2016 Science Day Abstracts

ORAL PRESENTATIONS

Invasive shrub removal changes spatial distribution of small mammal foraging behavior

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Spatial patterns of animal foraging have important consequences for understanding the dynamics of animal movement, the strength of plant-animal interactions, and the ecology of disease. Although invasive plants, such as buckthorn (*Rhamnus cathartica*) can modify the abundance and activity level of small mammals by providing a low-risk environment for them to forage, it is unknown whether this produces significant changes in space use by small mammals. Here, we test the influence of invasive *R. cathartica* on spatial patterns of small mammal foraging by investigating the one-dimensional (distance) and two-dimensional (pooled intensity and nearest-neighbor functions) spatial distribution of small mammal seed predation on *Quercus rubra*. In the fall of 2015, 200 metal-tagged seeds were placed in the center of 16 experimental plots (25 x 25 m) at the UW–Madison Arboretum that were heavily invaded by *R. cathartica*; *Rhamnus cathartica* was removed from half of the plots. Tags were recovered the following spring using a metal detector. In plots with buckthorn removed, small mammal foraging activity occurred closer to the seed source ($t = 4.6$, $p = 0.04$) and was significantly more clustered. Together, these results show that small mammal space use is distributed more uniformly under *R. cathartica*, providing the first experimental evidence that invasive plants change small mammal space use. By shifting the spatial distribution of small mammal foraging, invasive plants may indirectly increase the likelihood that native seeds are discovered and consumed, suggesting a possible mechanism by which invasive plants suppress competitors.

Distribution of the invasive *Amynthas* earthworm and potential effects on vegetation in hardwood forests of the UW–Madison Arboretum

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Forests in the northern temperate region of the United States lack native earthworms, but many European and Asian earthworms are now prevalent in much of North America. Non-native earthworms significantly increase the rate of leaf litter decay and influence nutrient cycling by mixing the organic litter layer with the mineral soil, and have been shown to decrease plant species richness. In 2013 a new Asian earthworm genus, *Amynthas*, was found in the UW–Madison Arboretum in Wisconsin. In order to understand where *Amynthas* and other European earthworm species are located in the Arboretum and how understory vegetation may be changing, earthworm and vegetation surveys were performed, with a distinct region of *Amynthas* distribution found in Wingra and Gallistel Woods. Preliminary data suggest that the new invasion of *Amynthas* is not having a significant effect on the understory plant community, but that different associations of European earthworm groupings may be correlated with vegetation changes and *Amynthas* distribution.

Effects of Asian jumping worm invasion on temperate forest and prairie soils in the Midwestern U.S.

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Non-native earthworm invasion is a global phenomenon that strongly affects ecosystem structure and function. Effects of invasive European earthworms in North America have been well documented, but ecological consequences of Asian earthworm invasion are poorly understood. In particular, Asian jumping worms (*Amynthas* spp.) are increasingly reported in North America and expanding northward. Most research on exotic earthworms has focused on forests; *Amynthas* are native to grasslands and may thrive in prairies with unknown effects. We conducted a mesocosm experiment and complementary field study from July to October 2014 in southern Wisconsin, U.S., to investigate effects of an incipient invasion of *Amynthas agrestis* on forest and prairie litter and soils. In both studies, *A. agrestis* caused substantial declines in litter and increased nutrients (including total carbon, total nitrogen, available phosphorus and exchangeable potassium) in the upper 0–5 cm of soils. Soil inorganic nitrogen (ammonium and nitrate N) and dissolved organic carbon concentrations increased across soil depths to 25 cm. Effects were observed in both forest and prairie soils, with stronger effects in forests. Effects were most pronounced late in the growing season when *A. agrestis* density and biomass peaked. Depletion of the litter layer and rapid mineralization of nutrients by *A. agrestis* may make ecosystems more susceptible to nutrient losses, and may cascade to understory herbs and other soil biota and affect important processes such as plant establishment and growth.

The effects of alum on bacterial communities

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Two years ago, the City of Madison started a pilot program to reduce phosphorus amounts in the Marion Dunn storm water pond in the UW–Madison Arboretum. The goal of the pilot program is to put aluminum sulfate, commonly known as alum, into the pond after measurable rain events. The alum will bind to solids and phosphorus suspended in the water and eventually settle on the pond's bottom in a flocculate. We are interested to see how the addition of alum will affect the bacterial communities within Marion Dunn. To study the possible change Manitou pond was chosen as a control pond, and both ponds were monitored over the course of the past two summers. The first summer acted more as baseline data, as it appeared the alum was not remaining in the pond. In order to measure the bacteria populations, we used a method called Automated Ribosomal Intergenic Spacer Analysis (ARISA). This allowed us to get a broad overview of the bacterial populations in a cost-effective and timely manner. After two summers of data collection, the alum does not appear to be affecting the variability or diversity of the bacterial community of Marion Dunn. However, the data is under further analysis, and further research would be highly beneficial.

