NAC2018

Monday, October 22, 2018 9:00am - 5:00pm

Best Management Practices for Pollinators Workshop

Want to learn about how to manage nature areas for the benefit of pollinators? Join the Xerces Society for a full-day workshop focused on concepts to protect and enhance populations of pollinators in natural areas and other wild landscapes.

This workshop will provide an overview of the natural history and basic identification of pollinators and will focus on management practices that both support or may negatively affect pollinators and other beneficial insects. The course will detail how to provide food and shelter for pollinators and address management actions such as grazing, mowing, control burning and pesticide use. Course participants will conduct a field tour to see pollinator habitat and best management practices on site.

This course will increase the ability of land managers to:

- Identify bees and distinguish them from other insects
- Assess pollinator habitat and identify habitat deficiencies
- Identify ways of increasing and enhancing pollinator and other beneficial insect diversity
- Understand best management practices that minimize land-use impacts on pollinators
- Make recommendations on management practices and habitat restoration to conserve pollinators

Best management practices for pollinators

Topic: Pre-Conference Workshop

Scott Black
Xerces Society for Invertebrate Conservation

Monday, October 22, 2018 9:30am - 4:30pm

Adapting to Climate Change: Updating our approach to land protection and site management decisions

Land conservation is an essential strategy for conserving diversity and maintaining nature's services. Climate change is impacting the way land managers plan conservation strategies to protect quality landscapes and steward existing lands. Climate change is creating uncertainty about the future, but we can be sure of this: there will be substantial effects on the places and resources we care about. Establishing a protected network of climate-resilient sites and linkages would help sustain the diversity of plants and animals in the U.S. while storing substantial amounts of carbon, creating cleaner air and water, and facilitating species migration and gene flow. During this workshop, we will discuss practical ways for land managers to integrate climate change strategies in their current work. With an emphasis on climate change adaptation, we will introduce characteristics of climate resilient lands and online mapping tools to help evaluate resilience in your landscape. We will also introduce a framework for assessing climate vulnerability and the development of sound, climate-informed management actions.

Led by staff from The Nature Conservancy, Northern Institute of Applied Climate Science, USFS, Michigan Tech and the Land Trust Alliance, this workshop will include:

A review of how to determine where landscapes might be more resilient to climate change, using TNC's online mapping tool and associated regional data sets.

Group exercises on how to develop climate-informed management actions on conservation lands.

A discussion of the challenges and opportunities participants see in communicating and addressing climate change risks to natural systems.

The workshop will explore these concepts through presentations from experts in the field, interactive exercises using web- and workbook-based tools, and case studies of land trusts that have successfully used these methods to develop local and regional plans. The workshop will require active participation and attendees will need a laptop with a wireless connection.

This workshop specifically addresses private land conservation and land management in the context of climate change. Participants will benefit from hands-on instruction for how to use the latest science and decision support tools to inform acquisitions and management.

Learning objectives include:

- Valuing how land trusts and other land managers can engage and be leaders in facilitating climate change adaptation through strategic land acquisition planning and climate-informed land management.
- Understanding the characteristics of climate-resilient lands and decision-making processes for how climate change could affect land management goals.
- Learning strategies for communicating about the benefits of climate-informed practices to land

Adapting to Climate Change: Updating our approach to land protection and site management decisions

Topic: Pre-Conference Workshop

Kelly Watkinson
Land Trust Alliance

Tuesday, October 23, 2018 1:45pm - 3:15pm

Communicating the Importance Our Work

Does technology have a place in nature education?

Topic: Communicating the Importance of our Work

Kostas Stavrianakis
Indiana University, Bloomington, School of Public Health

Author: Konstantinos Stavrianakis, Indiana University, Bloomington, School of Public Health, Department of Recreation, Parks and Tourism Studies.
The aim of the presentation is to discuss the practical implications that certain modern mobile technological advancements can have at a natural park environment. Although technology is a very broad subject that invokes controversy, it has multiple applications in parks and recreation. There is a suitable place for technology in parks, as it does not just provide education opportunities to the visitor, but it also has the potential of involving the visitor in conservation management through data collection. This paper will focus on audio-visual technologies, and will attempt to cover Augmented Reality (AR) as a mobile technology that is becoming increasingly easier to obtain and more user friendly. Existing AR examples will be showcased and discussed e.g. The Internet of Elephants. In addition to AR, the presentation will cover the use of technology in Citizen Science projects and the implications that can have on conservation. As education is moving towards a more audiovisual and technological approach, we believe that nature education should not dismiss technology, but embrace it. The limitations and drawbacks of such technologies will be presented and discussed.

Outside Science (inside parks): Engaging the Next Generation of Conservationists

Topic: Communicating the Importance of our Work

Kristy Burnett
National Park Service

The Outside Science (inside parks) series shares stories of crucial, creative science. Since January 2016, the Natural Resource Stewardship and Science directorate of the National Park Service has partnered with a videography crew from Colorado State University in Fort Collins, Colo., to uncover stories of young people doing science in our national parks. Part citizen science, part education, these videos have covered topics such as sea turtles and light pollution, toxic algal blooms, and mercury levels in dragonfly larvae.

This presentation walks through the development of this project, the success it has had, and suggestions for how attendees could apply lessons learned to their own outreach efforts.

Web-based digital tools and distance learning allow promotion of research and outreach far from population center

Topic: Communicating the Importance of our Work

John Wenzel
Carnegie Museum of Natural History

A challenge common to many of our institutions is that our assets at natural areas are far from population centers. This creates difficulty in reaching our audience for promoting our programs, whether the goal is teaching the public, informing potential donors, or attracting academic researchers to the facility. At Powdermill Nature Reserve, we have created a series of Web-based tools to increase our profile and improve visibility through several means. A gigapixel teaching tool supports learning aquatic macroinvertebrates by beginners and experts alike. Researchers can explore a large experimental study plot through a 3D model. An animated timeline promotes use of native wildflowers by gardeners, including navigable 3D botanical models. A Virtual Reality experience based on the botanical models provides visitors to see wildflowers in bloom regardless of when they visit. These digital experiences increase our audiences of all types, connect them to our natural areas in novel ways, and ultimately grow support for long-term natural areas conservation.

Tuesday, October 23, 2018 1:45pm - 3:15pm

Invasive Species

Forest Change through Exposure to Emerald Ash Borer

Topic: Invasive Species

Jordan Marshall
Purdue University Fort Wayne

Forest Change through Exposure to Emerald Ash Borer. Jordan M. Marshall, Purdue University Fort Wayne. Emerald ash borer (Agrilus planipennis) is an invasive forest pest introduced from Asia to North America in the mid-1990s. Since that introduction, it has spread throughout much of the eastern United States and Canada, infesting all species of North American ash. In 2007, I initially surveyed 44 sites in Indiana, Michigan, and Ohio, for overstory tree species and dominance. In 2017, I returned to those sites and re-surveyed the forests. In addition to overstory species, my second survey included understory and midstory tree species counts. Over the ten-year period, a substantial proportion of ash was lost to emerald ash borer infestation. Overall, sites shifted from 26% ash in the overstory to 2.5%. Some sites, however, experienced lower loss rates. Three sites in Michigan had slight increases in percent of overstory ash. While black, green, and white ash were the most important species at a third of sites in 2007, standing dead ash was most important at only a quarter of sites in 2017. Species that have become most important now were subordinate species in 2007 and not necessarily second ranked (median of fourth ranked). In the understory, ash species were most abundant at the majority of sites. However, in the midstory, ash species were most abundant at only half of sites. Even with the loss of ash in the overstory, regeneration has occurred establishing individuals in the understory and midstory at all sites. However, the likelihood of subsequent and/or continuous infestation by emerald ash borer in these forests is high. Future forest composition will likely include ash at low densities. It is highly unlikely that those forests will return to the ash dominance that previously existed. Localized loss of ash has impacted forests and will not go unnoticed. However, ash will most likely be retained at the landscape level.

Plant community response after the invasion of Emerald Ash Borer (EAB) in Northeast Ohio.

Topic: Invasive Species

Sarah Eysenbach
Cleveland Metroparks

PLANT COMMUNITY RESPONSE AFTER THE INVASION OF EMERALD ASH BORER (EAB) IN NORTHEAST OHIO.

Sarah R. Eysenbach and Constance E. Hausman. Cleveland Metroparks.

Emerald Ash Borer (EAB) (Agrilus planipennis) was first recorded in Cuyahoga County in 2006 near on of Cleveland Metroparks' property. By 2008, significant infestations were found throughout the >23,000 acre park district. Ash mortality has been recorded near 100% within 5-6 years after the tree becomes infested with EAB. Dead ash trees can quickly become brittle and break apart often snapping at various heights along the trunk. In an effort to develop management strategies and reforestation priorities due to rapid ash mortality, Cleveland Metroparks conducted multiple assessments beginning in 2007 of ash tree populations and their distribution in high use areas and natural areas with vegetation surveys. In addition, a Citizen Science project was developed specifically to survey areas along the paved all-purpose trails.

Cleveland Metropark's Plant Community Assessment Program (PCAP) has monitored tree species population, distribution and structure since 2010. PCAP is a long-term vegetation monitoring program with 400 permanent plots located throughout the park district that are sampled on a 5 year cycle. An intensive survey of ash tree (>10 cm DBH) canopy health and any EAB decline symptoms were incorporated into the PCAP monitoring protocol from the start of the program. Ash was originally found to comprise approximately 7 % of Cleveland Metroparks forests. However, between 2010 to 2015 ash tree populations have been reduced to 3% due to EAB induced mortality

Knowing location, quantity, size, and infestation status of ash trees helped prioritize areas for tree management and reforestation. This data refined existing management efforts to focus on removing ash populations near high use areas, roads and all-purpose trails or treating select ash with an insecticide. Highly visible areas with dense ash tree removal were replanted with native trees and managed for invasive plants. The information from this monitoring program provides changes in forest composition due the decline in ash trees and continue to identify areas to drive restoration efforts.

The Spatial Invasive Infestation and Priority Analysis (SIIPA) Tool

Topic: Invasive Species

Deborah Stone
Univeristy of Florida, St. Johns River Water Management Dist

The Spatial Invasive Infestation and Priority Analysis (SIIPA) Tool: Computer and Web-Based Tools for Prioritizing Invasive Species Treatments
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Effective and efficient prioritization of invasive species treatments is an important aspect of land management, as invasive species increase yet budgets are often decreasing. Land managers have many prioritization frameworks from which to choose but the majority only consider species as a whole rather than individual populations. We developed the Spatial Invasive Infestation and Priority Analysis (SIIPA) model (built in ESRI ArcGIS software), a customizable tool for rapid application of a prioritization framework to known invasives populations within a preserve, management area, region, etc. The SIIPA model is based on the framework in The Nature Conservancy's Draft Weed Management Plan, which uses four characteristics: 1) current extent; 2) current and potential impacts; 3) value of habitats the species infests; and 4) difficulty of control and establishing replacement species. The SIIPA model can be customized to have different rankings for each characteristic, different weights for each ranking, to include other characteristics, and so on. We applied this model in three different case studies to demonstrate its flexibility, and these versions of the SIIPA model are currently available for download on The Nature Conservancy's Conservation Gateway website.
The SIIPA model has also been adapted as a web-based modeling tool on the Early Detection and Distribution Mapping System (EDDMapS) website to increase access to private landowners and agencies that do not have access to ESRI software. The tool can be ran in any web browser and accessed on any computer without needing any specialized software. It is currently available for use in Florida, Georgia and Alabama through a project funded by the Florida Forest Service; adaption for use in Utah, and potentially Washington, is currently underway with availability expected in fall 2018. The web-based version utilizes the four main characteristics, but still allows flexibility in the ranking and weighting of each characteristic. It provides outputs that assist with creating treatment work plans and allows for download of the final products. The SIIPA model provides land managers with an adaptable, easy-to-utilize decision support tool for making on-the-ground prioritization choices.

Tuesday, October 23, 2018 1:45pm - 3:15pm

Maximizing Data and Technology to Inform Natural Areas Management

A Data-Based Future: Best Practices and Lessons Learned From 20 Years of Rare Plant Monitoring in San Diego County

Topic: Maximizing Data and Technology to Inform Natural Areas Management

Betsy Miller Vixie

City of San Diego

A Data-Based Future: Best Practices and Lessons Learned From 20 Years of Rare Plant Monitoring in San Diego County

Betsy Miller, City of San Diego Parks & Recreation Department

Land management often includes the daunting task of selecting management approaches to increase future resilience within fragile, fragmented ecosystems. The ability to base decisions on historical data (populations, habitat quality, threats and stressors) significantly improves the likelihood of positive outcomes while lowering stress on land management professionals. The City of San Diego has conducted a long-term rare plant monitoring program based on the requirements of our Multiple Species Conservation Program (a regional federal Habitat Conservation Plan and a State of California Natural Communities Conservation Plan) since 1998. The program has grown from 3-5 species in the early years to annual data collection for 20 species at 30 sites from 2003 to present. We utilize this experience to provide best practices for implementing long-term monitoring programs, including planning, staffing, funding, methods, and methodology updates. In addition, we discuss the analysis and use of data to inform natural resource management decisions to support a resilient future.

Accounting for Spatial Error in Herbarium Records for Species Distribution Models of Rare Plant Species

Topic: Maximizing Data and Technology to Inform Natural Areas Management

Michelle DePrenger-Levin
Denver Botanic Gardens

Accounting for Spatial Error in Herbarium Records for Species Distribution Models of Rare Plant Species

Michelle DePrenger-Levin, deprengm@botanicgardens.org, 720-865-3630. Denver Botanic Gardens and full-time student at CU Denver

Defining the distribution of rare plant species is essential for conserving populations, predicting future range extents, and directing resource management. Herbaria hold extensive data on the spatial and temporal distribution of plant species. Over a million plant specimens are digitally archived from herbaria across the US in an ongoing effort to increase data access for studies on individual rare species and plant communities. Biases and error in plant collections across taxonomic groups, space, and time have been quantified in previous studies but these studies have not addressed errors from the process of digitization. Rare species face additional challenges due to fewer total collections that can span decades reducing geographic accuracy due to range shifts, metapopulation dynamics, and collections made previous to the adoption of GPS. Despite promising efforts to standardize digitization data fields and processes, the current available data represent processes that are not consistent among or within herbaria. Unresolved and undetectable error could result in meaningless species distribution models at the scale informative for rare plants. Accuracy of species distribution models can be improved by increasing presence points or defining the extent of pseudo-absence points to the survey area, but only if geographic inaccuracies and sampling effort in the underlying data can be identified.
Heritage programs use standardized methods to determine a species range at a very fine scale and can act as an independent dataset against which geographic accuracy of digitized herbarium records can be tested. This study uses Colorado Natural Heritage Program's Element Occurrence Records to test the data quality of digital herbarium records for 46 G1/G2 Colorado plant species. The majority of herbarium specimens were collected within 1 km of an Element Occurrence with few falling farther than 3 km from an Element Occurrence.
While no discernable attribute of a digital herbarium record predicts the distance from a known population, the effect of known spatial data error can be examined. Recommendations are made for the effective use of digital herbarium data and the impact of spatial error on species distribution modeling.

Engaging citizens through technology in the field - an overview iNaturalist in Colorado's State Parks

Topic: Maximizing Data and Technology to Inform Natural Areas Management

Matt Schulz
Colorado Parks and Wildlife

Encourage your citizen scientists and visitors to embrace the digital age and collect data that become immediately available for educational programs and management decisions. Learn how iNaturalist has been a successful program for Colorado Parks and Wildlife to help document biodiversity and how it is providing new ways to connect visitors, staff and volunteers with biological resources. This presentation will focus on an overview of iNaturalist, our State Parks NatureFinder project, the challenges and opportunities that have presented themselves along the way and how these data are utilized for park management.

Tuesday, October 23, 2018 1:45pm - 3:15pm

Sedge Identification Workshop*

*You must be pre-registered to attend this workshop. Capacity is limited.

This workshop, suitable for beginners to more advanced learners, introduces basic vocabulary and identification tools related to the sedges (genus Carex), an important part of natural area plant diversity.

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

Sedge (Carex spp.) Identification Workshop

Topic: Identification Workshop

Paul Rothrock
Indiana University

Tuesday, October 23, 2018 1:45pm - 3:15pm

Urban and Wildland Interface Issues

Be Wildlife Aware: A Proactive and Collaborative Method to Mitigate Human-Wildlife Conflict in the Midwest

Topic: Urban and Wildland Interface Issues

Kelly Borgmann
Indiana University

Be Wildlife Aware: A Proactive and Collaborative Method to Mitigate Human-Wildlife Conflict in the Midwest

Kelly Borgmann
MPA and MSES Candidate, School of Public and Environmental Affairs, Indiana University, kvborgma@iu.edu

The United States once abounded with large mammal species, but persecution and habitat loss resulted in the near extinction of many of these species. Now, after decades of protection and hard work, these species are recovering. As their numbers grow they have a greater risk of moving into areas of human habitation. This creates the potential for human-wildlife conflict. There exists many ways of reactively implementing conflict mitigation strategies, but a proactive approach would give land managers and communities the chance to have a higher success rate. I propose a method for 1) identifying potential conflict areas and 2) identifying key conflict mitigation strategies using current and popular conservation planning tools. Using this model land mangers, NGO's, and communities would be able to mitigate human-wildlife conflict proactively.

Impacts of non-native birds on native wildlife in urban ecosystems: where is the evidence?

Topic: Urban and Wildland Interface Issues

Jessica Burnett
University of Nebraska-Lincoln

The abundance of ornithological studies in urban ecosystems is increasing, perhaps fueled by the ease with which birds can be studied, the accessibility of urban ecosystems, and increasing access to data resulting from long-term studies. The number of original, urban ornithological research articles has increased by an order of magnitude during the last decade, however, urban bird studies primarily focus on life history traits and single-species population dynamics of native birds. Despite this trend there is a paucity of published evidence for impacts of non-native and invasive birds on native wildlife. We reviewed the primary literature and evaluated the evidence for impacts of non-native birds on native wildlife in urban areas. Most studies evaluating the impacts of non-native species were conducted as observational studies or as quasi-experiments at the nest site and backyard feeders. Evidence for negative and positive impacts are suggested in the literature often using a single city, single species approach, with few comparative studies. The evidence for biologically relevant impacts of non-native birds on native, urban birds are limited to measures of simple community metrics, including species richness, alpha diversity, and community composition. We synthesize this evidence and make recommendations for future studies and management of non-native birds in urban areas.

Urban Wildlife Conservation in Practice

Topic: Urban and Wildland Interface Issues

Megan Dillon
Indiana Department of Natural Resources

An expanding human population and subsequent rapid development has created a need for a new field in conservation. In the United States we add 5,000 more people per day, and more than two-thirds of us are already living in cities. Ninety-five percent of our state is held in the private trust and managed by citizens. Cities can develop rapidly and without the necessary considerations for urban habitat unless we intervene. Natural spaces provide us with many valuable ecosystem services, including: carbon sequestration, natural cooling to combat the urban 'heat island' effect, improved mental health, mosquito control, and an enriched environment for childhood development. Over the past three years, the Indiana Department of Natural Resources has been operating an innovative 'Urban Program' within the Division of Fish and Wildlife. The Urban Program works to create high-quality habitat in urban spaces that benefit both people and wildlife. This habitat initiative is paired with a public education effort, focusing on fostering wildlife appreciation in cities and mitigating nuisance wildlife concerns. Two full-time Urban Wildlife Biologist provide technical assistance and administer financial assistance with cost-share agreements.
Many other urban conservation organizations exist in Indiana, particularly in Indianapolis. 'Urban Green Spaces' have become a familiar concept, established to perform ecosystem services such as stormwater management and soil health improvements. Valuable though these spaces may be, they can often be greatly improved by small changes to benefit wildlife, such as plant species selections or maintenance practices. The Urban Program has found its niche by partnering with a variety of these organizations, making simple suggestions for existing plans that significantly strengthen their value to wildlife.

The main purpose of this presentation is to provide a framework for urban wildlife conservation and report on the success of the new Urban Program. Specific topics include: ecosystem services, pollinators, native plants, and select examples from our 19 completed projects. The target audience, conservation professionals, will learn about how they can partner with the Urban Program, and how they can implement our techniques in their own roles.

Tuesday, October 23, 2018 3:45pm - 5:15pm

Fire Ecology

Fuel structure and moisture dynamics in a Kentucky bluegrass-invaded prairie

Topic: Fire Ecology

Megan Dornbusch
North Dakota State University

FUEL STRUCTURE AND MOISTURE DYNAMICS IN A KENTUCKY BLUEGRASS-INVADED PRAIRIE

Megan J. Dornbusch1, Ryan Limb2, Caley Gasch2, and Kevin Sedivec3
1Graduate Research Assistant, Range Science, North Dakota State University, Fargo, ND, megan.dornbusch@ndsu.edu
2Assistant Professor, School of Natural Resource Sciences, North Dakota State University
3Extension Range Management Specialist, North Dakota State University

Planning effective prescribed burns requires understanding fuel bed characteristics to make predictions on fire behavior and fuel consumption that align with management goals. Invasive species in fire-prone ecosystems, like the Great Plains, can transform surface fuels and complicate the ability of prescribed burns to meet specific objectives. Kentucky bluegrass (Poa pratensis) invasion in northern Great Plains prairies is resulting in the development of a thickened thatch layer on the soil surface that alters soil hydrology, seed germination, and solar and thermal radiation. Furthermore, thatch contains large pores capable of holding water as it consists of layers of dead vegetation and can be difficult to burn through to mineral soil. Controlling the inhibiting effects of bluegrass invasion is necessary to conserve biodiversity but there is a lack of information to suggest effective burn prescriptions to remove accumulated thatch. Our objectives were to quantify fuel structure and moisture dynamics for both standing fuels and the thatch layer in a bluegrass monoculture. We established our research site on a heavily invaded pasture with a history of idle management. To reveal hourly fluctuations in fuel moisture content, we collected fuel samples every hour over the course of four different days along with hourly weather data. We also collected fuel height and thatch depth for each sample and the weight by volume for each fuel component to calculate bulk densities. Fire behavior is often reduced as bulk density increases because it implies tightly packed fuels with less available oxygen. Our results indicate higher bulk density for the thatch fuel component and higher moisture content for standing fuels at all times. Moisture dynamics differed between the standing and thatch fuel component as the moisture content of thatch fuels decreased at a slower rate (0.15% per hour) than standing fuels (0.37% per hour) as relative humidity declined throughout the day. Therefore, bluegrass thatch likely reduces fire behavior and has a longer lag time that responds less quickly to changes in weather than standing litter. We expect these findings to influence burn prescriptions and enhance the ability to predict and model fire behavior in invaded prairies.

