DRAFT--14th Annual Emiquon Science Symposium

(presenting author in **bold)**
***Session groupings may still change, check the website for current information*

Keynote:

What Does Climate Change Mean for Illinois?
Jim Angel
University of Illinois

Human-induced climate change has become strongly evident around the world from concerns about rising sea levels to increased frequency of wildfires. But what does climate change mean for Illinois? We know that we are getting wetter with more heavy rain events, while temperatures have been rising. We will review historical trends in averages and extremes in Illinois and how they compare to the rest of the Midwest. And we will discuss impacts from these changes as well as look at future projections as a guide for what happens next.

Oral Session 1:

TNC's Strategies for Addressing Climate Change in Illinois
Karen Petersen
The Nature Conservancy

Climate change is one of the most pressing environmental issues of our time, and The Nature Conservancy is ramping up efforts to increase climate action. In this presentation, I will provide an overview of The Nature Conservancy's climate change mitigation and adaptation strategies in Illinois, with a focus on agricultural natural climate solutions; low-impact renewable energy siting; floodplain restoration to reduce flood risk; and mobilizing bipartisan support for climate action.

Habitat management: adapt or drown on the Illinois River
Jacob Randa and ***Mitchell Baalman***
USFWS

The Illinois River National Wildlife and Fish Refuges Complex manages approximately 13,000 acres of land and water along 124 miles of the Illinois River. A history of commercial river alterations, dating back over 180 years, has long made the Illinois River Valley a difficult place to manage habitat, but as we conclude the wettest 5-year period in over 120 years, land managers need to adapt to a new normal. Landscape-level changes and the need for commodity shipping have magnified the effect of increased precipitation on the Illinois River, as we witness flood severity, frequency, and duration increasing; meanwhile, river predictability models used for habitat management have become decreasingly useful. Annual repairs to infrastructure have become financially unsustainable, and failing to meet habitat management objectives has thus prompted the question “how do we adapt?”

Tallgrass prairie restoration at Emiquon: Flooding, burning, and diverging floristic quality
Amy B McEuen *and Sarah Lindholm*
University of Illinois Springfield

Long-term, longitudinal studies of succession in prairie flora are rare yet provide critical information. We quantified the floristic quality of Emiquon's reconstructed tallgrass prairie by examining floral change since the initial seeding in 2007. We sampled both early (2008) and later (2016) in the restoration across two transects in each of five prairie management sites across the reserve (15, 1-m2 plots per site; 75 plots total). Indices were calculated at both plot and community (site scale); including floristic quality index (FQI), mean coefficient of conservatism (C), mean coefficient of wetness (W), total species richness (S), and native (N) and non-native species (I) richness. Three of the five sites were heavily affected by unexpected flooding in 2013. Burning frequency also varied among sites with flooded sites burned less. Community level indices reflected this difference in disturbance history among sites, showing large differences among sites and large ranges in FQI, C, and N. Although there was no significant change in the average value of indices at the community level (n=5 sites) over time, there was a significant increase in variance over time for multiple indices. This suggests differences in restoration trajectories among the five sites despite the same initial seeding. Plot level results also indicated divergence in trajectories, with the two unflooded yet burned sites showing increases in floristic quality over time, and the three other sites showing a range of decreases. Our study agrees with previous prairie restoration research suggesting that with the appropriate disturbance type (burning) and frequency, floristic quality will increase over the first decade for prairie restorations. However, predicting specific restoration outcomes is extremely challenging. Learning to manage for ecological surprises is likely to become increasingly necessary given climate and other global changes; thus making adaptive and reactive management approaches increasingly critical.

