CHICAGO BOTANIC GARDEN

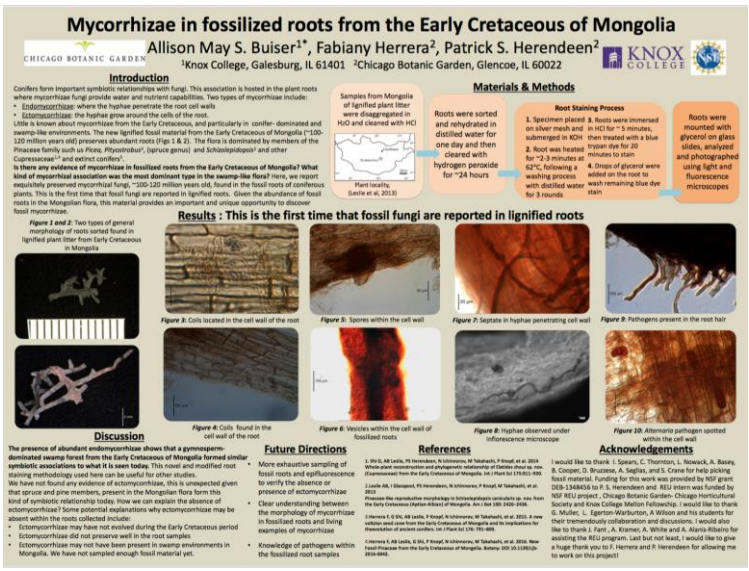
2016 REU POSTER SESSION
Research Experiences for Undergraduates

Plant Conservation Science Center
August 18, 2016

Poster Abstracts

1) Mycorrhizae in fossilized toors from the Early Cretaceous of Mongolia

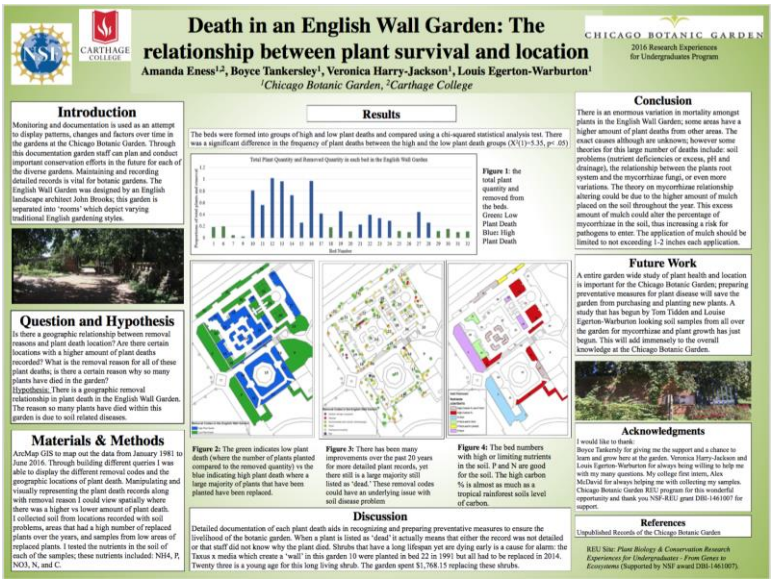
Student: Allison May Buiser
Mentors: Fabiany Herrera and Patrick Herendeen



Little is known about fossil plants and fungi from Mongolia, especially during the Early Cretaceous Period. The Early Cretaceous (100-120 million years ago) is particularly important for studying the origin of flowering plants (angiosperms) and the diversification of conifer plants. Paleobotanists at the Chicago Botanic Garden have collected abundant lignified fossil plants in central Mongolia dated to the Early Cretaceous, the fossils collected include wood, roots, leaves, seeds and pollen and seed cones. Many of these fossils are related to the spruce and cypress families, and other forms of extinct coniferous and gymnosperm plants. There is evidence that the Mongolian fossil flora was deposited in a swamp-like environment. Spruce and pinus plants today form important symbiotic relationships with soil fungi, this relationship is hosted in the plant roots and it is known as mycorrhizae. The importance of studying fossil mycorrhizae adds further information about when this kind of mutualistic relationship evolved. Is there any evidence of mycorrhizae present in fossilized roots from the early Cretaceous of Mongolia? Given the abundance of fossil roots in the Mongolian flora, this material provides an important and unique opportunity to discover fossil mycorrhizae. The fossilized roots were collected and photographed for analysing external morphology. The roots were then treated with, hydrogen peroxide, and undergo a root staining process in search of any evidence of mycorrhizae. The stained fossil roots were analysed under light and fluorescence microscopes. So far, I have found exquisitely preserved forms of endomycorrhizae, mostly arbuscular and vesicular mycorrhizae, based on the presence of hyphae, vesicles, and spores. The fossil hyphae identified show septate and aseptate morphology. Interestingly, evidence of ectomycorrhizae is still lacking from the fossilized roots from Mongolia. The lack of ectomycorrhizae is puzzling given that pine plants today (e.g., spruce genus) form this important symbiotic relationship. Future work on the Mongolian fossil material will continue with the discovery and identification of the mycorrhizal diversity as well as fungal pathogens.

2) Death in an English Wall Garden: The relationship between plant survival and location

Student: Amanda Eness
Mentors: Boyce Tankersley, Veronica Harry-Jackson, and Louise Egerton-Warburton