Tracking progress: The new Illinois Fires Accomplished Map

Topic: Fire Ecology

Bill Kleiman
The Nature Conservancy

What gets measured gets done. The Illinois Prescribed Fires Accomplished Map is unique in that we use a base map of all protected areas in the state, and then layer onto this map polygons of accomplished fires submitted by various agencies. This data will eventually allow us to parse out various patterns, such as the frequency of fire in oak woods vs prairies.
Surveys of fire managers and the emerging data suggest that successful fire programs have established effective habits that allow for large scale repeat prescribed fire.
• Annual burn reports are written that demonstrate what was done, what was not accomplished and suggest ways to improve the program
• Fire is viewed by the land owners as a vital stewardship activity
• Safe protocols are followed, crews have good maps and safety is seen as a priority
• All good fire weather days are used to put fire on the ground
• Burn units are as large as feasible with good and wide fire breaks
• Enough equipment is available to handle breakdowns and various contingencies
• Fire crews are motivated, trained, fit and empowered to put fire on the ground as often as possible
• A fire culture is encouraged, neighboring agencies are mentored, expertise is shared and a vision of sustainable fire programs for the entire region is envisioned

Tuesday, October 23, 2018 3:45pm - 5:15pm

Invasive Species

Extreme climate events affect density of the invasive biennial garlic mustard (Alliaria petiolata)

Topic: Invasive Species

Roger Anderson
Illinois State University

Garlic mustard, a strict biennial plant in North America, has alternating years of high abundance of 1st-yr and 2nd-yr plants. We monitored changes in abundance of 1st-yr and 2nd-yr plants in permanents plots from 2004 to 2016 and examined years when high abundance of 1st-yr plants was not followed by high abundance of 2nd-yr plants. Second-year plants had high abundance in 2004 and 2006 and 1st-yr plants in 2005 and 2007. However, beginning in 2008 the alternating yearly cycle of abundance was disrupted; 1st-yr plants had high and 2nd-yr plants had low abundances. High abundance of 1st-yr plants in 2008 was most likely due to soil seed bank germination. This unexpected change in abundance of 1st- and 2nd-yr plants occurs when a small proportion of 1st-yr plants in 2007 transition to 2nd-yr plants in 2008. Our data showed three times (2007-2008, 2008-2009, and 2013-2014) when years of high abundance of 1st-yr was not followed by a year with high abundance of 2nd-yr plants. For this presentation, we focus on the first period (2007-2008). We investigated factors likely to cause sharp declines in expected abundance of 2nd-yr plants in single year. We concluded that Extreme Climate Events (ECE), events deviating from long-term climatic data norms (10 or 90 percentile), and causing negative organism responses, played a role in disrupting alternating abundances of 1st-yr and 2nd-yr plants. We searched long-term data available from a NOAA Climate Station 15 km away from our study site that included total precipitation, number of days with Ã¢â€°Â¥0.13 cm of precipitation, and mean monthly temperature. September 2007 met the criteria for (ECE) and had significant Z-tests for all variables.
We first observed garlic mustard on our study site in 1988. It reached high abundance in the early 1990's. To determine if September 2007 was significantly different than September in 1994 to 2014, we used five variables: total precipitation, number of rainy days, contiguous days without precipitation, days with maximum temperatures > 30 C, and mean monthly temperature between 2007 and years 2004-2014 for September. These data were analyzed using Z-tests, ranking the 21 years for each variable from 1 to 21 with the year with the greatest drought stress having a rank of 1, and the year with the least stress having a rank of 21. We also used PCA and the five variables to determine the relationships among the 21 years in multidimensional space.

Using a Psychological Distance Lens to Examine Family Forest Owners' Perceptions of Invasive Plant Risks

Topic: Invasive Species

Kimberly Ordonez
Purdue University Forestry and Natural Resources

Using a Psychological Distance Lens to Examine Family Forest Owners' Perceptions of Invasive Plant Risks.

Kimberly Ordonez, Purdue University Department of Forestry and Natural Resources.
Zhao Ma, Purdue University Department of Forestry and Natural Resources.
Songlin Fei, Purdue University Department of Forestry and Natural Resources.
Erin Hennes, Purdue University Department of Psychological Sciences.

Invasive plants are costly ecologically and economically to the American public due to environmental damage, productivity loss, and control expenses. Five million private individuals and families own 55% of northern forests in the U.S., but little is known about how they perceive invasion risks and adopt control strategies. Each landowner may assume responsibility for a small portion of the total risk, but their individual actions or inactions over time collectively affect invasion risks across landscapes. Social psychology research suggests that people are resistant to solving problems when actions are perceived to be costly, risks are uncertain, and effects are psychologically distant in space or time. Our study incorporates these insights into understanding how Family Forest Owners (FFOs) conceptualize and respond to invasive plant-related risks. Through FFO interviews and a mail survey, we measure four dimensions of psychological distance between FFOs and invasive plants and identify the potential for incorporating these dimensions in landowner communication strategies. We find that to engage FFOs, invasion risk must be perceived as both sufficiently distant in time or space (happening in the future or in detached places) and sufficiently psychologically near so that landowners focus on the undesirability of invasion, desirability of invasion control, feasibility of invasion control, and specific actions to take. Such knowledge can expand current invasion risk assessments that solely rely on biological, ecological and landscape characteristics to incorporate social and cultural conditions that can mitigate or exacerbate invasion risks, thus contributing to more accurate understanding of invasion risks.

Tuesday, October 23, 2018 3:45pm - 5:15pm

Midwestern Fern Identification Workshop*

*You must be pre-registered to attend this workshop. Capacity is limited.

This workshop, geared toward beginners, introduces basic vocabulary and field identification tools related to some common Midwestern ferns.

With approximately 80 species in Indiana, ferns are beautiful and found in a variety of habitats from wetlands to xeric outcrops. Typically found in mesic woods, these plants are challenging to identify but are important members of the plant community. Learn to field identify some of the species found in the Midwest. Fern morphology, important field characteristics, and distribution will be addressed in this workshop. Please bring a hand lens.

Field identification of some common Midwestern ferns.

Topic: Identification Workshop

Roger Hedge
Indiana Department of Natural Resources

Tuesday, October 23, 2018 3:45pm - 5:15pm

Monitoring Species Populations and Natural Areas

Firefly Abundance Tied to Weather Variables Two Years Before Observation

Topic: Monitoring Species Populations and Natural Areas

Tracy Evans
None

Firefly Abundance Tied to Weather Variables Two Years Before Observation
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Abstract. Coleoptera are a less often considered group of pollinators. As they move from flower to flower to feed on pollen, or nectar, or on other insects attracted to the flowers, they may also carry pollen from plant to plant. For many beetles, temperature, precipitation and soil moisture are likely to have both direct effects on the eggs, larvae and pupae and indirect effects thru predators, competitors and prey items. We extracted data on the abundance of fireflies in North America from the publicly available data set gathered by the Museum of Science in Boston over a period of 9 years and documented the effects of weather in the 24 months previous to the observations of peak firefly abundance. Temperature, precipitation and soil moisture all impacted peak abundance two years before the observations. Management for pollinators should keep in mind weather parameters when planning treatments such as mowing and burning.

Population ecology of cancer root at Blossom Hollow Nature Preserve in central Indiana

Topic: Monitoring Species Populations and Natural Areas

Mahalah Wilson
Franklin College

Cancer root, Conopholis americana, is a non-green parasitic plant commonly found on oak trees throughout the eastern half of North America. The plant typically grows 12-20 cm high and produces white to pale yellow, tubular flowers measuring from 8-14 mm in length. The purpose of this research is to gain a better understanding of the population ecology of cancer root in Blossom Hollow Nature Preserve (BHNP), a 44 ha high quality mesic woods owned by the Central Indiana Land Trust. In the 2018 growing season, baseline metrics on the species will be obtained including number of flowers, fruits, and seeds per capsule as well as the number of plants in selected populations. GPS will be used to map individual plants and host tree DBH will be measured. Soil nutrients, pH, moisture, depth and CEC will also be examined. Permanent plots will be established to allow for long-term monitoring of this parasitic plant. Cancer root has a coefficient of conservatism of 8, indicating that the species grows in areas that are reminiscent of pre-European settlement and does not tolerate disturbance well. Understanding the population ecology of this highly conservative focal species may be useful in monitoring the ecosystem health at BHNP. As a continuing study, it may be possible to predict the impact of global climate change on this high-quality nature preserve by closely analyzing the reproduction of cancer root, which could become an indicator species for the site.

Tuesday, October 23, 2018 3:45pm - 5:15pm

Native Plant Materials in Natural Areas Management

Cultivating a Flourishing Market from a Good Idea; identifying conditions necessary for a sustainable seed market.

Topic: Native Plant Materials in Natural Areas Management

Courtney Gutman
Colorado State University and Southern Rockies Seed Network

Gutman, C. and Boehmer, C., Principal Investigators.
Human Dimensions of Natural Resources Department, Colorado State University.

In the 21st century, ecological restoration is fundamental to maintain highly functioning and resilient natural landscapes amidst increasing frequency and scale of ecosystem stressors by natural and human caused disturbances. Currently, native seed and plant material available on the market are often sourced from differing elevations, states, or countries (i.e., yarrow grown in New Zealand) than the plant installation location, or the species needed for restoration are not commercially available at all (i.e., purple fringe). Locally adapted, or ecotypic, plant material are crucial to not only successful restoration projects, but also to maintaining the biodiversity and resilience of the mosaic of Colorado and southern Wyoming's ecoregions vulnerable to climate change, mining, fire, floods, urban sprawl, recreation, habitat fragmentation, and other disturbances in the southern Rockies region.

The Southern Rockies Seed Network (SRSN) was established in 2014 to address this sense of inadequacy of the native seed market. A market feasibility study was conducted in the summer of 2018 to assess the Southern Rockies Seed Network's benefits to stakeholders as well as existing and expected future gaps in this ecotypic seed market. Focus group interviews and qualitative surveys were conducted along the producer to consumer supply chain (from local farmers, to plant production industry representatives and the Colorado/southern Wyoming conservation community) to assess perceptions, successes, and challenges faced by those involved in the ecotypic seed market. Additionally, this study analyzes the growth capacity of regional ecotypic seed and plant material needs for expected fire, flood, and development mitigation and recommends sustainable finance options for the Southern Rockies Seed Network to employ in their strategic planning. Our vision is to build a durable and long lasting conservation network that unites a breadth of conservation community stakeholders around a shared understanding of conditions necessary to develop a flourishing conservation market from a well seeded idea.

Evaluating the Success of a Prairie Reconstruction Project in Missouri: How Do You Know When You're Close Enough?

Topic: Native Plant Materials in Natural Areas Management

Chris Newbold
Missouri Department of Conservation

Evaluating the Success of a Prairie Reconstruction Project in Missouri: How Do You Know When You're Close Enough?
Chris Newbold

Missouri Department of Conservation, 3500 E. Gans Rd., Columbia MO, 65201, 573-815-7900, Chris.Newbold@mdc.mo.gov.

Prairie Fork Conservation Area (PFCA) is a 911 acre property located in Central Missouri with an on-going prairie, savanna and woodland reconstruction project. Prairie reconstruction activities consist of control of existing invasive plant species, harvesting seed from nearby remnant natural communities, and dormant season plantings in reconstruction sites. In 1999, prior to reconstruction activities, an area- wide inventory was conducted to assess the state of the plant communities at PFCA. In 2017, we conducted follow-up vegetation sampling to evaluate the success of 12+ years of invasive species control efforts and prairie plant community reconstruction activities. Permanent vegetation sampling points across PFCA were compared to established points on remnant prairies that provided source seed for reconstruction efforts. Sampling points were also located so that comparisons could be made across reconstruction age classes (not planted, 1-3 year old plantings, 4-7 year old plantings and 7-12 year old plantings.) Mean native and adventive species richness per plot were compared between pretreatment, different reconstruction age classes and remnant prairies. Mean-C (coefficient of plant species remnant dependence) and native species

richness per M2 (native density) values were also computed and tested for differences across unplanted sites, reconstruction age classes and remnant prairies. Remnant prairies had significantly greater mean-C and native density values than reconstruction plantings (P 0.05). However, our 7+ year old reconstruction plantings had a mean-C value approaching the remnant sites (7+ year old reconstructions = 3.24 +0.19 95% CI vs. remnant prairies = 3.73 +0.14 95% CI) and mean native density showed similar trends (7+ year old reconstructions = 10.74 +1.17 95% CI native species per M2 vs. remnant prairies = 12.99 +0.72 95% CI native species per M2.) Invasive plant species have also shown declines in importance values over time as reconstruction efforts progress. These vegetation community monitoring data are being used to measure success in our prairie reconstruction efforts and are intended to help managers make decisions on additional, future reconstruction and management efforts.

Revegetating Invaded Sites with Natives: New Resources for Local Invasive Species Management Groups and Beyond

Topic: Native Plant Materials in Natural Areas Management

Clair Ryan
Midwest Invasive Plant Network

There is an awful lot to know about the natural world. Due to limited time and capacity, practitioners tend to hone their expertise on one area of science, policy or management. Due to the abundance of invasive plants in the natural areas of the Midwest and due to the harm those invaders do, many natural resource practitioners (lead author included) have specialized in managing invasive plants. We can easily list a dozen bad, bad plants and rank ways to kill them in order of decreasing cost-efficiency, but when it comes to actively replacing invaders with desirable natives, we are less sure of ourselves. This knowledge and experience gap can become a problem for Cooperative Weed Management Areas and other land management entities, which often find themselves fighting a losing battle. They commit precious resources to controlling invasive plants in an area, quickly move on to the next priority, and eventually revisit previously treated sites only to find them re-invaded either by the original culprits or by other undesirables. The Midwest Invasive Plant Network worked in partnership with the U.S. Forest Service Northeastern Region to develop resources to help Midwestern partners with limited expertise in ecological restoration and limited funding to hire outside help feel more confident in pursuing site revegetation in multiple common habitat situations. These resources include a guidebook, which describes the basic tenants of site assessment and planning, tips and tricks, honest assessments of challenges and trade-offs, and regional suggested species lists for various ecosystem types. We have also developed detailed regional directories of vendors of native plant materials and ecological restoration service providers.

Authors: Clair Ryan, Midwest Invasive Plant Network, Susan Franklin, Midwest Invasive Plant Network, Jason Stevens, U.S. Forest Service Eastern Region.

Tuesday, October 23, 2018 3:45pm - 5:15pm

Restoration Ecology

Buck Creek Serpentine Restoration: A Case Study in Fire Management

Topic: Restoration Ecology

Duke Rankin
USDA Forest Service

Beginning in 1995, the National Forests in North Carolina, Tusquitee Ranger District, undertook the restoration of serpentine barrens in the Buck Creek area of eastern Clay County, NC. Originally described in the 1950's, the barrens had undergone woody succession towards a forested woodland. The barrens contained a large number of rare or unusual herbaceous species, and woody succession was viewed as a concern for the conservation of those species. Using soil maps as a guide, the Forest Service used a combination of prescribed fire, slashing, and, on one occasion, an unplanned wildfire, to manage the barrens towards a savannah condition, dominated primarily by rare grass

species. Our results included dramatic increases in many rare species, especially the grasses that were characteristic of the serpentine flora. Not all rare species, however, responded positively to management treatments. While fire may be an important and productive tool for the restoration of unmanaged serpentine barrens, it should be used cautiously, based on broad analyses for multiple resources.

The Effects of Bison Reintroduction on Grassland Bird Nest Success in Tallgrass Prairie

Topic: Restoration Ecology

Heather Herakovich Holly Jones
Northern Illinois University

The Effects of Bison Reintroduction on Grassland Bird Nest Success in Tallgrass Prairie

Heather Herakovich (1) and Holly Jones (1,2)

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Tallgrass prairie has been converted to agriculture over the past century, making it one of the most threatened ecosystems globally. Agriculture conversion of prairie has severely fragmented the landscape and many grassland birds are now in decline and threatened with extirpation. Restoration projects have sought to increase the quality and size of prairie fragments, hypothetically increasing breeding habitat for grassland birds. Bison and other native grazers are now being reintroduced to prairie restorations as a final step in a complete restoration to increase habitat heterogeneity. The goal of our study was to understand how restoration practices (recent bison reintroduction and prescribed fire) influence nest success and brood parasitism. We predicted that parasitism would increase with bison presence and prescribed fire and success would be different in areas grazed and burned, but the direction of the effect would vary by species. We measured nest survivorship and brood parasitism in four plantings and two remnant sites from 2014-2018. Bison presence and prescribed fire did not affect the survivorship of all nests found and did not increase brood parasitism. Vegetation density affected the success of the nests and it is possible bison grazing may indirectly impact overall vegetation density and decrease nest success with more time. Long-term research is needed to help understand how these restoration practices are influencing this higher trophic level and how they can be altered to help these declining species.

Twenty Years of Tallgrass Prairie Reconstruction and Restoration at Pawnee Prairie Natural Area, Missouri

Topic: Restoration Ecology

Mike Leahy
Missouri Department of Conservation

Twenty Years of Tallgrass Prairie Reconstruction and Restoration at Pawnee Prairie Natural Area, Missouri

Mike Leahy and Steve Buback
Missouri Department of Conservation

Tallgrass prairie is one of the most threatened terrestrial ecosystems on earth and ongoing efforts to protect, restore and reconstruct this ecological community are occurring across the Midwest. In 1996 the Missouri Department of Conservation purchased 190 ha of a mix of remnant tallgrass prairie, formerly row-cropped prairie and overgrazed and Festuca arundinacea invaded prairie on rolling terrain in the central dissected till plains ecoregion. Over the

following 20 years a mix of prescribed fire, herbicide treatments of invasive, exotic species; and over seeding and planting of local ecotype prairie seed occurred. Concurrently, four vegetation monitoring transects, totaling 80 0.25 m2 quadrats, were sampled for plant species composition and cover six times between 1996 and 2017.

Data pooled across all transects sampled in 1996 had a mean % native plant species cover per quadrat of 51.7% (± 3.0%, 1 SEM) that significantly increased (P 0.05) to 85.7% (± 3.3%) across all transects sampled in 2017. All four transects recorded significant increases in the total mean plant species conservatism value (a measure of a plant species dependence on remnant communities) across the six sampling periods (ANOVA, p 0.05). Trend analysis via linear regressions demonstrated a similar increase. The mean richness of native species per quadrat significantly increased from 7.5 (± 0.3) in 1996 to 11.5 (± 0.4) in 2017, across all transects.

Looking at changes in plant physiognomic groups with data pooled across all transects, between 1996 and 2017, native grasses increased by 28%, non-native grasses declined by 70%, native forbs increased by 90%, non-native forbs declined by 91% and native sedges declined by 24%. Non-native cool-season grasses and Lespedeza cuneata continue to compete with native vegetation but at diminished levels in comparison to the past. In 1996 the top ten species (importance value, relative cover plus relative frequency) included: Poa pratensis, Festuca arundinacea, Carex species, Daucus carota, Symphoricarpos orbiculatus, Trifolium repens, Muhlenbergia frondosa, Agrimonia parviflora, Dicanthelium lanuginosum, and Vernonia baldwinii. By 2017 the top ten species had transitioned to: Schizachyrium scoparium, Sorghastrum nutans, Monarda fistulosa, Solidago altissima, Poa pratensis, Helianthus grosseserratus, Oligoneuron rigidum, Ratibida pinnata, Symphyotrichum ericoides, and Rudbeckia subtomentosa. The results of this longer-term vegetation monitoring project will provide further information to guide prairie restoration practitioners.

Tuesday, October 23, 2018 6:00pm - 8:00pm

Poster Reception

15 years of amphibian and butterfly monitoring in the Toleston Strandplain of Northwest Indiana.

Topic: Monitoring Species Populations and Natural Areas

John Henry Drake
The Nature Conservancy

The Toleston Strandplain of Northwest Indiana consists of unique ridge and swale topography and is a globally rare ecosystem associated with large inland bodies of fresh water or other coastal communities. Because of past glacial events and subsequent ice melt the southern rim of Lake Michigan hosts an excellent representation of this ecotype. Unfortunately because of human settlement and industrial development very little of the original landscape is left and the remaining protected remnants are highly fragmented and isolated. These natural areas host an incredible diversity of plant and animal species. 15 years of consistent systematic monitoring of calling amphibians and butterflies have helped to better understand population trends across these remnant sites and how best to manage for sustainability of these small populations. Restoration and management have resulted in generally positive responses by these study taxa but there are important indications to support careful consideration of management techniques into the future.

A Walk in the Park? Developing Evidence-Based Outdoor Programming for the Public's Psychological Health

Topic: Communicating the Importance of our Work

Kristina Anderson
Indiana University, School of Public Health

Whether through the Japanese practice of shinrin-yoku ('forest bathing') or the National Park Service/Golden Gate National Parks Conservancy's ParkRx program, the relationship between time spent outdoors and health has

experienced increased attention in recent years. This comes at a time when Americans are increasingly indoors and technology-dependent: The average American spends 95% of their time indoors and five hours a day on mobile devices.

Consequently, this poster presentation will address an additional effect of wild and open natural areas beyond the ecological and conservation-based impacts frequently addressed: The land's ability to influence the public health, particularly individuals' psychological stress. The American Psychological Association's Stress in America report found that most Americans experience high or medium levels of stress, and nearly half report that their levels of stress have increased in the last five years. There is evidence suggesting that stress's impact on the body may ultimately impact a variety of physical, emotional, and cognitive health problems.

By first outlining indicators of population health and the leading determinants of 1) preventable morbidity, 2) mortality, and 3) reduced health-related quality of life, this presentation will then address the risks and protective factors for these three measures as they relate to psychological stress. Finally, the poster will address the evidence-based role of time spent outdoors and highlight appropriate leisure-based programming developed through the Behavior-Determinant-Intervention approach. Ultimately, this poster seeks to inform land managers and other conference participants of the potential to incorporate health-positive, evidence-based, stress-alleviating programming interventions on the lands they serve.

This presentation is a collaboration between Kristina Anderson, PhD Student, and Dr. Oghenekaro Omodior at Indiana University, School of Public Health, Department of Recreation, Park, and Tourism Studies.

Benthic macroinvertebrate development and community composition in mitigated wetlands in southwest Pennsylvania

Topic: Restoration Ecology

Matt Carter
California University of Pennsylvsnis

To compensate for impacts to project area wetlands resulting from Interstate 70 highway construction activities, constructed wetlands were built on Pennsylvania Game Commission property at State Game Lands 297 and 302 in southwest PA. Wetland mitigation efforts include the design, construction and subsequent monitoring. Monitoring of mitigated wetlands is essential to ensuring that projects are managed appropriately following construction, and adjusted or modified as necessary to comply with objectives as described in the mitigation plans. The intent of these monitoring efforts is to ensure that appropriate wetland development and function is occurring, and outcomes will achieve the intended mitigation goals. Results presented represent years 1-3 of a 5 year monitoring program for benthic macroinvertebrates. Benthic macroinvertebrates were sampled using Hester-Dendy plate samplers and D-frame dip nets. In 2018 emergent vegetation was clipped as well and sampled for macroinvertebrates. Preliminary results indicate an increase in yearly total numbers. Coleoptera represented the dominant group in years 1 and 2 for all wetlands at each site. Vegetation may be an early influence on the macroinvertebrate community development. Ongoing analyses will compare species diversity and seek to determine if there are differences in abundance and diversity between sites, and examine the development of the macroinvertebrate community over time. This study is part of a larger ongoing functional assessment that examines vegetation, soils, and hydrology as well.