Oral Session 2:

Wetland bird nest success, and nest site selection in a restored wetland system
Auriel MV Fournier[1]*, Joseph D. Lancaster[2], Aaron Yetter[1], Abigail Shaw[3], Macayla Greider[4], Daniel Wu[5],Tyler Beckerman[6], Antonio Gio[7], Kayanna Wolter[7], Jacob Figge[8], Max Laurreur[7], Mike Wood[7], Cody Johnson[9], Devin Jen[6], Benjamin O'Neal[7], and Heath Hagy[10]*
[1]Forbes Biological Station, [2]Gulf Coast Joint Venture, [3]Indiana University, [4]UW Steven's Point, [5]University of Michigan, [6]University of Illinois, Urbana-Champaign, [7]Franklin College, [8]Iowa State University, [9]Eureka College [10]US Fish and Wildlife Service

Emergent wetlands across much of central North America have been highly impacted by landcover changes and are now intensively managed to mimic natural disturbance and flooding patterns. These techniques are often used to balance the needs of a wide suite of wetland-dependent species, one subset of which is wetland dependent nesting birds who use emergent wetland vegetation. Many of these species, including rails, grebes, bitterns and stilts, have declining populations, for not yet understood reasons. Our work took place on an emergent wetland, which was restored in the past two decades and focused on two main questions, where did these species place their nests given the available habitat, and what habitat variables predicted nest success. Nest success is examined in terms of local scale factors (height of nest off

the water, plants used to form nest platform) and larger scale factors (surrounding vegetation). Nest selection is compared between places where nests were found, and that which were available to the birds. Long term these results can be paired with the associated management actions and used to evaluate tradeoffs in wetland management for nesting wetland birds and other important considerations.

Sustainable Rivers Program (SRP) Expands

Gretchen Benjamin[1] *and John Hickey*[2]
[1]The Nature Conservancy, [2]Corps of Engineers, HEC Davis, CA

Green River (KY) dam operations were impacting Mammoth Cave ecology as well as endangered fish and native fish species. Beginning in 1998, The Nature Conservancy (TNC) and U.S. Corps of Engineers (USACE) joined together to find a solution that included environmental flow prescription that could be managed within the flexibility of routine operations at the Green River dams. By 2006, TNC and USACE s designed an innovative water-release schedule for the Green River Dam that created more natural patterns of water flowing from the reservoir. Benefits of these modified operations included extension of the summertime recreational use; enhanced flood protection; and well-documented benefits to sensitive freshwater mussel species found downstream of the reservoir and within Mammoth Cave National Park. As this initial effort was underway, the value of the work was recognized as a practice that should expand on a national level, which led to the official launch of Sustainable River Project (SRP) for USACE in 2002. Each environmental flow prescription is determined for the individual river natural resource needs. E-flows often follow the seasonal variability of the system and include elements such as; spring flow spawning triggers for fish and native mussel, providing the right water at the right time on floodplain forests, reconnection of floodplain habitat such as oxbows during the seasonal optimal time, and flow management for optimum dissolved oxygen levels. SRP is presently active on 16 rivers, at 66 different sites and in 15 states. SRP has become a Program rather than a Project and this year received a 10X increase in federal funding, which will expand SRP to at least 11 more rivers including sites on the Kaskaskia River and Farmdale dry dam.

Lightning Talks:

Environmental Monitoring using Unmanned Aerial System (UAS) and Artificial Intelligence (AI) Method

Yun Zhao*, Yanhui Guo, and Thomas Rothfus*
University of Illinois-Springfield

Accurate and timely earth observation is essential for environmental monitoring applications, such as invasive species detection, phenology, wildlife management, and so forth. Recent technological advancements in Unmanned Aerial System (UAS) make it a cost-effective alternative to traditional satellite and aerial images by providing earth observation data in high spatial and temporal resolutions. As UAS-related technology becomes more precise and cheaper, an increasing amount of UAS images have captured the earth's environment and become publicly available. However, challenges in processing the huge volume of UAS data remain as it is a labor-intensive and error-prone process to extract reliable information from UAS images. AI-based image recognition techniques, such as computer vision and machine learning, have the

potential to automate and hence increase the efficiency and accuracy of the information extraction process from UAS images. A series of AI and UAS based projects have been proposed in the Emiquon Preserve area to identify and quantify species of interest to the management teams. Examples include the early detection of invasive plants (phragmites, willow etc.), muskrat lodges, and nesting bird sites using UAS and AI. Elevation maps will also be produced from overlapping UAS images using the Structure from Motion (SfM) technique. The resulting automatic data pipeline solution will provide an innovative and cost-effective alternative for environmental scientists and land managers in better monitoring, assessing, and managing the natural environment.