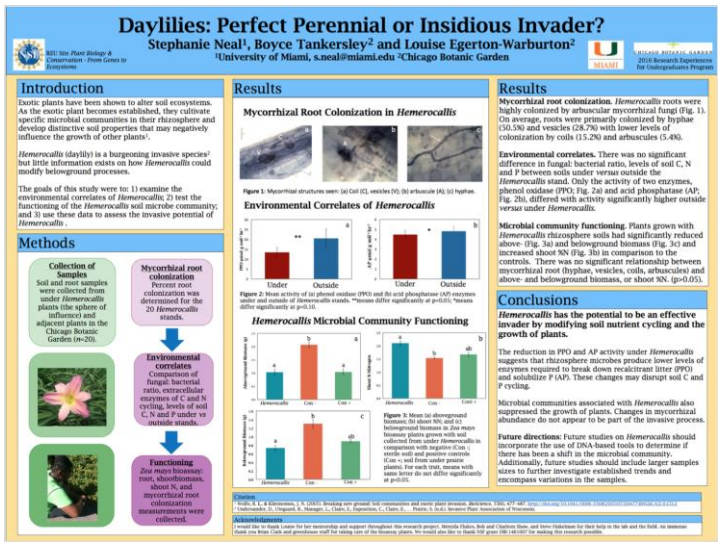
Monitoring and detailed documentation of all the plants that live at the Chicago Botanic Garden is vital for the success of the species chosen to be planted but also for the longevity of each of the plants. Staff can use these detailed records to conduct important conservation efforts and planning for the future of the Garden. The purpose of this project is to identify locations not conducive to long term plant growth in the English Wall Garden; as well as assessing the removals to indicate if there is a pattern of removal codes within the 27 beds in this specific garden. Assessments where made using ArcMap GIS software along with the records for all plant removals in the English Wall Garden with the specific geographic locations. Through ArcMap GIS the removals along with the removal codes were applied to the map of the English Wall to spatially display the data. There was a significant difference in frequency of plant deaths between the beds in the English Wall Garden. Also, the soil was tested for the following nutrients: NH4, NO3, P, N and C. Some beds had excess nutrients while others had deficiencies, some beds had an excess of carbon. There is an enormous amount of variation in mortality amongst plants; although the exact causes are unknown. Even though the exact causes are unknown why so many plants have died within

this garden, some theories include soil (excesses or deficiencies), the relationship between the mycorrhizae altering, etc. The altering of this relationship could be due to an excess amount of mulch being placed in the English Wall Garden; if there is less mycorrhizae then there could be more pathogens and vice versa. These results are of value to all of the staff at the Chicago Botanic Garden as encouragement towards increasing the amount of research of the Garden. Through learning and implementing preventative measures for ensuring the longevity and health of each of the plants the garden can not only save money but can expand education on conservation towards the public.

3) Daylilies: Perfect perennial or insidious invader?

Student: Stephanie Neal

Mentors: Boyce Tankersley and Louise Egerton-Warburton

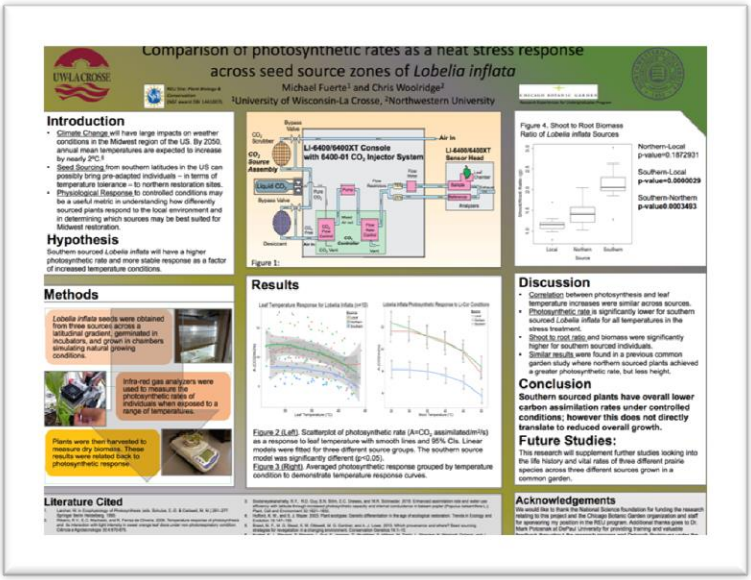


Exotic plants have been shown to alter soil ecosystems. As the exotic plant becomes established, they cultivate specific microbial communities in their rhizosphere and develop distinctive soil properties that may negatively influence the growth of other plants. *Hemerocallis* (daylily) is a burgeoning invasive species but little information exists on how *Hemerocallis* could modify belowground processes. The goals of this study were to: 1) examine the environmental correlates of *Hemerocallis*; 2) test the functioning of the *Hemerocallis* soil microbe community; and 3) use these data to assess the invasive potential of *Hemerocallis* . The reduction in PPO and AP activity under *Hemerocallis* suggests that rhizosphere microbes produce lower levels of enzymes required to break down recalcitrant litter (PPO) and solubilize P (AP). These changes may disrupt soil C and P cycling. Additionally, microbial communities associated with *Hemerocallis* also suppressed the growth of plants. Changes in mycorrhizal abundance do not appear to be part of the invasive process. Future studies on *Hemerocallis* should incorporate the use of sDNA-based tools to determine if there has been a shift in the microbial community. Additionally, future studies should include larger samples sizes.