Biological integrity of mixed-grass prairie topsoils subjected to long-term stockpiling

Topic: Restoration Ecology

Pamela Block

Surface mining often requires storage of topsoil in large piles for long periods of time (1-30 years). Such soil handling and storage results in physical and biogeochemical changes and may alter the soil microbial community and seedbank. Microbial activity regulates nutrient cycling and soil quality, and revegetation of most native forb species relies on a viable seedbank. Soil condition and biological viability influences the establishment and success of the aboveground plant community, and therefore should be considered in understanding successful reclamation. In this

study, we characterized the seed bank and microbial community in order to understand their viability in stockpiled soils (depths of 15cm-750cm). Microbial community structure was measured using phospholipid fatty acid analysis, which provides abundance estimates of soil microbial groups at broad taxonomic levels. The seed bank was assessed using the seedling emergence method under greenhouse conditions. We hypothesized that with increasing depth, soil biota would decrease in abundance and perhaps exhibit a shift in community structure, and that stockpiled soils would display different communities than an undisturbed reference site. Using principal component analysis, we found microbial communities had distinct shifts in terms of community structure and declines in overall abundance of organisms with increased depth. Further, overall abundance of microbes within the top 15 cm of stockpiled soil was nearly 1/3 less than our native reference site. Some seedlings did emerge in stockpiled soil, but viable seed abundance and diversity was reduced in all stockpiled soils compared to the reference soil. Our results demonstrate that stockpiling greatly affects soil microbial communities and the forb seedbank, which may have implications for successful reclamation

Determining the role of biotic interactions on the restoration success of the federally endangered Astragalus bibullatus

Topic: Restoration Ecology

Noah Dell
Missouri Botanical Garden

Determining the ecological factors that limit population establishment and growth are critical for successful restoration of rare plant species. However, few studies have concurrently examined the role of above- and below-ground biotic factors in determining restoration outcomes with rare plants. In this study, we examined the effects of rhizobia inoculation and vertebrate herbivores on the demographic performance of reintroduced populations of the federally endangered perennial legume, Astragalus bibullatus. We tested the following hypotheses: 1) plants inoculated with genus specific rhizobia during propagation would exhibit enhanced demographic performance compared to uninoculated plants, 2) excluding vertebrate herbivores would increase growth and flowering of reintroduced plants, and 3) caged transplants with rhizobial inoculation would exhibit superior demographic performance compared to other treatments. In this experiment, A. bibullatus was introduced in October (2016) and April (2017) to limestone glade-barrens at two Tennessee state natural areas – Couchville Cedar Glade and Flat Rock Cedar Glade and Barrens. At each site, we developed a 2 x 2 factorial experiment (caging and rhizobia inoculation) with a randomized complete block design, with eight blocks per site, four treatments per block, and four plants per treatment (128 plants per site). In spring 2018, cumulative survival rates of transplants across treatments were greater at Couchville (91 %) than Flat Rock (68 %). Overall, we observed stronger and more consistent effects of herbivores than rhizobia inoculation on demographic performance. Across sites and rhizobia treatments, flowering rates of caged transplants were 20-50% greater compared to uncaged transplants, although fruit set was low across all sites and treatments. At Couchville, stem lengths of caged transplants were 87% greater than uncaged transplants while at Flat Rock differences were greater (31%) but less pronounced. We found inconsistent evidence of interactive effects between rhizobia inoculation and caging treatments. Caged transplants with rhizobia inoculum exhibited greater flowering rates relative to other treatments at Couchville, but not at Flat Rock. In contrast, caged transplants with rhizobia inoculum exhibited greater survival rates relative to other treatments at Flat Rock, but not at Couchville. Our results indicate that above- and below-ground biotic factors can be important determinants of establishment rates in rare plant reintroductions, but the magnitude of their individual and interactive effects can differ among restoration sites. Future studies are needed to determine whether rare plants, like A. bibullatus, form species-specific microbial associations that may influence their population dynamics and and restoration success.

Effects of predation pressure on O. virginianus behavior in Wayne County, Indiana

Topic: Monitoring Species Populations and Natural Areas

Anna R. Carlson
Earlham College

Effects of predation pressure on O. virginianus behavior in Wayne County, Indiana

Anna R. Carlson, Earlham College Biology Department

Eliza C. Balch, Earlham College Biology Department and University of New Hampshire, Department of Natural Resources and the Environment

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Both humans and coyotes, Canis latrans, predate white-tail deer, Odocoileus virginianus, throughout the east-central region of the United States, which can regulate density and behavior of O. virginianus populations. We explore O. virginianus behavioral responses to threat of C. latrans and human predation through analysis of photographs collected over one year from 16 camera traps dispersed throughout forest interior and edge habitats on private conservation lands. We measure changes in behavioral response in O. virginianus through displayed behavior including vigilance (head position), group size, and the time of day during which individuals are active, by comparing those behaviors before, during, and after both hunting and fawning seasons. Because behavioral changes, not only population reductions, may alter ungulates' impacts on ecosystems and human communities, this research has the potential to inform management of often-overabundant O. virginianus populations.

Effects of seed source on drought performance and implications for native prairie restoration

Topic: Native Plant Materials in Natural Areas Management

Katherine Fu
University of Colorado Denver

Effects of seed source on drought performance and implications for native prairie restoration: a multi-species greenhouse drought experiment

Authors: Katherine Fu (University of Colorado Denver, Denver Botanic Gardens), Rebecca Hufft (Denver Botanic Gardens)

Local provenancing is the most widespread seed sourcing approach in ecological restoration because local seed populations are assumed to possess local adaptation to the environmental conditions of the restoration site. However, contemporary climate change can alter selective pressures such that local populations will no longer be best adapted. Therefore, seed sourcing from populations adapted to predicted future climatic conditions may result in greater restoration success, but these populations must be able to establish in current and future conditions for successful restoration. In Colorado and much of the Southwest US, drought frequency, duration, and severity are expected to increase. To understand how performance of wild and cultivar plant populations across drought conditions relates to the climatic conditions of their source collection sites, a greenhouse study with three watering frequencies (control, mild drought, and severe drought) was conducted on seven plant species commonly used in North American native prairie restoration: Artemisia frigida, Bouteloua gracilis, Koeleria macrantha, Liatris punctata, Pascopyrum smithii, Penstemon strictus, and Poa secunda. For each species, plant height, growth rate, and aboveground biomass was compared across six wild-collected populations and 1-2 cultivar populations in the three watering treatments. This project informs guidelines for seed sourcing; ideal source populations perform well across all drought treatments, while for populations that do not differ in their performance any of these populations may potentially be used to achieve reasonably similar restoration outcomes.

Identifying and assessing vernal pools to inform conservation planning and management in light of climate change

Topic: Land Management in Light of Climate Change

Desiree Robertson
National Park Service

When developing conservation management plans for large areas, smaller habitat types such as vernal pools, are not always considered. Vernal pools provide critical breeding grounds for many invertebrates and amphibians and their surrounding landscapes are important habitat for birds, bats, rare plants, and other organisms. At Indiana Dunes National Lakeshore, the implementation of a management plan for a large and diverse unit calls for the possible conversion of forest to woodland and oak savanna. A number of vernal pool complexes exist throughout the unit and it is unknown how proposed management actions might impact these fragile habitats. Furthermore, because of their seasonal nature, vernal pools may be especially vulnerable to climate change. The National Park Service is working to identify and assess vernal pools to assist with conservation planning and management of the unit. Using remote sensing products and field surveys, vernal pools have been identified, mapped, and inventoried. Vernal pools are now being assessed to better understand what characteristics contribute to climate change resiliency and how potential management actions might further impact them.

Invasive Plant Response to Windstorm Forest Canopy Damage

Topic: Invasive Species

Melissa Daniels
University of Illinois at Urbana-Champaign

Invasive Plant Response to Windstorm Forest Canopy Damage

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As plant invasions continue to increase worldwide and negatively impact forests, it is important to understand how disturbances affect the dynamics of forest plant invasions and how those invasions are affecting post-disturbance forests. Forest recovery from windstorms, a major source of forest disturbance, can be difficult to predict. In general, understory plants increase in blowdown gaps due to increased light availability but are later competitively suppressed as the canopy regenerates. However, invasive plants that establish in blowdown areas can significantly impede or even prevent closure of canopy gaps by competitively suppressing or preventing tree growth, regeneration, and recruitment. We use a time series of three major windstorms in southern Illinois to explore which pathway is occurring in blowdown gaps: invasive plants declining over time as canopy regenerates or invasive plants continuing to thrive in canopy gaps. We used a change detection workflow with Landsat imagery to locate and measure magnitude of canopy damage after windstorms. We then matched blowdown areas to comparative units based on factors such as slope, elevation, aspect, road density, trail density, and soil type. In June and July 2018, we surveyed invasive plants in blowdown areas and comparative units and then evaluate the effect of three factors on invadedness: whether a site is disturbed or undisturbed, time since disturbance, and magnitude of canopy damage. We also repeated our analyses for the most recent storm with higher resolution imagery to determine if higher resolution imagery allows for a more accurate explanation invasive plant response to windstorm damage. Our results highlight the significance of monitoring recent blowdowns for invasive plant establishment and treating invasive plants in those gaps to promote native canopy tree regeneration.

Mixed-grass vegetation response to grazing management strategies in Kentucky bluegrass-invaded pastures

Topic: Working Landscapes Conservation

Megan Dornbusch
North Dakota State University

MIXED-GRASS VEGETATION RESPONSE TO GRAZING MANAGEMENT STRATEGIES IN KENTUCKY BLUEGRASS-INVADED PASTURES

Megan J. Dornbusch1, Ryan Limb2, Caley Gasch2, and Kevin Sedivec3
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3Extension Range Management Specialist, North Dakota State University

The conservation of biodiversity in working landscapes requires understanding the response of vegetation to different land management practices, especially where biological invasions threaten biodiversity. Kentucky bluegrass (Poa pratensis) invasion in the northern Great Plains is currently homogenizing mixed-grass prairies through the development of a thick thatch layer that alters soil hydrology, seed germination, and solar and thermal radiation. We sought to determine the response of bluegrass-invaded mixed-grass vegetation to traditional season-long grazing (SL) and alternative grazing management strategies based on those used to control invasive species in the Flint Hills and historic disturbances that promote heterogeneity. Early-intensive grazing (EI) was one strategy that involved grazing livestock at triple stock density for the first third of the grazing season. The other alternative strategy was patch-burn grazing (PB), which involved season-long stocking and burning a different fourth of the pasture annually. Three pastures were established for each grazing treatment in 2014 and three idle (control) pastures were added in 2016. Vegetation surveys revealed that plant species richness was generally lowest in idle pastures followed by SL pastures. Species richness in EI and PB pastures was similar and generally the highest. Species evenness and diversity followed the same trend for each year with the highest values for EI followed by PB, SL, and idle respectively. Cover of bluegrass in grazed pastures was lowest in PB (27.0% ± 2.3) and highest in SL (47.8% ± 3.9) pastures in 2017, the final study year. Annual biomass production was not significantly different among grazing treatments, but was the most variable for EI management. Our results suggest that PB and EI grazing can maintain diversity in bluegrass-invaded mixed-grass prairies of the northern Great Plains and that annual biomass production may be more predictable and consistent with PB grazing. Management strategies that not only promote biodiversity but also promote consistent biomass production may help livestock producers adjust to climate change and avoid losses associated with climatic variability. The consequences of bluegrass invasion remain largely unknown but understanding how different management strategies impact invaded pastures aids the advancement of research to mitigate its deleterious effects and conserve biodiversity.

Municipal mallards: Movement ecology and harvest of urban ducks

Topic: Urban and Wildland Interface Issues

Bradly Wehus-Tow
Franklin College

Mallards (Anas platyrhynchos) have long been recognized for their importance to wetland ecology, hunting, conservation, and disease dynamics. In general, our management and conservation models for this important species have focused on traditional population segments such as those in the Prairie Pothole and Great Lakes Regions. Many of these traditional nesting regions are facing mounting pressure from land conversion, while more developed regions of the Midwest are experiencing increases in aquatic habitats, particularly in developed landscapes. Mallards have shown an affinity for these human-dominated landscapes; however, little attention has been given to these urban population segments in terms of research or management. During summers 2015-2018, we banded 2,238 mallards within the developed landscapes of Champaign-Urbana, Illinois and greater Indianapolis, Indiana. To date, we have had 91 hunter-harvested band returns (6% recovery rate). Of these birds, 42 (46%) were banded as after-hatching year birds, 35 as hatching year birds (39%), and 14 (15%) as flightless juveniles. The majority (50 of 91 [55%]) were male, but 32 (35%) were female, and 9 (10%) were unknown sex. With respect to the seasonal timing of harvest, 13 birds (14%) were harvested in October, 23 (25%) in November, 43 (47%) in December, and 12 (13%) in January. In

terms of distance traveled, 42 of the 91 were harvested locally (10 km), but 49 of 91 traveled a considerable distance (overall mean = 83 km; median = 12 km), including one that traveled 1,954 km. Birds traveled in every direction and showed no significant directional affinity (Rayleigh's Z = 1.18; p = 0.31), however, 49 (54%) moved in a direction with some northerly component. Our study birds were encountered in a diversity of habitat types (e.g., agricultural fields, ponds, and marshes) and contributed to harvest in 9 different states/provinces in 2 countries. Our results indicate that mallards inhabiting urban/suburban landscapes during the summer do, in fact, move outside of their human-dominated summer environments during the autumn and winter months. In addition, our findings also support the simple hypothesis that urban mallards are spending time in huntable areas and are contributing to regional harvest at a meaningful level.

Prairie Microgeography: The Study of the Tangled Prairie

Topic: Monitoring Species Populations and Natural Areas

Mary Damm
Indiana University

Prairie Microgeography: The Study of the Tangled Prairie

Mary C Damm1, Marc Bogonovich1, and James D Bever2
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Abstract

We introduce the term microgeography to highlight an aspect of plant community ecology that has received little attention. Plant ecologists commonly study spatial patterns and measure richness and diversity at scales ranging from continents, to communities, to plots. However, plant ecologists less regularly examine these patterns at a scale less than a square meter. Microgeography considers the spatial structure of plants at a geographical scale of centimeters. More specifically, microgeography documents a variety of patterns including species richness of a single point, spatial arrangement of plants with respect to neighboring conspecifics and other species, and species composition similarity over distances of centimeters. Microgeographical patterns can be used to evaluate theoretical and applied concerns, such as theories that aim to explain plant species diversity (e.g., resource partitioning and plant-soil feedback) and applications to measure 'success' of a prairie restoration or reconstruction. We used a microgeographical approach to examine the spatial structure of native and reconstructed tallgrass prairies in Iowa. Using a 0.5 m2 point-intercept frame with intercepts 10 cm apart, we recorded all species present at each of 49 points. We sampled 7 frames in each of 3 native and 2 reconstructed black-soil prairies. We found that the 2 prairie types differ in spatial structure. Native prairies have greater species richness than reconstructed prairies all the way down to a single point. Native prairies also have lower similarity than reconstructed prairies between neighboring points at distances of centimeters. This fine-scale spatial structure observed is consistent with negative plant-soil feedback as an important mechanism structuring native prairies, and the disruption of microbial interactions with plants contributes to the more homogenous spatial structure in reconstructed prairies.

Pre-emergence control of Japanese stiltgrass (Microstegium vimineum) in a state park using indaziflam

Topic: Invasive Species

Victor Maddox
Mississippi State University

Japanese stiltgrass (Microstegium vimineum) continues to be problematic in Mississippi natural areas, particularly in shaded habitats. Japanese stiltgrass can suppress native vegetation producing monostands in these areas. The use of post-emergence herbicides in natural areas can be an issue by damaging native species during the summer growing season. This study was initiated to evaluate particular herbicides for pre-emergent control of Japanese stiltgrass. Indaziflam (Esplanade) at three rates (51.15, 73.1, and 102.3 g ai/ha); indaziflam plus rimsulfuron at three rates (87.8, 131.8, and 175.7 g ai/ha); indaziflam (73.1 g ai/ha) plus sulfometuron (Oust XP at 105.1 g ai/ha), and

pendimethalin (Prowl H2O at 2,327 g ai/ha) were applied using a CO2 backpack sprayer at 25 PSI and 25 GPA on 27 Feb 2018 to evaluate control of stiltgrass during the 2018 growing season. Overall cover ranged from 98 to 99 percent and residual stiltgrass cover ranged from 33 to 40 percent on average at 0 MAT. By 1 MAT, stiltgrass control ranged from 66 to 93 percent. At 2 MAT, a similar trend was observed. Pendimethalin was not as effective as treatments with indaziflam. These and further results of the study during 2018 will be presented during the conference.

Simulated herbivory affects plant-soil feedback dynamics among native and invasive woodland plants.

Topic: Invasive Species

Savannah Bennett
Indiana University

Bennett, Savannah* and H.L. Reynolds. Simulated herbivory affects plant-soil feedback dynamics among native and invasive woodland plants. Indiana University Bloomington, Bloomington, IN. Email: savabenn@indiana.edu

Herbivory and plant-soil feedbacks (PSFs) are ubiquitous processes, each with strong effects on plant communities and ecosystem processes. Yet little is known about the interactive effects of herbivory and PSFs. Such interactions might play a strong role in shaping native-invasive plant dynamics. For example, plant invasion success is thought to be enhanced both by escape from enemies, including specialist herbivores, and by positive PSFs, suggesting that herbivory x PSF interactions could be important. The purpose of this study was to determine whether an interaction between herbivory and PSFs influences an invasive species' PSF advantage. Better understanding of these interactions could inform the design of strategies for promoting native plant resilience against invaders. In this full reciprocal PSF study conducted under greenhouse conditions, experimental communities of three native plants common to eastern U.S. woodlands (Elymus hysterix, Solidago flexicaulus, and Aster lateriflorus) and monocultures of the invasive liana Euonymus fortunei were established. In phase I of this study, the vegetation treatments were assigned to two herbivory treatment groups, unclipped controls and herbivory simulated by clipping, imposed for a three-month period. In phase II, conditioned soils from phase I were used to grow native communities, Euonymus monocultures, and native community-Euonymus mixtures using a pairwise PSF design. Above and belowground biomass was measured after another three months of growth.

When phase I soils were conditioned in the absence of simulated herbivory, results indicated strong positive feedback promoting invasive growth: Euonymus productivity was higher, whereas native community productivity was lower, in soil conditioned by conspecifics relative to heterospecifics. For a Euonymus enemy escape scenario, conditioning soils with simulated herbivory reduced the strength of this positive feedback, because native community productivity markedly increased in soils conditioned by conspecifics exposed to simulated herbivory. The legacy effect of simulated enemy escape in reducing positive feedback was similar when Euonymus and the native community were grown in competitive mixture. These results indicate that herbivory can influence PSF dynamics between native and invasive plants. In particular, herbivory can reduce the positive feedback advantage exhibited by an invasive species of eastern U.S. woodlands. Translating these results into management strategies will require tests of the relative importance of herbivory vs. PSF in promoting plant invasions.

The Hardwood Ecosystem Experiment: Findings from the first 10 years

Topic: Working Landscapes Conservation

Charlotte Owings
Hardwood Ecosystem Experiment

Forest management in the United States faces many challenges including, but not limited to, managing for threatened and endangered species, changes in climatic conditions, and meeting public, economic, and ecological objectives. In the Central Hardwood Forest region, there are concerns regarding maintaining oak-hickory forests and lack of early-successional habitat for wildlife. To address these concerns, land managers are utilizing timber harvesting and prescribed burning to promote oak-hickory forest regeneration and to create early-successional habitat. Science is needed to understand the short and long-term effects of these management techniques on forest ecosystems.

In 2006, the Hardwood Ecosystem Experiment (HEE) was established to examine the effects of various forest management practices on plants and animals. The HEE was designed as a 100-year, landscape-level study and as a collaborative project involving the Indiana Department of Natural Resources Division of Forestry, Purdue University, Indiana State University, Drake University, Ball State University, and the University of Indianapolis. Over the first 12 years of the project, many studies have taken place as part of the HEE including studies examining how endangered species respond to timber harvesting and the effectiveness of timber harvesting and prescribed burning for promoting oak and hickory regeneration. Twelve years into the project, we can begin to summarize the early effects of different forest management techniques on a variety of species.

Using a baseline bee survey to inform future management guidelines along an urban greenway in Denver, CO

Topic: Pollinators in Natural Areas Management

Liam Cullinane
University of Colorado Denver

Pollinating animals are vital organisms for natural, agricultural, and urban ecosystems. A majority of flowering plants and human-consumed crops rely on animal pollination for their reproductive success. However, pollinator populations - especially bees - have significantly declined worldwide over the past century. A key driver of this decline is habitat loss, including the conversion of natural land to urban development. In the United States, urban development currently covers about 68 million acres, and urban areas are expected to continue to increase in the future. Understanding how wildlife interacts with this urban interface and how best to manage wildlife in these areas is increasingly important. Previous urban bee surveys found cities can support a diverse bee assemblage, with research focusing on determining drivers of bee richness and abundance in urban environments, including assessing the impacts of local ecological and broader landscape variables. While Colorado has an extensive list of bee species (almost 1000), Denver, CO, the largest urban center in Colorado, has not been thoroughly sampled. Results from a baseline survey of the bee community (species richness and abundance) along a 114-kilometer urban greenway (High Line Canal) that traverses the Denver Metro Area will be presented. These bee community measures are presented in relationship to several local-scale plant metrics (including floral richness and floral abundance, percent vegetative cover, percent bare ground cover, and percent rock cover) and landscape scale metrics (including the proportion of surrounding developed area). Determining which spatial scale (local vs. landscape) has a greater influence on the High Line Canal bee population will help inform future management and city planning recommendations. Effectively managing the High Line Canal bee and floral communities is an important aspect of ensuring the Canal remains a diverse and functional ecosystem and a quality natural area for the citizens of the Denver Metro Area to recreate.

Genetic Diversity of the Federally Endangered Avon Park Harebells in Ex Situ and Natural Populations.

Topic: Endangered Species Conservation

Diana Bolton
Center for Conservation and Research of Endangered Wildlife

Genetic Diversity of the Federally Endangered Avon Park Harebells in Ex Situ and Natural Populations.
Diana Bolton, Megan Philpott, and Valerie C. Pence
Center for Conservation and Research of Endangered Wildlife (CREW), Cincinnati Zoo & Botanical Garden, 3400 Vine Street, Cincinnati, OH 45220
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Avon Park harebells (Crotalaria avonensis) is a federally endangered Florida legume threatened by habitat destruction compounded by slow growth and challenges to natural reproduction. CREW has conserved tissues from multiple genotypes of C. avonensis ex situ in CREW's CryoBioBank. To further Target 8 efforts of the Convention on Biological Diversity's Global Strategy for Plant Conservation, CREW's goal is to conserve tissues in liquid nitrogen so that they are available for reintroduction projects. This study was directed at understanding the genetic diversity captured in CREW's ex situ collection of C. avonensis to learn how faithfully it represents in situ populations.