Conceptual design for a new Illinois River Biological Station
Jim Lamer

Obligate cavity-nesting shapes the evolution of territorial aggression, but not testosterone, in both female and male birds
Sara Lipshutz *and Kimberly Rosvall*
Indiana University

Our understanding of the proximate and ultimate mechanisms shaping competitive phenotypes primarily stems from research on male-male competition for mates, even though female-female competition is also widespread. Obligate secondary cavity-nesting provides a useful comparative context to explore the phenotypic effects of competition because this reproductive strategy has evolved repeatedly across avian lineages, and it is thought to generate strong competition for a pre-made cavity in which to nest, for both females and males. We are currently testing hypotheses that cavity-nesting 1) elicits more robust aggressive responses to conspecifics, 2) that this behavioral trait is facilitated by elevated testosterone levels in circulation in both sexes, and 3) that cavity-nesting species share parallel evolutionary changes in neural gene expression.

Why Mussels Matter
Dakota Kobler *and Thomas Rothfus*

With over 300 native species, North America is a biodiversity hotspot for freshwater mussels. Unfortunately, this taxon is one of the most imperiled— according to The Nature Conservancy, 55% of North America's mussel species are extinct or otherwise imperiled. Freshwater mussels are considered ecosystem engineers because their biological processes ameliorate environments; as a result, their decline has far reaching consequences on freshwater ecosystems. One of the most dramatic ways freshwater mussels can improve freshwater systems is by removing particulate matter from the water column as they filter feed. Dense assemblages of native freshwater mussels can filter hundreds to thousands of gallons of water each day, which can drastically improve water quality. In turn, this can increase the recreational and consumer value of a waterbody. To demonstrate their filtration abilities, we placed native freshwater mussels in aquaria filled with Lake Springfield water and collected time-lapse video. After five hours of feeding, mussels transformed waters with a Secchi disk depth of approximately zero to completely transparent. In this talk, I will present the video footage and discuss this important ecosystem service performed by mussels. In order to advocate for native freshwater mussels' conservation, it is important to demonstrate these often-unseen ecosystem functions.

Current plans for 2020 water level management at The Nature Conservancy's Emiquon Preserve

K. Douglas Blodgett
The Nature Conservancy

Water level management can be an invaluable tool for restoring and managing wetlands; such is the case for The Nature Conservancy's Emiquon Preserve along the Illinois River. A water control structure built in 2016 provides the capacity for bidirectional gravity flow of water between the river and the preserve when the river cooperates, and to pump water to the river when the pumps cooperate; neither of which has been dependable in recent years. However, current plans are to use the two submersible electric pumps beginning later this spring and extending into summer, to drop water levels approximately four feet below the present level.

Oral Session 3:

Stormwater Credit Trading in Cook County as a Means to Improved Natural Infrastructure Distribution

John Legge *and Jennifer Jenkins*
The Nature Conservancy

Stormwater credit trading presents an emerging opportunity for improving distribution and equity of natural infrastructure in Cook County. The Nature Conservancy and Metropolitan Planning Council have worked with Metropolitan Water Reclamation District (MWRD) to determine the feasibility and benefits of creating a stormwater credit trading program in Cook County. Today we are faced with more frequent and more consequential impacts from urban flooding. Excess stormwater has resulted in water quality degradation of our river systems and economic burdens to communities throughout the Chicago area. These effects are often disproportionally experienced in lower-income or minority neighborhoods. People, ecosystems and even industries extending from Lake Michigan to the Mississippi have all been impacted in some form by urban stormwater problems and this represents both a challenge and opportunity for our region.

The traditional approach of centralized stormwater management relies heavily on hard infrastructure and may not be sufficient to tackle our stormwater future. Our analysis shows that a supplemental market-based option could facilitate relief in flood-prone areas, while also incentivizing investment for stormwater control in underinvested neighborhoods. This session will explain the functionality and benefits of StormStore (the proposed stormwater credit trading model); highlight MWRD's pilot program that will initiate demonstration projects; showcase case studies of stormwater credit trading opportunities that would encourage more strategic and greener stormwater solutions; and touch on on how this type of market might be applied beyond Cook County.