4) Comparison of photosynthetic rates as a heat stress response

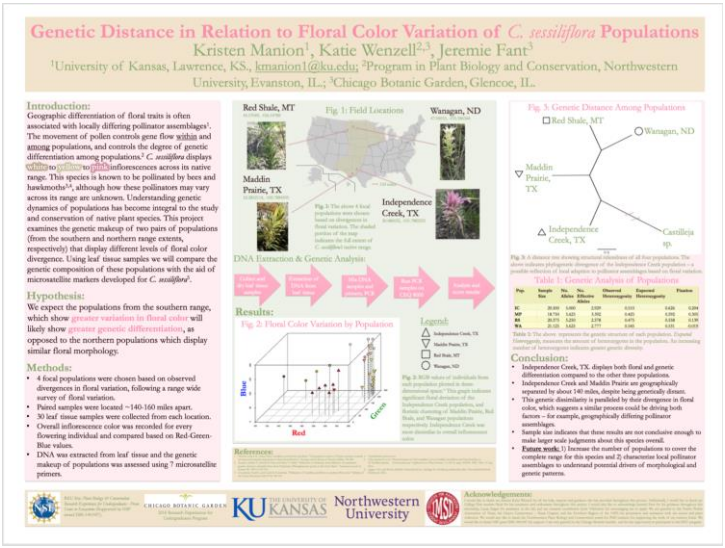
Student: Michael Fuerte

Mentor: Chris Woolridge



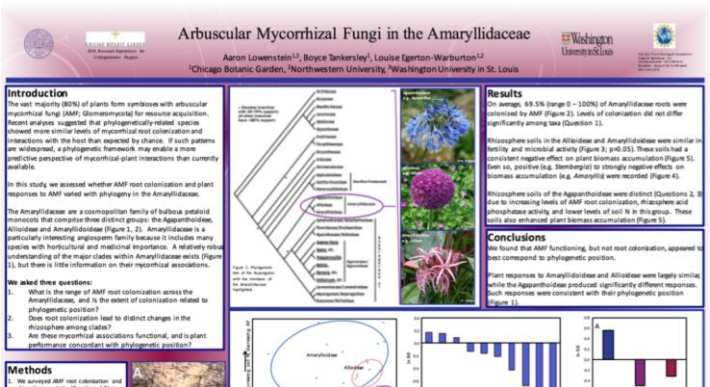
Seed Sourcing from southern latitudes in the US can possibly bring pre-adapted individuals – in terms of temperature tolerance – to northern tallgrass prairie restoration sites. The implications of this study could shed light on provincial provenancing methods and help better inform land managers as to which seeds are right for Midwest restoration practices. To determine how differently sourced plants may be affected by future climate conditions, a LI-6400XT portable photosynthesis system was experimentally used to determine how carbon assimilation for *Lobelia inflata* would change in accordance to heat stress. Experimental trials were repeated for three distinct latitudinal seed sources (n=10). My hypothesis was that southern sourced *Lobelia inflata* would have a higher photosynthetic rate and more stable response as a factor of increased temperature conditions. Additional observations were made to see if carbon assimilation had a direct correlation with total plant biomass. Factorial design ANOVAs and linear regression modeling were conducted at an α=0.05 threshold to determine how the photosynthetic rates of the three sources responded to increasing temperatures and if there were differences across seed sources. I conclude that southern sourced individuals have overall lower photosynthetic rates under controlled conditions; however, this does not directly translate to reduced overall growth.

5) Genetic distance in relation to floral color variation of *C. sessiliflora* populations
Student: Kristen Manion
Mentors: Katie Wenzell and Jeremie Fant



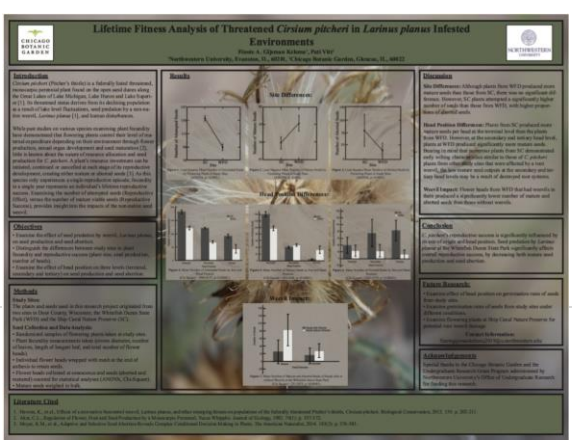
Understanding the genetic dynamics of populations is integral to the study and conservation of native plants. Because the movement of pollen (often mediated by pollinators) controls gene flow within and among populations, these processes control migration and thus the degree of genetic differentiation among populations. While many studies have been done to investigate genetic dynamics of native plants, few have been able to link genetic differentiation and phenotypic variation to possible local adaption. *Castilleja sessiliflora* (Downy Indian Paintbrush) is widely distributed across the southwestern and Midwestern United States. Across the majority of its range, *C. sessiliflora* displays white to yellow inflorescences, with populations in the southern range sometimes bearing pink inflorescences. Geographic differentiation of floral traits is often associated with locally differing pollinator assemblages (Herrera et al. 2006). This project aims to investigate whether increased floral variation is associated with greater genetic differentiation, reflecting the adaption of local pollinators. This project examines the genetic makeup of two pairs of populations from the southern and northern range extents that display different levels of floral color divergence. Using leaf tissue samples collected from these populations, we will compare the genetic composition of these populations with the aid of microsatellite markers developed for *C. sessiliflora* (Fant et al. 2013).

6) Arbuscular mycorrhizal fungi in the Amaryllidaceae
Student: Aaron Lowenstein
Mentors: Boyce Tankersley and Louise Egerton-Warburton



The Amaryllidaceae are a family of mainly perennial, bulbous angiosperms of significant horticultural importance, that can be divided into three subfamilies: Amaryllidoideae, Agapanthaceae, and Allioideae. The Amaryllidaceae form symbioses with arbuscular mycorrhizal fungi (AMF) to survive. However, the extent of AMF root colonization or their functional effects on the Amaryllidaceae is poorly known. In this study, our objectives were to document the range of mycorrhizal root colonization, examine how mycorrhizal colonization affects rhizosphere fertility and microbial activity, and whether there are any correlations between mycorrhizal abundance or functioning with phylogenetic position. Thus, we analyzed root and soil samples for nutrients (C, N, and P), fungal:bacterial ratio, enzymes of microbial C and N cycling, and mycorrhizal root colonization. We also used a corn (*Zea mays*) bioassay to test the efficacy of Amaryllidaceae AMF on biomass accumulation, foliar nitrogen, and AMF root colonization. We found that AMF root colonization was high (>65%) but varied considerably among taxa. Analyses showed that rhizosphere soil fertility and microbial activity were similar in the Amaryllidoideae and Allioideae, and soils from these groups suppressed plant growth. In contrast, rhizosphere soils in the Agapanthoideae were characterized by low N and enzyme levels, and the soils enhanced plant growth. These results suggest that AMF functioning (not abundance) was consistent with phylogenetic position.