This study observed two groups of C. avonesis: 71 genotypes maintained in CREW's ex situ collection originating from three Florida populations and 144 genotypes collected from three natural populations and one outplant group in Florida. Sequence-related amplified polymorphism (SRAP) markers were used to investigate the population genetic structure of both ex situ and in situ populations. Analyses showed significant evidence of genetic variance within populations and suggest that populations are not very distinct from one another in both ex situ and in situ samples. Results parallel between the ex situ and in situ study groups, suggesting that the CREW collection accurately represents wild populations.

Based on these findings, the most useful focus for conservation of C. avonensis would be to prioritize individuals from Avon Park while continuing to conserve those from Carter Creek and Saddle Blanket, as Avon Park is the largest population with presumably the most genetically diverse individuals.

This study was funded by grants provided by the Charlotte R. Schmidlapp Scholar Program at the Center for Conservation and Research of Endangered Wildlife at the Cincinnati Zoo and Botanical Garden and Archbold Biological Station in Florida.

Investigating Land-Use History impacts on oak-hickory forests in the Shawnee Hills of Southern Illinois

Topic: Working Landscapes Conservation

Charles Ruffner
Dept Forestry-Southern Illinois Univ

Ongoing studies across oak-hickory forests of southern Illinois document short and long-term impacts of human land-use history on species composition, regeneration potential, and general diversity patterns. While developing a land management plan for the Touch of Nature Environmental Center researchers at SIUC had to measure numerous stand structure features including stand age, successional status, and presence of invasive species. Our research illustrates the strong role that land-use history has played in stand development since European-American settlement in the late 1800s. Human land-uses including forest cutting for timber needs and land clearance for agriculture followed by varying degrees of grazing and pasturing through the mid 20th century are the major drivers of modern stand conditions including overstory basal area, species composition, and successional status. Our project utilizes a broad methodology to investigate land-use history including historical records and aerial photogrammetry, as well as tree ring studies, and stand structure analysis all georeferenced in a gis database for the off-campus environmental center and teaching forest.

Wednesday, October 24, 2018 8:30am - 10:00am

Collaborative Approaches to Conservation

Collaborative Approach to Sand Savanna Restoration and Natural Area Management Within Indiana Dunes State Park

Topic: Collaborative Approaches to Conservation

Derek Nimetz
Indiana DNR, Division of Nature Preserves

The Indiana Dunes State Park contains biologically diverse natural areas set within an urban landscape along the shore of Lake Michigan. There are three dedicated nature preserves within the Indiana Dunes State Park and one of those, Dunes Nature Preserve, is a National Natural Landmark. However, due to limited resources, portions of high-quality natural areas within the park began to degrade. Collaborating with local conservation organizations increased communication and strengthened partnerships, which has led to the restoration of sand savannas within the Indiana Dunes State Park. Furthermore, assistance has been provided by Federal and non-profit organizations for the maintenance and management of these restored sand savannas. Without these strengthened partnerships, the restoration of sand savannas and natural area management activities would not have occurred.

Fifty Years of Natural Area Protection in Indiana: the Product of Successful Partnership Collaboration

Topic: Collaborative Approaches to Conservation

John Bacone
Indiana Division of Nature Preserves

FIFTY YEARS OF NATURAL AREA PROTECTION IN INDIANA: THE PRODUCT OF SUCCESSFUL PARTNERSHIP COLLABORATION

John A. Bacone
Indiana Division of Nature Preserves, 402 W. Washington, Room W 267, Indianapolis, IN 46204, 317-694-2523, jbacone@dnr.in.gov

Natural area protection in Indiana started with a group of committed individuals building on the efforts of Indiana scientists and Nature Conservancy founder George Fell. One of the country's earliest natural area inventory efforts, by Alton Lindsey, established the first set of priority sites in need of protection. A citizen-led effort resulted in nature preserve legislation affording sites with in perpetuity protection. Additional legislation established public-private funding for natural area acquisition, and many priority sites were acquired with funds matched by non-profit land trusts. Today a system of nature preserves protects nearly all of Indiana's natural community types. 90% of Indiana's endangered and threatened species have protected populations within nature preserves. This collaborative partnership has resulted in 285 nature preserves, encompassing over 52,000 acres, owned and managed by 45 different entities, including colleges, park boards, land trusts, and DNR state agencies, leaving a legacy to be enjoyed and appreciated by future generations. Many sites were acquired using a combination of state funds and private matches, along with bargain sales, donations, and federal grant funds.

National Natural Landmark Designation, A Valuable Tool to Advance Conservation of Natural Heritage in Indiana

Topic: Collaborative Approaches to Conservation

Leo Acosta
National Natural Landmarks Program, National Park Service

Leo Acosta (National Park Service, National Natural Landmarks Program, 601 Riverside Drive, Omaha, NE 68102, 402-661-1870, leo_acosta@nps.gov) and Heather Eggleston (National Park Service, National Natural Landmarks Program, 12795 W Alameda Parkway, Lakewood, CO 80228, 303-969-2945, heather_eggleston@nps.gov)

Designations, from local to national to international, are used worldwide within the conservation community to denote the value or importance of particular areas. These distinctions often call out qualities such as scenic views, scientific importance, recreational opportunities, or the presence of rare species or communities. One such tool is designation associated with the National Natural Landmarks (NNL) Program, a community assistance program administered by the National Park Service. NNL sites are owned by a variety of public and private land stewards and are designated by the Secretary of the Interior to formally recognize sites that possess outstanding biological or geological features. Indiana has 30 NNL sites, the second most in the country; surpassed only by California, a state with three times the land area. Nearly half (14) of NNL sites in Indiana are also within state Nature Preserves. NNL ownership includes state (47%), local (private and city = 40%) and federal (13%). Indiana landmarks represent 23 distinct natural feature classifications, 11 biologic-focused, and 12 geologic-focused classifications. This diverse NNL portfolio adds value to private landowners, local communities and states, serves to build community identity and enhances collaborative conservation. Indiana's history of NNL involvement provides an excellent opportunity to investigate the value of the federal designation to conservation efforts. How land managers utilize the NNL designation to promote stewardship will be explored. Specific examples, from NNL sites raising awareness to landscape-scale projects, will be shared to illustrate the value gained from such partnership and recognition opportunities.

Session Topic: Collaborative Approaches to Conservation
Format: Oral Presentation (general session)
Student Competition: No

Wednesday, October 24, 2018 8:30am - 10:00am

Endangered Species Conservation

Clover Stem Borer Causes Decreased Reproductive Capacity in Sundial Lupine (Lupinus perennis)

Topic: Endangered Species Conservation

Sara Tangren
University of Maryland Extension

Sundial lupine (Lupinus perennis) is an imperiled species in many of the states where it occurs, and both karner blue (Lycaeides melissa samuelis) and frosted elfin (Callophrys irus) butterflies depend upon it as a host plant. As such, sundial lupines are the focus of many conservation and restoration projects. We will discuss recognition, distribution, and impact of the native clover stem borer (Languria mozardi) beetle on sundial lupine reproductive capacity. The findings of this multi-year, statewide survey suggest that lupine conservation projects should avoid any unnecessary connection to the modern anthropogenic meadow complex of roadsides and power lines.

Cypripedium candidum in the southeast glacial plains of Wisconsin: Distribution, ecology and threats

Topic: Endangered Species Conservation

Andrea Weissgerber
UW-Madison

Title: Cypripedium candidum in the southeast glacial plains of Wisconsin: Distribution, ecology and threats.

Author: Andrea Weissgerber, University of Wisconsin-Madison. Major Advisor: John Harrington, University of Wisconsin-Madison.

The purpose of this study is to determine what biotic and abiotic factors influence the presence and disappearance of the white lady's-slipper orchid (Cypripedium candidum) in the southeast glacial plains of Wisconsin. C. candidum was once a prevalent species in southern Wisconsin calcareous fens and wet prairies. However, populations have experienced rapid decline due to habitat loss and degradation and it is now a state threatened species. This orchid is believed threatened due to habitat loss contributed by land use change, alteration of hydrologic regimes, woody and invasive species encroachment and herbivory. The current distribution of C. candidum is anecdotal; last known comprehensive surveys in Wisconsin occurred over thirty years ago and its population response to both community and ecosystem level changes are unknown. Without determining and understanding the spatial-environmental factors affecting C. candidum presence and absence, land managers, conservationists, and ecological restorationists are ill equipped to sustain current and foster future populations. I surveyed forty sites in Dane, Jefferson, Waukesha, and Walworth counties where C. candidum has been previously documented in order to determine changes in population distribution. Three of the survey sites were studied for potential relationships with significant biotic and abiotic factors thought to be associated with C. candidum presence and absence. I expect woody and invasive species encroachment, alteration of hydrologic regimes, land use change, and herbivory will be negatively correlated with the presence of C. candidum.

The Historic Occurrence and Current Status of Canebrakes in the Lower Ohio River Valley of Indiana.

Topic: Endangered Species Conservation

Michael Homoya
Indiana DNR Division of Nature Preserves

The Historic Occurrence and Current Status of Canebrakes in the Lower Ohio River Valley of Indiana

Michael A. Homoya, Indiana DNR Division of Nature Preserves

A canebrake natural community is one exemplified by an extensive growth of giant cane (Arundinaria gigantea), a woody grass that by some early reports reached 9 meters in height and 3-5 centimeters in diameter. Vast areas of cane – some thousands of hectares in size – formerly occupied mesic floodplain forests and a few upland sites along the lower Ohio River. The historic occurrences of canebrakes in Indiana can be mapped rather precisely using section line information provided in the GLO Public Land Survey. Early journal reports also help to identify significant stands of cane. With the advent of settlement by Euro-Americans in the early 19th century, canebrake communities were soon converted to large scale agricultural use. While today giant cane is not an endangered species in the lower Ohio River valley, there is such a paucity of it that it rarely if at all exists as a canebrake natural community.

Wednesday, October 24, 2018 8:30am - 12:00pm

Symposium: Natural Partners: Using the Humanities in Conservation Work

During this symposium, five practitioners will share examples of how they've used the humanities in conservation and stewardship efforts. The examples illustrate a range of humanities approaches as they intersect with stewardship, including using historical sources to reconstruct landscapes and guide present-day conservation efforts; engaging girls in STEM and conservation by learning the stories of significant women in conservation history; incorporating place-making and social practice art strategies in natural areas to build awareness and engage new audiences; and taking literature on the trail in order to spark meaningful conversations about the values and beliefs that guide our personal and policy choices as they relate to the environment.

Following the presentations, we'll conduct a short panel around the larger question of how such efforts contribute to the resilience of natural areas and conservation organizations. We plan to leave time for questions and comments from the audience with the goal of sharing best practices and next steps for those who want to take these ideas back to their local contexts.

"Wondrous World: Introducing Nature-Study and the History of Female Naturalists and Conservationists to Girls"

Topic: The Role of Humanities in Conservation

Mary Ellen Lennon/ Holly Gastineau-Grimes
New Teacher Project

"Wondrous World: Introducing Nature-Study and the History of Female Naturalists and Conservationists to Girls,"
Mary Ellen Lennon, Ph.D., New Teacher Project/
Holly Gastineau-Grimes, Ph.D., Marian University/

Writing in 1911, Anna Botsford Comstock--a pioneer naturalist and the first female professor at Cornell University--argued for the importance of children studying nature "out-of-doors" through the paths "that lead to the seeing and comprehending of what he may find beneath his feet or above his head." Her passionate advocacy for nature-study was rooted in two strongly held convictions: first, of humans as intricately bound to the soil, water, plants and animals of the world, and second, of the value of nature-study to the human soul: "Nature-study cultivates in the child a love of the beautiful; it brings to him early a perception of color, form and music....And the patter of the rain, the gurgle of the brook, the sighing of the wind in the pine, he notes and loves and becomes enriched thereby."

Inspired by this vision (even if one chafes at the use of the universal 'he'!) and funded by an Indiana Humanities' Quantum Leap grant, we created a series of nine interdisciplinary workshops led by professors of biology, history, literature and political science for the 80 young women (ages 5-16) enrolled in the Girls, Inc afterschool program in Franklin, Indiana. In these workshops, the girls were introduced to the science of nature study in Blossom Hollow Nature Preserve, studied the global history of female naturalists and conservationists, and read and experimented with nature-writing...all while raising a few butterflies along the way! Following a female professor of biology along a muddy path into the forest and then studying the history and contributions of pioneering women naturalists and scientists pushed students to interrogate the history of gender bias in the sciences as well as identify pioneering role models of conservationism from the past and in the present.

In this presentation, we introduce our project as a case-study in order to facilitate a larger conversation on the meaning of integrating the arts and humanities into STEM learning. In addition, we explore the feminist, interdisciplinary and global impact of introducing nature-study to girls.

Canebrake Habitat in 19th Century Arkansas

Topic: The Role of Humanities in Conservation

Patrick Solomon
Arkansas Natural Heritage Commission

Title: Canebrake Habitat in 19th Century Arkansas

Authors: Patrick Solomon, Arkansas Natural Heritage Commission
Jess Porter, University of Arkansas at Little Rock

Abstract: Giant River Cane (Arundinaria gigantea) is one of three bamboos native to the North American continent. It was once integral to the human ecology of the southeastern United States. According to some estimates, as much as 98% of canebrake habitat has been lost to development within the last century. The body of river cane research has grown more comprehensive over the past five decades and recently, efforts to map historical canebrakes have intensified. A better understanding of the environmental features that hosted significantly large brakes can assist restoration efforts. Here, historical references to canebrakes in Arkansas were collected from 19th century travelogues and explorers' journals, while the Public Land Survey System General Land Office (GLO) field notes offer comparative data. Pilot study sites were chosen to illustrate the relationship between narrative accounts, the GLO field notes, and estimated contemporary landscapes. This research demonstrates that canebrakes were a relatively common feature on the 19th century Arkansas landscape, especially along waterways, and that a majority of canebrake habitats have been destroyed. However, enhanced understanding of remnant cane habitat can aid future conservation management and contribute to canebrake mapping via remote sensing technologies.

Communicating the Land: Storytelling through Science and Art

Topic: Communicating the Importance of our Work

Kristina Anderson
Indiana University, School of Public Health

Land managers, researchers, and program staff are often confronted with demystifying the 'science' of their land and its management. Whether managing species populations, planning for multiple uses, or addressing the complexities of climate change, science plays a critical role in public understanding but may be difficult to effectively convey. This presentation focuses on the integration of storytelling, art and science to 'communicate the value of land.'

A growing body of research finds that audiences are challenged to quickly synthesize complex, quantitative data; individuals more easily absorb and recall information related to images, narratives and metaphors through a balance between 'numbers and nerves'. Thus, scientific information produced and the format in which it is commonly presented-reports and academic articles-pose challenges to general audiences.

This presentation, then, illustrates ways in which 1) the dramatic arc in storytelling, 2) gauging and engaging audiences, and 3) different communication media have a profound impact on how science is conveyed, interpreted and understood. A variety of examples will be highlighted, including podcast, visual art, video, and more. The presentation will conclude with exploring applications of these communication methods 'on the ground' with a wide variety of stakeholders.

Presentation attendees will walk away with the ability to answer questions like, 'why is utilizing storytelling important in explaining the scientific basis for our land management practices?' 'How can we engage a new audience-e.g., a middle school classroom, or a local community group, in our work?' and 'What are some new, unique mediums for reaching out to our neighbors in the area?' Ultimately, by learning how to engage audiences' more intuitive and automatic cognitive processes through storytelling that incorporates both art and science, land managers, researchers, and program staff will be better equipped to engage stakeholders in their work through fostering relationships with the land.

This presentation is a collaboration between Dr. Teresa Cohn, Research Assistant Professor; Dr. Mark Wolfenden, Research Assistant Professor; and Kayla Bordelon, PhD Student, of the University of Idaho and Kristina Anderson, PhD Student at Indiana University.

Natural Partners: Using the Humanities in Conservation Work

Topic: Symposia

Leah Nahmias
Indiana Humanities

Kevin McKelvey
University of Indianapolis

Patrick Solomon
Arkansas Natural Heritage Commission

Holly Gastineau-Grimes Mary Ellen Lennon
Girls Inc of Johnson County, New Teacher Project, Marian U.

Kristina Anderson
Indiana University, School of Public Health

"Canebrake Habitat in 19th Century Arkansas"
Patrick Solomon, Arkansas Natural Heritage Commission

"Wondrous World: Introducing Nature-Study and the History of Female Naturalists and Conservationists to Girls"
Mary Ellen Lennon, Ph.D., New Teacher Project/
Holly Gastineau-Grimes, Ph.D., Marian University/

"Arts, Creativity and Placemaking in Conservation"
Kevin McKelvey, University of Indianapolis

"Next Indiana Campfires: Connecting Nature and Literature to Spark Conservations about Indiana's Future"
Leah Nahmias, Indiana Humanities

"Communicating the Land: Storytelling through Science and Art"
Kristina Anderson, Indiana University

Wednesday, October 24, 2018 8:30am - 12:00pm

Symposium: Urban Restoration Through Collaboration

This session will feature five of the Chicago Park District's Natural Areas Program staff discussing respective experiences of collaborating with large institutions, professional contractors, volunteers, local communities, artists, historic preservation advocates, and others. The Natural Areas Program of the Chicago Park District (CPD) manages 1,800 acres of native prairie, savanna, woodland, wetland, and dune habitats at over 70 designated natural areas across the city. As the primary owner and/or manager of public green space in the City of Chicago, the country's third largest city, with an area of over 230 square miles and approximately three million residents, CPD is the necessary partner for non-landowning organizations wanting to be involved in on-the-ground restoration that generates public benefits within city limits. Additionally, CPD's Natural Areas Program, with a proportionately small management staff of seven people, relies on strong partnerships with a multitude of public and private entities to accomplish restoration, maintenance, and public engagement goals. This symposium is intended for people interested in the range of partnerships needed to effectively restore, manage, and activate publicly accessible natural areas within a large, highly urbanized context.

Urban Restoration Through Collaboration

Topic: Symposia

Naureen Rana
Chicago Park District

Matt Freer
Chicago Park District

Jason Steger
Chicago Park District

Lauren Umek
Chicago Park District

Forrest Cortes
Chicago Park District & The Nature Conservancy

Author 1: Matt Freer, Assistant Director of Landscape, Natural Areas Program, Department of Cultural & Natural Resources, Chicago Park District.
Title 1: Collaboration with Large Institutions.
Abstract 1: Mr. Freer is responsible for overseeing Chicago Park District's Natural Areas Program. He will discuss the Program's established partnerships with large, nationally recognized institutions, including The Field Museum, the Student Conservation Association (SCA), and the Audubon Society. Both SCA and Audubon Great Lakes employ ecological restoration crews to work specifically on CPD's south side natural areas. Audubon focuses its crew at one particular site, Indian Ridge Marsh, due to their organizational interest in improving nesting and foraging habitat for wetland-dependent birds. The SCA crews working at CPD natural areas include all-women's crews and crews comprised of local high school students. The Natural Areas Program's relationship with The Field Museum is with its Science Action Center, which is staffed by anthropologists, ecologists, and educators. It is largely a result of that partnership that CPD has taken a deeper dive into deliberate, meaningful, and participatory public engagement in natural areas.

Author 2: Jason Steger, Natural Areas Manager, Natural Areas Program, Department of Cultural & Natural Resources, Chicago Park District.
Title 2: Collaboration with Professional Contractors and Amateur Naturalists

Abstract 2: Mr. Steger oversees the development and maintenance of the majority of the natural areas within the City of Chicago. He will discuss how the Program works with professional contractors to manage a variety of terrestrial and aquatic habitat at these locations. CPD hires professional ecological maintenance contractors to handle the day-to-day, on-the-ground activities associated with natural areas management; in this role, the terrestrial contractors control invasive plants, conduct prescribed burns, install and seed native plants, repair and/or install fencing and nature trails, among other things. CPD employs a separate contractor for the management of its lagoons, which are man-made water bodies often surrounded by native vegetation, that support aquatic wildlife including waterfowl, fish, and a variety of invertebrates. He will also discuss the intersection of the Natural Areas Program with Park Advisory Councils and the Program's relatively recent foray into nature play spaces, which rely heavily upon strong partnerships with the communities within which they are located.

Author 3: Naureen Rana, Project Manager, Natural Areas Program, Department of Cultural & Natural Resources, Chicago Park District.
Title 3: Collaboration with Community Organizations and Artists.
Abstract 3: Ms. Rana manages grants for the Natural Areas Program and is also one of the primary managers of community involvement in the Burnham Wildlife Corridor, one of the largest CPD natural areas. She will discuss the collaborative process utilized to design and program culturally relevant artistic installations within the BWC, a 100-acre natural area along Chicago's south lakefront, to inspire people's connections with nature and deepen their understanding of the importance of natural areas. These installations, referred to as Gathering Spaces, include sculptural elements as well as seating; their construction marks the first time CPD has allowed art installations in its natural areas. Teams of local community organizations and artists were selected through a competitive proposal process to design, construct, and activate five Gathering Spaces within the BWC. The project selection committee required that the awarded teams be from/representative of the communities adjacent to the BWC: the predominantly African-American Bronzeville, the predominantly Latinx Pilsen/Little Village, and the predominantly Chinese Chinatown. Not only are the resulting installations a reflection of nature appreciation, they also celebrate the rich cultural and artistic histories of the neighboring communities. It is through the intersection of Culture, Arts, and Nature that CPD hopes to attract a wider variety of visitors to its natural areas.

Author 4: Lauren Umek, Project Manager, Natural Areas Program, Department of Cultural & Natural Resources, Chicago Park District.
Title 4: Collaboration with Historic Preservation Advocates.
Abstract 4: Dr. Umek oversees the design and construction of the natural areas component of major capital projects -- primarily on Chicago's south side and along the Chicago River. She will discuss the influence of historic preservation on the design and species composition of the natural area within Jackson Park, one of Chicago's most historic parks. Designed by Frederick Law Olmsted, Jackson Park, located along Chicago's lakefront, is undergoing a full-scale restoration. The park is unique for many reasons, most notably for the role it plays as the 'backyard' of the Museum of Science and Industry, which is the site of the 1893 World's Columbian Exposition. Dr. Umek will talk about how the restoration team is balancing potentially conflicting goals, like maintaining historical elements of the park while enhancing habitat for wildlife and native plants. She will show how ecologists, landscape architects, engineers, planners, and historians are working side by side to meet these goals. The restoration of Jackson Park embraces 21st century sustainability through a historically based and integrated project of landscape preservation and ecological restoration in a public, urban park.

Author 5: Forrest Cortes, Community Stewardship Program Manager, Chicago Park District's Natural Areas Program and The Nature Conservancy.
Title 5: Collaboration with Stewardship Volunteers and Ecological Monitors.
Abstract 5: Mr. Cortes is a joint hire between the Chicago Park District (CPD) and the Illinois Chapter of The Nature Conservancy (TNC). He manages CPD's Community Stewardship Program, which also advances the goals of TNC's Volunteer Stewardship Network. He will discuss the role of volunteer stewards in the maintenance of natural areas, as well as the ecological monitoring partnerships the Program supports in order to assess restoration impacts on flora and fauna. Volunteer stewards are essential to the process of recruiting other volunteers to contribute to the

improvement of natural areas around the city. Not every CPD natural area has a steward, but those that do benefit from organized stewardship workdays and regular oversight by local residents. In terms of monitoring, CPD works with Audubon Great Lakes to monitor wetland-dependent birds, the Chicago Botanic Garden's Plants of Concern (POC) Program to monitor plants, the Peggy Notebaert Nature Museum to monitor butterflies, and the Lincoln Park Zoo's Urban Wildlife Institute to track wildlife via motion-sensor cameras. Also, POC has developed a rapid plant monitoring protocol that CPD will be introducing its volunteer stewards to in order to expand monitoring capacity and amass data that can inform the adaptive management of CPD natural areas.

