CHICAGO BOTANIC GARDEN

2015 REU POSTER SESSION

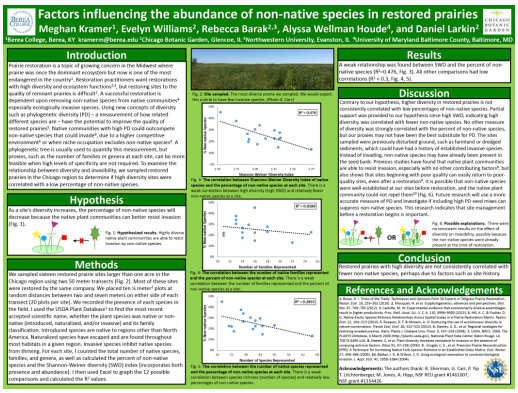
NORTHWESTERN UNIVERSITY

Funding : NSF-REU DBI-1461007 (Fant, Larkin), NSF- Dimensions-1342873 (Skogen, Fant and Wickett) and NSF_DEB -1354551 (Larkin,Williams, Lonsdorf), Chicago Botanic Garden College First Program, Northwestern Office of Undergraduate Research, Oakton Community College , Associated Colleges of Illinois Internships & SPARKS (Stevenson High School)

Posters Abstracts

1) *Factors influencing the abundance of non-native species in restored prairies*

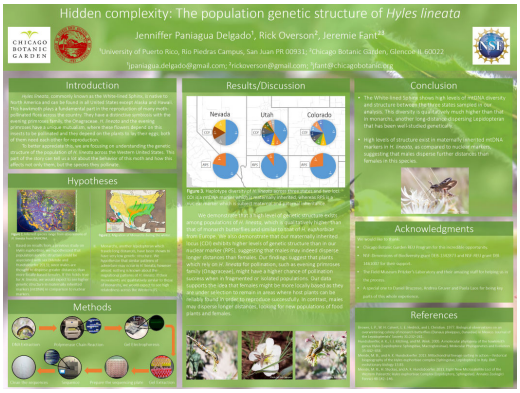
Student: Meghan Kramer
Mentors: Evelyn Williams, Rebecca Barak, and Daniel Larkin



Restoration efforts of prairie ecosystems have increased as prairies have moved from a once dominant landscape to one of the most endangered. High quality restorations are desired to match the remnant prairies that are now being protected. New concepts, such as phylogenetic diversity (PD), have the potential to improve the quality of restored prairies. We hypothesized that native communities are able to better resist invasive species as their diversity increases. We sampled sixteen restored prairies in the Chicago region to examine our proposed hypothesis if sites with high diversity were correlated with a lower abundance of non-native species. I calculated the Shannon-Weiner Diversity Index, number of species, genera, and families at each site as well as the correlation between diversity measures and the percent of non-native species. A weak relationship was found between the Shannon-Weiner Diversity Index and the percent of non-native species at each site. Contrary to our hypothesis, higher diversity restored prairies were not consistently correlated with low percentages of non-native species, perhaps due to other factors such as site history. Future research will use a more accurate measure of PD and investigate if including high PD seed mixes can suppress non-native species. This research indicates that site management before installing a restoration is important.

2) *Hidden complexity: The population genetic structure of Hyles lineata*

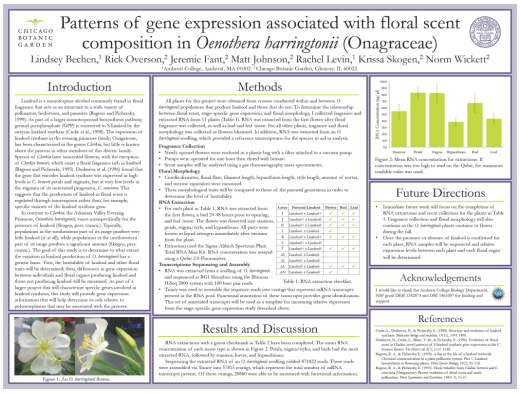
Student: Jenniffer Paniagua Delgado
Mentors: Rick Overson, Jeremie Fant



Hyles lineata, commonly known as the White-lined Sphinx, plays a fundamental part in the reproduction of many moth-pollinated flora in North America. In this study, we are focusing on understanding the genetic structure of the population of *H. lineata* across the Western United States. To accomplish this, we use one mtDNA and one nuclear marker to make two hypotheses that can tell us total different stories about the genetic structures of this moths. One of them using as a model the population genetic structure of *Hyles euphorbiae*, which is associated with sex and the second one based on the migrational patterns of the Monarchs, who are known for being long distances travelers like the *H. lineata*. Using basic protocols for sequencing, we found high levels of mtDNA diversity and structure in three states of the ones we sampled. This means that in contrast to the Monarchs, in *H. lineata* exists a complex structure in maternally inherited mtDNA markers as compared to the structure in the nuclear markers, suggesting that males disperse further distances than females, which was expected if *H. lineata* follows the genetic structures of the European sphingid *H. euphorbiae*.

