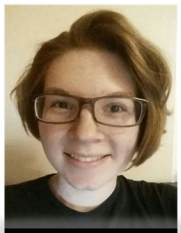
Jalen Holloway
Pollination
Biologist

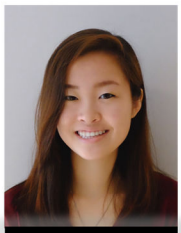


Brooke Allen
Root Scientist

Marina Malone
Geneticist

Sydney Weil
Entomologist

Imeña Valdes
Seed Biologist



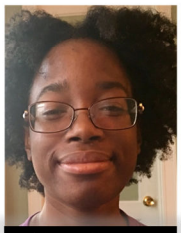
Stephanie Roh
Pollination
Biologist

Corina Godoy
Plant Anatomy

CHICAGO BOTANIC GARDEN

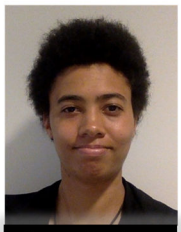
2017 REU POSTER SESSION
Research Experiences for Undergraduates

Plant Conservation Science Center
August 17, 2017



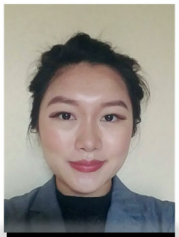
Evana James
Geneticist

Ana Flores
Ecologist



Renata Poulton
Kamakura
Ecologist

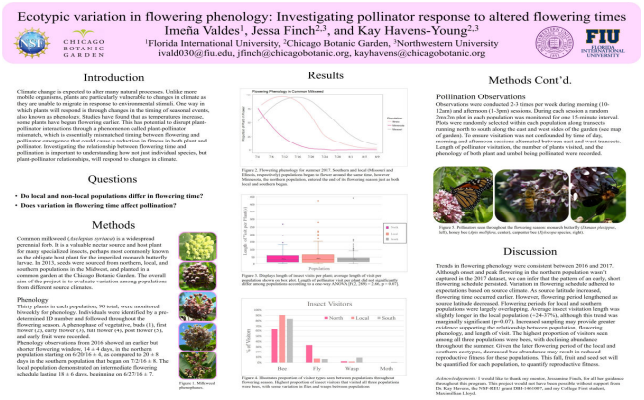
Elizabeth
Donaldson
Geneticist



Anni Wang
Bioinformatician

Justyn Carrasco
Geneticist

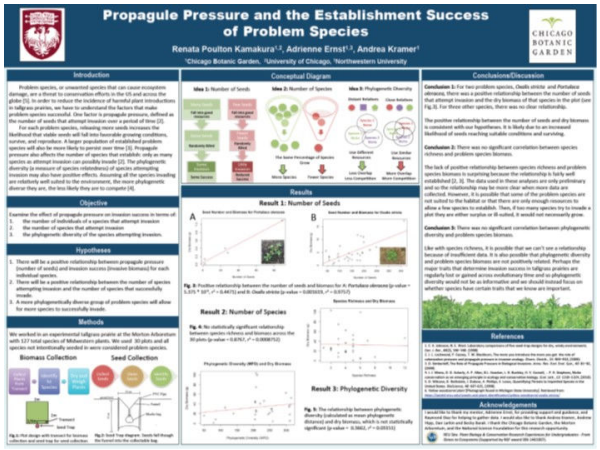
1) **Imeña Valdes** is studying Biological Sciences at Florida International University and is expecting to graduate in 2018



Title: Ecotypic variation in flowering phenology: Investigating pollinator response to altered flowering times

Abstract: Climate change is expected to alter many natural processes. One way in which plants will respond is through changes in the timing of seasonal events, also known as phenology. Studies have found that as temperatures increase, some plants have begun flowering earlier, with the potential to disrupt plant-pollinator interactions. Mismatched timing between flowering and pollinator emergence (i.e. pollinator mismatch) could cause a reduction in fitness in both plant and pollinator. Investigating the relationship between flowering time and pollination is important to understanding how not just individual species, but plant-pollinator relationships, will respond to changes in climate. In 2013, common milkweed seed was sourced from northern, local, and southern populations in the Midwest, and planted in a common garden at the Chicago Botanic Garden to study ecotypic variation. This summer we used phenology surveys and pollinator observations to answer the following questions: 1) Do local and non-local populations differ in flowering phenology? 2) Does variation in flowering time affect pollination? Variation in flowering schedule adhered to expectations based on source climate. As source latitude increased, flowering time occurred earlier. However, flowering period lengthened as source latitude decreased. Flowering periods for local and southern populations were largely overlapping. Average insect visitation length was slightly longer in the local population (+24-37%), although this trend was marginally significant (p=0.07). Increased sampling may provide greater evidence supporting the relationship between population, flowering phenology, and length of visit. The highest proportion of visitors seen among all three populations were bees, with declining abundance throughout the summer. Given the later flowering period of the local and southern ecotypes, decreased bee abundance may result in reduced reproductive fitness for these populations.

