Arboretum Research Symposium

Thursday, February 5, 10 a.m.–12:30 p.m.

ORAL PRESENTATIONS

Arboretum research program update

Dr. Jared Beck, Research Ecologist, UW–Madison Arboretum

Jared started as the Arboretum's Research Ecologist in June 2025. In this talk, Jared will introduce himself and share updates from the Arboretum's research program. Specifically, he will highlight research priorities for the Arboretum over the next three to five years. Jared will also share information about a handful of new research projects led by Arboretum staff. These include newly established monitoring plots that will track restoration progress in the Lost City forest and a new seed addition experiment designed to understand factors that influence the establishment and survival of herbaceous vegetation in savanna restorations.

Supercool winter physiology: At what temperature do trees chill?

Francisco Campos-Arguedas, PhD candidate, Department of Plant and Agroecosystem Sciences, UW–Madison

Dormancy is a critical survival strategy for trees that live in cold temperate and boreal regions. During fall and winter, buds enter a resting phase that protects them from harsh conditions. At the same time, they develop cold hardiness, which helps them tolerate freezing temperatures. However, we still do not fully understand which temperatures are most effective for completing dormancy. Recent studies suggest that cold hardiness may influence how quickly buds "wake up" in spring, which could explain why current chilling models often fail to predict tree behavior in different climates.

This study aimed to learn how temperature affects both dormancy and cold hardiness in seven tree species: balsam fir, red maple, sugar maple, forsythia, American larch, Norway spruce, and flowering cherry. Twigs from these species were placed in controlled temperature chambers set at constant temperatures (-4°C, 4°C, 8°C, 16°C) or fluctuating ranges (-4°C to 8°C and 4°C to 16°C). These treatments were compared with natural outdoor conditions by collecting twigs from the field at matching intervals.

After 3, 6, 9, and 12 weeks of chilling—using samples collected during both fall and winter—the twigs were moved into a warm environment (22°C) to force budbreak. We measured how cold hardy the buds were during chilling and forcing, as well as how long they took to begin growing. By combining controlled and field results, this project aimed to identify which temperatures promote dormancy completion and improve models that predict how trees respond to winter conditions.

Coauthors: Erica Kirchhof, Michael North, Al Kovaleski

The role of environmental heterogeneity in maintaining leaf chemical diversity in prairie populations of wild bergamot

Linden Taylor, PhD candidate, Department of Botany, UW–Madison

Plants produce compounds that mediate interactions with other organisms, such as attracting pollinators, defending against herbivores and pathogens, and influencing the growth of nearby plants. The composition and abundance of these compounds vary both among and within species. Wild bergamot (*Monarda fistulosa*; Lamiaceae), a perennial herb native to North America, exhibits exceptional within-species chemical diversity with six distinct chemical phenotypes, called chemotypes, each associated with a dominant compound in plant extracts. Among the six chemotypes, the dominant compounds differ structurally and are known to have differential defense effects. In addition, differences in the energetic cost of producing defenses among the chemotypes may result in differential growth in varying abiotic and biotic environmental contexts, making *M. fistulosa* a useful system to study both growth-defense trade-offs and maintenance of intraspecific chemical diversity. Using surveys of Wisconsin prairie populations, this study tests whether *M. fistulosa* populations and chemotypes show variability in fitness, growth, chemical production, and response to herbivory and fungal pathogens along soil moisture and nutrient availability gradients. This study at the UW–Madison Arboretum provides insight on whether heterogeneity in soil resources has a role in the distribution and maintenance of chemical diversity in native prairie plants. Understanding how environmental variation drives plant chemical diversity can contribute to ecological restoration efforts and improve our understanding of species interactions in changing environments.

Coauthors: Ken Keefover-Ring, Madeleine Afonso

Seven decades of change at Faville Prairie

Sam Anderson, PhD candidate, Department of Botany, UW–Madison

Around the globe, human impacts and environmental factors influence the structure and composition of plant communities, having important consequences for biodiversity, habitat, and ecosystem services. To adaptively manage our natural communities, it is important that ecologists understand the pace and trajectory of change over time. However, the long-term, quantitative datasets necessary for such analyses are relatively rare. Fortunately, generations of researchers at the UW-Arboretum have gathered such data for the Faville Prairie, a high-quality wet prairie just west of the Crawfish River in Wisconsin. Having experienced historic and on-going disturbances like flooding, burning, and the introduction of invasive species, the Faville Prairie provides a rare opportunity to look at long-term changes in one of Wisconsin's more imperiled ecosystems.