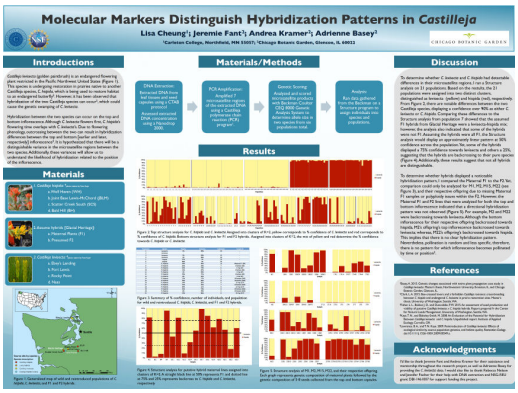
3) ***Patterns of gene expression associated with floral scent composition in <u>Oenothera harringtonii</u> (Onagraceae)***

Student: Lindsey Bechen
Mentors: Rick Overson, Jeremie Fant, Matt Johnson, Rachel Levin,Krissa Skogen, Norm Wickett



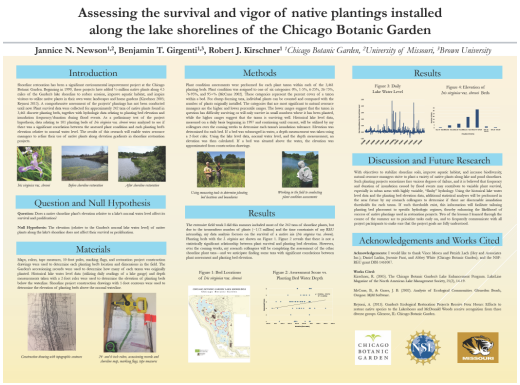
Linalool is a common component of floral fragrance, acting as an attractant for pollinators, herbivores, and parasites. *Oenothera harringtonii* varies geographically in linalool production, but the extent to which this variation has a genetic basis is unknown. This project seeks to determine the heritability of linalool and other floral traits as well as determine the differences in gene expression between individuals producing linalool and those not producing linalool. This was accomplished through collecting floral fragrance, measuring floral morphology, and extracting RNA from offspring of crosses within and between linalool+ and linalool- populations. Currently, 8 out of 11 plants have been extracted from, yielding an average RNA concentration of 61.8 ng/µl. A reference *O. harringtonii* seedling transcriptome was also assembled, yielding 20860 functionally annotated transcripts. Data collection will proceed through the fall on the remaining plants. Once linalool presence or absence is confirmed, RNA samples will be sequenced and assembled into transcriptomes. This will allow for the comparison of relative expression levels, using the reference transcriptome as a template, within and between linalool+ and linalool- individuals.

4) **Molecular Markers Distinguish Hybridization Patterns in *Castilleja***
Student: Lisa Cheung
Mentors: Jeremie Fant, Andrea Kramer, Adrienne Basey



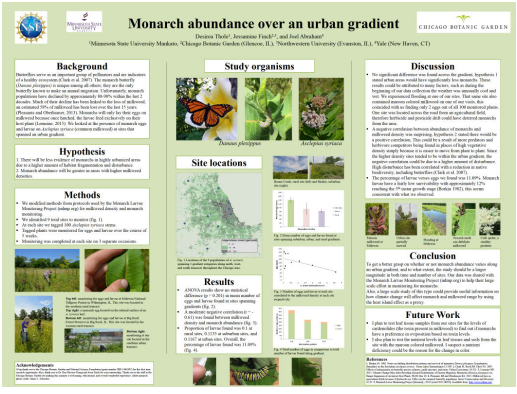
Castilleja hispida, an Indian paintbrush species, is being used to restore habitat for an endangered butterfly; however, they are outcrossing with an endangered paintbrush species, *C. levisecta*. Our objective was to find presence of specific microsatellites between the two species and utilize those variances to distinguish a hybridization inflorescence pattern. To do so, we had to extract, amplify, score, and analyze DNA from the *hispida* and hybrid samples. From the analyzed data, there was indeed a distinguishable difference (>90% confidence) between the two species and a noticeable mix of the two species in the hybrids. However, there did not seem to be any observable pattern in hybridization direction. In conclusion, not all hybrids are distinguishable and we believe that there is no pattern to hybridization inflorescence due to pollination being less specific and random. Thus, more research is necessary to identify hybridization patterns.

5) Assessing the survival and vigor of native plantings installed along lake shorelines at the Chicago Botanic Garden
Student: Jannice N. Newson
Mentors: Benjamin T. Girgent, Robert J. Kirschner



The purpose of this project is to assess the survival of native plants installed along the Chicago Botanic Garden's lake shorelines relative to their elevation from the lakes' normal water level. Planting bed elevation along with historical lake water level data collected daily since 1997 allowed us to see frequency and duration of inundation of each planting bed, which could reveal whether or not there was an inundation threshold for each of the 242 taxa planting along the 4.5 miles of restored lake shoreline. Assessments of plant condition were made, and historical lake water levels and planting bed elevation were documented. A native iris, *Iris virginica var. shrevei*, is highlighted as to provide an insight to the forthcoming assessment of all the shoreline plant taxa. While not seen for the native iris, statistically significant relationships, between plant performance and planting bed elevation for some of the other 242 taxa are expected in my colleagues' forthcoming assessment. These results will be of value to natural resource managers in planning future restoration projects because knowing whether or not a taxon has an inundation threshold will allow the taxa to be planted at the elevation best-suited for its long-term survival. This information can be particularly valuable for designing storm water detention basins, where plants' water inundation tolerance is particularly important.

