2018 Science Day Abstracts

ORAL PRESENTATIONS

Is it spring yet? Tree and shrub response to an extreme warm winter event

Laura Ladwig, postdoc, UW–Madison Department of Integrative Biology

Climate is changing in a variety of ways, and we do not fully understand the implications of these changes on natural systems. In particular, extreme climate events can have significant negative impacts on society and natural systems. Yet, because these climate events are inherently rare, research to understand the impacts of extreme events is also rare. To better understand the impacts of extreme events, we assessed bud break of many woody species following an extreme warm event during winter (February 17–22, 2017). The climate event was the warmest and longest winter climate event in the 40-year climate record. Longenecker Horticultural Gardens in the UW–Madison Arboretum provided the ideal location for this study, as it contains mature individuals of many different species of trees and shrubs. In total, 100 species were examined to see if they had started to open their buds in response to the warm temperatures. Remarkably, nearly half of the species showed an observable response to the event, with buds starting to swell and open in February. In general, shrubs were more responsive than trees, and whether or not a species broke bud related to the climate in its native range. Given the early timing, it was surprising that so many species responded to this extreme warm event. Average winter temperatures returned after the event, and plants with newly exposed tissues could presumably be damaged more by freezing temperatures than plants that remained dormant. Across the northern hemisphere, temperatures are rising faster in winter than during other seasons and the frequency of extreme events is projected to increase. Therefore, continuing to monitor the ecological impacts of winter climate change, including extreme climate events, is important to understanding the ecological impacts of climate change.

Coauthors: Jennifer Chandler, research assistant, Peter Guiden, PhD student, and Jonathan Henn, PhD student, UW–Madison Department of Integrative Biology

The Phenology of Snow

Kim Thompson, PhD student, UW–Madison Department of Forest and Wildlife Ecology

A seasonal refuge exists underneath the snow that provides a haven for a diversity of species to survive extreme winter temperatures. Much attention has been given to changes in the timing of snow cover extent and duration; however, these broad characteristics do not capture the more detailed dynamics of below-the-snow environments. Understanding the phenology of this refuge—the timing of its establishment, maintenance, and disintegration—is important for characterizing the current conditions to which species are exposed and for predicting future exposure.

Coauthors: Jon Pauli, associate professor, UW–Madison Department of Forest and Wildlife Ecology; Benjamin Zuckerberg, associate professor, UW–Madison Department of Forest and Wildlife Ecology; Warren P. Porter, professor, UW–Madison Department of Integrative Biology

Citizen science for invasive species monitoring: Madison's first citywide jumping worm survey

Carly Ziter, PhD student, UW–Madison Department of Integrative Biology

Jumping worms (*Amynthas* and *Metaphire* spp.) are earthworms native to East Asia, but invasive to Wisconsin. This pest was first found in Madison in the fall of 2013, and researchers and managers are concerned about potential negative effects on soil and plant growth. While research on jumping worm ecology has increased in recent years, the majority of this work has focused on natural or semi-natural areas (e.g. forests, prairies), rather than urban homes and gardens. We conducted Madison's first citywide jumping worm survey—a citizen science initiative jointly sponsored by the UW–Madison Arboretum, the Department of Integrative Biology, and the North Temperate Lakes Long Term Ecological Research site. At the interface of science, education, and outreach, the survey connected academics and practitioners across disciplines and engaged dozens of community members. The overarching goal of the survey was to get a first assessment of the distribution and abundance of jumping worms in the Madison metro area. Specifically, we asked: 1) What is the current distribution of jumping worms in the Madison metropolitan area? (i.e., where are the worms?), and 2) How do the presence and abundance of Asian jumping worms vary with land-cover categories? (i.e., what habitats do they prefer or avoid?). A group of 40 scientists and volunteers sampled 123 sites on 85 Madison properties, including residential yards and gardens, open space (i.e. parks), forests, and grasslands (i.e. restored prairies). Jumping worms were present across Madison, with both presence and abundance most pronounced in the near-west area of the city. Jumping worms were present across all sampled habitat types with the exception of grassland, but were most frequently found in residential gardens, and reached the highest abundance in forested areas. Three related species of jumping worms were identified: *Amynthas agrestis, Amynthas tokioensis,* and *Metaphire hilgendorfi*. Survey results provide an important baseline for future research and management of the jumping worm in Madison and other urban environments while demonstrating the role of citizen science in invasive species monitoring.