7) Lifetime fitness analysis of threatened Cirsium pitcheri in Larinus planus infected environments
Student: Finote Gijsman
Mentors: Pati Vitt



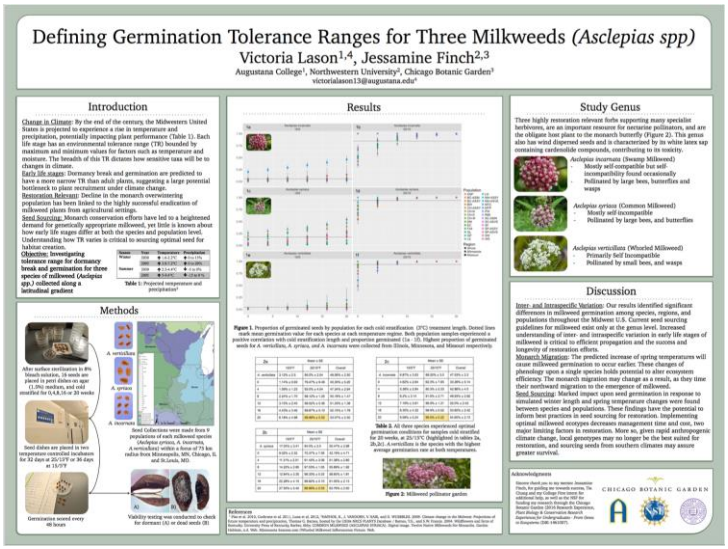
A study on the lifetime fitness of *Cirsium pitcheri*, a federally threatened thistle species endemic to the Great Lakes region, was conducted with the aim of understanding the impact of the non-native seed weevil, *Larinus planus*, on *C. pitcheri*'s reproductive success. Randomized samples of flowering plants were generated from two study sites in Door County,

Wisconsin - the Whitefish Dunes State Park currently host to *Larinus planus* and the Ship Canal Nature Preserve. Individual flower heads were wrapped at the end of anthesis and collected at senescence for data collection and analysis on mature and aborted seed counts. The number of seeds produced at each site did not differ significantly, yet the number of attempted seeds at the Ship Canal Nature Preserve greatly exceed those from the Whitefish Dunes State Park. Mature seed outputs and seed abortion rates at the Whitefish Dunes State Park were also significantly lower in flowering plants with weevils than those without. The study's results ultimately highlighted the significance of head position, site of origin and seed predation on *C. pitcheri*'s overall reproductive success.

8) Defining germination tolerance ranges for three milkweeds (Asclepias spp.)

Student: Victoria Lason

Mentors: Jessamine Finch



Our changing climate is growing as a major variable in plant science as it may have a marked impact upon early life stages of plants. Furthermore, germination and seedling establishment have recently been identified as a large potential bottleneck to plant recruitment under climate change, as seedlings will be more sensitive than mature individuals. As an important source of nectar for pollinators, and the obligate host plant for monarch butterflies, three species of milkweed were chosen to forecast species responses to variables such as heightened temperatures. Seeds from 9 populations of each species were collected along a latitudinal gradient and lab-based germination trials occurred in two light and temperature controlled incubators for a period of 32 days at 25/15°F, and for 36 days at 15/5°. After the incubation trials, viability tests were conducted upon non-germinated samples to check for dead or dormant seeds. Our results identified significant differences in milkweed germination among species, populations, and regions, in response to simulated winter length and spring temperature changes throughout the Midwest U.S. These findings have the potential to inform best practices in seed sourcing for restoration. Implementing optimal milkweed ecotypes decreases management time and cost, two major limiting factors in restoration.

9) The Impacts of Deicing Salts on Chicagoland Roadside Soil Composition

Student: Ramsey Millison

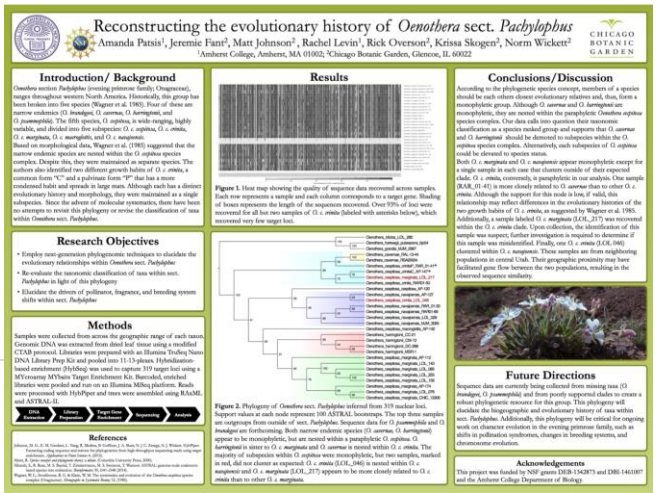
Mentors: Louise Egerton-Warburton

Every year deicing salts are applied to Chicagoland roads in preparation of winter. Due to melting snow and rainfall, runoff can occur and cause deicing salts to be applied to roadside soils. Little is known on how yearly increasing salinity can affect soil composition. In this study soil samples were collected along both sides of the Chicago Botanic Garden berm. The soil samples collected this year are part of a study that started in 2006. Soil nutrient analysis for nitrate, phosphate, and ammonium were conducted using an epoch microplate spectrophotomer. Carbon and nitrogen percentage were also analyzed using a leco combustion analyzer. Salinity and pH of soil samples were also taken. Soil sample composition of 2016 were compared to soil sample composition of 2006. The average soil salinity of 2006 and 2016 were significantly different resulting in a $p < .001$. The average salinity of 2006 was larger than 2016. Soil nutrient between both years were also significantly different resulting in a $p < .001$. Soil samples for 2016 had larger average values for nitrate, phosphate, and ammonium. It is imperative to continue studying this affect because increasing salinity can cause a change in both plant composition and mycorrhizal composition.

10) Reconstructing the evolutionary history of Oenothera sec. Pachylophus

Student: Amanda Patsis

Mentors: Jeremie Fant, Matt Johnson, Rachel Levin, Rick Overson, Krissa Skogen, and Norm Wickett



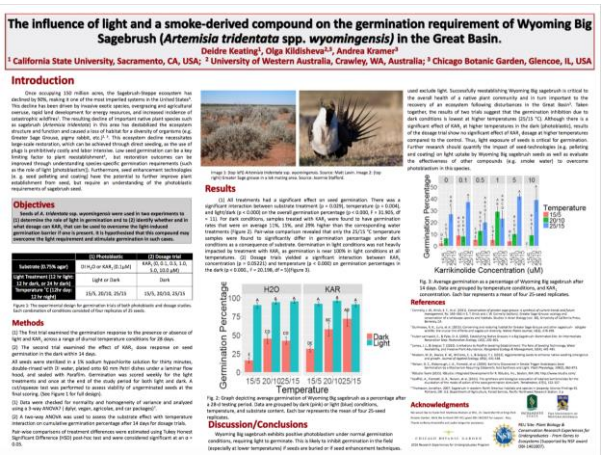
Past studies of *Oenothera* sect. *Pachylophus* defined four narrow endemic species and one highly polymorphic species containing five subspecies based on morphological variation. In this study, we reevaluate these species delineations using next-generation phylogenomic techniques. Twenty-six samples spanning the geographic ranges of seven *Pachylophus* taxa were sequenced using HybSeq to target 319 phylogenetically informative loci. Species trees were then assembled with coalescent-based models. The resulting

phylogeny suggests that two of the narrow endemic species (*O. cavernae* and *O. harringtonii*) are monophyletic, but are nested within the greater *O. cespitosa* species complex. This calls into question their current ranking as species, and suggests the need to re-evaluate their taxonomic classification. The subspecies of *O. cespitosa* are largely monophyletic, though potential misidentifications and potential hybridization complicates these relationships. Increased taxon sampling will further elucidate the relationships within *Oenothera* sect. *Pachylophus*, allowing us to create a more robust phylogenetic resource that will inform ongoing work on character evolution in the evening primrose family.