Keynote address: Flooding, recovery, and the future of the Faville Prairie in an era of climate change

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The Faville Prairie is a 60-acre Arboretum outlying property located in Jefferson County that was acquired in the 1940s through the efforts of Aldo Leopold and his students. The site is the largest of two remnants of the historically extensive Crawfish Prairie, so named because it lay to the west of the Crawfish River. When acquired, the site supported nearly treeless wet and wet mesic prairie grading to marsh along the river. The western portion continues to support high quality prairie vegetation, but the eastern edge is heavily invaded by reed canary grass, shrubby willows, aspen, and other trees. The site is now managed cooperatively with the Madison Audubon Society, which is sponsoring a program of land acquisition and restoration on adjacent lands. UW–Madison Botany Dept. graduate Max Partch established a set of 180 permanent plots in conjunction with his 1948 thesis, and returned in 1978–79 to resample the vegetation. In 2008 the largest flooding event recorded for the Crawfish River occurred in mid-June, making it unprecedented in its timing as well as its extent. Herrick and Zedler, with the help of a small team, resampled the western portion in 2010–12 to assess the effect of the flooding, and in 2015 the eastern (heavily invaded) portion of the site was sampled. The immediate response of the prairie to flooding was to kill most (but not all) of the above-ground vegetation. Recovery, in terms of cover, was rapid. By 2010 the vegetation was substantially recovered as measured by visual assessment of cover. Comparison with the 1978 data showed that the composition had shifted significantly, with some species substantially reduced in abundance, a few seemingly to the point of local extinction. Other species increased, with a not surprising tendency for these to be species with higher rankings for tolerance of wetland conditions. The heavily invaded area adjacent to the river has changed dramatically from its 1978 condition, and seems to be undergoing succession to support a bottomland forest.

POSTERS

Stormwater monitoring in Curtis Prairie

Elizabeth Buschert
UW–Madison Arboretum

Stormwater runoff from the urban environment is a major issue for land managers. At the UW–Madison Arboretum, stormwater runoff is blamed for an increase in erosion, invasive species, and habitat degradation. Ongoing monitoring efforts at the Arboretum evaluate the effectiveness of various management and control measures to reduce flooding and improve the runoff water quality. In 2015, automated ISCO water samplers were put in place to monitor stormwater from a storm sewer that empties into Curtis Pond, an old stormwater pond overdue for maintenance, the pond outfall, and outlet of Curtis Prairie. Results showed that while the pond and the prairie are effective at reducing concentrations of suspended solids in stormwater flows, the impact on nutrient concentrations is less clear. Future monitoring goals include measuring nutrient loading (as opposed to just concentrations) through the Curtis system and examining individual storms events in greater detail.

Using a watershed approach to improve surface water quality entering Curtis Pond and Prairie

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Excess nutrients and poor-quality water from urban runoff often lead to a prevalence of invasive species and degraded ecosystems downstream. A watershed approach could address the upstream sources of problems in order to alleviate the symptoms downstream. In our visits to local watersheds, we saw how erosion of nutrient-rich soil causes pollution, discharges nutrients, allows invasive species to spread, and stimulates algal blooms, all affecting the condition of downstream ecosystems. Collectively, we identified opportunities to resolve some negative effects of urban runoff on Curtis and Coyote Ponds and Curtis Prairie wetlands. Fifteen case studies, drawn from scientific publications, support our findings. Our top-priority field experiment would test an approach to minimize soil erosion on an upstream Grady Tract trail. Wetland restoration should not start downstream, but rather upstream, for optimal ecosystem health.

Identifying seasonal adaptations and potential alternative hosts of the invasive pest spotted wing drosophila (SWD), *Drosophila suzukii*

