Moranz, Xerces Society, Rangeland grazing for pollinators, Craig Maier, Tallgrass-savanna Fire Consortium, Indigenous fire, and Joseph Walton, Dakota County Parks, Bison in exurbia.