Coauthors: Brad Herrick, ecologist, UW–Madison Arboretum; Marie Johnston, Honorary Fellow, UW–Madison Department of Soil Science, and Monica Turner, Professor, UW–Madison Department of Integrative Biology

Lessons in Integrated Tick Management

Jordan Mandli, MPH student, UW–Madison Department of Public Health, and Scott Larson, postdoc, Midwest Center of Excellence for Vector-borne Disease

With the increase in tick abundance and the expansion of ticks into new territories, tick-borne disease continues to have a negative impact on the health of human populations. Landscape manipulation and host-targeted acaricides offer a dynamic strategy to interrupt the sylvatic cycle of *Borrelia burgdorferi* (bacteria that causes Lyme disease) by reducing the abundance of immature deer ticks (*Ixodes scapularis*) feeding on white footed mice (*Peromyscus leucopus*) or questing on vegetation. In the UW–Madison Arboretum, treatment plots were established between 2014 and 2018 using a full factorial design. Landscape manipulation was completed through the removal of dense invasive vegetation while host-targeted acaricides were deployed evenly across plots in PVC tubes containing permethrin treated cotton. After four years of study, reductions in the abundance of questing ticks and host burdens were observed among treated plots. These results support the value of employing integrated management strategies on a homeowner scale capable of reducing tick density and potential Lyme disease.

Coauthor: Susan Paskewitz, professor, UW–Madison Department of Entomology, and Co-Director, Midwest Center of Excellence for Vector-borne Disease

Keynote address – The art and science of using tree rings to understand Wisconsin history

Jed Meunier, research scientist, Division of Forestry, Wisconsin Department of Natural Resources

Much of what we know about historical landscapes and the processes—such as fire—that shape them are derived from European settlement accounts, which are often general in nature and limited temporally and spatially. We understand that, while diminished in extent, fire still has a natural role in prairie and oak savanna landscapes today. However, we forget that much of our savanna and prairie was pine savanna and barrens, and fire was also central to maintaining these systems. A paucity of information on historical forest structure and fire facilitates such generalized and limited understanding of historical systems. Tree rings give us detailed, site-specific history that can sharpen our understanding of historical systems and help us hone our use of fire as a conservation and management tool. Tree rings are also a tangible education tool that can demystify seemingly complex ecological problems and provide new ways of understanding issues ranging from individual tree processes, landscape scale patterns, to global phenomena. This presentation will cover the how and why of what we know regarding historical fire in Wisconsin as well as challenge basic assumptions and provide guidance for managing more resilient systems.

POSTERS

The role of burn seasonality, fire temperature, and residence time in controlling woody invasive plants

Nicolas Bargren, undergraduate student, Edgewood College Department of Biology

The control of invasive woody species presents one of the greatest challenges for restoration and management of fire-dependent ecosystems. Common buckthorn (*Rhamnus cathartica*) and honeysuckle (*Lonicera* spp.) are exotic invasive species that frequently degrade forest understories, edges, and grasslands in the Upper Midwest. Black (*Quercus velutina*) and red oak (*Q. rubra*) are natives that can be invasive in prairie and barrens restoration projects. While prescribed fire is often used to manage these species, its use can be complicated given the inability to inflict damage to larger stems under low-intensity fires and the species' tendency to vigorously resprout after being top-killed by fire. While the vast majority of prescribed burning occurs in the early spring (March–April), there is evidence that burning during other times of the year can offer more effective shrub suppression. In this project, we ask how seasonality, fire temperature, and fire residence time interact to influence stem damage and resprouting of woody shrub and tree species that are often targeted by prescribed fire treatments in Wisconsin. The "tree roasting" system employed in this study allows us to reliably control fire intensity and residence times at any time of the year using a propane torch on individual plants. We apply two heat treatments and residence times to several focal species: red/black oak (at the Necedah Wildlife Refuge), exotic honeysuckles (on the UW–Platteville campus), and common buckthorn (at the UW–Madison Arboretum). The stems were burned for either short (15-second) or long (30-second) durations and hot (>246° C) or moderate (125–175° C) temperatures. These fire residence times and temperatures were derived from temperature profiles of prescribed fires conducted in the spring of 2016 in southern Wisconsin. We implemented the different treatments on individual plants during spring, early growing season, late growing season, and fall. We selected 20 individual plants per treatment per season plus 20 control plants (n=340). Top-kill and resprouting will be determined for each stem during the summer of 2018.

Coauthors: Tim Kuhman, associate professor, Edgewood College Department of Biology; Jed Meunier, Research Scientist, Division of Forestry, Wisconsin DNR; Nathan Holoubek, research scientist, Division of Fish, Wildlife, and Parks, Wisconsin DNR; Yari Johnson, assistant professor and program coordinator of Reclamation, Environment, and Conservation, UW–Platteville School of Agriculture; and Brad Strobel, regional biologist, Necedah Wildlife Refuge, US Fish and Wildlife Service

Uncovering the secret life of the *Amynthas* earthworm cocoon

Marie Johnston, honorary fellow, UW–Madison Department of Soil Science

Earthworm species *Amynthas agrestis* and *Amynthas tokioensis* present a new challenge for the Upper Midwest. No effective controls are known, but compost operations that maintain 55° C may kill cocoons in addition to soil pathogens. We investigated: (1) cocoon abundance when reared in the laboratory, and (2) cocoon

temperature tolerance. *Amynthas* earthworms housed in the laboratory produced more than 3,000 cocoons, and heat treatments at 40° C or higher, resulted in cocoon inactivation (cold treatments are in progress). These results support the use of large-scale licensed compost operations as a management practice to help reduce the spread of *Amynthas* cocoons.