6) Monarch abundance across an urban gradient
Student: Desirea Thole
Mentors: Jessamine Finch

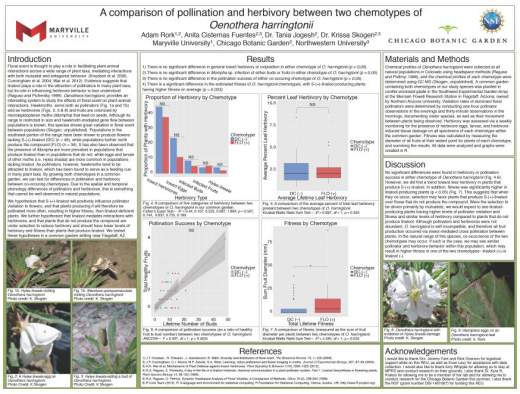


Declining populations of pollinators has been a significant issue in recent years, and the monarch butterfly (Danaus plexippus) is the face of many efforts to educate the public involving repercussions of pollinator loss. Monarch butterfly populations have decreased by 80-90% within the last two decades. Members of the milkweed genus (Ascelpias spp.) serve as the obligate host plant for monarch eggs and larvae. Numerous monarch conservation efforts have been focused in cities, such as the establishment of pollinator gardens. However, urban areas contain many environmental stressors that may fail to support monarch reproduction and survival. To investigate the impact of urbanization on monarch abundance, we monitored nine populations of A. syriaca spanning an urban gradient in the Chicago region. We chose A. syriaca specifically because it the most widely used monarch host plant and is widely found in both urban and rural areas. We found no significant difference in monarch presence along the gradient. We found an unexpected negative correlation (r = -0.61) between milkweed density and monarch abundance. These results indicate there may be many environmental dynamics influencing monarch abundance beyond the discrete driver of urbanization. Additionally, these results suggest that urban pollinator gardens may prove as successful as rural milkweed populations in supporting monarchs despite the added stressors of the urban environment.

7) A comparison of pollination and herbivory between two chemotypes of *Oenothera harringtonii*

Student: Adam Rork

Mentor: Anita Cisternas-Fuentes, Dr. Tania Jogesh, Dr. Krissa Skogen



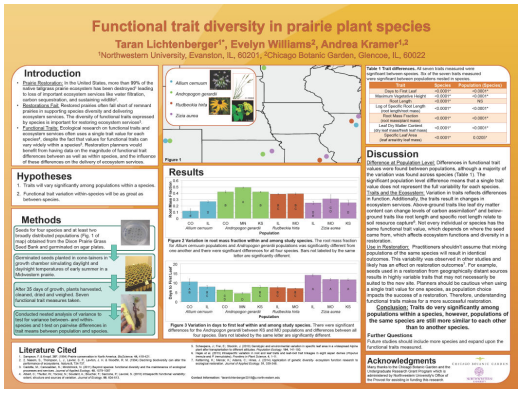
Floral scent is thought to play a role in facilitating plant-animal interactions across a wide range of plant taxa, mediating interactions with both mutualist and antagonist behavior (Knudsen et al. 2006, Cunningham et al. 2004; War et al. 2012). Evidence suggests that linalool plays a role in the attraction of pollinators in many plant taxa, but its role in influencing herbivore behavior is less understood (Raguso and Pichersky 1999). Oenothera harringtonii, provides an interesting system to study the effects of floral scent on plant-animal interactions. Hawkmoths serve both as pollinators and as herbivores, and fruits are colonized by microlepidopteran moths (Mompha) that feed on seeds. Although its range is restricted in size and hawkmoth-mediated gene flow between populations is known, this species shows great variation in floral scent between populations (Skogen, unpublished). Populations in the southeast-portion of the range have been shown to produce flowers lacking S-(+)-linalool (DC) (n = 46), while populations further north produce the compound (FLO) (n = 34).

We hypothesized that S-(+)-linalool will positively influence pollinator visitation to flowers, and that plants producing it will therefore be pollinated more often, resulting in higher fitness, than linalool-deficient plants. We further hypothesize that linalool mediates interactions with herbivores, and that plants that do not produce the compound are under selection to reduce herbivory and should have lower levels of herbivory and fitness than plants that produce linalool. We tested these hypotheses in a common garden setting near Flagstaff, AZ. We found that while there is a significant difference in neither visitation rates of pollinators between chemotypes or insect herbivory (albeit there is a trend toward higher levels of herbivory in linalool deficient plants), plants producing linalool have higher fitness than those that do not. This may be due to lower herbivory in the linalool producing plants, which may lead to them having higher relative fitness than linalool deficient plants.