11) The influence of light and smoke-derived compound on the germination requirement of Wyoming Big Sagebrush (Artemisia tridentata ssp. wyomingensis) in the Great Basin

Student: Deidre Keating

Mentors: Olga Kildisheva and Andrea Kramer

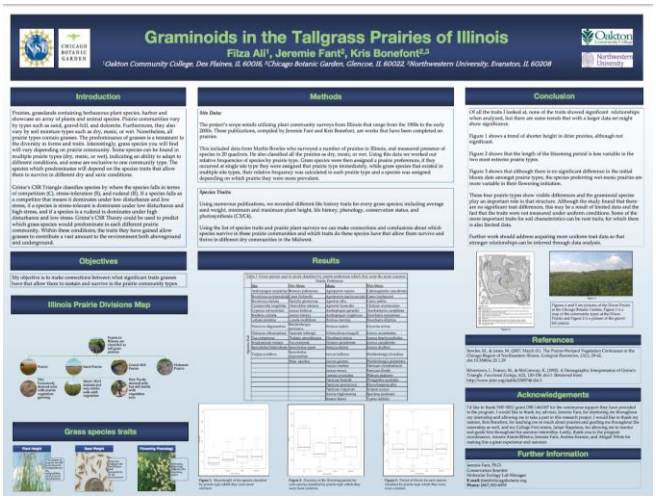


The imperiled Sagebrush-Steppe ecosystem is a focus for restoration in the Great Basin as native plant communities and the wildlife they support are rapidly declining due to human footprint. Restoration using native seed during post-disturbance recovery is limited by the understanding of species-specific seed germination requirements. Wyoming Big sagebrush is a keystone shrub vital to the establishment of the ecosystem. The use of this species in restoration and potential impact of seed enhancement treatments and distribution in soil requires an understanding of the light requirement for germination. To Investigate this, seeds were germinated in presence and absence of light and treated with karrikinolide (KAR_1), a smoke-derived compound, to determine if it overcame any light requirement present. Sagebrush exhibited a strong photoblastic requirement across all temperature conditions tested. KAR_1 was found to significantly increase germination in dark conditions at higher temperatures while a non-significant impact was observed at lower temperatures. Given the impact of light on germination, considering soil depth and the impact of seed-enhancement technologies on exposure to light is critical in achieving successful establishment of Wyoming Big sagebrush. Treatment with either KAR_1 or smoke-water in conjunction with seed-enhancement technologies warrants further research to understand its benefits to germination.

12) Graminoids in the tallgrass prairies of Illinois

Student: Filza Ali

Mentors: Kris Bonefont and Jeremie Fant

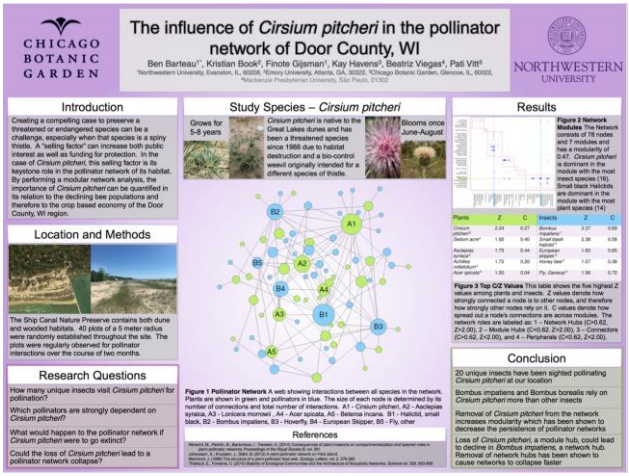


Prairies, grasslands containing herbaceous plant species, harbor and showcase an array of plants and animal species. Prairie communities vary by types (short or tallgrass), moisture (wet, mesic and dry), and in soil type (with rich prairie soil, sandy, gravel-hill, and dolomite). My project is focused on graminoids, a major functional group within prairie communities that have a major contribution to the ecosystem function. The predominance of grasses' in all prairies is a testament to the diversity in forms and traits. The species which predominates will depend on their ability to adapt and traits that allow them to survive in different conditions. Grime's CSR Theory classifies species into competitors (C), stress tolerators (S) and ruderal species, which could be used to predict which grass species would predominate in each different prairie community. The project's scope entails utilizing plant community surveys in Illinois that range from the 1900s to the early 2000s, including a survey done by Marlin Bowles at 103 prairies. The prairies were classified into Wet, Wet-mesic, Mesic, Dry-Mesic and Dry. Species traits were compiled for all grass through various scientific publications, and entered into a database. Comparison of traits of all the grasses were analysed based on preferred soil type. Of all the traits I looked at, none of the traits showed significance, but there are some trends that with a larger data set might show significance.