Wednesday, October 24, 2018 8:30am - 12:00pm

Symposium: Using Digital Specimen Data in Conservation Research and Practice

Introduction: Digitization and the Accumulation of Digital Specimen Data for Conservation

Speaker: Gil Nelson, Research Faculty, Florida State University, iDigBio

Abstract: The first two decades of the 21st Century have seen an exponential increase in the generation and mobilization of digital, specimen-based biodiversity data and turned natural history museums and biodiversity collections in academic institutions into major resources of conservation data. Led in the U.S. largely by the National Science Foundation's Advancing Digitization of Biodiversity Collections (ADBC) initiative, more than 700 U.S. institutions in 50 states and two territories are digitizing their biodiversity collections and serving these data through iDigBio (Integrated Digitized Biocollections), the national coordinating center for digitization and data mobilization in the U.S. The iDigBio portal (https://www.idigbio.org/portal) now serves more than 110 million records representing 300-400 million specimens, and just over 24 million media records, the majority of which are 2D images. These resources expose previously difficult-to-access collections to wider audiences of conservation practitioners and provide access to the best biodiversity data in the modern era outside of nature itself. Here I will focus on a brief history of digital specimen data generation mobilization in the U.S., the data that are now available and accessible to conservation planners, and the importance of these data to the implementation of conservation strategies.

Use case 1: Journey to Grasslandia: can biological specimen records, ecological data, landscape models, historical information, and art be used to build an interactive 'time machine' that can be a new, innovative tool for conservation?

Speaker: Dwayne Estes, Southeastern Grasslands Initiative, Austin Peay State University's Center of Excellence for Field Biology, Clarksville, Tennessee

Theo Witsell, Southeastern Grasslands Initiative

Alan Weakley, UNC Chapel Hill & Southeastern Grasslands Initiative

Reed Noss, SGI Tennessee and Executive Director of the Southeastern Grasslands Initiative

Abstract: No one disputes the fact that eastern North America has undergone major change since Europeans began arriving more than 500 years ago. Although historically many ecologists subscribed to the notion that the eastern U.S. in particular was once covered by vast unbroken forests stretching from the Atlantic Ocean to the Mississippi River, the current vision for the unglaciated eastern U.S. reveals the presence of more than 100 million acres of grasslands prior to 1700, including prairies, savannas, barrens, glades, various graminoid-dominated wetlands, and associated open, grassy woodlands, more than 90 percent of which have disappeared or been transformed and are nearly unrecognizable. Pollinators, grassland birds, small mammals, certain reptiles and amphibians, and thousands of plant species are in decline as a result of these losses. Thanks to large-scale biological specimen digitization efforts funded by the National Science Foundation (e.g. SERNEC, VertNet, iDigBio), coupled with data from natural heritage program databases (e.g. NatureServe's Biotics), we can now map the distribution of grassland-dependent species spanning the last century-and-a-half. The existing National Vegetation Classification and NatureServe Ecological

Systems Classification can now be used to understand the modern vegetation (SEGAP project) with which these specimen records can be associated. Here I present several examples of the use of digital specimen-based data in conservation applications and underscore the importance of eventually combining specimen, observational, quantitative vegetation, and various forms of historical data (USGS GLO plat maps, witness tree data, historical landscape descriptions, vegetation mapping) to create visual 3-D, virtual reality models depicting the Southeastern landscape at different points in time. Given the importance of specimen data to conservation practice, the Southeastern Grasslands Initiative is pursuing partnerships with NatureServe and funding from corporate and philanthropic sources to develop Grasslandia, new interactive software designed to help us reimagine and restore lost landscapes while at the same time informing and guiding on-the-ground conservation.

Use case 2: Fossil and historic collections reveal the ecological legacy of California's lost bears

Speaker: Alexis M. Mychajliw, PhD, La Brea Tar Pits and Museum, Los Angeles, CA.

Abstract: Data from the fossil record is becoming increasingly relevant to conservation decision-making in today's changing world. Bears represent a significant part of California's human history, with grizzly bears featured on the state's flag and in numerous pop culture references prior to their disappearance in the 1920's AD. In 2014, the Center for Biological Diversity submitted a petition to list grizzlies in California under the Endangered Species Act, thus providing a path to reintroduction. In this study, we leverage the fossil and historical records to address two ecological questions related to the management of bears in California: 1) the extirpation and hypothetical re-introduction of grizzly bears (Ursus arctos) across the state, and 2) the true nature of a 1933 human-mediated range expansion of black bears (Ursus americanus) to southern California. We apply radiocarbon dating and stable isotope analysis to describe spatiotemporal variation in grizzly resource use and extirpation patterns from the Mid-Holocene to the early 1900's AD. The fossil record provides a comparative dataset for understanding differences in niche breath and prey preference before and after the arrival of Europeans and their land use practices. Radiocarbon dating of data deficient grizzly specimens held in mammalogy collections revealed unexpected ages in the Mid/Late Holocene, rather than historic periods. We employed these Holocene radiocarbon dates in a GRIWM modeling approach of extinction timing for comparison with known last appearances in the historic record for counties across the state. One key question that can be answered only with the fossil record is how grizzlies might interact with California's still extant black bears, particularly in areas where black bears were intentionally translocated to replace grizzlies. Such work has uncovered that the translocation of black bears from Yosemite to the Los Angeles area by California Fish & Wildlife Service in 1933 was in fact the first re-introduction or 'Pleistocene rewilding' of a large carnivore, as fossil records clearly show the presence of the species in Late Pleistocene, followed by a historic absence. Ultimately, we present two case studies that highlight the real-world applications of a 'conservation paleobiology' toolkit, and demonstrate the clear benefits of looking to the past for clues to the future.

Use case 3: The Use Of Herbarium Specimens In Distribution And Dispersal Modeling And Conservation Planning: The Answer Is Blowing In The Wind

Speaker: Herrick Brown, South Carolina Department of Natural Resources, University of South Carolina

Abstract: We coupled available specimen locality data from the SERNEC portal with US Forest Inventory Analysis data since 1979 to develop a robust data set for use in Species Distribution and Seed Dispersal Modeling. The Southeastern endemic tree species, Gordonia lasianthus, may serve as a surrogate for less common species in the region that exhibit anemochorous seed dispersal patterns. The number of available records of G. lasianthus in the SERNEC portal has increased eightfold over the past four years (2014-2018), and these data suggest that its range may be larger than previously understood (approaching the eastern border of Louisiana and possibly entering Virginia to the North). In addition to the use of occurrence data, physical specimens and specimen images were scrutinized for the timing of phenological events (namely fruiting) to establish a time frame for potential dispersal opportunities. Twenty seeds were extracted from the fruits of one specimen at the A. C. Moore Herbarium at the University of South Carolina (USCH) and used in seed drop trials to determine terminal velocities as a means of calculating maximum dispersal distance. Freshly collected ripe fruits (recently dehisced) were subjected to controlled humidity conditions

using saturated salt solutions to determine the maximum relative humidity (RH) below which capsules would remain open. Using weather data from the North American Regional Reanalysis (NARR 1979-2017) and the European Centre for Medium-Range Weather Forecasts (ECMWF ERA-20C 1900-2010), we constructed a model to record prevailing wind directions and velocities during potential dispersal conditions (i.e. October through March during times of day when RH was below 67%) across the Northern (inland) and the Southern (peninsular Florida) range boundaries. Results indicate that winds during the seed season under these conditions typically blow into the existing range along the northern boundary thereby limiting northward expansion and suggest a possible evolutionary trap.

Demonstration

Title: Discovering taxa, specimens, and distributions using digital data from the iDigBio portal

Speakers: Molly Phillips, iDigBio, Florida Museum of Natural History, University of Florida; Cathy Bester, iDigBio, Florida Museum of Natural History, University of Florida

Abstract: iDigBio, the National Science Foundation's national resource and coordinating center for the creation and mobilization of digital specimen data from museum and academic collections now maintains a database (http://portal.idigbio.org/) of more than 110 million records representing 300-400 million specimens, plus approximately 24 million media records (largely 2-D images) aggregated from over 700 biodiversity collections worldwide, largely from the U.S. These data provide an important store of critical information in support of conservation planning on public and private lands. Here we provide a detailed overview of the portal and its data, with an emphasis on their use for conservation and ecological research and practice.

Using Digital Specimen Data in Conservation Research and Practice

Topic: Symposia

Gil Nelson
iDigBio/Florida State University

Dwayne Estes
Austin Peay State University's Center of Excellence for Fi

Alexis Mychajliw
La Brea Tar Pits & Museum Natural History Museum of Los Ange

Herrick Brown
University of South Carolina

Molly Phillips
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grizzly specimens held in mammalogy collections revealed unexpected ages in the Mid/Late Holocene, rather than historic periods. We employed these Holocene radiocarbon dates in a GRIWM modeling approach of extinction timing for comparison with known last appearances in the historic record for counties across the state. One key question that can be answered only with the fossil record is how grizzlies might interact with California's still extant black bears, particularly in areas where black bears were intentionally translocated to replace grizzlies. Such work has uncovered that the translocation of black bears from Yosemite to the Los Angeles area by California Fish & Wildlife Service in 1933 was in fact the first re-introduction or 'Pleistocene rewilding' of a large carnivore, as fossil records clearly show the presence of the species in Late Pleistocene, followed by a historic absence. Ultimately, we present two case studies that highlight the real-world applications of a 'conservation paleobiology' toolkit, and demonstrate the clear benefits of looking to the past for clues to the future.

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Wednesday, October 24, 2018 10:30am - 12:00pm

Fire Ecology

Fire seasonality influences the demographic performance of the endangered limestone glade endemic, Astragalus bibullatus

Topic: Fire Ecology

Matthew Albrecht
Missouri Botanical Garden

Determining optimal fire regimes for rare plant species in fire-adapted ecosystems is a key component of conservation recovery programs. In Nashville Basin limestone glades and woodlands, natural area managers recently expanded a prescribed burning program to reduce woody encroachment and reverse the decline of several rare endemic plant species. However, determining the optimal fire season for rare endemics presents many challenges given the limitations of performing controlled experiments on small natural populations. To determine the effects of fire season on the endangered perennial legume, Astragalus bibullatus, we subjected experimental populations composed of one-year old transplants and seeds to three treatments: unburned control, dormant burn, and non-dormant burn. Our experimental burns were timed before (dormant) and immediately after (non-dormant) shoot emergence of established plants. We created standardized fuel conditions, used burn-boxes to control the spatial extent of experimental fires, and quantified plant-scale fire temperatures at the soil surface. We added non-dormant seed to plots after the burn treatments, and monitored survival, growth, and reproduction (vital rates) of established plants and seedlings over a three-year period. Overall, demographic vital rates were unrelated to plant-scale fire temperatures, which ranged from 121-288Â°C. First-year survival rates of established plants were high (> 92%) and varied little among treatments. However, non-dormant burning reduced flowering probabilities of established plants by 60-70% relative to dormant burning and the unburned control. In contrast, 3-year seedling survival rates were over two times greater with non-dormant burning compared to dormant burning and the unburned controls. Dormant burns increased inflorescence production, fruiting probabilities, and legume production in established plants relative to the non-dormant burn and unburned control. Although vital rates of established plants did not differ among treatments the second- and third-years following burning, a single dormant burn increased cumulative multi-year fitness by over 130% relative to the non-dormant burn and unburned controls. Our results indicated that the interaction of plant phenology and the timing of prescribed burns can directly affect plant vital rates and may have important long-term consequences for the population dynamics of rare perennial plants in fire-managed ecosystems.

The Short-term Effects of Cutting and Burning on Spider Abundance, Diversity, and Taxonomic Composition in Forests in NC

Topic: Fire Ecology

Marc Milne
University of Indianapolis

The biodiversity of invertebrates in forests may be impacted by repeated fuel reduction treatments such as prescribed burning or mechanical understory removal. For three years (2014 - 2016) in a temperate forest in North Carolina, we collected and identified spiders to determine the effects of four treatments on spider diversity, abundance, and taxonomic composition. These four treatment units (n = 3 per treatment) consisted of an unmodified control (C), repeated prescribed burns (four times over the study; B), mechanical understory removal (twice over the study; M), and mechanical understory removal followed by a high-severity prescribed burn and three subsequent burns (MB). The initial high-severity burn in MB resulted in substantial tree mortality and an open canopy; leaf litter depth was reduced after each burn in B and MB, followed by rapid recovery as leaves dropped each fall. We found no significant difference in spider diversity among treatments. However, spider abundance was significantly greater in MB when compared to C. Moreover, the taxonomic makeup of spiders significantly differed among treatments, though this difference was lost when spiders were grouped into guilds rather than by taxon. These data demonstrate the significant impact that high-severity burns can have on invertebrate abundance and composition.

Wednesday, October 24, 2018 10:30am - 12:00pm

Urban and Wildland Interface Issues

Bush honeysuckle in an urban (Chicagoland) preserve, 3 kg per square meter

Topic: Urban and Wildland Interface Issues

Dennis Nyberg
University of Illinois at Chicago

Bush honeysuckle in an urban (Chicagoland) preserve, 3 kg per square meter

Dennis Nyberg, Damian Wolak and Olga Dabrowski
Department of Biological Sciences, University of Illinois at Chicago
845 W. Taylor St., Chicago IL 60607

Many woodlands, especially those near residential areas, have large amounts of bush honeysuckle (Lonicera maackii, L. tatarica, and other species and their many hybrids) which suppress, dramatically in many cases, native vegetation. We sampled a heavily invested location in an oak woodland in a Cook County, Illinois, Forest Preserve. In six 6m x 6m plots we recorded the species and measured the diameter (50 cm above the surface) of all woody vegetation >2cm diameter. Stems of woody species 2 cm diameter were counted. The plots were sampled destructively. A sample of cut honeysuckle was cut into smaller pieces and weighed (in the field). A regression between weight and diameter cubed, d^3, had an R squared value of 0.97. The sampled area had 24 individuals of native species (13 Prunus serotina, 6 Crataegus sp., 4 Vitis riparia and 1 Celtis occidentalis) for an estimate of 1111 native stems >2cm per hectare. 170 honeysuckle stems were >2cm diameter (from 152 plants). The maximum diameter was 10.0 cm. Based on the 216 m^2 sampled there were 7870 honeysuckle stems >2cm diameter per hectare. Woody stems 2cm dia were estimated to be 17,546 per hectare, 45% Japanese barberry, Berberis thunbergii. The total basal area of native trees was 31 m^2 per hectare, 50% black cherry. The basal area of the shrub honeysuckle was 10 m^2 per hectare. The estimate weight (live) of the honeysuckle was 30,370 kg per hectare or 3 kg per square meter. In 2016 the area surrounding our study site had all non-native woody vegetation chipped as part of a restoration project.

The Impact of Forest Management on Edge Effects in Roadside Forests

Topic: Urban and Wildland Interface Issues

Julia Rogers
University of Connecticut

The Impact of Forest Management on Edge Effects in Roadside Forests

Julia Rogers, Robert T. Fahey, John C. Volin, and Thomas E. Worthley;
University of Connecticut Department of Natural Resources and the Environment.

Connecticut is among the most forested states in the country and has the highest tree cover in urban areas (67%). There is a need to improve the resilience of this forest cover to storms and disturbances adjacent to roadways and built infrastructure. Roadside forest management may decrease the risk of tree-caused damage to infrastructure and improve the resilience of the forest. However, adopting widespread roadside forest management practices may increase edge influence into the forest, changing the abiotic environment, and the structure and composition of the plant communities in these forests. Roads serve as a corridor of spread for invasive species, and forest management may enhance the establishment and growth of the invasive species. Stormwise is a collaboration among the University of Connecticut, Eversource, and other partners to manage roadside forests to decrease the risk of tree caused power outages. The objective of our study was to quantify the magnitude and depth of edge influence on plant communities and environmental conditions in 'Stormwise' management treatments throughout Connecticut. We expected a greater percent cover and deeper spread of invasive species at managed sites than control sites. In both treatments, we expected to see an increase in plant species richness; however, we expected a greater percent cover of woody shrubs in managed sites. We estimated the percent cover of invasive and native plants, and we measured the light environment at increasing distance from the road at eight managed roadside sites and paired control sites.

Light availability was greater in managed sites relative to control sites. There was no detected edge influence in control sites for any parameters, but in managed sites, the edge influence extended as far as 15m into the forest. In managed sites, the depth of edge influence for light extended to 2.5m, but reached to 15m for woody species richness and diversity. The percent cover of invasive plants showed a greater edge influence (10m) than that for native plant percent cover (5m). Based on the enhanced edge influence observed in managed sites, we are conducting a follow-up study to examine the effects of management on the growth responses of native and invasive plants. The results from both studies will inform management decisions along permanent edges.

Wednesday, October 24, 2018 2:00pm - 3:30pm

Grasses Identification Workshop*

*You must be pre-registered to attend this workshop. Capacity is limited.

After a short introduction/review of the floral and vegetative characteristics, as well as associated terminology, of grasses, an examination of the characteristics of various groups/genera of grasses (and to some species), such as Poa, Phalaris, Phragmites, Setaria, Elymus, etc. will be conducted.

Introduction to the Grasses (Poaceae)

Topic: Identification Workshop

Donald Ruch
Ball State University

Wednesday, October 24, 2018 4:00pm - 5:30pm

Invasive Forest Insects Identification Workshop*

*You must be pre-registered to attend this workshop. Capacity is limited.

Learn about the biology of and how to identify invasive forest pests including emerald ash borer, Asian longhorned beetle, hemlock woolly adelgid, and spotted lanternfly.

Invasive insects can kill even the healthiest trees and are economically and environmentally costly. The best way to protect forests is to be watchful, record and report any finds, and follow treatment recommendations. Many invasions were stopped in their tracks because observant land managers and citizens made a report when they encountered an odd insect or unusual tree damage. However, the first step is learning to identify these organisms and recognize their signs.

Participants in the workshop will learn to successfully identify key invasive forest insects and recognize their signs and symptoms. They will have the opportunity to practice their identification skills using real specimens of invasive forest pests and their look-a-likes.

Invasive forest insect identification workshop

Topic: Identification Workshop

Elizabeth Barnes
Purdue University

Thursday, October 25, 2018 8:30am - 10:00am

Maximizing Data and Technology to Inform Natural Areas Management

Bridging the gap between technology and restoration using adaptive management in the fight against invasive Phragmites.

Topic: Maximizing Data and Technology to Inform Natural Areas Management

Will Overbeck
Applied Ecological Services, Inc.

Bridging the gap between technology and restoration using adaptive management in the fight against invasive Phragmites.
Todd Polacek; Joshua LaPointe, Steve Apfelbaum1, and Will Overbeck2.
1Applied Ecological Services, Inc., Brodhead, WI, 608-897-8641
2Applied Ecological Services, Inc., West Dundee, IL, Will.Overbeck@appliedeco.com

The invasive phenotype of Phragmites australis (Cav.) Trin. Ex Steud. continues to spread and invade new areas, having numerous and diverse deleterious effects on Great Lakes shorelines, coastal marsh habitats, inland wetlands and transportation/transmission corridors used as vectors of invasion. Approaches for control by natural area managers vary dramatically, depending on location and capacity/capability. A cross-disciplinary team of natural resource professionals have developed new technology, field management techniques, and ecological responses for adaptive management (prioritization, logistics, treatment and monitoring) on Phragmites infestations within ecological restoration sites, based on years of experience and data collection. New aerial imaging technology and remote sensing approaches are contributing to efficiencies of Phragmites monitoring in Lake Michigan's Green Bay, Lake Huron's Saginaw Bay, and elsewhere, with significant agency, academic, and NGO collaboration.

Evolution of a weed-mapping program

Topic: Maximizing Data and Technology to Inform Natural Areas Management

John Taylor
Ball State University

Evolution of a weed-mapping program
John Taylor, Land Manager
Field Station and Environmental Education Center
Biology Department
Ball State University
Muncie, IN 47306-0440

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Homepage: www.bsu.edu/fseec

This presentation details successes and challenges in developing a modern system for management of garlic mustard (Alliaria petiolata) on one of the largest remaining old-growth forests in Indiana (Ginn Woods, Delaware County). As a seasonal management priority over the last 18 years, garlic mustard patches were mapped and population and life-cycle data were recorded at each location throughout the 161 acre (65 Ha) mesic flatwoods. Data compiled each year provided opportunities to increase efficiency within the short (4-6 week) management window in the following two springs, by targeting probable locations of seed-producing plants. Over the years, improvements in technology have combined to enhance field efficiency through better mapping capabilities and real time reporting from the field. Adopting this changing technology has been challenging, sometimes frustrating, but in the end, entirely worthwhile. Land managers and citizen scientists alike can now benefit from easy-to-use programs on mobile devices without having to go through much of the development process.

Show me the Money: Calculating Long-Term Stewardship Costs for Successful Conservation

Topic: Maximizing Data and Technology to Inform Natural Areas Management

Angela Sturdevant
The Nature Conservancy

Show me the Money: Calculating Long-Term Stewardship Costs for Successful Conservation

Authors: Angela Sturdevant, The Nature Conservancy and Joanna Woodruff, Central Indiana Land Trust

You can't just walk away once the deed is signed. Long-term stewardship is a balance of monitoring, maintenance, and land management to ensure ongoing site sustainability. However, the costs associated with long-term stewardship are inherently difficult to predict and consequently are often underestimated.

To support better long-term cost calculation and management, The Nature Conservancy convened a group of national experts from within and outside of the Conservancy to develop a stewardship calculator and accompanying handbook. We developed several products, including a spreadsheet for calculating stewardship costs, an accompanying handbook and quick reference guide, and a web-based portal for these resources. These resources help consolidate and highlight common expenses, allowing land managers to more accurately estimate the costs of long-term protection and management and, in turn, the amount of funding that should be set aside in a stewardship endowment to provide a secure source of funding into the future. The calculator was designed to be used by both easement holders and land managers, and is available for free at www.nature.org/stewardshipcalculator.

This presentation highlights the components of the calculator as well as key factors that affect cost estimation, using the Central Indiana Land Trust's new 300-acre Glacier's End Preserve as an example. Funds were set aside for this new acquisition based on 10% of the fair market value, according to the land trust's policy. But will that be enough? I'll present the estimated long-term stewardship costs determined using the calculator and discuss whether the flat fee approach was sufficient for this particular preserve.

Thursday, October 25, 2018 8:30am - 10:00am

Private Land Conservation

Saving the best, to last. A new conservation plan for Central Indiana

Topic: Private Land Conservation

Cliff Chapman

Saving the best, to last. A new conservation plan for Central Indiana. Cliff Chapman, Executive Director, Central Indiana Land Trust.