8) Functional trait diversity in prairie plant species

Student: Taran Lichtenberger

Mentor: Evelyn Williams, Andrea Kramer

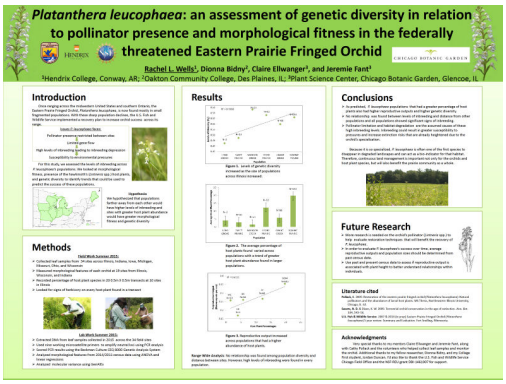


The diversity of species' functional traits plays a key role in restoring ecosystem services. Unfortunately, ecological research on functional traits and ecosystem services often uses a single trait value for each species, despite the fact that values for functional traits may vary widely within a species. We hypothesized that traits will vary significantly among populations of a single species and that functional trait variation within-species will be as great as between-species. We used four species with at least two broadly distributed populations from the Dixon Prairie Grass Seed Bank and germinated them on agar plates. We planted the germinated seeds in cone-tainers in a growth chamber simulating daylight and temperatures of early summer in a Midwestern prairie. After 35 days of growth, I measured seven above- and below-ground traits. We found differences in functional trait values between populations for six traits, although all seven traits were variable across species. The significant population level differences mean that a single trait value does not represent the full variability for each species. The trait variation likely results in changes in ecosystem services. Practitioners shouldn't assume that mixing populations of the same species will result in identical outcomes. Seeds used in a restoration from geographically distant sources results in highly variable traits that may not be suited to the new site. Planners should be cautious when using a single trait value for one species, as population choice impacts the success of a restoration. Therefore, understanding functional traits makes for a more successful restoration.

9) ***Platanthera leucophaea*: an assessment of genetic diversity in relation to pollinator presence and morphological fitness in the federally threatened Eastern Prairie Fringed Orchid**

Student: Rachel Wells

Mentor: Claire Ellwanger and Jeremie Fant



The Eastern Prairie Fringed Orchid, *Platanthera leucophaea*, was listed as federally threatened in 1989 as populations due to drastic population declines across its Midwestern range. These declines led to habitat fragmentations and have been thought to limit the orchid's pollinator presence between sites. Lack of pollination across populations can cause limited gene flow that could lead to high levels of inbreeding and subsequent inbreeding depression. We worked extensively in the field and the lab to assess if inbreeding was occurring across *P. leucophaea*'s range and analyzed whether a relationship existed between morphological fitness, presence of pollinator host plants, and genetic diversity. We found that levels of genetic diversity and host plant presence increased as population sizes increased and that there is a significant positive relationship among host plant presence, reproductive output, and genetic diversity. However, we also found high levels of inbreeding within each population; likely as a result of pollinator limitation and habitat degradation. This lack of genetic diversity puts this already specialized orchid at an even greater risk to environmental pressures, which could ultimately lead to its extinction. Therefore it is imperative that land management continues to be active throughout the orchid's habitats to help the success of *P. leucophaea* and its entire prairie community.

10) A Better Look at Fusarium Species Living in Mexican Vanilla Orchids Using RPB2

Student: Joshua Dansie

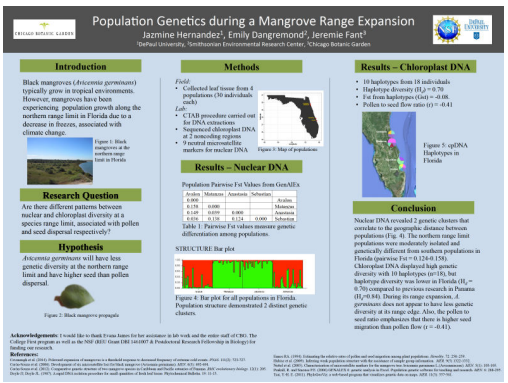
Mentors: Lynnaun Johnson, Greg Mueller

Known worldwide for its commercially valuable flavor, Vanilla planifolia is a hemi-epiphytic orchid that maintains a special relationship with soil fungi to maintain healthy growth and germination. The Vanilla orchid is the only genus of over 25,000 species of orchid that is used industrially for its products. In Mexico, several farms in Veracruz and Puebla regions that grow vanilla for high-demand markets are threatened by infection by a number of organisms. Fusarium is a fungal genus containing a number of known pathogens that inflict upwards of 67% mortality on contaminated plantations. Recent research has discovered various cultures of Fusarium living within healthy Vanilla roots alongside beneficial mycorrhizae. To better understand which Fusarium spp. are present, extracted DNA from cultured samples were amplified at the RPB2 marker and compared to reference sequences from known Fusarium using database-matching and phylogenetic methods. Results indicate a suite of at least three species, with two exhibiting a strong history of pathogenic behavior.