13) The influence of Cirsium pitcheri in the pollinator network of Door County, WI

Student: Benjamin Barteau
Mentors: Kay Havens and Pati Vitt

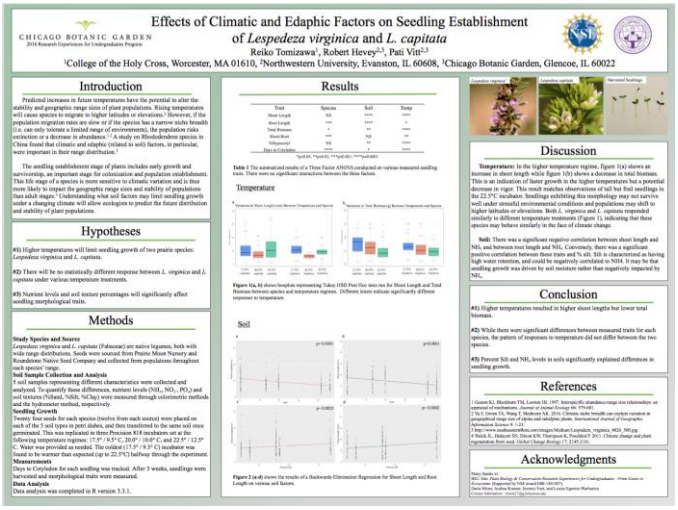
Cirsium pitcheri, or Pitcher's Thistle, is threatened for extinction as a result of habitat destruction and a bio-control weevil originally intended for a different species of thistle. Due to its unique blooming period and frequent pollinator visits, it was hypothesized to play an important role in the local pollinator network. Using the Ship Canal Nature Preserve in Door County, WI, as a testing site, 40 plots were randomly selected throughout the site and were regularly observed for 10 minutes each over the span of two months during *C. pitcheri*'s flowering period. All insect interactions with flowering plants were recorded, analyzed for modularity, and constructed into a visual network. Artificial removal of *C. pitcheri* from the network causes the modularity to increase, which has been shown to decrease the persistence of pollinator networks. *C. pitcheri* is also strongly linked with multiple species of bees, including *Bombus impatiens*, a key network hub pollinator. The extinction of *C. pitcheri* could lead to a decline in *B. impatiens*, which would likely cause a network collapse that would have a broad impact on the survival of other species and on the crop-based economy of the Door County, WI, region.



14) Effects of climatic and edaphic factors on seedling establishment

Student: Reiko Tomizawa
Mentors: Robert Hevey and Pati Vitt

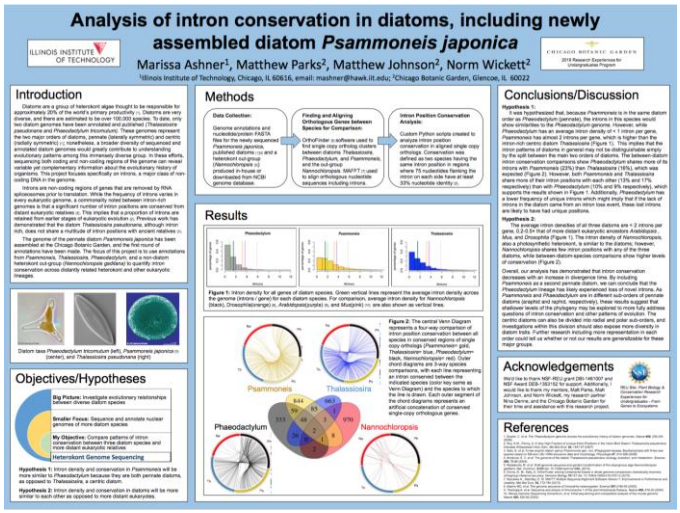
Predicted increases in future temperatures will likely cause plant species to migrate to higher latitudes or elevations. However, population range shifts may be limited by narrow niche breadths. In a previous study, soil was found to influence the range distribution of Rhododendron species. Understanding how soil factors limit seedling establishment, a life stage that displays greater sensitivity to climate change than adults, is important in predictions on population stability. In our study, 5 soil samples were analyzed for nutrient levels and textures. Seeds from two native prairie species, *Lespedeza virginica* and *L. capitata*, were germinated and grown into these soils. The seedlings were kept under three different temperature regimes: 17.5°/ 9.5° C, 20.0°/ 10.0° C, and 22.5°/ 12.5° C for three weeks before harvest and measurement. Our results showed higher temperature regimes caused higher shoot lengths but lower total biomass. This is an indication of faster growth in the higher temperatures but a potential decrease in vigor. Percent silt and NH_4 levels in soils significantly explained differences in seedling growth. Silt is characterized as having high water retention, and could be negatively correlated to NH_4. It may be that seedling growth was driven by soil moisture rather than negatively impacted by NH_4.



15) Analysis of intron conservation in diatoms, including newly assembled diatom Psammoneis japonica

Student: Marissa Ashner
Mentors: Matthew Parks, Matthew Johnson, and Norm Wickett

Diatoms are a group of heterokont algae thought to be responsible for approximately 20% of the world's primary productivity. To date, only two diatom genomes have been annotated and published. These genomes represent the two major orders of diatoms, pennate (laterally symmetric) and centric (radially symmetric); nonetheless, a broader diversity of sequenced and annotated diatom genomes would greatly contribute to understanding evolutionary patterns among this immensely diverse group. The focus of this project is to use annotations from the Chicago Botanic Garden's newly assembled genome of the pennate diatom *Psammoneis japonica,* and published genomes of the diatoms *Thalassiosira pseudonana, Phaeodactylum*

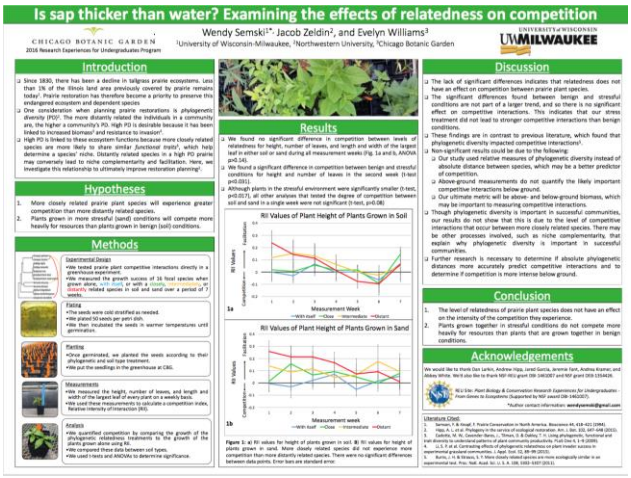


tricornutum, and non-diatom out-group *Nannochloropsis gaditana* to quantify intron conservation across distantly related heterokont and other eukaryotic lineages. Intron conservation analysis was completed using software programs OrthoFinder, MAFFT, and custom Python scripts. Overall, our analyses of whole genome intron density and intron position conservation in single copy orthologs have demonstrated that intron conservation decreases with an increase in divergence time. Additionally, by including *Psammoneis as* a second pennate diatom, we concluded that the *Phaeodactylum* lineage has likely experienced loss of novel introns.