Formed in 1990, the Central Indiana Land Trust took a mostly shotgun approach to land conservation for many years. A strategic conservation plan was adopted in 2009 focused on ecological targets and defining Core Conservation Areas. The results included saving the last unprotected old growth forest in Indiana (Meltzer Woods) and assembling a 700 acre forest block home to rare and endangered species located less than an hour from downtown Indianapolis. In 2017, the land trust's board of directors decided to expand the reach of the organization to the central third of Indiana and create a new conservation plan. This new plan will be presented including targets, sites, protection methods, funding strategies, potential challenges and stewardship implications resulting from growth. Strong partnerships and collaborative approaches to conservation will be a key factor in the plan's success.

Family forest landowner management in southern Illinois: a qualitative study of goals, trends, and opportunities

Topic: Private Land Conservation

Kealie Vogel
University of Illinois at Urbana Champaign

Family forest landowner management in southern Illinois: a qualitative study of goals, trends, and opportunities

Kealie Vogel1, Daniel C. Miller2
1,2 Department of Natural Resources and Environmental Sciences, College of Agricultural, Consumer, and Environmental Sciences, University of Illinois at Urbana - Champaign

Abstract: Non-industrial private forest (NIPF) land accounts for more than half of forested land in the United States. In the southernmost 13 counties of Illinois, private forest landowners own over 83% (3.4 million acres) of forested land in the area. It is in the interest of the state of Illinois, the forest industry, and the NIPF owners to support those landowners who wish to manage their forestland and improve the ecosystem services the forest can provide. Methods of forest management include timber stand improvement, prescribed burning, invasive species management, and native species planting for the benefit of the forest as a whole. In addition to government programs aimed at supporting or increasing NIPF landowners' forest management practices via education, regulation and/or incentives that have been in existence for some time, the state of Illinois and local governments have created several programs and pieces of legislation that exist to provide technical and financial assistance to those wishing to begin or continue to manage trees on their land. This project serves as an in-depth exploration into the forest and tree management programs that exist in southern Illinois for the purpose of improving understanding of the ways that managed forest lands on private property contribute to the socio-economic status of the landowners and the ecological health of the southern Illinois area. Drawing on qualitative data from 18 interviews (8 with professional natural resource managers, 10 with family forest landowners), our objective is to describe, from the perspective of the interviewees, (1) management goals, (2) direction, (3) opportunities, and (4) areas of improvement in terms of their own land and then expanding to the complex forest management network of southern Illinois. Following analysis of all data gathered over the summer, several themes and commonalities emerged: Utility of legislation and assistance programs, Need for implementation, Necessity of education, Necessity of cooperation, Motivations for management, and Financial barriers. These findings highlighted the need for statewide support of forest management activities in southernmost Illinois.

Thursday, October 25, 2018 8:30am - 10:00am

Restoration Ecology

Hardwood tree seedling growth and survival under varying planting treatments on reclaimed mine land.

Topic: Restoration Ecology

Alexys Nolan
The Wilds

Nolan, A.K.1, P.J. Boleman2, and R.M. Swab1. Hardwood tree seedling growth and survival under varying planting treatments on reclaimed mine land. 1The Wilds Restoration Department, Cumberland, Ohio. 2Willowsford Conservancy, Ashburn, Virginia. Email: anolan@thewilds.org, pboleman@willowsfordconservancy.org, rswab@thewilds.org

Reforestation of previously mined lands is essential for restoring forest ecosystems in the Appalachian region of the United States. At The Wilds, a conservation research facility in Ohio, forests historically dominated the landscape. Reclamation of the previously mined land occurred in the mid to late 1900s; after new federal regulations in the 1970s, reclamation primarily involved grassland establishment. Reforestation of The Wilds grasslands have had limited success due to constraints such as soil compaction, low nutrient availability, and invasive species competition. To increase tree seedling establishment, an experiment was designed to test multiple planting treatments on seedling

growth and survival: fertilization, Terra-Sorb® root dip, post-planting herbicide application, and a control. In spring 2016, roughly 5,000 tree seedlings were planted representing five native hardwood species. After two growing seasons, Quercus alba had the highest survival rate while Liriodendron tulipifera had the lowest. Plots fertilizer tablets were used demonstrated the highest survival rates while plots with herbicide treatments demonstrated the lowest. The mean root collar diameter of seedlings increased from 2016 to 2017, however, the mean seedling height decreased. Herbivore browse damage was observed on 83.1% of seedlings in 2017. Tulip poplar seedlings demonstrated substantially lower survival rates than oaks in 2017, indicating that they responded poorly to stress relative to oak species. Survival results from treatment methods run contrary to contemporary tree planting protocol where sites are typically sprayed with herbicide to reduce vegetative competition. Results show that future tree plantings at The Wilds should consider protection from herbivore browse and use fertilizer tablets to increase seedling growth and survival. Thus an experiment testing tree tube use and different ground de-compaction methods on seedling growth and survival was initiated in the spring 2018. Over 3,000 hardwood trees comprised of five different species were planted on a 5-acre site. Ground preparation consisted of two plots that were ripped with a dozer, and two plots excavated with a track hoe. The effects of tree tubes will be evaluated across all ground preparation plots, which were divided into subplots and half were randomly assigned tree tubes. Assessment of tree survival and growth will be done annually in the fall.

Restoring mine land- tradeoffs and benefits of prairies

Topic: Restoration Ecology

Rebecca Swab
the Wilds

Title: Restoring mine land- tradeoffs and benefits of prairies
Rebecca Swab 1, Nicola Lorenz 2, Richard Dick 2
1. The Wilds, Cumberland, OH
2. Ohio State University, Columbus, Ohio.
Surface mining for coal represents one of the most severe anthropogenic disturbances in the United States, and has affected nearly 1 million hectares of land. Required reclamation of these landscapes post-mining is minimal, and most are planted with invasive grasses and shrubs. However, it has been shown these cool season grasslands can be beneficial habitat for grassland birds declining elsewhere.
The Wilds is a conservation, education, and research facility located on nearly 10,000 acres of reclaimed strip mine land. At the Wilds we have undertaken restoration efforts to replace these low diversity cool season grasslands with high diversity prairies. Vegetation and soil microbial studies focus on the effectiveness of our restoration efforts and how prairie species might change the soil community. The response of wildlife such as insects and grassland birds to prairie installations has been studied as well, to evaluate how other species might benefit from restoration efforts.
To further understand how restored prairies differ from cool season grasslands, we have begun long term monitoring of prairie vegetation and soil microbial activity. So far, we have shown that soil becomes healthier with time since reclamation, as indicated by microbial biomass, however there is not a clear relationship between prairies and soil. As soil health improves, we can expect bottom up improvements across all trophic levels. Vegetation diversity decreases with time since prairie restoration. However, prairies increase the cover of native plants on the landscape. Different wildlife species may respond differently to restoration- for instance, pollinators are positively influenced by increases in floral resources while some grassland bird species are negatively impacted by prairie installations.
Overall, results on this landscape shows that engineering sustainable diverse ecosystems following mining requires more work and different methods than current reclamation laws require. Restoring prairie is beneficial for some, but not all species. Therefore, mixing cool season and warm season grasslands on reclaimed minelands across the landscape may maximize wildlife diversity.

Thursday, October 25, 2018 8:30am - 12:00pm

Symposium - Karst Conservation and Management

The session will commence with an overview of karst in Indiana, including caves, springs and sinkholes and their uniquely evolved, rare and endangered inhabitants. This will be followed by a talk on current trends and challenges of cave bats in light of the catastrophic White nose syndrome that is decimating populations of the endangered Indiana bat as well as many other species. The symposium then addresses the challenges of land management and conservation in an era of expanding human encroachment on delicate karst lands, where localized disturbances can not only affect a specific area, but may then funnel underground to continue a path of disturbance and re-emerge miles away.

Karst conservation and management

Topic: Symposia

Julian Lewis
Indiana Karst Conservancy

William D. Orndorff
Virginia Natural Heritage Program

Rick Olson
Mammoth Cave National Park

Scott Johnson
Indiana Division of Fish & Wildlife

Mike Slay
The Nature Conservancy

Karst landforms and their unique communities

Julian J. Lewis

This symposium is a contribution of the Indiana Karst Conservancy, a land trust dedicated to the conservation of karst in our state. This initial presentation lays the foundation for four invited speakers, each an expert on karst management, to address more specific topics of karst ecosystems and their conservation. Karst is a landform produced by the dissolution of soluble rocks, e.g., limestone, where the results are underground drainage systems – caves -- with water entering via sinkholes, sinking streams or fissures, and exiting at springs. The subterranean component of karst ecosystems creates conservation issues because problems tend to become 'out of sight, out of mind'. Looking first at groundwater recharge sites, sinkholes are frequently portrayed as menaces to society in which homes and highways suddenly disappear, requiring extraordinary means to fill or otherwise destroy them to protect mankind. In reality, sinkholes are unique habitats that shelter significant communities and funnel water and nutrients into the caves below. Research has demonstrated that in comparison to the surface, sinkhole environments are buffered to minimize swings in temperature and humidity. Biodiversity is higher in sinkhole floors, with species previously considered troglobites (obligate cave inhabitants) being discovered there. In Indiana some karst invertebrates are known only from sinkholes. In the subsurface epikarst, in the saturated interstices of soil and bedrock fissures much too small for human entry, are found another diverse community of eyeless, unpigmented animals. The absence of light in caves generally dictates nutrient availability is a fraction of that in surface communities. In Indiana caves the majority of nutrient input is probably in the form of dissolved or particulate organic matter. The cave environment is buffered compared to the surface, but the paradigm of caves as constant temperature zones is flawed. Despite the challenges of life underground, thousands of species (many of them narrow endemics) exquisitely adapted to subterranean habitats are known from North American. Subterranean organisms live in delicately balanced environments that are all too vulnerable to human encroachment and disturbance. At the

end of the journey through a cave, the water resurfaces at springs. Spring communities usually include a variety of stenothermal animals (e.g., crustaceans, snails, flatworms) adapted to cool, lotic waters. Molecular phylogenetic research reveals that some species previously considered to be widespread are now recognized as complexes of species endemic to individual spring basins.

Mammalian inhabitants of Indiana karst environments: Challenges and tactics for solutions

Scott Johnson
Indiana Division of Fish & Wildlife

The management and conservation of rare, declining, and at-risk species that occupy cave and karst habitats often present unique challenges that require novel solutions. As a group, mammals may pose additional difficulties because they are mobile, typically leave little sign to indicate their presence, and occur at relatively low population densities. Such factors complicate estimates of abundance, which are essential to inform adaptive management and conservation strategies. During the last 30+ years, the Indiana Division of Fish and Wildlife (IDFW) implemented focused, yet holistic, programs to better understand and improve the conservation status of two karst-dwelling mammals: the Allegheny woodrat (Neotoma magister) and Indiana bat (Myotis sodalis). Allegheny woodrats are habitat specialists that occupy cliffs, caves, and other rocky areas in mature forested environments primarily along the Appalachian Mountains. They are listed as endangered in Indiana and of conservation concern in most states in which they occur. Population stressors for woodrats include habitat fragmentation, reduction in food resources, parasitic raccoon roundworm (Baylisascaris procyonis) infection, and loss of genetic diversity. From 1991 through 2017, IDFW and partners implemented a comprehensive woodrat conservation program that included elements of population monitoring, genetic analyses, parasite mitigation, hard mast availability, animal translocations, captive breeding, and soft releases. Although populations responded favorably, both numerically and genetically, continued management will likely be necessary to maintain Allegheny woodrats in Indiana. Since the mid-1980s, IDFW's management for the federally endangered Indiana bat has emphasized identification and protection of winter hibernacula, microclimate studies, restricting unauthorized human visitation, and population responses as measured through biennial winter bat counts. Methods to manage hibernacula were site-specific and included landowner outreach, cooperative agreements, signage, fences, angle-iron gates, and simulated alarm systems. The statewide winter population nearly doubled from 1983 to 2013, reaching a high of ca. 224,700 bats, largely due to substantial gains at several caves and discovery of a previously unknown site. However, since the initial detection of white-nose syndrome (WNS) in Indiana in 2011, Indiana bat populations have declined 19% at the state's largest hibernacula. Other cave-dwelling bat species, specifically tri-colored bats (Perimyotis subflavus) and little brown bats (M. lucifugus) have suffered much larger declines post-WNS (95% and 90%, respectively) during the same time period at these hibernacula. In the face of this devastating disease and other known stressors, continued management to aid remnant populations of cave-dwelling bats in Indiana will be necessary.

Ozark perspectives on karst conservation

Michael E. Slay
Ozark Karst Program, The Nature Conservancy

More than 13,000 caves occur in the Ozarks Ecoregion, and provide critical habitat for many species. While some of these species are common and may occur in similar conditions aboveground, at least 100 species (i.e. troglobionts) are restricted to the subterranean environment. Most of these troglobiotic species are rare and endemic to the Ozark Ecoregion. Nine species have federal protection under the Endangered Species Act, and include four bats, two cave crayfish, two cavefish, and a cave snail. The presence of federally listed species in Ozark caves has helped direct interest and funding toward conserving karst habitats in the Ozarks, and partnerships and collaborations that extend beyond jurisdictional boundaries facilitate many conservation and management projects. Three collaborative projects will be discussed in more detail to illustrate the range of strategies being used to conserve caves and karst habitats. First, a threat assessment of Arkansas and Oklahoma karst habitats containing rare species was completed. The

assessment evaluated site-specific threats at 391 karst habitats (cave, springs, or seeps) using threat indicators from 25 geospatially available datasets. Results of the threat assessment are being used to evaluate conservation priorities in these states. Second, cave protection efforts have benefited from partnerships between agencies and conservation organizations that determine funding priorities for acquisitions, restoration, and management. Leveraging public and private resources, through programs such as USFWS Recovery Land Acquisition Grants and State Wildlife Grants, have resulted in the protection of additional priority sites and habitats. Leveraging voluntary habitat offset funding from infrastructure projects has also supported protection efforts. Lastly, a technical committee and advisory group comprised of researchers, consultants, city representatives, and developers was created to develop a strategy for protecting groundwater resources in Cave Springs Cave, Benton County, Arkansas. The cave provides habitat for 47 species, including the largest population of Ozark Cavefish (Troglichthys rosae), a federally listed species. The teams summarized available biologic and hydrologic information about the cave, refined the recharge area delineation, designed karst-appropriate Best Management Practices (BMPs) based on land vulnerability that protect groundwater resources while permitting development, and assisted cities with enacting ordinances to implement these BMPs within the recharge area. Results of the project, along with other ongoing conservation efforts, should provide long-term benefits to Cave Springs Cave.

Conserving rare and endangered cave invertebrate species in the Appalachian karst of Virginia

William D. Orndorff
Virginia Natural Heritage Program

Approximately 200 cave limited invertebrate species occur beneath the Commonwealth of Virginia, with most restricted to very small ranges. Of these species, over half have rarity ranks of G1 and G2, with many known from a single site. Major terrestrial invertebrate groups include carabid beetles, millipedes, diplurans, pseudoscorpions, and collembola. Major components of the aquatic fauna are isopods, amphipods, and gastropods. Cave limited species new to science continue to be discovered in Virginia on a regular basis, as do new localities for known species. Our current knowledge of the biodiversity significance of cave limited fauna, though extensive, is rather incomplete and skewed, distorting agency conservation priorities. This situation has been exacerbated by the lack of legal protections for the vast majority of these extremely rare and vulnerable animals. Only two cave limited species in Virginia, both aquatic isopods, are protected under the U.S. Endangered Species Act. An additional three terrestrial and three aquatic species are protected under the Virginia Endangered Species Act. Because of the funding support available for working with federally listed species, most conservation focus has been on caves and karst areas where these species occur, at the expense of conservation for many species at a similar or in many cases higher level of risk. The Lee County cave isopod (Lirceus usdagalun) is limited to vadose cave streams underlying a single karst area of about ten square miles in extreme southwestern Virginia. Conservation efforts here have focused on restoration of the Thompson Cedar cave system, as well as discovery of additional populations and their incorporation into the Cedars Natural Area Preserve, which now includes all known extant occurrences of this species. Conversely, the Madison Cave isopod (Antrolana lira) is an inhabitant of the phreatic karst aquifer of the Shenandoah Valley in northwestern Virginia, with a range of one hundred fifty miles that includes adjacent West Virginia. This wide-ranging species is sensitive to hydrological alterations and conservation efforts have focused on development and implementation of best management practices designed to protect habitat. Efforts at protection through acquisition are underway, including the type locality, Madison Saltpetre Cave. Both species are relatively secure in comparison to the majority of G1 cave limited species that lack legal protected status. A critical component of conservation of the cave fauna will remain education and outreach.

Managing the World's Longest Cave

Rick Olson
Mammoth Cave National Park

Environmental problems affecting the Mammoth Cave area range in scale from local to global. In park caves, much impact is linked to tourism, which is part of the National Park Service Mission to preserve and yet provide access for the enjoyment of cultural and natural resources. Some impact is unavoidable; for instance if you build a trail through a cave passage then you are trading initial impact for less in the future. Cave management issues include corroding copper wire and aluminum light fixtures, lamp flora from cave lights, lint, dust, graffiti, excessive bolt holes drilled in cave walls for infrastructure, fumes from gasoline lanterns, creosote treated wood in cave streams, and management of cave atmospheric conditions. Surface issues affecting park caves include runoff from parking lots and highways, sewage treatment, sinkhole dumps, prescribed fire, hydrocarbon extraction, pipelines, and pollution plus impoundment effects on the Green River. On a global scale, there are exotic species brought in by commerce or war, air pollution, and the rising concentration of carbon dioxide in the atmosphere from combustion of fossil fuels. This along with other greenhouse gasses is causing warming on a global scale and probably severe weather extremes. On occasion, what appear to be cases of pollution almost certainly are not. Sulphur River in Parker Cave (near Park City, adjacent to Mammoth Cave National Park) was initially thought to be contaminated by brine and hydrogen sulfide from a nearby oil well. However, enlargement of a room where the water enters appears to have been caused by sulfuric acid, and this could not happen in a matter of decades. As well, seeps with low concentrations of hydrogen sulfide in Marianne's Pass in Mammoth Cave were initially thought to be from a possible sewage leak (restrooms nearby). However, the seeps are weathered into the limestone bedrock, which would take a lot of time and there were no coliform bacteria present. Instead, at both locations there are microbial mats created by oxidizing hydrogen sulfide in a process called chemoautotrophy. Subterranean ecosystems in the Mammoth Cave area have always been thought to be ultimately dependent on energy from photosynthesis. This is still true for the most part, but there does seem to be energy from below that may be a factor in why this region is a biodiversity hot spot for cave life.

Thursday, October 25, 2018 8:30am - 12:00pm

Symposium: Indiana's Grassroots Efforts for a Statewide Partnership to Address Invasives

This symposium session will begin with a review of three existing cooperative invasive species management areas (CISMAs) and the efforts they have made since establishment. The third CISMA discussion will include a description of the need to increase grassroots efforts for broader public support to bolster conservation efforts across the state. The fourth discussion will outline the grassroots project, Indiana's Invasive Initiative, the status of the project and hopes to foster discussion and the way forward during the question period of the session. The symposium presentations will culminate with a review of a new program to increase availability and use of native plants in landscaped areas. The symposium will end with a question session to allow participants to discuss the project, citizen science and partnerships and agency efforts to address invasive species that have expanded since the project began.

Indiana's Grassroots Efforts to Grow a State-wide Partnership to Address Invasives and Strengthen Ecosystem Resilience

Topic: Symposia

Dawn Slack
TNC

Cheryl Coon
Southern Indiana Cooperative Invasives Management

Ellen Jacquart
MC-IRIS

Allison Shoaf
Brown County Soil and Water Conservation District

Katherine Green
The Nature Conservancy

1.Brown County Native Woodlands Project - The Beginning of a Movement.
Allison Shoaf, Coordinator, Brown County SWCD
In 2006, several individuals, who share the belief that we must act now to save our forests from the devastating impact of non-native invasive plant species, formed The Brown County Native Woodlands Project (BCNWP). This was the first Cooperative Invasive Species Management Area (CISMA) in Indiana and really laid the ground work for subsequent CISMAs to form. Since then, the group has educated 1,000s of landowners and land managers about the threat of non-native invasive species (NNIS) and ecology; trained volunteers to help map NNIS plant infestations; encouraged public and private entities to eradicate targeted species, encouraged other CWMAs to form, all while suggesting native plant alternatives and sharing knowledge about local ecosystems to improve conservation efforts locally. This presentation will highlight the history and successes of this well-established CISMA, and share tips and tricks for successful community engagement and partnership creation.
2. The Effects of Teamwork in the Indiana Coastal Area.
Kate Green, Restoration Crew Leader, The Nature Conservancy
The Indiana Coastal Cooperative Weed Management Area (ICCWMA), founded in 2009, will provide information on projects they are undertaking or have undertaken as a cooperative weed management area to advance stewardship in the Lake Michigan Coastal Region of Northwest Indiana. During this presentation, attendees will learn about their success in developing an early detection program for invasive species and other projects underway, including an invasive species mapping and planning project in the Hobart, IN Marsh/Prairie Grove complex in Lake County. Information will also be presented on how the ICCWMA works with a utility/pipeline right-of-way manager in the area.
Kate Green: Kate Green is a Restoration Crew Leader with The Nature Conservancy in Indiana. She earned her degree in Integrative Biology with an emphasis in ecology and natural history from University of Illinois at Urbana-Champaign. Kate has worked with local government agencies implementing public outreach programs and has worked with non-profits and private companies implementing restoration projects on privately and publicly owned natural areas. In her current role as a Restoration Crew Leader with The Nature Conservancy, Kate currently works with a team to implement management activities in dune and swale habitat to remove beneficial use impairments to fish and wildlife in the Grand Calumet River Area of Concern. She is an active member of the Indiana Coastal Cooperative Weed Management Area (ICCWMA) and lends her experience managing natural areas to help develop and implement projects undertaken by the ICCWMA.
3.SICIM History and Future - Why the Need for a CISMA in Every County.
Cheryl Coon, Forest Botanist, Hoosier National Forest and Steering Committee Member for SICIM
Southern Indiana Cooperative Invasives Management (SICIM) was founded in 2008 to increase awareness about invasive species in 35 counties of southern Indiana. Overtime, the group has worked on multiple projects, engaged partners and provided education. However, it was realized that to fully reach constituents in such a large area, a grassroots level was needed to fully engage the different demographics across the region and promote local stewardship. As a result, SICIM established an agreement with NRCS for $914,000 to fund the development of CISMAs at a state-wide level and grow the education, support and implementation of invasive species management through a bottom-up approach. This presentation will look at the decade of development that led to SICIM's involvement in Indiana's Invasive Initiative.
4.Indiana's Invasive Initiative
Dawn Slack, Land Manager & Chair, Invasive Plant Advisory Committee, The Nature Conservancy
The Southern Indiana Cooperative Invasives Management Area (SICIM) and the Natural Resource Conservation Service (NRCS) developed an initiative to address apathy, lack of state and federal resources and the need for public support to effectively manage invasive species. This initiative's, 'Indiana Invasives Initiative', primary goal is to develop a cooperative invasives species management area (CISMA) for every county in Indiana in 5-6 years to

improve overall habitat protection, restoration, and management efforts across the state. This presentation lists examples of existing CISMA projects, the project plan, partnerships and collaborations developing, speed bumps, and the status of county CISMA establishment.
5.Grow Indiana Natives - Another Way to Fight Invasives
Ellen Jacquart, Invasive Education Chair, Indiana Native Plant and Wildflower Society (INPAWS)
Many of the invasive plant species in Indiana come from horticulture. 'Grow Indiana Natives' is a native plant certification program led by INPAWS to reward plant sellers who agree to stop selling invasive plants, and help consumers find sellers of native plants in Indiana. This program is not only a stand-alone project, but it is a necessary resource for citizens and businesses, and a necessary component of the state-wide effort to increase native landscapes across the state. The program went statewide in 2017, and an update on the Grow Indiana Natives program will be given.

