Poster Abstracts for 2024 Nachusa Grasslands Science Symposium

"Small mammal trophic niche dynamics in response to prescribed fire and bison grazing in tallgrass prairie" – *Lizzy Small*, MS candidate, Department of Biological Sciences, Northern Illinois University. Advisor: H. Jones

In grasslands, one of the most threatened ecosystems globally, changes in small mammal trophic niche can result in changes in ecosystem function. Small mammals in grasslands hold a position at the center of food webs making them essential to energy flow within the ecosystem. Understanding drivers of variation in small mammal trophic niche can determine what promotes coexistence between species with similar diet requirements and is critical information in the context of global efforts to reverse the biodiversity crisis and restore damaged ecosystems. Reintroduction of historical land management techniques, such as prescribed fire and megaherbivore grazing, are vital to successful grassland ecosystem restoration, however, these disturbances may impact competition and resource availability for small mammal species, resulting in adaptive dietary behaviors. These behaviors are reflected in variations in C and N isotopes. Isotopic values can be used to determine fluctuating trophic niche positions. I will characterize variation in trophic niche for the three most common small mammal species, *Peromyscus maniculatus* (deer mouse), *Peromyscus leucopus* (white-footed mouse), and *Microtus ochrogaster* (prairie vole), coexisting at Nachusa Grasslands. Examining small mammal trophic niche dynamics will reveal any dietary adaptations in response to management techniques. Combining prescribed fire and bison grazing, which increases plant diversity, may increase resource availability for essential small mammal communities and better support grassland ecosystem functioning.

"Grazing legacy effects on soil microbiota alter *Monarda fistulosa* (L.) vegetative volatile phytochemistry"- *Jacob Hopkins, PhD & Andrea Fetters, PhD,* Department of Biological Sciences, The Ohio State University

Plants interact with a wide variety of above- and belowground organisms including bison, insects, and microbes. These interactions allow for the exchange of energy between trophic levels that influence the ecological and evolutionary trajectories of all organisms involved. Despite the close connections between herbivores, microbes, and plants, management practices used to maintain healthy prairie ecosystems rarely take the entire system into account. The goal of this study was to identify how grazing legacy effects on soil microbiota alter plant growth and phytochemical responses to insect herbivory. We assessed how bison grazing effects on soil microbiota influenced *Monarda fistulosa* growth and vegetative volatile phytochemistry, as well as *M. fistulosa* responses to insect herbivory. We hypothesized that microbes from ungrazed sites would promote greater growth and volatile production in the vegetative tissue of host *M. fistulosa* host plants, when subjected to herbivory by *Spodoptera frugiperda* larvae. Microbes from ungrazed sites promoted greater production of anti-microbial, insect-repelling, and bee-attracting volatiles; however, this effect was not influenced by insect herbivory. This demonstrates that management effects (e.g., grazing) on soil microbiota can influence plant host phytochemistry and future interactions with symbiotic insects and microbes.

"Effects of Controlled Burning and Grazing on Macro-Moth Diversity in Illinois Tallgrass Prairie"- *Tyler Anthony McMahon,* MS candidate ***& Anant Deshwal, PhD*,** Assistant Professor, Bradley University

Globally, invertebrates have seen a decline species diversity and abundance. Agriculture and urbanization have fragmented and destroyed Illinois' vast tallgrass prairie that supported most previous arthropod diversity. Insects such as moth (*Lepidoptera)* are critical to food chains, soil formation, pollination, and nutrient cycling. Restoration efforts have been implemented to restore the Illinois Tallgrass Prairie, such as protected areas, urban parks, and wildlife preserves. Controlled burns and grazing of herbivores are implemented to maintain prairies and promote high species diversity. This study shows the effects of grazing from American Bison and controlled burning of prairies on Macro-moth diversity in Nachusa Grasslands. Blacklight traps were placed in various prairie management stules to capture moth specidiments. The captured macro-moths were identified and compared to calculate diversity and abundance between sites. The results show significant differences between grazed and burning areas hosting the most species diversity. Understanding prairie management can create effective protected areas and offset the Arthropod decline.

"Prevalence and distribution of zoonotic pathogens and parasites in raccoons (*Procyon lotor*) of northern Illinois"

Ashley G. McDonald, PhD candidate, ***Jennifer R. Schultze,*** MS candidate, ***Clayton K. Nielsen, PhD, F. Agustin Jimenez, PhD -*** Southern Illinois University – Carbondale