16) Is sap thicker than water? Examining the effects of relatedness on competition

Student: Wendy Semski

Mentors: Jacob Zeldin and Evelyn Williams

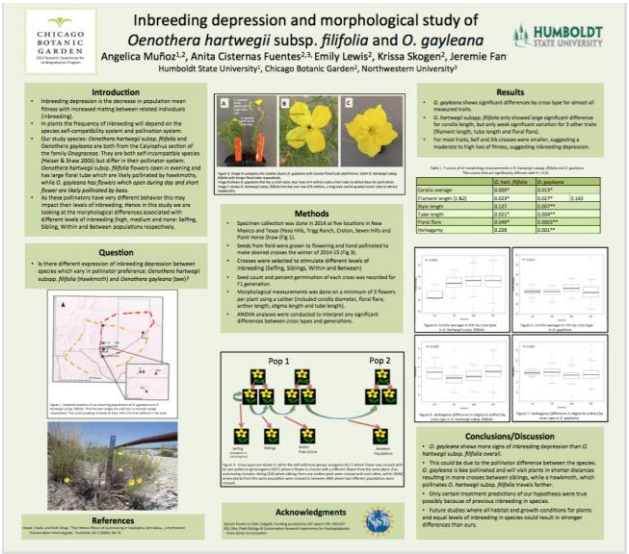


Since 1830, there had been a decline in tallgrass prairie ecosystems. Phylogenetic diversity (PD), a measure of biodiversity in a community, has become an important consideration during prairie restoration planning because it has been shown to have a positive effect on community biomass and resistance to invaders. More closely related species tend to share similar functional traits, so they may compete more heavily for available resources than more distantly related species. We investigated whether closely related species experience stronger competitive interactions than distantly related species, and if overall competition for resources increases in stressful rather than benign soil conditions. We measured the growth success of 16 focal species according to five relatedness treatments in soil and sand over 7 weeks and found that there is no significant difference between competition intensity at any relatedness level. There were also no significant differences between benign and stressful soil conditions. These results indicate that relatedness does not have an effect on competitive interactions between prairie species and that competition does not increase in more stressful conditions. More research is needed to determine if absolute phylogenetic distances accurately predict completive interactions and to determine if competition is more intense below ground.

17) Inbreeding depression and morphological study of Oenothera hartwegii subsp. Filifolia and O. gayleana

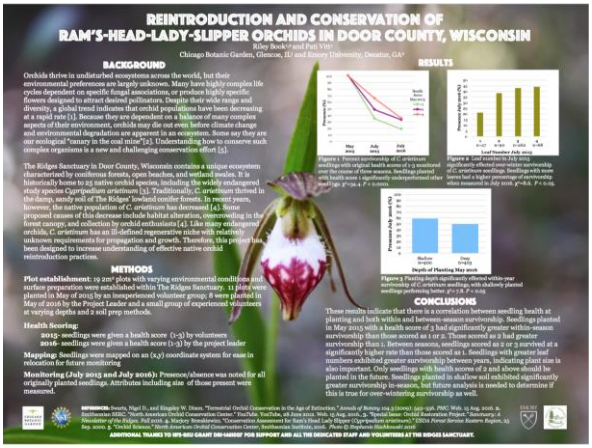
Student: Angelica Munoz

Mentors: Anita Cisternas Fuentes, Emily Lewis, Krissa Skogen, and Jeremie Fant



Inbreeding depression is the decrease in population mean fitness with increased mating between related individuals (inbreeding). In plants the frequency of inbreeding will depend on the species self-compatibility system, pollination system, and environment. Our study species: *Oenothera hartwegii* subsp. *filifolia* and *Oenothera gayleana* are both from the Calylophus section of the family *Onagraceae.* They are both self-incompatible species tested to see if inducement of inbreeding will affect fitness of offspring. To accomplish this we made 4 cross type treatments in each species with 5 populations (Selfing, Sibling, Within populations and Between populations) and measured morphology of 3 flowers on each plant. Using linear models in R we were able to determine if there were significant differences among the cross types.. O. *gayleana* showed significant differences when comparing cross types showing moderate to high fitness decline. *O. hartwegii* subsp. *filifolia* only showed strong differences in corolla length suggesting less inbreeding than their parents. Pollinator type may be the reason for these values due to the short range of pollen distribution for *O. gayleana,* pollinated by bees, versus *O. hartwegii* subsp. *filifolia*, which is pollinated by hawkmoths who travel farther and create more diversity naturally. Future research with more controlled seeds could show stronger results in these species.

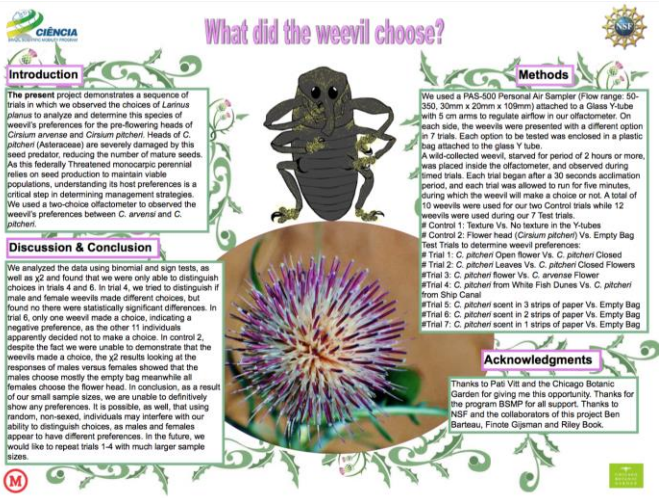
18) Reintroduction and conservation of Ram's-Head-Lady-Slipper orchids in Door County, Wisconsin
Student: Riley Book
Mentor: Pati Vitt



This project at The Ridges Sanctuary in Bailey's Harbor, Wisconsin was designed to re-establish a declining population of *Cirsium arietinum*, a state-threatened orchid. In May 2015, eleven $2m^2$ plots were planted with a maximum of 400 seedlings per plot by a large group of volunteers. In May 2016, eight $2m^2$ plots with alternating surface preparation methods were planted at varying depths with a maximum of 100 seedlings per plot by a small group of volunteers and the project leader. All seedlings planted in 2015 and 2016 were given a health score from 1-3 at planting and mapped using an (x,y) coordinate system. Survivorship of May 2015 seedlings was monitored in July 2015. Presence/absence, leaf number, and shoot number were recorded. Survivorship of May 2015 and May 2016 seedlings was monitored in July 2016 with additional performance attributes. Results indicate that there is an association between the health score of May 2015 seedlings and their within-season and between-season survivorship. There is also an association between the leaf number of seedlings measured in July 2015 and their between-season survivorship. Planting depth also significantly impacted within-season survivorship of May 2016 seedlings.