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When invasive pests establish in a novel environment these populations can quickly disperse and can generate a cascade of negative effects to native ecosystems, agriculture, and human health. Spotted wing drosophila (SWD), *Drosophila suzukii*, is an invasive vinegar fly that was first detected in the U.S. in 2008 and was confirmed in Wisconsin in 2010. SWD has been documented in both cultivated crops, primarily soft skinned fruit crops, and many wild hosts. However, we hypothesize it utilizes alternative, currently unidentified, wild hosts in early spring or late fall to overwinter. Mushrooms are often present for an extended period beyond most fruit crops; in addition, recent research found that more SWD were trapped in wooded areas adjacent to farms than in the raspberry crop, suggesting SWD utilizes wild hosts. We conducted a mushroom survey in the UW–Arboretum, as part of our lab's broader research to identify seasonal adaptations of SWD by monitoring SWD phenology in Wisconsin, identifying seasonal morphs, assessing reproductive output, and identifying potential alternative hosts. Five locations within the Arboretum were selected and fruiting mushrooms were recorded as they were encountered and visually assessed for the presence of drosophila. SWD was seen and collected in the Arboretum on September 24, 2015. The small numbers of SWD caught does not provide a confirmation that SWD can utilize mushrooms as a host. Identifying where and how SWD overwinters is crucial to providing effective management for this invasive pest.

Selective grazing of reed canary grass (*Phalaris arundinacea)* in Curtis Prairie

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This study investigated the hypothesis that eastern cottontail rabbits (*Sylvilagus floridanus*) preferentially graze reed canary grass (*Phalaris arundinacea*) in Curtis Prairie. To determine whether the rabbits selectively consumed reed canary grass (RCG), GPS and GIS mapping was used to compare heavily-grazed patches of vegetation to adjacent patches of RCG and other species, especially Canada bluejoint (*Calamagrostis Canadensis*). The hypothesized relationship was investigated through two tests using either a T-test or an analysis of variance to determine if the relationship between heavily-grazed patches and RCG-dominant patches returned a statistically significant P value of less than 0.05. The ratio of new shoots to grazed stems was also analyzed in order to help test for a significant relationship. Statistical analysis found that the sampled patches exhibited a similar ratio of regrowth. This suggests that grazing can be used to control grass species.

If selective grazing of RCG occurs, it could be slowing the spread of this invasive grass. Although statistical analysis of geographic data failed to demonstrate selective grazing of RCG, future tests should be conducted to further explore this phenomenon.

The effects of nitrogen and salt on *Carex stricta*

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Nutrients and road salt carried in agricultural and urban runoff have impacts in downstream sedge meadows. Nitrogen, a nutrient that typically limits plant growth due to lack of availability, increases in downstream sedge meadows. Salt, applied to icy roads in winter, runs into wetland communities in spring, where it can inhibit plant growth. Learning how these two contaminants commonly interact and affect *Carex stricta*, the dominant plant in tussock sedge meadows, is important to understanding overall human impacts on native wetlands. We hypothesized that salt would decrease growth, but that nitrogen addition would mitigate the effect. Our test of salt + nitrogen on the growth of *Carex stricta* in mesocosms demonstrated a wide range of variability among individual containers receiving the same treatment. This suggests that maximum leaf length, leaf area index, and biomass were unable to detect effects—or that the coping mechanism to varying combinations of nitrogen and salt is not identical among *Carex stricta* mesocosms. Aboveground end-of-season biomass measurements showed a range of 4.7 to 130.2g dry tissue harvested per plot (0.17m^m2) for containers receiving the same treatment. *Carex stricta* may be adaptable to a wider variety of environmental conditions than previously realized. We recommend more stressful treatments, earlier in spring, to investigate how *Carex stricta* responds to this contaminant during pulsed inflows after the spring thaw.

The effect of an organic fertilizer on the survivorship of jumping worms (*Amynthas* sp.) at the UW–Madison Arboretum

Justin Wiese
UW–Madison Arboretum

Exotic invasive earthworms are a global concern to the health of native ecosystems. The effects of European earthworms on litter and soil properties in northern temperate forests in the United States are well documented. However, much less is known about Asian jumping worms (*Amynthas* spp.), although they have been shown to affect soil structure and function. Jumping worms were discovered at the UW–Madison Arboretum in 2013. Because of their potential to negatively impact native habitat, the Wisconsin Department of Natural Resources is looking for ways to slow the spread of this invasive species. Currently, there are no methods to control jumping worms. However, previous research has shown that an organic urea-based fertilizer (Early Bird®) greatly reduced the density of European earthworms in golf course settings. To test the efficacy of this product to control Asian jumping worms, enclosure plots were established in a disturbed maple woods at the Arboretum. Three plots each were given a high and low (10:1 and 20:1, respectively) dosage treatment of a water:fertilizer mixture. All jumping worms were killed regardless of concentration. Ammonium nitrate levels remained elevated 96 hours after treatment, but total nitrogen soil pH results were inconclusive. This pilot study suggests that Early Bird fertilizer is lethal to *Amynthas* spp. and thus could help control the spread at small scales. More data is needed to definitively show if the fertilizer significantly alters soil chemistry and native biota.