Raccoons (*Procyon lotor*) are mesopredators that are distributed across the entire continental United States. The growing abundance of raccoons has led to heightened concern regarding disease transfer between raccoons, other wildlife, and humans. Zoonoses are attributed to approximately 75% of emerging infectious diseases. Urbanization is a major cause of this increase in human infection with zoonotic disease as land development increases the probability of human interaction with wildlife. Omnivorous animals such as raccoons thrive in urban settings due to the abundance of anthropogenic resources such as food and shelter, placing them in close proximity to humans. In the USA raccoons are known to carry roughly sixteen zoonotic pathogens, but efforts to quantify their prevalence and distribution along a rural-urban gradient are scarce. The goals of this study are to assess the prevalence and distribution of zoonotic pathogens and parasites, namely *Rickettsia rickettsii*, *Borrelia burgdorferi*, *Babesia microti*-like, *Anaplasma phagocytophilum*, *Ehrlichia chaffeensis*, *Trypanosoma cruzi*, and *Baylisascaris procyonis*, in raccoons at 5 study areas in northern Illinois that represent a rural-urban gradient and evaluate the influence of raccoon density on the prevalence of pathogens and parasites. Raccoons will be captured and removed from sites by collaborators during April-June 2022-2024. One hundred raccoons will be necropsied each year (n=300 total) and tissue samples and intestinal tracts will be collected to assess pathogen and parasite prevalence. Out of 128 raccoons examined for parasite presence from 2022-2023, 98% contained parasites and 25% contained *B. procyonis* (raccoon roundworm). The results of this study will allow an assessment of public health risk that raccoons pose to humans and will help inform wildlife management decisions to integrate the health and wellbeing of wildlife and humans.

"What Matters for the Survival of Head-Started Blanding's Turtles?" – *Callie Golba,* PhD candidate ***& Richard King, PhD,*** Department of Biological Sciences, Northern Illinois University.

We conducted a replicated study of head-start survival at 7 sites in Northern Illinois from 2020-2023. A total of 304 turtles (up to 35 turtles per site per year) were released and tracked using radio-telemetry for 1-3 active seasons post-release and for 1-3 overwintering periods. Head-starts varied in size and age at release and sites varied in size, predator management, and Blanding's Turtle population status. Survival was significantly greater for head-started Blanding's Turtles that were larger at release and that were released at sites and in years with raccoon removal. These results will be combined with Population Viability Analysis and estimates of economic costs to develop recommendations of best practices for Blanding's turtle head-starting.

"Understanding the newly discovered cleptoparasitic relationship between the nomad bee *Nomada banksi* and the sunflower mining bee *Andrena asteris"* – ***Josh Klostermann,*** PhD candidate, Department of Biological Science, University of Missouri. Advisor: D. Finke

Over the previous three field seasons I have tracked multiple aggregations of bees and wasps in several wallows which led to the discovery of previously unknown host/parasite interactions between two species. In the summer of 2020, I photographed the regionally rare Nomada banksi parasitizing the nests of Andrena asteris, an association only previously hypothesized in literature. I followed up in the summer of 2021 to gather more evidence of this interaction and witnessed N. banksi enter the nests of A. asteris at all 13 of our wallow sites across Nachusa. While attempting to characterize the behaviors between these two bee species I also observed and recorded footage of the mutillid wasp Pseudomethoca simillima entering the nests of A. asteris and took photographs of an unidentified Miltogrammine fly (Satellite fly) attempting to larviposit on the pollen loads of an A. asteris. Both interactions stated above have not yet been recorded in literature. In 2023, I returned continued my observations of the large A. asteris aggregations found in the rolling thunder wallows to thourogly record the nesting biology of A. asteris and further characterize the behaviors of its newly discovered cleptoparasite *Nomada banksi.*

"Bees of Nachusa Grasslands: Community dynamics, flower preferences, and parasite loads of native bees and domesticated honey bees at Nachusa Grasslands" - ***Robert Jean, PhD***, Senior Entomologist, Environmental Solutions and Innovations, Inc. (ESI), Indianapolis, IN

Pollinators are important for the ecological services they provide and because many species are suspected of declining. Bees are among the most important pollinators as they are species rich, provide important pollination services, and several species have recently been listed under the Endangered Species Act, including the federally endangered rusty patched bumble bee (RPBB, Bombus affinis), which regularly occurs at Nachusa Grasslands. During bee studies at Nachusa, ESI has observed many RPBB, other native bees, and honey bees (not native to Nachusa Grasslands) using flowers on Nachusa. The presence of many honey bees is interesting as The Nature Conservancy does not manage hives but a large apiary with several honey bee hives along Stone Barn Road is present in about the middle of the grasslands. Since RPBB is listed as a federally endangered species and parasite transfer and competition with honey bees are among the leading concerns for RPBB conservation (see species status assessment or species recovery plan), interactions between bumble bees and honey bees are being assessed. To assess these interactions, all non-RPBB bee specimens were vouchered; RPBB were identified, a DNA sample collected, and then released ensuring no RPBB are vouchered. Surveys comprised two sampling events during peak bloom periods at 12 sites distributed at three distances (0.5 km, 1 km, and 2km) across Nachusa Grasslands Nature Preserve from a known apiary. Surveys yielded a total of 2,395 bee specimens (5 families, 23 genera, and 53 species) vouchered or observed visiting native and/or non-native floral resources at various distances from the known apiary. Honey bees were observed and collected in all but one area of Nachusa and at all three distances from the apiary. The highest number of honey bees were observed at 0.5 km this was mainly driven by one of the four samples having 65 honey bee observations. Bumble bees were found across all samples at all distances from the apiary, but species composition and abundance varied with distances. RPBB occurred only at 2.0 km from the apiary but in very low numbers (n=2). Honey bees utilized 12 flower species across the three distances from the apiary on Stone Barn Road. These included several resources used by many bumble bee species such as Monarda fistulosa, Pycnanthemum tenuifolium, Silphium integrifolium, S. perfoliatum, and Veronicastrum virginicum. Honey bees utilized both flower species on which RPBB were observed suggesting direct competition for resources as well as the potential for direct interactions which could promote parasite transfer. Parasite load analyses on bumble bees and honey bees are currently ongoing.