2) **Renata Poulton Kamakura** is studying Biological Sciences, Ecology and Evolution Specialization at University of Chicago expecting to graduate in 2018



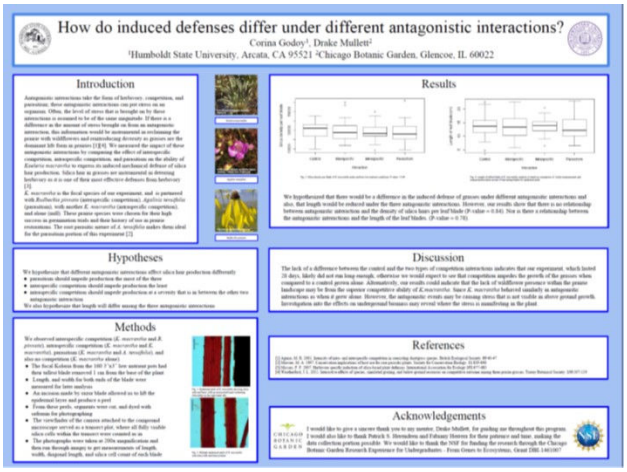
and is

Title: Propagule Pressure and the Establishment Success of Problem Species

Abstract: Invasive species are a threat to ecosystems worldwide, including the already diminished tallgrass prairies. Propagule pressure, the number of seeds that attempt to enter a community over a period of time, can affect the establishment success of invasive species. Previous studies indicate that an increase in the total number of seeds of an invasive species increases its probability of successful invasion and that an increase in the number of species attempting invasion increases the number of species that successfully invade. The effects of the phylogenetic diversity of the invasive species are less clear. Generally, more closely related species have more niche overlap and will compete more than more distant relatives. Therefore, we hypothesized that greater invasive phylogenetic diversity will lead to more invasive species successfully establishing due to reduced competition. We used 30 plots of prairie plants and collected dry biomass of invasive species to measure invasion success and collected a seed sample from each plot to measure propagule pressure. Our results indicate a positive correlation between the number of seeds of an invasive species and its biomass in a plot but did not indicate a correlation between either species richness or phylogenetic diversity and invasive biomass. Thus our preliminary data indicate that species richness and phylogenetic diversity are not major predictors of invasive species success

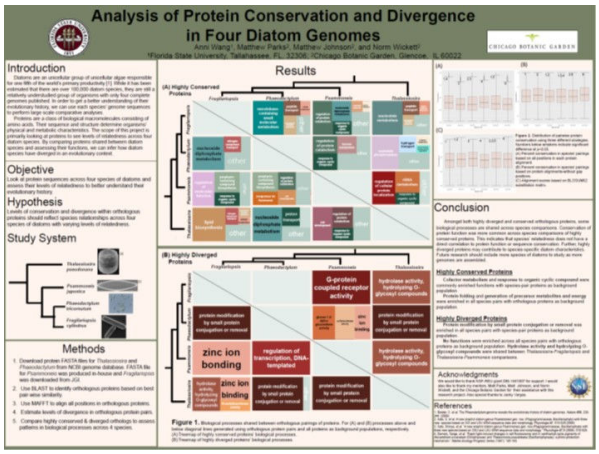
3) **Corina Godoy** is studying Environmental Science and Management at Humboldt State University and is expecting to graduate in 2018

Title: How do induced defenses differ under different antagonistic interactions?
Abstract: Different antagonistic interactions are assumed to cause a similar level of stress in the participants of these interactions. Our experiment would challenge this idea, as we hypothesize that there will be a difference in expression of the induced defenses of our focal plants. We tested for the difference of induced defenses in three antagonistic interactions: interspecific competition, intraspecific competition, and parasitism, by how they affected the induced mechanical defense of *Koeleria macrantha*.



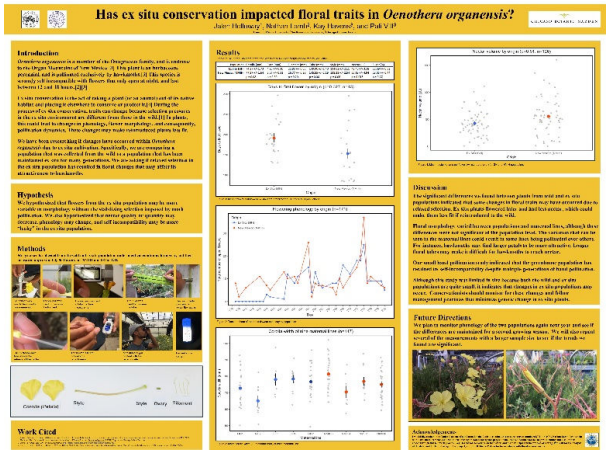
4) **Anni Wang** is studying Biological Science at Florida State University and is expecting to graduate in 2017

Title: Analysis of Protein Convergence and Divergence in Four Diatom Species
Abstract: Diatoms are an understudied group of unicellular algae responsible for one fifth of the world's primary productivity. In order to get a better understanding of their evolutionary history, we can use species' genome sequences to perform large scale comparative analyses.