11) Population genetics during a Mangrove Range Expansion

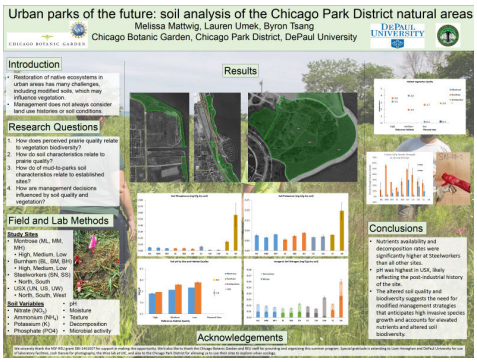
Students: Jazmine Hernandez

Mentors: Emily Dangremond, Jeremie Fant



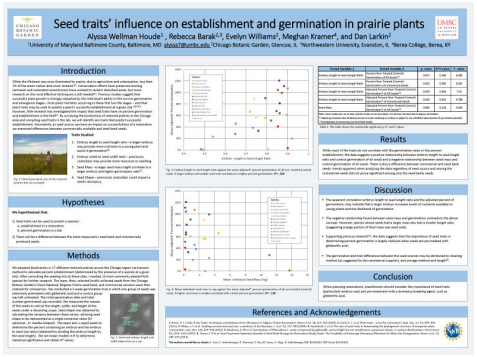
Mangrove trees offer coastal protection, stability, shelter and food for both marine and terrestrial species. The geographic range of the black mangrove, *Avicennia germinans*, spans from northern Florida to southern Brazil. Due to decreasing freeze temperatures in northern Florida, *A. germinans* is experiencing an expansion at its northern range limit in Florida. We hypothesized that *A. germinans* would have less genetic diversity at the northern range limit than more southern populations, and seed dispersal would be higher than pollen dispersal due to hydrochorous seeds. Leaf tissue was collected from 30 individuals at 4 different populations along the east coast of Florida. Nine neutral microsatellite markers were used to measure genetic diversity, gene flow, and inbreeding in nuclear DNA. Chloroplast DNA was sequenced from a subsample of individuals to measure haplotype diversity and seed-to-pollen flow ratios. We found no significant differences in genetic diversity (He) among populations, but the populations at the range edge were moderately isolated from populations further south in Florida (pairwise Fst = 0.124-0.158). Nuclear DNA revealed 2 genetic clusters that correlate to the geographic distance between populations (Fig 1). Chloroplast DNA displayed high genetic diversity with 10 haplotypes (n=18), but haplotype diversity was lower in Florida (Hd = 0.70) compared to previous research in Panama (Hd=0.84). During its range expansion, *A. germinans* does not appear to have less genetic diversity at its range edge and the pollen to seed ratio emphasizes that there is higher seed migration than pollen flow (r = -0.41).

12) Urban parks of the future: soil analysis of the Chicago Park District natural areas
Student: Melissa Mattwig
Mentors: Lauren Umek, Byron Tsang



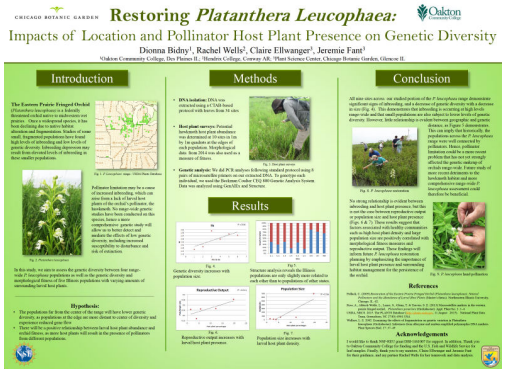
The Chicago Park District's Natural Areas Program employs traditional management techniques similar to other regional land managers. In southern Chicago, some new parks have been built upon post-industrial brownfields with imported soils. We compared the plant community and soil characteristics of two established prairies and two post-industrial sites with imported sediment soil along Chicago's lakefront. Sites were characterized by vegetation quality and soils were characterized by physical (moisture and texture), chemical (NO_3, NH_4, K, PO_4, pH), and biological (decomposition rate, and enzymatic activity) properties. Nutrient content, decomposition, and enzymatic activity were dramatically elevated at one post-industrial site (Steelworkers), but comparable among reference sites and the other post-industrial site (USX). At Steelworkers, soil chemical properties varied widely between sampling locations. At reference sites, soil pH generally reflected plant diversity, but this trend was not observed with the post-industrial sites. The altered soil quality and biodiversity of the post-industrial sites with imported sediments suggests that these sites require a modified management approach that anticipates high invasive species growth and accounts for elevated nutrients and altered soil biodiversity.

13) Title: Seed traits' influence on establishment and germination in prairie plants
Student: Alyssa Wellman Houde
Mentor: Rebecca Barak, Evelyn Williams, and Dan Larkin



Less than 1% of the Midwest's native prairies remain today and, though conservation efforts have been made to preserve existing remnants and reclaim disturbed areas, little research has been done on the most effective restoration techniques. By surveying the biodiversity of restored prairies in the Chicago area and compiling seed traits of 13 common prairie plants, we identified traits that predict successful establishment and germination and examined differences in germination between commercially available and seed bank seeds. Specifically, we chose to study a given seed's embryo length to seed length ratio, embryo width to seed width ratio, mass, and shape. Using linear models we found a positive relationship between the embryo length to seed length ratio and germination, a negative relationship between seed mass and germination, and a difference between commercial and seed bank seeds' germination rates. This suggests that larger embryos increase levels of nutrients available to young plants and the likelihood of germination. We also found that the importance of seed traits in determining percent germination is largely reduced when seeds are pre-treated with gibberellic acid. Practitioners should consider the importance of seed traits (particularly embryo size) and pre-treatment with a dormancy breaking agent, such as gibberellic acid, when planning restorations.