“Arbuscular mycorrhizal fungi support nurse plants in both an established and new prairie restoration” – ***Reb Bryant***, PhD candidate, Department of Ecology and Evolutionary Biology, University of Kansas. Advisors: J.Bever, P.Schultz

Arbuscular mycorrhizal (AM) fungi are important in supporting plant biodiversity in remnant tallgrass prairies. These fungi, which associate with the roots of plants and provide them with nutrients like phosphorus in exchange for carbon, are altered with conventional agriculture. To assess how these different types of AM fungi impact plant communities in prairie restoration, we cultured AM fungi from four remnant prairies and one post-agricultural field at Nachusa Grasslands. We introduced these fungi to both an established and new prairie restoration in 2022 by growing “nurse plants” in uninoculated soil or soil inoculated with AM fungi from remnant prairies or a post-agricultural field. We planted these nurse plants in plots separated by this soil treatment, and in 2023 we observed nurse plant survival and growth as well as their impact on the plant community of the plot. In the established restoration, inoculated plants generally survived at higher rates ($p < 0.001$). In the newer restoration, we saw species-specific effects of treatment on plant height ($p < 0.05$) with two conservative plant species growing significantly larger when grown with remnant-cultured AM fungi than when uninoculated ($p < 0.05$). We did not observe any consistent plant community differences due to treatment in 2023. As plant competition increases in the third year, we may see community differences appear more in following growing seasons. For this reason, we will monitor both nurse plants and plant community changes in the summer of 2024. This work can help us better understand when inoculation with native AM fungi can help us improve the biodiversity of our tallgrass prairie restorations.

“Vegetative Composition of Bison Wallows at Nachusa Grasslands” – ***Susan McIntyre, MS***, Assistant Scientist, Wetland Plant Ecology, Illinois Natural History Survey, Champaign, IL

Plant species associated with bison wallows were surveyed at Nachusa Grasslands in June, July, and September 2023. The purpose of the surveys was to investigate whether wallows created a gap for invasion by weedy and non-native species or allowed an opportunity to introduce conservative species that are difficult to establish in dense prairie vegetation. Land managers are also interested in whether

wallows should be seeded to expedite native revegetation. After remote and field mapping wallows across Nachusa, 15 active and 13 inactive wallows in fields of various planting ages and management histories were chosen for quantitative sampling. Plant species composition and percent cover was investigated within, at the edge of, and outside each wallow. Many “inactive” wallows became “active” during the survey period, and “active” wallows tended to be completely bare. Ruderal and native species were both abundant, but invasive species did not necessarily invade adjacent high-quality prairies. Of more concern was the level of denuding created by bison activity. Seeding may not be an effective strategy for revegetating wallows.

“Silica in American bison (*Bison bison*) diets and its consequences for prairie restoration and management” – *Luke Fannin,* PhD candidate; Ecology Evolution, Environment and Society, Dartmouth College. Advisor: NJ Dominy

Silica is the second-most abundant mineral in the Earth’s crust and a crucial structural component in most plants. Elevated soil silica may improve plant growth responses to high aridity and temperature, perhaps mediated by animal consumers returning silica to the soil via dung. We investigated the impacts of American bison (*Bison bison*) herbivory on seasonal silica cycling in the tall-grass prairies of Nachusa Grasslands. We estimated from dung that an average Nachusa bison consumes ~ 150kg of inorganic silica per year, on average, or almost 4,000 kg over the course of the lifespan. Silica consumption was notable higher in the C3 seeding season than in the C4 seeding season. Most notably, however, was that bison appeared to suffer no immediate reductions in their fecal particulate size (a proxy for chewing performance) to the elevated silica in their diets. We suggest that bison may be excellent reservoirs for bioactive silica at Nachusa, which may improve plant growth responses to elevated summer temperatures and aridity. Yet bison suffer few immediate costs for consuming elevated silica, perhaps suggesting a stable cycling system that could aid in restoration management.