An Interactive GIS-Based Tool for Guiding Floodplain Protection and Restoration in the Mississippi River Basin

Eugene Yacobson*, Kris Johnson, and Casey Schneebeck*

The Nature Conservancy

For many decades, floodplains in the Mississippi River Basin (MRB) have seen extensive degradation, conversion, and hydrologic disconnection, leading to severe disruption of natural processes and contributing to the vast hypoxic "dead zone" in the Gulf of Mexico. Large-scale floodplain restoration is a critical strategy for restoring the health of the MRB, with potential to yield benefits for water quality, wildlife, and human communities that are increasingly vulnerable to extreme flood events. With limited resources available to accomplish this strategy, it is critical to identify high-impact areas to target for investment in floodplain projects. The Nature Conservancy has developed a spatial analysis and web-based decision tool designed to identify priority opportunities for floodplain restoration and protection (available at fptool.org).

This project leverages a state-of-the-art, large-scale floodplain model and integrates a variety of basin-wide spatial datasets including nutrient export, likelihood of future floodplain development, critical habitat benefits, and human exposure to flood damage. The interactive online tool provides regional, state, and local stakeholders with portfolios of priority sites, integrating selected aspects of these data inputs at their discretion. Potential sites are identified at multiple, nested watershed scales and for distinct potential management actions of protection and restoration. Overall, this project fills an urgent need to increase the pace of floodplain restoration and to direct resources towards floodplain projects likely to have the greatest impact on restoration of the MRB and the most benefits for communities in the region.

Conservation Efforts at Dogtooth Bend

Shelly Morris *and Viv Bennett*
The Nature Conservancy

The focus area of Dogtooth Bend covers approximately 17,000 acres behind the Len Small Levee on the Mississippi River, in Alexander County, Illinois. Landowners and farmers have experienced repetitive and prolonged flooding in this area for decades, and especially since the record flood on the Mississippi River in 1993, and more recently the levee breach of 2016. These floods are becoming more frequent, longer in duration, and more unpredictable in timing. Many landowners have expressed interest in transitioning away from farming in this landscape and are actively looking for financial mechanisms to do so. The Nature Conservancy (TNC) has worked with landowners and local officials in order to hear questions and concerns about various potential paths forward not limited to sale of easement, outright land purchase, and alternative cropping.

In 2019, TNC was awarded a $14.36M NRCS Wetland Reserve Enhancement Partnership (WREP) project. These funds will go through NRCS to landowners for the purchase of permanent conservation easements and restoration. In addition, in 2019 Illinois NRCS received $10.6M in Floodplain Easement funds from the federal disaster bill. In total, this approximately $25M will protect and restore an estimated 6200 acres of land in Dogtooth Bend. By comparison, there are currently over 7000 acres in program applications for this same area. We anticipate pursuing other innovative approaches to funding and implementation that will be complimentary to the NRCS easements.

Although restoration activities will not begin for another few years, partners are currently pursuing opportunities to establish baseline conditions at the site for nutrients, flora, and fauna. This will aid in comparing pre and post restoration conditions, and provide insight to adaptive management needs for large river floodplain restoration projects. Once restored, this area will provide dynamic floodplain habitat and floodwater storage, as well as capture nutrients and sediment.

Oral Session 4:

Wetlands at work: Nitrogen reduction and phosphorus sequestration of constructed wetlands receiving tile-drained waters from agricultural systems in the Midwestern U.S.
Krista G. Kirkham[1]*, A. M. Lemke*[1]*, D. A. Kovacic*[2]*, M. P. Wallace*[2]*, J. F. Berkowitz*[3]*, and C. M. Van Zomeren*[3]
[1]The Nature Conservancy, [2]University of Illinois Urbana-Champaign, Champaign, [3] USACE Engineer Research and Development Center, Vicksburg, Mississippi