14) **Title: Restoring Platanthera Leucophaea:Impacts of Location and Pollinator Host Plant Presence on Genetic Diversity**
Student: Dionna Bidny
Mentor: Claire Ellwanger and Jeremie Fant

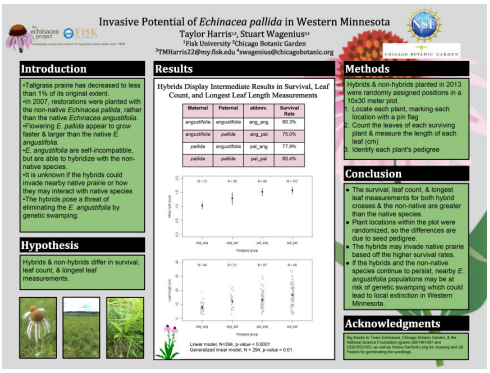


The Eastern Prairie Fringed Orchid (*Platanthera leucophaea*) is a federally threatened orchid native to midwestern wet prairies. Once a widespread species, it has experienced drastic population declines and is subject to high levels of inbreeding. Elevated levels of inbreeding may lead to inbreeding depression, the decrease of fitness due to inbreeding, placing the species at a greater risk of extinction. Increased inbreeding could be due to a lack of nearby pollinator larval host plants, which are sought out by pollinators because they are necessary to complete their lifecycle. This study examines the genetic diversity between four range-wide sites as well as that of five Illinois populations with varying amounts of surrounding host plants. We genotyped DNA from each individual and analyzed this for inbreeding and genetic diversity. Our results demonstrated high levels of inbreeding across the orchid range and confirmed an increase in genetic diversity with size. In addition, population size and reproductive output both increase with larval host plant density. This information will inform future *P. leucophaea* restoration planning by emphasizing the importance of larval host plant presence for population fitness.

15) Title: Invasive Potential of *Echinaceae pallida* in Western Minnesota

Student: Taylor Harris

Mentor: Stuart Wagenius

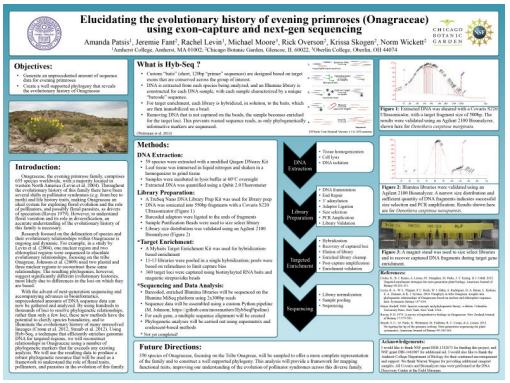


Tallgrass prairie of Western Minnesota has been reduced to less than 1% than it was originally. Restorations have been planted to re-establish the prairie. In 2007, a restoration was planted near a study site for the Echinacea project; instead of containing the native Echinacea angustifolia (narrow-leaved purple coneflower), the restoration was planted with non-native Echinacea pallida (pale purple coneflower). Though E. pallida look similar to E. angustifolia, this non-native species appears to grow faster and larger. E. angustifolia are self-incompatible, but the two species are able to hybridize, which may threaten the native species by genetic swamping (a process that occurs when the genes of a dominating species overshadow those of a smaller populated species as a result of being crossed). Hybrids and non-hybrids planted in 2013 in an adjacent restoration were investigated by measuring the survival, leaf count, and longest leaf length of each plant. Both hybrid crosses (angustifolia x pallida and pallida x angustifolia) along with the pure E. pallida had higher survival rates, higher leaf counts, and longer leaf lengths than the pure E. angustifolia species. If the hybrids and E. pallida continue to persist, they could invade native prairie and threaten nearby populations of E. angustifolia.

16) Title: Elucidating the evolutionary history of evening primroses (Onagraceae) using exon-capture and next-gen sequencing

Student: Amanda Patsis

Mentors: Jeremie Fant, Rachel Levin, Michael Moore, Rick Overson, Krissa Skogen, Norm Wickett

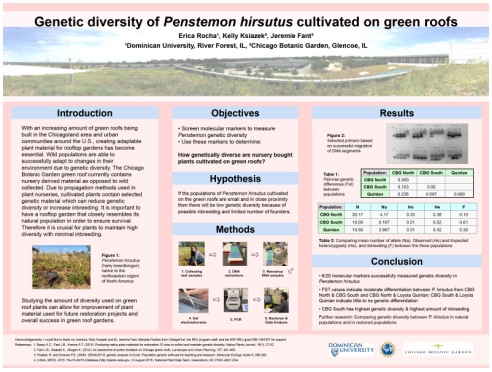


Onagraceae is a diverse plant family currently under development as a model system to understand the evolution of floral functional traits and their role in speciation; however, the current family-level phylogeny is characterized by several relationships that are unresolved or poorly supported. The methods previously used to resolve relationships in this group were labor intensive, limiting the number of genes and species that could be included in phylogenetic analysis. Recent developments in technology and bioinformatics have enabled the efficient generation of a large number of markers and the tools to analyze these data within reasonable time frames. The goal of this project is to capture over 350 nuclear genes for over 48 species of Onagraceae using liquid-based sequence capture techniques with baits designed from existing transcriptome data. High throughput sequencing technology will allow us to sequence these loci simultaneously, and will ultimately provide a robust phylogenetic framework for current ecological and evolutionary studies of functional traits across this diverse family of flowering plants.