Coauthor: Brad Herrick, ecologist, UW–Madison Arboretum

Effects of invasive jumping earthworms on sugar maple hydraulics at the UW–Madison Arboretum

Kimberly O'Keefe, postdoc, UW–Madison Department of Botany

Invasive earthworms can have significant consequences for ecosystem structure and function as they alter soil texture, soil nutrient cycling, soil microbial communities, and the diversity and cover of understory vegetation. However, whether invasive earthworms impact overstory tree functioning, either directly or indirectly through other ecological changes, is unknown. Because earthworms degrade soil organic matter and consequently reduce the capacity of the soil to retain water, invasive earthworms may indirectly induce water stress in trees and reduce their ability to move water. Here, we assessed the impacts of Asian jumping earthworms (*Amynthas agrestis* and *A. tokiensis*), on sugar maple (*Acer saccharum*) water-use. Specifically, we asked, do *Amynthas* earthworms induce water stress and reduce the ability of sugar maples to move water? We addressed this question by sampling sugar maple trees at the UW–Madison Arboretum during the 2017 growing season. We measured the rate of water movement through stems (stem hydraulic conductivity), stem anatomy, and leaf water stress on sugar maple trees growing in areas with and without the *Amynthas* earthworms present. We found that the presence of *Amynthas* reduced the rate of water movement through sugar maple stems. Furthermore, lower water movement was associated with smaller and fewer water-conducting vessels in the stem tissue, but not with leaf water stress. These results suggest that *Amynthas* earthworms can induce long-lasting changes in the structure of sugar maple tissue, altering their ability to move water and having unknown consequences for sugar maple-dominated forests in a changing climate.

Coauthor: Kate McCulloh, assistant professor, UW–Madison Department of Botany

Impact of Asian jumping worms (*Amynthas* spp.) on soil aggregate size and stability

Marie Johnston, honorary fellow, UW–Madison Department of Soil Science

Three species of invasive Asian jumping worms have been found in the Midwest, including Wisconsin. As *Amynthas tokioensis*, *Amynthas agrestis*, and *Metaphire hilgendorfi* invade forests and urban landscapes in the Madison area, they change the aggregate structure of the ground surface with visible granularity. However, little is

known about the rate at which these different species affect soil aggregate size and water stability over time and in relation to each other. We hypothesized that Asian earthworms would increase the proportion of soil in aggregates of 1–2 mm diameter and that larger individuals would create larger aggregates at a faster rate. We raised individual earthworms in a laboratory incubation study to evaluate the change in soil aggregation from a uniform, pre-sieved soil (>1 mm) to earthworm casts. Soil was harvested and sieved at three intervals (20, 40, and 60 days) of incubation. After 60 days, soil water aggregate stability increased by 1.75-fold (72% of 1–2 mm aggregates were water stable after exposure to earthworms vs. 45% in the control). Thus, immature Asian jumping worms can impact surface aggregation within one growing season, and the changes in soil structure occur in proportion to earthworm size.

Coauthors: Karly Remondino BS, UW–Madison, and Nick Balster, associate professor, UW–Madison Department of Soil Science

The presence and disappearance of *Cypripedium candidum* in the southeast glacial plains of Wisconsin

Andrea Weissgerber, MS student, UW–Madison Department of Landscape Architecture

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* is most commonly found in glaciated regions in calcareous fens and wet prairies. *C. candidum* was once a prevalent species in southern Wisconsin. However, populations have experienced rapid decline due to habitat loss and the orchid is now a state threatened species. The current distribution of *C. candidum* is anecdotal; last known surveys in Wisconsin occurred in the early 1980s, and its population response to both community and ecosystem level changes is unknown. This species is believed threatened due to habitat loss contributed by land-use change, alteration of hydrologic regimes, and woody and invasive species encroachment. Increased herbivory, possibly a result of fragmentation, is also thought to be a potential factor in its decline. I will survey 32 sites in Dane, Jefferson, Dodge, Waukesha, and Walworth counties in order to determine current population distribution. Four of the survey sites will be studied to explore potential relationships with significant biotic and abiotic factors thought to be associated with *C. candidum* presence and disappearance. We 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*.

Coauthor: John Harrington, professor, UW–Madison Department of Landscape Architecture