Thursday, October 25, 2018 8:30am - 12:00pm

Symposium: Research Related to the Native Seed Strategy

The National Seed Strategy for Restoration and Rehabilitation (NSS) is a five year plan launched in 2015 with a clear and simple vision; the right seed in the right place at the right time. The NSS fosters interagency and public-private collaboration to guide the development, availability, and use of seed needed for timely and effective restoration. One of the four major goals in the NSS is undertaking research and improving technologies for the production and use of native plant materials. This has catalyzed research activities in government, academic and non-profit sectors to address critical research needs related to restoration. These include understanding seed transfer zones now and under climate change, improving seed storage capabilities, understanding plant establishment and community assembly in a restoration context, and monitoring and quantifying restoration impacts and outcomes. This research supports the overarching goal of ensuring the availability of genetically appropriate seed to restore viable and productive plant communities and sustainable ecosystems. In this session we will discuss research related to the NSS on seed sourcing, seed mix design, seed germination, and the native seed market in the U.S. This symposium is intended for land managers, researchers and others interested in restoration ecology and seeds.

Improving Restoration Outcomes in the US: Research Related to the National Seed Strategy

Topic: Symposia

Kayri Havens
Chicago Botanic Garden

Andrea Kramer
Chicago Botanic Garden

Jessamine Finch
Northwestern University

Rebecca Barak
David H. Smith Conservation Fellows

Katie Kucera
Northwestern University

Prairie restoration: How to make the best decisions about what seed provenances to collect and where to use them

Kayri Havens1, Andrea Kramer1, Rebecca Barak1,2, Jessamine Finch1,2, and Abbey White1,2

1Chicago Botanic Garden, Division of Plant Science and Conservation, Glencoe, IL 60022, U.S.A.
2Northwestern University, Department of Biological Sciences, Evanston, IL 60201, U.S.A.

The U.S. tallgrass prairie is one of the world's most endangered ecosystems. It is also an ecosystem where ecological restoration has been practiced for nearly a century. Proper sourcing of seed for this restoration has never been straightforward, and it is becoming even more challenging and complex as the climate changes. For decades, restoration practitioners have subscribed to the 'local is best' tenet, even if the definition of 'local' was often widely divergent between projects. However, given rapid climate change, we can no longer assume that locally-sourced seeds are always the best option. Using examples from our work in the tallgrass prairie and the grasslands of the Colorado Plateau, we discuss what we are learning from provenance trials and how this may influence seed sourcing decisions. We review provisional seed zone maps and seed decision tools, including a new tool under development to assess options of plant provenance based on the goals and context of a given project. Lastly we will discuss our findings in the context of other grassland restoration around the world.

Drivers and constraints of seed mix design for prairie restoration

Rebecca Barak1,2,3,4, Zhao Ma2, Kayri Havens3, and Lars Brudvig4

1David H. Smith Conservation Fellows
2Forestry and Natural Resources, Purdue University, West Lafayette, Indiana, U.S.A.
3Plant Science and Conservation, Chicago Botanic Garden, Glencoe, Illinois, U.S.A.
4Plant Biology Department, Michigan State University, East Lansing, Michigan, U.S.A.

The process of ecological restoration begins long before seeds are sown, in the decision-making process of land managers and other stakeholders in the restoration process. Land managers face multiple, potentially confounding, objectives and constraints as they make decisions for restoration. While restoration ecologists tend to focus on biological considerations when studying restorations and designing experiments, managers must also consider social, economic and other drivers for restoration in general, and for seed mix design in particular. We will report results from a social science analysis of restoration land managers working in the tallgrass prairie ecosystem. We conducted semi-structured interviews with 18 prairie restoration land managers in Illinois, Indiana and Michigan, seeking to understand the decision processes they use to design seed mixes. We asked questions that focused on 1) restoration objectives and the role of seed mix design, 2) drivers and constraints of the seed mix design process, 3) tools and resources for making seed mix design decisions (including the role of restoration research), and 4) determinants of restoration outcomes. Themes brought forth in manager responses will help restoration researchers and practitioners better understand the intricacies of the seed mix design process, and encourage collaboration between restoration researchers and practitioners. This work relates to several goals of the National Native Seed Strategy.

Effects of seed source vary among species, early life stages, and field sites for two milkweeds (Asclepias sp.)

Jessamine Finch1,2, Alexandra Seglias1,2, Andrea Kramer2, and Kayri Havens2
1Northwestern University, Department of Biological Sciences, Evanston, IL 60201, U.S.A.
2Chicago Botanic Garden, Division of Plant Science and Conservation, Glencoe, IL 60022, U.S.A.

A key consideration in ecological restoration is the sourcing of plant material. Ideal sourcing maximizes the likelihood that material is ecologically appropriate, while minimizing any negative genetic effects (e.g. swamping, outbreeding). In seed-based restoration, the first test of ecological suitability is germination and seedling emergence. A mismatch between seed traits and the conditions at the restoration site can serve as a major bottleneck to recruitment, ultimately reducing restoration quality and/or increasing costs. Despite their importance to restoration outcomes, empirically based seed transfer guidelines are not available for most species. Instead, practitioners rely on provisional seed transfer zones, derived from ecological and climatic data, which are intended as a generalized framework to guide seed sourcing for any species. In recognition of this limitation, the National Seed Strategy (for Rehabilitation

and Restoration) has called for immediate research to determine empirical seed transfer zones for key restoration species. Given their central role in monarch habitat restoration, proper seed sourcing for milkweeds (Asclepias sp.) has become a top priority. To assess the utility of provisional seed transfer zones, and inform the establishment of empirical zones, we investigated the effect of population and collection zone on field recruitment for two milkweeds (Asclepias incarnata, A. syriaca). Populations (n=18) were sourced from three collection zones and sown at two field sites in the Midwest U.S. We used germination bags and grid-seeded plots to assess variation in germination, emergence, establishment, and juvenile performance. Magnitude and direction of source effects varied among species, life stages, and field sites. For A. incarnata, germination rates and aboveground biomass were greater for southern populations, while seedling emergence was greater for northern populations (P 0.001). Interestingly, germination, emergence, and biomass of A. syriaca displayed no significant difference among seed sources. Emergence timing, seed source, and field site significantly affected survival for both species (P 0.001). Overall, survival increased with latitude of population origin at the northern site, but slightly decreased with latitude at the southern site. Variation in early life stages among collection zones was considerably more pronounced for A. incarnata than A. syriaca, suggesting that restoration establishment of A. incarnata is more sensitive to seed sourcing. However, seed sourced from within a single collection zone did perform similarly, indicating that current zones appropriately delineate some degree of intraspecific variation. Implications of these results will be discussed in the context of the ongoing monarch habitat restoration effort and seed sourcing guidelines.

Variation in seed germination requirements and response to gibberellic acid among populations of Penstemon pachyphyllus: implications for the production of genetically diverse mixed-source seed lots

Katie Kucera1, Kevin Gunnell2, Scott Jensen3, Melissa Landeen2, and Andrea Kramer4
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Multi-source seed lots (MSSLs) combine multiple populations of a species to increase the genetic diversity of a seed lot beyond what is possible with a single-source approach, and are increasingly being produced for use in ecological restoration. However, the process of producing seed in nursery settings can potentially lead to unintentional shifts in genetic diversity, and little research has been conducted to identify best practices to ensure genetic diversity remains representative of all populations used. For example, if not all populations germinate at the same time or under the same conditions, some populations may be favored in the final seed lot over others. These impacts may be amplified if the species is produced in nursery conditions over more than one generation. We utilize wild-collected and nursery-produced seeds from six populations of Penstemon pachyphyllus, a priority restoration species in the Great Basin region of the western United States where MSSLs are currently being produced for restoration use, to assess this question. Research has shown that the species has intraspecific variation in seed dormancy-breaking requirements, and to establish nursery beds of this species, gibberellic acid is often used to overcome dormancy and ensure the greatest possible germination response across populations. However, it is not known if all populations respond similarly to gibberellic acid and if this may impact which populations are represented in MSSLs. We conducted seed germination trials that included multiple treatments of cold stratification length as well as gibberellic acid. Results confirmed that the germination response of P. pachyphyllus varies among population, and is an interactive function of source population, seed generation, and stratification treatment. Importantly, the relative success of the GA3 treatment compared to the cold stratification treatments varies based on source population and seed generation. These results will be important for monitoring and maintaining unique trait variations and genetic diversity among P. pachyphyllus populations as they are combined and seeded in large-scale restorations.

Assessing capacity of the U.S. native plant production industry to support the restoration of species diversity

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Seed-based restoration efforts often require large quantities of diverse and appropriately-adapted native plant seeds. Shortages of seeds for the range of species targeted for restoration may prevent the restoration from meeting species diversity and structure goals. In the United States, the native plant industry is helping meet these demands, but very little is known about its capacity to support the needs of species-diverse restoration efforts. We conducted the first comprehensive and quantitative assessment of the native plant industry in the U.S. in order to better understand the capacity of this industry to support the restoration of species diversity. Our assessment includes more than 800 vendors nationwide, as well as the native plant species they make available for restoration. By synthesizing lists of available species sold by native plant vendors across the U.S., we were able to identify gaps in species availability and inform the research, development, and production of native plant materials. Out of ~25,000 native vascular plant taxa native in U.S., we found that 26% are commercially sold, and that the growth form, conservation status, distribution, and taxonomy of the species significantly predicted whether or not it was available. In contrast, less than 0.1% of the nation's ~3,000 native nonvascular taxa were identified as being sold commercially. Additionally, we investigated how the demand for germplasm for high-quality restoration efforts in the Midwestern tallgrass prairie region is being met by vendors. Restoration efforts in this region have been the target of high-quality restoration efforts for decades. We found that 74% of more than 1,000 target species are commercially available in this well-developed native plant market, and genetically-diverse locally-sourced seeds are often available. Building on the successes of regional markets like the tallgrass prairie region, and to fill gaps that we identified, we recommend that future efforts foster stronger regional collaboration, expand on efforts to ensure consistent and clear demand for more diverse species, and support greater investment in applied research of understudied species currently missing from production efforts.

Thursday, October 25, 2018 10:30am - 12:00pm

Genetic Diversity & Biodiversity

Secondary Old Growth Forests in Indiana: State Forest Legacy, Opportunity and Debatable Future

Topic: Genetic Diversity & Biodiversity

Leslie Bishop
Earlham College

SECONDARY OLD GROWTH FORESTS IN INDIANA: STATE FOREST LEGACY, OPPORTUNITY AND DEBATABLE FUTURE
Leslie Bishop1 and Paul Rothrock2

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Old-growth forests are rare in Indiana, found only in small patches of nature preserves. Recent research underscores the values of large tracts of old-growth forests, including carbon sequestration, forest resiliency, mitigation of climate change impacts, and conservation of biological diversity. Due to historical management, many Indiana state forests are reaching a stage foresters call 'over-mature.' Yet we see these forests as an opportunity for the recovery of large tracts of old-growth. In 1981, 1093 hectares were designated as a Back Country Area in the Morgan-Monroe / Yellowwood State Forests in Indiana. Our study of the forest composition of this area, sponsored by the Indiana Forest Alliance as part of a three-year Ecoblitz, asks the question, is this mature forest developing characteristics of old-growth? We analyzed tree species composition, distribution, and age class; tree cores of the largest trees; coarse woody debris (CWD) and standing dead trees; and the floristic quality of the herbaceous layer. We randomly selected five sites for each of four Ecological Landtype Phases (ELP: Ridges, NE Slopes, SW Slopes, and Bottoms). Within

each site, we sampled living and dead trees and downed logs within 3-5 circular plots (15m radius). Dominant tree species include Quercus spp., Acer spp., Carya spp. Fagus grandifolia, and Liriodendron tulipifera, but relative importance (RI) of these species varies across ELPs. Of the total measured tree stems, 8.5% are standing dead, which are evenly distributed among ELPs. Analysis of tree cores showed that 81% of cored trees are over 100 yrs., with 40% over 130 yrs. The Floristic Quality Assessment of the herbaceous community revealed that this forest has very high 'remnant natural value,' perhaps the highest in the state. These attributes together are comparable to several Indiana nature preserves and indicate a high quality, relatively undisturbed forest with characteristics of old-growth. Based on recent logging in Back Country Area, we conclude that Indiana's current forest management does not reflect the value of setting aside areas of state forests to mature into old-growth. Yet all successional stages are necessary to maximize forest biodiversity. The remaining questions are: to what extent do we value old-growth forests, and what is the future of mature tracts of state forest under current management regimes?

Taxonomic Inventory of the Back Country Area in Morgan-Monroe and Yellowwood State Forests

Topic: Genetic Diversity & Biodiversity

Rae Schnapp
Indiana Forest Alliance

Taxonomic Inventory of the Back Country Area in Morgan-Monroe and Yellowwood State Forests

Rae Schnapp1, Jeffrey Stant2, and Leslie Bishop3

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Since 2014, the Indiana Forest Alliance has been conducting baseline taxonomic inventories on a 900-acre tract of relatively undisturbed interior mature hardwood forest within the Back Country Area at Morgan-Monroe/Yellowwood State Forest. We engaged teams of volunteers led by scientists in an Ecoblitz to collect data on a variety of taxa over several growing seasons and reproductive cycles. Twenty eight species of mammals were found, including mink, coyote, red fox and bobcat. Two species of special concern' in Indiana, the pygmy shrew and smoky shrew, were also confirmed. The bat team documented eight species. By mist netting, they captured Indiana Bat, Eastern Pipistrelle, Northern Long-eared Bat, Big Brown Bat and Red Bat, and acoustic monitoring indicated the presence of Little Brown Bat, Hoary Bat and Evening Bat. Two new Indiana Bat maternity roosts were located, leading mammalogists to conclude that a maternity colony for this endangered species exists in the area. So far, 1300 species of moths, 54 bee species, and 120 spider species have been identified. Sixty eight bird species were identified. We studied the natural history of the Cerulean Warbler in order to document nesting behavior. We confirmed reproductive success at two sites where fledglings survived to leave the nests. The fungus team identified more than 50 mycorrhizal fungi indicative of older forest conditions. Our inventory of 108 species of lichens is the first Indiana survey of forest lichens in 70 years. More than half of the lichen species had not been previously recorded in the state. Overall, our inventory has identified more than 3,316 species in this mature hardwood forest, including several records for the state and at least 21 endangered, threatened and rare species of birds, mammals, reptiles and amphibians. These results, together with old growth forest characteristics, indicate that this area would be an ideal candidate for Nature Preserve or High Conservation Value forest designation.

Where the Glaciers End: Newly Discovered Spiders Highlight High Diversity at a Central Indiana Nature Preserve

Topic: Genetic Diversity & Biodiversity

Marc Milne

University of Indianapolis

Glacier's End Nature Preserve in central Indiana is a 300-acre section of a 700-acre preserve called the Hills of Gold Conservation Area. This land is a mix of rolling hills, steep bluffs, and flattened land where the glaciers came to a halt thousands of years ago. The preserve is owned by Central Indiana Land Trust and largely consists of a temperate forest of maple, oak, and hickory. In 2015, a bioblitz was conducted at Glacier's End, coordinated through the Indiana Academy of Science. Due to the unique spider specimens we found during that bioblitz and in an attempt to further characterize the spider diversity at this site, for every year since 2015 we collected spiders at the Preserve at least once a year using a variety of trapping methods. Within the past three years, we discovered seven potentially undescribed spider species and nine new distribution records of spiders new to the state of Indiana. It's likely that, for these spider species, this Preserve acts as an island of ideal natural habitat that is now surrounded by a swath of agriculture and development.

Thursday, October 25, 2018 10:30am - 12:00pm

Maximizing Data and Technology to Inform Natural Areas Management

A Collaboration to Address Invasive Plants Using GIS and a Phone Application

Topic: Maximizing Data and Technology to Inform Natural Areas Management

Kevin Rohling
University of Illinois Extension Forestry

Title: A Collaboration to Address Invasive Plants Using GIS and a Phone Application

Author: Kevin Rohling, University of Illinois Extension Forestry

Abstract: A partnership in southern Illinois developed a database using ArcGIS software and Collector for ArcGIS phone application, and are collecting and analyzing invasive species data to improve management decisions in the region. The partnership began entering data into the shared database to record and track invasive plants throughout the region using the Collector phone application and ArcGIS Online. ArcGIS Online allows for real-time updates of the database to be shared within seconds of the entry or data upload. A roadside survey targeting location data of bush honeysuckle (Lonicera maackii) within prioritized stewardship clusters was conducted last fall with the help of several regional partners. The data gathered from this survey will lead to improved regional strategies for addressing this invasive and plans are underway for continuing similar survey efforts into the future. The database is compatible with other existing databases already being used and can be integrated for more elaborate analyses. This database and subsequent analysis will improve natural areas management though data driven decision-making.

How Open-Source Technology is Maximizing Data Value and Fostering Collaboration for Large Land Management Organizations

Topic: Maximizing Data and Technology to Inform Natural Areas Management

Liz Christeleit
Sitka Technology Group

Public investment in 2014 to better track Environmental Improvement Program expenditures and accomplishments in the Lake Tahoe Basin is now fostering sustainable land practices throughout California, protecting salmon in Oregon's Willamette Valley, restoring forests to reduce the risk of severe wildfires in Colorado, and fostering conservation throughout the state of Idaho. How is this possible? It's thanks to the forward-thinking of the Tahoe Regional Planning Agency (TRPA) when they chose to place an open-source license on the award-winning Lake Tahoe Environmental Improvement Program Project Tracker. As of August 2018, TRPA and over 50 partner agencies are tracking more than 950 projects dating back to 2010 in this publicly-accessible, online platform viewable to all at: https://eip.laketahoeinfo.org/. The open-source license on the project and accomplishments tracking system has

allowed other organizations to quickly increase data collection efficiency and program transparency.

Learn how this online platform is uniquely suited to support larger land management organizations, both public and private, efficiently manage multiple projects across multiple partners.

Attendees of this presentation will:

• Get a better understanding of what open-source technology is and how it is uniquely suited to help us all build resilience of our natural areas.
• Receive an overview of the open-source technology behind the ProjectFirma platform and what types of organizations and programs are best suited for the platform.
• Gain behind-the-scenes information about what it took to launch this online resource by the California RCDs and the Idaho Soil & Water Conservation Commission.
• Experience a live demo of the award-winning platform.
• Learn how Natural Areas Association members can increase data collection efficiency and program transparency with ProjectFirma.

Indiana Plant Atlas – An Online Data and Technology Tool

Topic: Maximizing Data and Technology to Inform Natural Areas Management

Marcia Moore
Friesner Herbarium, Butler University

Indiana Plant Atlas – An Online Data and Technology Tool

Marcia E. Moore, Friesner Herbarium, Butler University

The Indiana Plant Atlas (IPA) is a customized web based county level interactive tool that compiles and shares research about Indiana flora with the world, using botanical resources from Butler University's Friesner Herbarium (https://herbarium.butler.edu). The Friesner Herbarium, one of the finest in Indiana, grew out of the personal collections of Ray C. Friesner, founder of the Botany Department in 1919. It contains over 100,000 specimens, with approximately 43,000 of those being from Indiana. Herbaria preserve examples of nature's diversity for future generations; their specimens are lasting records that document species' variability. The master species list used to build the Atlas is from Yatskievych, Dolan, Moore, King and Kartesz Indiana Vascular Plants Catalog (in prep.) Nomenclature in the IPA is based on the Catalog. The IPA features beautiful photographs of plants taken by photographers from around the state. It is mobile optimized, making it useful in the field with a tablet or smartphone. This presentation will demonstrate how the Atlas works and will discuss the nascent Consortium of Indiana Herbaria.The Indiana Plant Atlas is an invaluable resource for educators, ecologists, entomologists, restorationists, and everyone else who is interested in Indiana plants. The technology compliments and builds on other online biodiversity portals associated with the iDigBio national effort funded by the National Academy of Science. Additional features new to the IPA include comprehensive synonomy and the ability to add specimen records from other herbaria in Indiana and Indiana specimen information from herbaria in other states as they become digitized and available on regional nodes.

Thursday, October 25, 2018 10:30am - 12:00pm

Pollinators in Natural Areas Management

An Overview of the Potential Impacts of Honey Bees to Native Bees, Plant Communities, and Ecosystems in Wild Landscapes

Topic: Pollinators in Natural Areas Management

Scott Black
Xerces Society for Invertebrate Conservation

The question of whether introduced honey bees belong on public lands and natural areas in North America has been debated for decades. As more areas of natural habitat that formerly provided resources for pollinators are converted to agricultural and suburban uses, the pressures for the beekeeping industry to find pesticide-free areas in which honey bees can forage while they are not actively pollinating crop fields are increasing. As a result, there is a critical need to present evidence-based considerations for landowners and managers of public lands and natural areas that are considering whether honey bees would be appropriate in these landscapes, and if so, the timing, duration, and numbers of hives that should be allowed.
While honey bees are essential pollinators in our agricultural environment, their role in public lands and natural areas is less clear. There is evidence that, at least in some cases, honey bees can alter plant and native bee communities because of their foraging habits, relatively high level of pathogen loads, degree of resource (pollen and nectar) removal, and their interactions with native bees.
This talk will discuss the potential for competition with native bees and other pollinators and disease transfer from honey bees to native bee species and will present science based recommendations for any land manager who is considering placing honey bees in natural areas where native pollinators might be impacted.

Creating Restoration Planting Palettes to Support Pollinators in a Changing Climate

Topic: Pollinators in Natural Areas Management

Carianne Campbell
Sky Island Alliance

The diverse ecosystems of the Sky Islands of southeastern Arizona support an incredible species-richness, including over 4,000 species of native plants and impressive numbers of associated pollinating animals such as bees, flies, butterflies, moths, ants, birds, and bats. Changes in winter precipitation and accelerated spring warming have affected when, and at what elevation, many plant species are blooming, which will likely have implications for pollinator populations. Restoration of plant diversity and floral resources for pollinators and wildlife is critical to support adaptation in areas dominated by invasive species or unable to support mid-story pollinator plants due to lack of infiltration of water. We are conducting restoration projects at locations along riparian corridors in southeastern Arizona, and we have made several adjustments to the standard restoration process to account for current and future climate conditions. An important first step in this process has been developing a process for building site-specific planting palettes that are climate smart and geared toward providing resources for pollinators now and into the future. This process can be adapted to any restoration site, and we are actively seeking your ideas to make it even better.

