2024 Arboretum Research Symposium Presentation Abstracts

Prescribed fire timing drives differing emergence phenology in tallgrass prairie species. Michelle A. Homann, PhD student, Department of Integrative Biology, UW–Madison

Disturbance by fire plays an important role in temperate grassland restoration by removing buildup of plant material, stimulating productivity, and promoting native species diversity. During tallgrass prairie restoration and maintenance, fire is often prescribed in either spring or fall. Yet, the timing of fire, even when prescribed during the "dormant" season, can alter prairie plant community composition. Spring emergence timing is an understudied aspect and potential driver of plant community responses to fire. To better understand how fire seasonality affects grassland plant community composition, we examined emergence timing, growth rate, and flowering effort for ten common tallgrass prairie plant species throughout the 2023 growing season. We hypothesized that spring prescribed burns would damage emerging plants, leading to delays in growth when compared to fall-burned conspecifics. To test our hypothesis, we collected weekly data on emergence timing and growth rate for species in plots that have been burned annually in April or November since 2016. Additionally, we determined how many individuals flowered during the growing season. We found that some species emerged prior to, and were damaged by, the spring prescribed burn. Percent cover of plants in the spring burn treatment was significantly lower than in fall burn plots for five weeks following the spring burn. Growth rate and flowering effort responded to fire timing in different ways depending on the species. Our findings suggest that plant emergence timing may be a mechanism that drives plant community responses to prescribed burn timing and can inform management decisions surrounding prescribed fire.

Coauthor: Ellen I. Damschen

Invasive shrubs amplify seasonal granivory, creating optimal windows for seed survival following invasive shrub removal. Mark Fuka, PhD student, Department of Integrative Biology, UW–Madison

Invasive shrubs dramatically reduce the biodiversity of native plants, making invaded areas important targets for restoration efforts. While adding seeds may be promising for restoring native plants, the success of seeding efforts may be reduced because invasive shrubs can create dense habitats that lead to increases in seed consumption by small mammals. Importantly, previous studies have only evaluated granivory in a few seasons (summer and autumn). As such, to help guide the timing of seed addition studies to improve restoration success, it is imperative to understand whether seasonal changes in invasive shrubs might generate strong seasonal changes in granivory, creating times of year when seed additions could be maximally effective. We manipulated the presence of the widespread invasive species common buckthorn (*Rhamnus cathartica*) in a deciduous oak-maple forest to track rodent granivory of three native tree species, basswood (*Tilia americana*), black cherry (*Prunus serotina*), and sugar maple (*Acer saccharum*) and the invasive shrub *R. cathartica* over a year. Our results reveal that the effect of invasive shrubs on rodent granivory changed across seasons with invaded habitat experiencing, on average, 25.6% higher seed removal, with the largest difference in winter. These results indicate that sowing seeds in winter may optimize seedling establishment by minimizing granivory. Understanding the mechanisms that

could be affecting seasonal granivory within invaded systems is critical for continual conservation and restoration efforts aimed at promoting forest regeneration.

Coauthor: John Orrock

Roots, litter, deep soil, and microbes – investigating the paradigm shift of soil organic matter persistence. Mia Keady, PhD student, Nelson Institute for Environmental Studies, UW–Madison

The accumulation of soil organic matter (SOM) and soil organic carbon (SOC) have the potential to provide ecosystem services such as offsetting greenhouse gas emissions, increasing water infiltration, and reducing erosion. These ecosystem services are critical as we experience a warmer and more erratic climate. Yet, our understanding of the factors underlying SOM formation continue to evolve. Over the last decade, our understanding has shifted from a plant-centric, litter input perspective to one that includes below-ground, biological components such as bacteria, fungi, and rhizosphere interactions. My research investigates the relative importance of 'above-ground', plant litter inputs and 'below-ground', root and microbial community inputs on soil carbon accumulation over time. I collected 1-meter-deep soil cores from the long-term Detrital Input and Removal Trial (DIRT) at the University of Wisconsin – Arboretum. The DIRT trial was established by Dr. Francis Hole in 1956 with sites located in Noe Woods, Wingra Woods, and Curtis Prairie. Treatments vary between woodland sites (double litter, no litter, control) and grassland sites (bare, burned, no roots, no litter, and control). I will compare soil carbon data by treatment, over time, across the soil profile, and between ecosystems. Future work will assess microbial community composition and microbial carbon use efficiency. My findings provide a long-term assessment of factors contributing to soil organic carbon accumulation and have the potential to inform management to increase or maintain carbon stocks in the face of climate change.

Coauthors: Randall D. Jackson and Thea Whitman

Persuasive messaging and its effects on sustainable behavior. Benjamin Douglas, PhD candidate, Department of Psychology, UW–Madison

As we continue to feel the effects of anthropogenic climate change, the importance of fostering a community which prioritizes its relationship with the environment is paramount. From a social psychological perspective, education engagement is largely dependent on two concepts: "catch" and "hold." "Catch" is what initially sparks a person's curiosity to try something for the first time, whereas "hold" is the retention of that interest. In this two-part study, I explore factors that could contribute to each. In Study 1, I examine the Arboretum's weekly educational nature walks and assess "hold" via feedback surveys about those programs. In Study 2, I use that feedback to craft social norms messages aimed at increasing participation in the arboretum's education programs by "catching" individuals who have not yet taken one of the education courses. In this later study, I placed signs with different social norms messages at the entrance to the Arboretum's visitor center. Each sign featured a QR code which linked to the Arboretum's events page. I compared the number of people who visited the webpage via the provided link. While I did not find any one particular social norms message was more effective at increasing engagement, I will discuss opportunities to increase engagement with environmental education programs and sustainable behavior.

Bumble bee responses to prescribed fire in restored prairie are life cycle stage dependent. Jade Kochanski, PhD candidate, Department of Integrative Biology, UW–Madison

Habitat restoration may mitigate declines in bumble bee populations, but restored habitats require regular management to maintain their quality. For example, tallgrass prairie restoration requires intentional, controlled burning (i.e., prescribed fire) to maintain plant abundance and diversity. Although restorations often target plant communities, they may affect bumble bees as well through improved food (i.e., flowers) and nesting resources for bees. However, management activities like prescribed fire may also influence bees through mortality. We surveyed bumble bee worker abundance and nest density in 2021 - 2023 across Southern Wisconsin at tallgrass prairie restorations that varied in fire history. Preliminary results suggest that different stages of the bumble bee colony cycle (nest establishment vs. foraging workers), are influenced by fire management differently. We generally found that in years immediately following fire (e.g., 0-2 yrs), flower abundance was greater than at sites that had not been recently burned (e.g., > 4 yrs). We observed greater bumble bee worker abundance at sites with higher flower abundance. We found a contrasting pattern using nest density as an indicator of bumble bee population size. Sites that had longer periods without fire ($\geq$ 4 yrs) accumulated more vegetative litter and had less bare ground. These sites tended to have greater nest abundance than recently burned sites ($\leq$ 2 yrs). This study highlights that for bumble bee conservation, in addition to the availability of flowers, we should consider management for nesting conditions that are amenable for colony establishment and success. Practically speaking, this suggests that varying "time since last fire" at sites could be beneficial due to variable effects of fire across the life stages of bees.

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