In compiling the Faville dataset, we have found that the most substantial survey-to-survey changes in composition occurred in the late 1900s, while microsites with better drainage tended to have higher species richness through time. Since the historic 2008 flood, many plots demonstrate increased species richness, though we see increasing evidence of woody species encroachment, particularly in wetter microsites. Moving forward, the standardized surveying of Faville coupled with better records of prescribed fire and woody species removal will help us better understand the demographic impacts of these integral land management tools both in Faville and grasslands writ large.

Coauthors: Jared Beck, Paul Zedler

Vertical distribution dynamics of grassland pyrogenic carbon one year post-fire

Mengmeng Luo, PhD candidate, Department of Soil and Environmental Sciences, UW–Madison.

Pyrogenic carbon (PyC), formed during incomplete combustion of organic matter, is a crucial but under-characterized component of soil carbon (C) pools in fire-adapted ecosystems. While PyC is known for its chemical stability and resistance to microbial degradation, its vertical movement and long-term dynamics in soil remain insufficiently understood, particularly under frequent, low-intensity fire regimes such as those found in grasslands. This study investigates the vertical distribution and microbial availability of PyC within the top 15 cm of soil over one year following spring 2025 prescribed fires on the Curtis Prairie at the UW Arboretum. We combine field measurements with isotopic tracing using 13C-labeled PyC to quantify post-fire PyC dynamics over time and depths. Soil samples are being collected at seven time points before and after fire and analyzed through three complementary trials: 1) a field sampling trial, operationally quantifying PyC stocks and PyC:TC ratio; 2) a field isotope trial, tracing 13C-labeled PyC to evaluate vertical movement under natural conditions and tracking $13CO_2$ release to assess microbial degradation; 3) a parallel laboratory isotope trial in a controlled environment with rainfall simulation, tracing 13C-labeled PyC movement in contained soil cores and assessing microbial degradation of 13C-labeled PyC. We hypothesize that shallow soils will show immediate PyC enrichment and total C decrease post-fire, followed by gradual downward PyC translocation and gradual increases in total C during the growing season. Microbial degradation of PyC is expected to be minimal ($<5\%$), regardless of soil-level fire intensity. This research will advance the understanding of PyC persistence and translocation in managed grasslands, informing C sequestration strategies and improving depth-resolved PyC modeling in fire-prone ecosystems.

Coauthors: Emily Kaufman, Olivia Oswald, Timothy Berry, Michael Hansen, Keith Bourne, Kara Yedinak and Thea Whitman

Does selective deer browsing promote soil homogenization in forest ecosystems of Wisconsin?

Aundrea Taylor, MS student, Department of Forest and Wildlife Ecology, UW-Madison

White-tailed deer (*Odocoileus virginianus*) are considered ecosystem engineers due to their prolific reproduction and selective foraging. High deer densities across Wisconsin are reshaping forest ecosystems by reducing vegetation diversity and structural heterogeneity via preferential browsing. While it is well supported that selective deer herbivory homogenizes aboveground vegetation, less is understood about these influences on soil properties. This study observes how deer exclusion affects forest floor vegetation and corresponding soil conditions across a variety of soil types in southern, central, and northern Wisconsin. Data collection includes vegetation diversity and total biomass (< 1m), as well as soil physiochemical properties. Findings from this project aim to make statewide inferences on deer primary and secondary effects from 22 deer exclosures and corresponding control plots. The results of these initial observations will advance our understanding of deer–vegetation–soil interactions across a diversity of soil types.

Coauthors: Nick Balster, Noel Manirakiza

POSTER PRESENTATIONS

Investigating the reproductive cycle and distribution of new non-native Asian earthworms in the Midwestern U.S.

Andrea Rodriguez Quiros, Hilldale Fellow, Conservation Biology and Environmental Studies, Department of Botany, UW–Madison

More than mushrooms: educational and community outcomes of a student-organized mycoblitz

George Meindl, Associate Teaching Professor, and Kiki Liss-'s-Gravemade, undergraduate student, Forest and Wildlife Ecology, UW-Madison

Woody invasive species monitoring in Noe Woods

Dr. Cooper Rosin, Lecturer, Nelson Institute, UW–Madison, and capstone students