*Carianne Campbell, Louise Misztal, and Marci Caballero-Reynolds (all from Sky Island Alliance, Tucson, AZ)
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Plant invertebrate relationships and seasonal dynamics of invertebrates in natural areas with emphasis on pollinators

Topic: Pollinators in Natural Areas Management

Anand Persad
Davey Institute

Invertebrates occur in the soil, plant- soil interface and may be incident on or occurring on plants. In natural areas, plant – host and invertebrate relationships and seasonal dynamics of invertebrates in a temperate zone can be quite complex with interactions between groups occurring with high intensity as the limited growing season peaks. This multi-year study in natural areas in the US was designed to observe plant communities, host invertebrates and seasonal dynamics of invertebrates in situations where land management may be cyclical and longer term. Thirty-

four species of invertebrates are tracked along 67 transects lines set up in the mid- atlantic and mid-west US from the onset of spring through fall. The data indicate that in invertebrate populations, some such as pill bugs and sow bugs vary with ground cover more than others such as ants which appear to be ubiquitous. Plants were fed or foraged upon by 11 groups of herbivorous invertebrates several of which also acted as pollinators. Various herbivorous invertebrates also were observed displaying host -plant preferences that were evident for example in leaf feeding beetles that were predominantly found on foliage of native mesic forbs which also supported several fly species. Flies constituted the majority of insects incident on all plants. Bee populations are extremely dependent on plant species present with native forb cover, proximity of water and presence of woodlots enhancing their presence. While Bees are well known pollinators, seven other groups of invertebrates are recorded foraging on flowers. A pollinator habitat quality assessment rating based on plant type, quality and abundance and invertebrate populations that may pollinate plants was developed. The use of remote sensing to further extrapolate this ground level data is presented. The use of remote tools may lend valuable insight to land managers to more effectively plan for programs aimed at encouraging useful plant material that may be more preferred by invertebrate herbivores and promote health of native invertebrate populations and by extension pollinators.

Thursday, October 25, 2018 1:30pm - 3:00pm

Collaborative Approaches to Conservation

Collaborative Conservation on the Grand Canyon's North Rim

Topic: Collaborative Approaches to Conservation

Cerissa Hoglander
Grand Canyon Trust

The Kane and Two Mile Research and Stewardship Partnership is a multi-stakeholder collaborative group formed in 2012 to generate knowledge, information, and tools that can inform and advance conservation-driven resource management practices on the Kane and Two Mile Ranches landscape. This ecologically significant landscape – collectively known as the North Rim Ranches – consists of 830,000 acres of predominantly federally-managed multiple-use public lands north of Grand Canyon National Park. Public lands management is often challenged by limited agency resources and a wide gap between novel scientific approaches and on-the-ground implementation. Public lands stakeholders that form collaborations to implement conservation actions may have a greater opportunity of achieving common goals, and building strong working relationships in the process. We present examples of scientific research and on-the-ground stewardship projects from the Kane and Two Mile Research and Stewardship Partnership as case studies of a collaborative conservation approach. This partnership, consisting of agency land and resource managers, researchers, and a local ranching operation, supports research projects designed to inform science-driven management and conservation-oriented livestock grazing practices within these multiple-use lands. Ongoing projects include experimenting with native grassland restoration approaches in the face of the invasive cheatgrass-catastrophic wildfire feedback cycle and identifying climate-adapted genotypes for re-seeding native plants within common gardens. The Research and Stewardship Partnership has also collaborated to restore and enhance the adaptive capacity of ecosystems in the face of an increasingly arid climate. Recent collaborative efforts to restore degraded springs ecosystems have improved native riparian plant cover and important wildlife habitat without impact to livestock water access. Over the last several years of the formal partnership, relationships among environmental conservation advocates and local ranchers have strengthened, and cross-jurisdictional management of this large landscape has improved. We look forward to the next several years of advancing conservation action on the North Rim Ranches landscape, and make a call for future research, restoration, and adaptation practitioners to consider teaming up with our collaborative group.

Collaborative Project to Stop the Spread of Asian Carp and other Invasive Species from a Land Trust's Perspective

Topic: Collaborative Approaches to Conservation

Betsy Yankowiak Amy Silva
Little River Wetlands Project

In 2010, Eagle Marsh Nature Preserve located in Fort Wayne, Indiana was identified as a potential site where Asian carp could transfer from the Mississippi River watershed to the Great Lakes watershed. Eagle Marsh is jointly owned by the land trust Little River Wetlands Project (LRWP) and the Indiana DNR Division of Nature Preserves with a conservation easement held by the Natural Resources Conservation Service through the Wetland Reserve Program. Within months, multiple federal and state partners installed a 1,200 ft. chain link fence to stop adult Asian carp from crossing at Eagle Marsh during flooding while the area was examined to see if transfer was possible at the site. After further study by the US Army Corps of Engineers, Eagle Marsh was identified in 2012 as the site with the second highest risk of aquatic nuisance species transfer, just behind the Chicago shipping canal. From 2012 to 2015, a collaborative group of multiple divisions of the Indiana DNR, NRCS, and US Army Corps of Engineers along with 20+ local, state, and federal stakeholders completed a 9,000+ ft. long barrier to stop Asian carp. This proactive project was constructed to stop 200 aquatic nuisance species including Asian Carp from transferring between the major watersheds. LRWP has transformed the Aquatic Nuisance Species Barrier into a community asset by creating a Continental Divide Trail with interpretative signs about the barrier project, invasive species, and watersheds.

Managing Oak Woodlands in Orange County, California: A Model Collaborative Approach to Conservation

Topic: Collaborative Approaches to Conservation

Nathan Gregory
Irvine Ranch Conservancy

Managing Oak Woodlands in Orange County, California: A Model Collaborative Approach to Conservation

Nathan Gregory, PhD, the Irvine Ranch Conservancy

Coast live oak woodlands are a critical component of the coastal sage scrub habitat mosaic that is part of the historic Irvine Ranch in Orange County, California. This habitat type was once widespread but has declined as a result of land-use change, including degradation due to invasive plants and insects as well as too-frequent fire due to anthropogenic ignition sources and abundant invasive, annual grasses. In particular, oak woodlands are being impacted by gold-spotted oak borer, a flathead beetle from southeastern Arizona that likely first arrived in California in San Diego County via infested firewood. The beetle lays its eggs on mature oak trees, and the larvae burrow below the bark and feed, creating galleries that disrupt nutrient transport. This feeding by multiple generations of beetles eventually kills the tree, thus threatening this important habitat for many species of plants and animals. The first infestation in Orange County was discovered in 2014 in Weir Canyon, a nature reserve in the urban-wildland interface that is part of the nationally recognized Irvine Ranch Natural Landmarks. In addition to chemical control, treatment requires that heavily infested trees be removed, which impacts the integrity of the habitat, and the loss of cover was recently exacerbated by fire that also threatened nearby communities. Managing these interacting threats to natural areas and the public and restoring these oak woodlands requires cooperation among diverse stakeholders. The Irvine Ranch Conservancy is a non-profit, non-advocacy organization that works on behalf of multiple landowners to protect, restore, and enhance the natural resources of the wildlands in Orange County and to provide opportunities for public participation by conducting and supporting scientific, recreational, and educational initiatives and programs. Together with Orange County Parks, the Conservancy is leading a unique and extensive public-private conservation partnership that includes the Orange County Fire Authority, the University of California, the California Department of Forest and Fire Protection, the US Forest Service, the California Forest Pest Council, the Nature Conservancy, and the California Department of Fish and Wildlife.

Thursday, October 25, 2018 1:30pm - 3:00pm

Digital Herbarium Workshop*

*You must be pre-registered to attend this workshop. Capacity is limited.

Presented by Paul Rothrock

The Consortium of Midwest Herbaria (CMH) data portal currently holds over 181,000 Indiana vascular plant specimen records, including 76,990 specimens from the Indiana University Herbarium and 43,301 records from the Butler University Herbarium. This workshop will introduce participants to the features of the CMH data portal, with tips on how to search and download botanical information for a range of disciplines from plant systematics to community ecology. The CMH data portal also has online plant identification tools that can be used by a broad range of audiences. The taxonomic structure of the data portal includes most of the old names previously used for Indiana plant species, so you do not need to be a professional botanist to use the site. The portal provides an up-to-date inventory of Indiana's flora, along with the species descriptions from Gleason & Cronquist's (1991) Manual of Vascular Plants, and the species observations from Deam's (1940) Flora of Indiana. Of particular interest to natural areas managers is specimen mapping capabilities and the ability to host floristic inventories from individual conservation areas (with links to voucher specimens). Examples from Indiana natural areas and the Indiana Dunes National Lakeshore will be highlighted.

Participants are encouraged to bring a laptop or iPad.

The Digital Herbarium as a Natural Areas Tool: How to Use the Consortium of Midwest Herbaria Data Portal

Topic: Identification Workshop

Paul Rothrock
Indiana University

Thursday, October 25, 2018 1:30pm - 3:00pm

Invasive Plant Identification Workshop*

*You must be pre-registered to attend this workshop. Capacity is limited.

This workshop will focus on educating conservation partners including students, landowners, land managers, educators, etc. about invasive plants impacting the Midwest by providing:

- identification tips for about 20 invasive plants,
- differences between each invasive plant and a native plant that resembles the invasive,
- discuss current range of invasive plant,
- present current knowledge about ecological impacts for each species presented,
- if the invasive plant is available at retail markets,
- native alternative(s).

Invasive Terrestrial Plant Identification Workshop

Topic: Identification Workshop

Dawn Slack

Thursday, October 25, 2018 1:30pm - 3:00pm

Land Management in Light of Climate Change

Climate Change-Related Interpretation-Findings from a Qualitative Study in two National Parks

Topic: Land Management in Light of Climate Change

Brian Forist
Indiana University

Climate Change-Related Interpretation-Findings from a Qualitative Study in two National Parks

Brian Forist, Ph.D., Lecturer in Outdoor Recreation, Parks, and Human Ecology, Indiana University

Public communicators in parks and protected areas, often referred to as 'interpreters,' play a crucial role in land management in light of climate change. In many public programs conducted for visitors to national parks and other protected areas, communicators hope to address the projected impacts of climate change and other critical environmental issues on the protected resources at their sites. They often assume that communicating about such issues leads to stewardship behavior by the recipients of their messages. The effectiveness of this type of communication, particularly from the visitors' perspective is not well understood. As part the qualitative study presented here, researchers observed public programs dealing with climate change at Shenandoah National Park and Cape Cod National Seashore in 2014. Program participants were then interviewed between three and twelve months after their park visit. From the interview data, important lessons have been learned about the value their park experiences have and the elements that linger in their memory. In addition, the results can be applied by public communicators as they structure public programs such as those observed here. In particular, the timing and location of climate change-related content has been illuminated. Presented here will be results from the study and recommendations for the structure of such programs using insights from the visitor interviews as well as constructivist education theory.

Designing Restorations to Increase Ecological Resilience in Oak Barrens/Sand Prairie Mosaics for a New Climatic Future

Topic: Land Management in Light of Climate Change

John Shuey
The Nature Conservancy

In states like Indiana, restoration plays a huge role in conservation. Thanks to land-use decisions over the last century, we have significantly damaged virtually every ecosystem in the state! While SER defines restoration as an 'attempt to return an ecosystem to its historic trajectory', climate change turns this on its head. If we expect our restorations to perform into the foreseeable future, we must envision potentially alternant trajectories that conserve native biodiversity. We can embrace a restoration-centric future that allows us to anticipate impending change and design restorations as initial solutions that can increase ecological resilience and response to future change.

In Indiana, future climates will have two primary impacts to sand barrens/prairie mosaics; increased growing season mortality from drought and, associated impacts to hydrologic cycles impacting both plants and animals. Based on these threats, TNC developed a 2-pronged restoration strategy for enhancing climatic resilience in NW Indiana.

1- We implemented aggressive 'managed transformation' of mesophied woodlands to open oak barrens canopy structure. This will allow natural establishment of drought tolerant herbaceous communities under oak, relative to mesic closed canopy conditions.

2- We acquired and restored a series of agricultural tracts (>3 km2) that included agricultural drainage systems that lower the near surface water table within adjacent oak barrens preserves. By eliminating the drainage network, we restored 'natural hydrologic regimes' to both the restorations and adjacent nature preserves. Agricultural fields were restored to create permanent and seasonally inundated wetlands at the bottom of the hydrologic gradient. Hydrologic

zones (xeric, mesic and wetland) were seeded into appropriate high-diversity plant communities that emulate a native, dynamic habitat mosaic across the gradient.

Together, these restorations create resilience-enhancing landscape attributes that impact a larger contiguous conservation area (>7 km2) . Perched on xeric dune ridges, healthy oak barrens grade downward through native and restored mesic sand prairies into emergent wetlands. The restored communities themselves are thought to resemble hypsothermal relicts Ãƒ Â¢Ã¢â€šÂ¬' hence pre-adapted to increasing severe growing season drought. And the intact hydrologic gradient should allow shifts in response to changing climates. Together these two restoration strategies should allow a re-shuffling of native species assemblages that will function as reservoirs of biodiversity into the foreseeable future.

Developing a conservation strategy for riverine fish habitat in oxbow lakes along the Wabash and White Rivers in Indiana

Topic: Land Management in Light of Climate Change

Cassandra Hauswald
The Nature Conservancy

Title: Developing a conservation strategy for riverine fish habitat in oxbow lakes along the lower Wabash and White Rivers in Indiana

Authors:Cassie Hauswald, Freshwater Ecologist & Brad Smith, Lower Wabash and Wetlands Director, The Nature Conservancy

Oxbow lakes are an important habitat type found along Indiana's major rivers in southwest Indiana. They are an integral part of a river's ecology. Many species of riverine fish use oxbows to reproduce or rear young. Oxbow lakes are also home to many species of rare plants, and they provide wintering and nesting habitat for waterfowl and songbirds.

Despite the ecological importance of oxbow lakes, little is known about their overall health. As a result, there have been no conservation strategies developed around this important habitat in Indiana. Oxbow lakes face many threats, including levees, ditching within the lake basins, agricultural runoff, and fragmentation of surrounding woodlands.

The purpose of this study was to priority rank natural oxbow lakes as habitat for large river fishes and for their service as nutrient sinks in an agriculturally-dominated landscape. This evaluation is guiding The Nature Conservancy's efforts at floodplain restoration in southwest Indiana to prioritize emphasis and outreach to landowners.

We have completed an initial ranking process, based largely on publicly available GIS data, to determine which of the hundred plus oxbow lakes in southwest Indiana are the best remaining habitat for conservation. Through this process and through input from fisheries biologists our interest was narrowed down to eight lakes.

In 2017, a monthly water sampling effort began within the top oxbow lakes and is continuing through 2018. In 2018, two comprehensive fish-sampling events will also occur in these lakes. Questions of succession have arisen from this evaluation so in 2018 we will use isotope assessments to understand the age of oxbow lakes to inform habitat restoration in a dynamic environment.

The end objectives are to establish a baseline of habitat conditions in the lakes and select the top three to develop conservation plans for long-term protection of oxbow lake function.

Thursday, October 25, 2018 1:30pm - 3:00pm

Restoration Ecology

Do's and Don'ts: Lessons Learned in Natural Area Restoration, Installation, and Maintenance

Topic: Restoration Ecology

Jacob Bannister
Davey Resource Group

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Text:Restoring, installing, and maintaining natural areas comes with many challenges and variables. It's through overcoming these challenges that Davey Resource Group has gained knowledge to adapt and improve our processes. This presentation will showcase some difficult restoration projects, as well as some great successes; will expand on the experiences and knowledge gained working through the variables; and will provide tangible insights that will aid in future natural area restoration, installation, and maintenance.
Conference Topic: Restoration Ecology

Mentor Marsh: History, Tragedy, Recovery.

Topic: Restoration Ecology

David Kriska
Cleveland Museum of Natural History

Mentor Marsh: History, Tragedy, Recovery. David J. Kriska, Ph.D. Cleveland Museum of Natural History
Mentor Marsh has been designated by a National Park Service as the National Natural Landmark since 1965 for being one of the most species-rich sites on the Great Lakes shoreline. The Marsh was named Ohio's first State Nature Preserve in 1971. This unique wetland located in the city of Mentor suffered dramatically in the late 1960s when salt-mine tailings leached into Blackbrook Creek. By the early 1970s, most of the swamp forest trees and marsh plants had died. The site was overtaken by reed grass (Phragmites australis), a 14-foot-tall non-native invasive plant. Phragmites grew so densely within the nearly 4-mile-long marsh basin that an estimated 1 billion plants were growing just a few inches apart. After partial abatement of the salt source, the Cleveland Museum of Natural History began a large-scale restoration research project at the Marsh. The largest Phragmites marsh in Ohio, at nearly 800-acres with 12 miles of perimeter is being treated via helicopter and ground-based amphibious vehicles using an aquatic-approved herbicide. The Phragmites has also been physically mashed to stimulate germination from the soil seed bank. The results thus far have been positive. Dozens of native plant species are sprouting throughout the Marsh and Leopard Frogs (Lithobates pipiens) are expanding rapidly throughout. Rare marsh birds - such as American and Least Bitterns, (Botaurus lentiginosus and Ixobrychus exilis) Virginia, King and Sora Rails, (Rallus limicola, Rallus elegans and Porzana carolina) and Gallinules (Gallinula galeata) are now nesting. The restoration has created stopover habitat for other waterbirds and waterfowl, and fish such as Northern Pike (Esox lucius) are spawning and Yellow Perch (Perca flavescens) fingerlings are starting to use the marsh as a nursery. Full habitat recovery is attainable if restoration efforts that guide ecological processes and community rebuilding are able to continue in the near term.

Restoring Coastal Habitats Through Compromise Beach Management In New Jersey

Topic: Restoration Ecology

Jessica Ray
Pinelands Preservation Alliance

Title: Restoring Coastal Habitats Through Compromise Beach Management In New Jersey
Authors: Jay Kelly, Ph.D*, Ryan Rebozo, Ph.D**, Jaclyn Rhoads, Ph.D**, Jessica Ray**
*Raritan Valley Community College
**Pinelands Preservation Alliance
Abstract: Human populations are concentrated in coastal regions throughout the world with projections of growth in the future. Solutions are needed to balance the recreational and other economic uses of local habitats with the ecosystem services these natural areas provide, such as supporting endangered plants and animals, enhancing

storm protection, reducing erosion and more. In New Jersey, one of the most intensively developed coastlines in North America, mechanical beach raking and off-road vehicle use cause severe damage to coastal beach habitat on approximately 70% of the shoreline. These two activities are the primary anthropogenic causes of degraded beach habitat, resulting in sediment erosion, inhibition of dune development and loss of habitat for endangered beach species. However, because recreational beach uses are concentrated near the water in most areas, the opportunity exists to restore ecological conditions in the upper beach without imposing significant losses to recreation. Our project focuses on using this compromise beach management approach to restore habitat along state and municipal beaches across the NJ coastline. Using 'symbolic' string and post fencing, vehicular use and beach raking are deterred from the back beach, allowing beach plants and animals to recolonize these areas naturally. Through a variety of mechanisms, this project has been successful in establishing compromise protection areas along ~10% (13.5 miles) of the New Jersey's coastline to date. Implementation of these protected areas has led to population increases in globally-rare beach plants, such as Amaranthus pumilus (Seabeach Amaranth, federally threatened) and beach-nesting birds, such as the Piping Plover (federally threatened). On multiple occasions, species appeared in these areas after having been absent for decades or more. Because beach plants stabilize sediment and facilitate the development of dunes, major increases in beach elevation, vegetation cover, and dune development were also documented in some areas. This low-cost alternative to conventional beach management, therefore, appears to offer a long-term solution to enhance the development of dune systems, reduce coastal erosion, and provide greater habitat for rare plant and animal species; all while maintaining existing recreational uses of the shoreline along NJ's highly developed coast.

Thursday, October 25, 2018 1:30pm - 3:00pm

Working Landscapes Conservation

Population and community dynamics of non-native species differ with agricultural land-use history

Topic: Invasive Species

Marion Holmes

Population and community dynamics of non-native species differ with agricultural land-use history
Marion A. Holmes and Glenn R. Matlack, Ohio University
Modern forest communities have been influenced by land use practices and the introduction of non-native species. We compared trajectories of non-native population and community attributes including richness, community composition, and abundance between formerly cultivated and pastured stands, two common land uses that differ in the extent of soil disturbance and structure. The goal of this project was to describe the dynamics of exotic species, individually and in the community, as legacy effects of agriculture and determine the interactions of land-use history and life history through time.

We described community attributes and species abundance through time with a paired replicated chronosequence consisting of 40 forest stands growing on abandoned pastures and cultivated fields going back to 80 years after canopy closure. Species were analyzed individually and aggregated into functional groups based on life history traits to test the influence of dispersal on successional trajectories.

Abundance of non-native species declined significantly through the chronosquence and was significantly higher in formerly cultivated than pastured sites. Species richness and the non-native proportion of the total community remained elevated in cultivated sites 61-80 years after canopy closure, which indicates a persistent legacy of cultivation. All life history classes declined through the chronosequence; ingested species were most abundant in formerly pastured sites, reflecting structural complexity, and primarily clonal species were more common in cultivated stands due to shorter dispersal distance and environmental homogenization that supports vegetative expansion.

Wilder working lands: native seeds, oats, olives, bees, bugs, blossoms and bison

Topic: Working Landscapes Conservation

Stephanie Frischie
Xerces Society

Wilder working lands: native seeds, oats, olives, bees, bugs, blossoms and bison
Stephanie Frischie, PhD; Xerces Society for Invertebrate Conservation

Working lands are currently underutilized and undervalued for conservation and habitat. Through the addition of selected native plants, agroecosystems can support pollinators, other beneficial insects, arthropods, microbial communities, and vertebrate populations which contribute to the overall profitability of the crops in production while conserving biodiversity. Semi-wild on-farm habitats provide additional benefits to soil health and water management. Through two project examples: the oat-growing region of the northern Great Plains of North America and the olive orchards of southern Spain, I will show how native plant materials are being used for beneficial insect habitat and to enhance conservation in working lands. In both locations, native seed producers are key partners in recognizing and developing the available seed supply for underutilized and under-available native species.

An emerging need and demand for native seeds in the Mediterranean Basin is the use of native species as cover crops to restore biodiversity and increase sustainable production in perennial agroecosystems of olive, citrus, almond and vineyard. With over 2.6 million hectares of land under olive production in southern Spain, there is great potential for native cover crops to integrate conservation with agricultural production.
I present a species selection methodology and results using criteria for 1) compatibility with olive production, 2) biodiversity and ecosytems services 3) feasibility for seed increase. These concepts can be applied to match native cover crops to other orchard, vineyard, or agroforestry systems.

The second example is from the Northern Great Plains. Through a partnership with General Mills, Xerces is working with farmers and native seed producers to establish pollinator habitat on farms in this region. Farms have a diversity of crops: cattle, bison, hay, pasture, native grasslands, and annuals such as oats and canola. Our project tests the establishment and management of diversity-enhancing forage mixes, tame+wild seed mixes, and native plant borders.

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