19) What did the weevil choose?
Student: Beatriz Viegas
Mentor: Pati Vitt

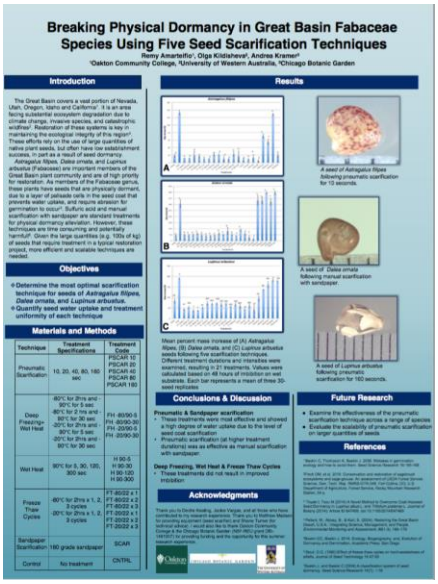
The present project is about a weevil specie *Larinus planus* and it's interactions with two thistle species, *Cirsium pitcheri* and *Cirsium arvensi*. Nowadays this insect has been causing significant damaged to the native thistle (Cirsium pitcher) threatening its existence in Whitefish Dunes, WI (accordingly to Pati Vitt researches the weevil was introduced in the area as a biocontrol of the invasive thistle, C. arvensi). The goal of the project is to learn about this weevil and what it prefers, as to source of food, protection or reproduction and even observe if there is a different between male and female choices. Therefore during the processes there were 9 trials, with almost 12 weevils each experiment. It was possible to observe some reasons why the weevil chose between determinate flower content such as, leaves, flower head or extracted sent, but for more accurate information in the future will be necessary to observe more weevils per trial.



20) Breaking physical dormancy in Great Basin Fabaceae species using five seed scarification techniques

Student: Remy Amarteifilo

Mentors: Olga Kildisheva and Andrea Kramer

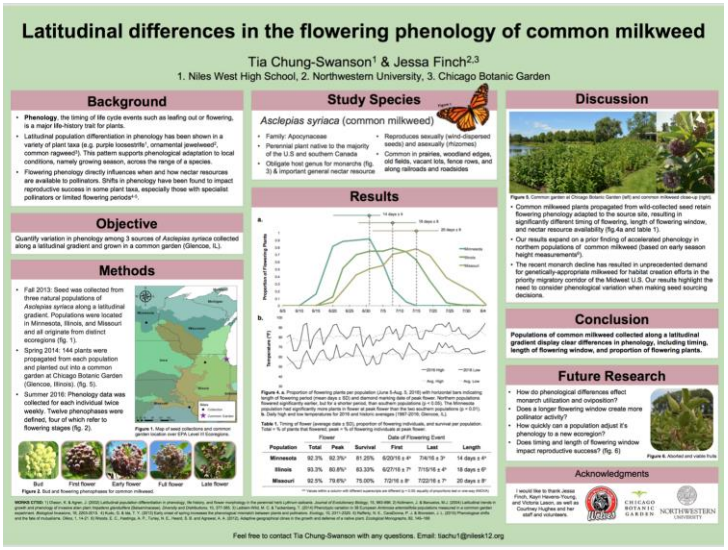


The Great Basin ecosystem is facing substantial degradation due to climate change, invasive species, and catastrophic wildfires. Restoration of these systems is key in maintaining the ecological integrity of this region and often rely on the use of large quantities of native plant seeds. *Astragalus filipes*, *Dalea ornata*, and *Lupinus arbustus* (Fabaceae) are important members of the Great Basin plant community. These plants have seeds that are physically dormant and cannot take up water. Therefore, without the abrasion of the seed coat, germination cannot occur. Sulfuric acid and manual scarification with sandpaper are standard treatments for physical dormancy alleviation, but are inefficient and potentially dangerous. The purpose of the study was to determine better alternative scarification techniques that are safe, efficient, and scalable. I examined the effects of pneumatic scarification, deep freezing + wet heat, wet heat, and freeze thaw cycles on seed water uptake in comparison to manual scarification. Results suggest pneumatic scarification achieved the best results, which were similar to those obtained by manual sandpaper scarification. Manual scarification is time-consuming and inefficient; thus pneumatic scarification is a better option for the treatment of large quantities of physically dormant seeds.

21) Latitudinal differences in flowering phenology of common milkweed

Student: Tia Chung Swanson

Mentors: Jessamine Finch



Populations of *Asclepias syriaca* (common milkweed) thrive across several distinct ecoregions in the United States and southern Canada. *Asclepias* spp. are the obligate larval host of the monarch butterfly, which has experienced an alarming population decline in recent years. In an effort to bolster the monarch population, there has been a surge in milkweed plantings throughout the region. When sourcing plant material, it is important to consider clinal variation in life history traits, and how they might impact your restoration objective. Our study examined three populations of *Asclepias syriaca* taken from across a latitudinal gradient to quantify differences in flowering phenology. We found that populations of common milkweed from differing ecoregions display clear differences in phenology, including timing, length of flowering window, and proportion of flowering plants. This study may help determine how phenological variation linked to seed source may impact future restoration efforts.

THANKS TO:

REU Coordinator: Abigail White

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Poster Judges: Andrew Bunting (Assistant Director of the Garden and Director of Collections), Jennifer Schwarz Ballard (Vice President, Education & Community Programs) and Patrick Herendeen (Senior Director, Systematics and Evolutionary Biology and Senior Scientist)

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