17) Title: Genetic diversity of Penstemon hirstus cultivated on green roofs

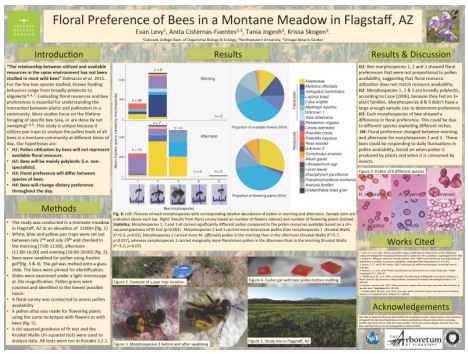
Student: Erica Rocha

Mentor: Kelly Ksiazek, Jeremie Fant



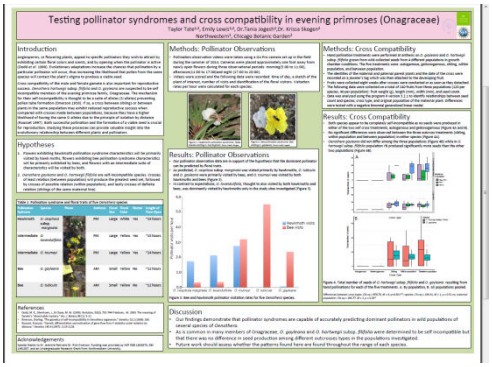
With an increasing amount of green roofs being built in the Chicagoland area and urban communities around the U.S., creating adaptable plant material for rooftop gardens has become essential. Wild populations are able to successfully adapt to changes in their environment due to genetic diversity. The Chicago Botanic Garden green roof currently contains nursery derived material as opposed to wild collected. Horticultural plants from nurseries contain selected genetic material which can reduce genetic diversity or increase inbreeding. It is important to have a rooftop garden that closely resembles its natural population in order to ensure survival. Therefore it is crucial for plants to maintain high diversity with minimal inbreeding. This project aims to determine which molecular markers measure genetic diversity in an Illinois native plant, *Penstemon hirsutus*, and to compare the genetic diversity within three populations. Studying the amount of diversity used on green roof plants can allow for improvement of plant material used for future restoration projects and overall success in green roof gardens. By collecting Penstemon leaf samples from two Chicagoland green roofs, molecular markers were used to analyze repeats in DNA called microsatellites. Through analyzing allelic data from the microsatellites, we determined little to no genetic differentiation as well as moderate differentiation between the populations. Inbreeding and genetic diversity statistics indicated a bottleneck effect in a population.

18) Title: Floral Preference of Bees in a Montane Meadow in Flagstaff, AZ
Student: Evan Levy
Mentor: Anita Cisternas-Fuentes, Tania Jogesh, & Krissa Skogen.



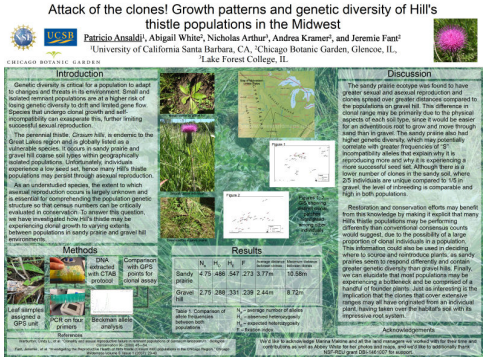
Native bees are becoming an increasingly important topic in conservation. However, the floral preference for most bees remains unknown. Foraging habits range from strictly oligolectic to broadly polylectic. Most of the studies to look at the use of floral resources by bees have used analysis of pollen in nests or used nets to sweep bees off of plants. This study uses pan traps, the least biased way of sampling bees, to determine floral preference. Samples were collected from a montane meadow in Flagstaff, Arizona, at an elevation of 2100m for 12 days during the month of July. Traps were checked in the morning, afternoon, and evening. Three morphospecies of bees were found to be broadly polylectic, with diets differing significantly from each other. These same three morphospecies of bees used floral resources in a disproportionate way to the available floral resources, suggesting some sort of floral preference. Lastly, two morphospecies were found to change their floral preference between morning and afternoon. This study augments current knowledge about how a community of bees utilizes local floral resources.

19) Title: Floral Preference of Bees in a Montane Meadow in Flagstaff, AZ
Student: Taylor Tate
Mentor: Emily Lewis, Tania Jogesh, & Krissa Skogen.



Flowering plants pollinated by insects can be put into a pollinator syndromes based on the floral traits they have. My research has explored which pollinator syndromes flower species within the Oenothera Family fall into along with which pollinator is attracted to those species as a result of their floral traits. The main pollinators I considered were hawk moths, which are associated with floral traits such as night time opening, long floral tubes, and nectar containing, and bees, which are associated with floral traits such as morning opening flowers, short floral tubes and a lack of nectar. Additionally, I studied genetic crosses in two different species of Oenothera from a total of three different populations. I explored how crosses between different populations affected seed viability. This was measured using fruit weights, and the number of seeds relative to the the number of unfilled ovules.

20) Title: Attack of the clones! Growth patterns and genetic diversity of Hill's thistle populations in the Midwest
Student: Patricio Ansaldi
Mentors: Abigail White, Jeremie Fant