The Nature Conservancy, University of Illinois, and the Franklin Family of Lexington, IL have a 15-year partnership on the 250-acre Franklin Research and Demonstration Farm (FRDF). The farm showcases various in-field and edge-of-field agricultural conservation practices, including sequential constructed wetlands that represent 3%, 6%, and 9% of farm drainage areas. Two major goals of the FRDF are to determine: 1) the effectiveness of constructed wetlands in reducing nutrient concentrations in tile runoff, and 2) what wetland/watershed ratio is needed for significant nutrient reduction. Ten years of water quality analysis demonstrate that the wetlands removed an average of 13%-41% of nitrate nitrogen and 45%-94% of orthophosphorus loadings from tile drainage waters. Denitrification is the primary removal process for nitrogen in wetlands, however the phosphorus (P) cycle lacks an equivalent atmospheric removal pathway. As a result, the capacity of wetlands to sequester P often decreases over time as the availability of soil sorption sites declines. In response, we evaluated the P sorption capacity of the treatment wetlands. Results indicate that the wetlands sequestered P, with water soluble P displaying significant decreases in sequential treatment cells (range 61.0 - 81.7% reduction). However, the magnitude of P retention varied significantly across wetlands, underscoring the influence of soil properties on P sequestration dynamics. Soil P sorption capacity increased in the direction of treatment water flow as anticipated but varied significantly between treatment wetlands with soils ranging from P sinks to potential P sources. Future management actions may be required to enhance P retention in constructed wetland systems. Study results highlight that soil type, land use history, and nutrient inputs are important considerations for proper placement and operation of wetlands in the landscape to optimize long-term reduction of nutrients in tile-drained systems.

Complex effects of nutrients on amphibian-trematode host-parasite interactions
John A. Marino, Jr. *and Kiernan Robinson*
Bradley University

Infectious diseases can dramatically affect wildlife populations, and ongoing changes in nutrient availability due to pollution likely influence disease impacts. However, the influence of nutrients on host-parasite interactions can be complex due to multiple mechanisms that occur

simultaneously, which poses challenges to predict overall effects of parasitism on host populations. For example, nutrient inputs may have complex effects on parasitism of amphibians by trematodes, a widespread class of parasites with complex life cycles, via impacts on multiple trematode developmental stages and hosts involved in the life cycle. To gain an understanding of this complexity, we have been investigating potential mechanisms by which nutrient levels influence trematode parasitism in amphibians using a combination of a field survey and experiments. In a field survey of Illinois wetlands, we found evidence that nutrient inputs may increase risk of infection by trematodes in larval amphibian second intermediate hosts, due to positive effects of nutrients on the densities and infection levels of first intermediate hosts (snails). Experiments, however, suggest other effects may also occur simultaneously. Laboratory experiments indicate that changes in food resource quality, which are expected under changing nutrient conditions, influence larval amphibian host susceptibility to disease. Further, at high enough concentrations, mesocosm experiments suggest that nutrients may have negative effects on the survival of both snail and amphibian hosts, which overwhelm any indirect effect on parasite risk. Moving forward, our goal is to gain a more integrated understanding for how these different effects interact in nature. We expect that our findings will have implications for conserving wildlife in the face of eutrophication and ongoing changes in disease risk.

Early-life stressors and physiological condition in juvenile birds of prey in Central Illinois
Travis E. Wilcoxen[1]*, Emily Mihalkanin*[1]*, Jessica Brinegar*[1]*, Jane Seitz*[2]*, and Jacques Nuzzo*[2]
[1]Millikin University, [2]Illinois Raptor Center

Though multiple studies have explored the effects of stress on symmetrical growth in birds over short periods of time, there have been comparatively fewer long-term measurements of how stress affects asymmetrical growth, particularly in birds of prey. Fluctuating asymmetry (FA) is known to occur as a product of poor early-life conditions and experience with persistent stressors. One way to quantify stress in birds is to measure corticosterone (CORT) in feathers. Birds deposit CORT into their feathers when first growing the feathers as nestlings and also during molt, but they cannot deposit CORT after that feather is grown. We examined FA in juvenile birds, from four species, admitted to the Illinois Raptor Center for rehabilitation and concurrently measured CORT in feathers. We also measured levels of lead in the blood of each bird to explore a possible link between toxicology and stress or symmetrical growth. Finally, we explored additional downstream consequences, such as parasite prevalence in birds with varying degrees of asymmetry. We found that for juvenile birds, feather CORT showed a positive, linear relationship with asymmetry. However, there was no significant relationship between CORT and asymmetry in adult birds. Blood lead levels were significantly correlated with fluctuating asymmetry, and fluctuating asymmetry was a significant predictor of parasite prevalence for all species. Overall, our findings add to the existing body of evidence that early-life stressors can have long-lasting consequences for birds.