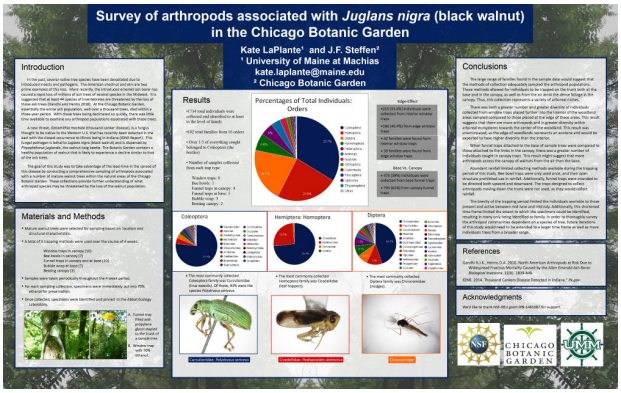


Maintaining genetic diversity via sexual reproduction within populations is important for increasing the likelihood of adapting to environmental change, resisting pathogens, and increasing establishment. However, asexual reproduction in plants is relatively common and can be linked to inbreeding depression, which can impact survival. To this end, we looked at the reproductive behavior of a vulnerable perennial thistle, *Cirsium hillii,* or Hill's thistle. This plant is a habitat specialist found on coarse soil types such as sandy prairies and gravel hills throughout the Midwest and southern Ontario. The reproductive activity of populations on these soils can vary substantially with many individuals hypothesized to be clones of the same plant. To examine its population structure, we compared samples from a sandy prairie and a gravel hill habitat to see the extent of its potential clonal growth and how it differed between soil types. We collected leaf samples and associated them with a GPS coordinate, extracted DNA, and used PCR with four primers and a Beckman analysis of alleles to determine how many clones there were and their range within each population. We found that there were more clones in a smaller geographic area at the gravel hill prairie compared to the sandy prairie site. There was also more genetic diversity in the gravel population, although both populations were found to have similar levels of elevated inbreeding. Our investigation indicates that clonal growth can make up much of population census figures for this species and that differences in genetic diversity between habitat types should be considered in restoration work.

21) Survey of arthropods associated with Juglans nigra(black walnut) in the Chicago Botanic Garden

Student: Kate LaPlante

Mentors: Jim Steffen

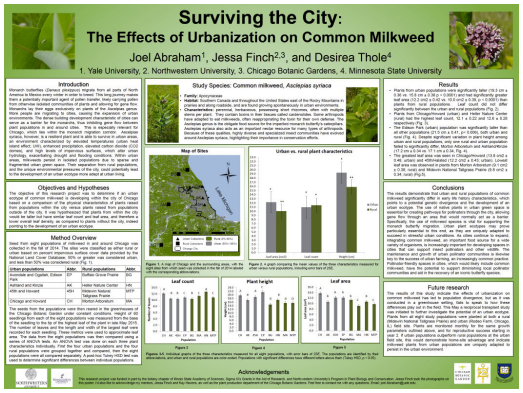


Native tree species have been devastated due to introduced insects and pathogens in the recent past. A new threat, *Geosmithia morbida* (thousand canker disease), is a fungal pathogen that is lethal to *Juglans nigra* (black walnut) and has been discovered in Indiana and may move into the woodlands of Illinois in the near future. The goal of this study was to conduct a comprehensive sampling of arthropods associated with walnut trees within the Chicago Botanic Garden to begin to understand what species of arthropods may be under threat should the walnut trees decline throughout the Midwest. Five trapping methods were employed over the course of four weeks, with samples taken periodically throughout that time. Collected specimens were identified to at least the family level, preserved by pinning and housed at the Chicago Botanic Garden. A broad range of arthropods were sampled, with the most common orders being Coleoptera (the beetles), Homoptera (e.g. hoppers and cicadas) and Diptera (the flies). Samples taken from the interior of the woodland and from the canopy of individual trees were found to be more diverse and supplied larger sample sizes than those from the woodland edge and from the base of individual trees. Time constraints and sampling area limited this study. Sampling over a broader area for a greater period of time is recommended and would produce more comprehensive results.

22) Surviving the City: The Effects of Urbanization on Common Milkweed

Student: Joel Abraham

Mentors: Jessa Finch



Common milkweed, *Asclepias syriaca*, is an important floral resource in the increasingly urbanized modern world, supporting diverse arthropod communities within cites. To determine if the extreme environmental pressure of the urban setting has selected for a different genotype, seed was collected from 4 urban and 4 rural populations throughout the Chicago region. Seeds were grown under constant greenhouse conditions and the characteristics of the seedlings, such as plant height, leaf count, and leaf area, were compared. Overall, milkweeds from urban populations were taller (19.3 cm ± 0.36 vs. 15.8 cm ± 0.38) and had greater leaf area (12.2 cm^2 ± 0.42 vs. 10.0 cm^2 ± 0.39) than milkweeds from rural populations ($p < 0.0001$). However, growth metrics varied significantly at the population level, highlighting specific populations as drivers of the significance observed. These results point to a potential genetic divergence between urban and rural populations and the development of an urban ecotype, possibly due to the increased competition for scarce resources in urban environments.

THANKS TO:

REU Coordinator: Abigail White

Mentors: We want to send a special thanks to all mentors. A 10 weeks training program would not be possible with all your help. We appreciate all the time and effort you have put into these students and hope that it is been as rewarding for you as it was for the students.

Funders: This summer program was made possible with funding from NSF-REU DBI-1461007 (Fant, Larkin), NSF- Dimensions-1342873 (Skogen, Fant and Wickett) and NSF_DEB -1354551 (Larkin,Williams, Lonsdorf), Chicago Botanic Garden College First Program, Northwestern Office of Undergraduate Research, Oakton Community College , Associated Colleges of Illinois Internships & SPARKS (Stevenson High School)

Poster Judges: Andrew Bunting (Assistant Director of the Garden and Director of Collections), Eileen Prendergast (Director, Education) and Greg Mueller (Negaunee Foundation Vice President of Science)

See more at: http://cbgreu.org/