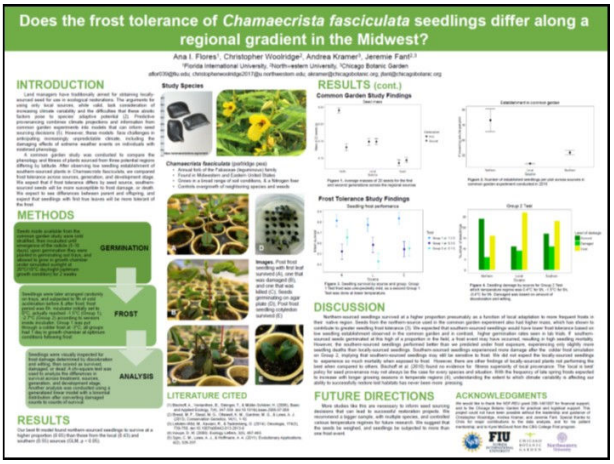


5) **Jalen Holloway** is studying Environmental Science at Humboldt State University and is expecting to graduate in 2017

Title: How is ex situ conservation impacting *Oenothera organensis*?
Title: *Oenothera organensis* is a flowering perennial in the Onagraceae family, and it is endemic to the Organ Mountains of New Mexico. The flower is self-incompatible and pollinated exclusively by hawkmoths. We compared the wild and the ex situ populations of *O. organensis* to investigate whether hand-pollination over multiple generations is changing the floral morphology of the ex situ population. If changes in the ex situ population occur, it could lead to a difference in pollination outcomes because the hawkmoths may find their new traits either more or less attractive. Over one flowering season, we measured floral morphology and phenology of both populations to compare corolla length, tube length, style length, nectar quantity, nectar sugar content, date of first flowering, and peak flowering. We also carried out controlled crosses to assess whether self-incompatibility had been lost in the ex situ population.

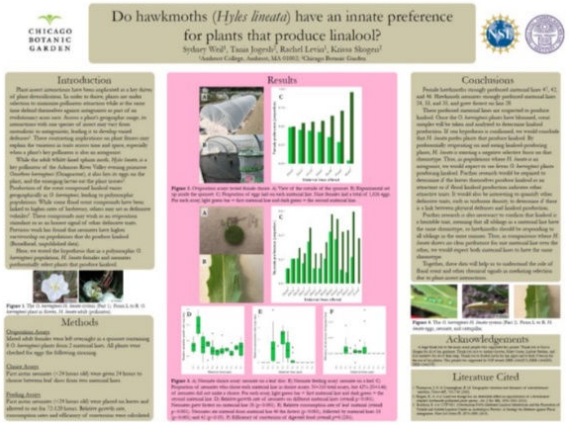


6) **Ana Flores** is studying Biological Sciences at Florida International University and is expecting to graduate in 2018



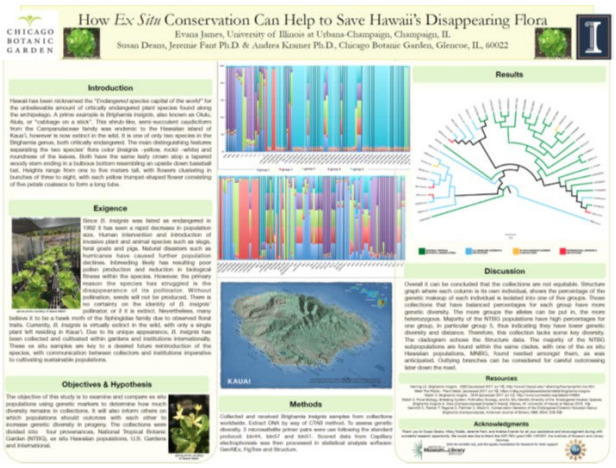
Title: Does frost tolerance of Chamaecrista fasciculata seedlings differ along a regional gradient in the Midwest?
Abstract: Current efforts to restore prairie ecosystems require that ecologists and land managers choose a seed sourcing strategy that minimizes genetic risks and increases adaptive potential in the face of climate change. Predictive provenancing combines climate projections and information from common garden experiments into models that can inform seed sourcing decisions. However, predictive models face challenges in anticipating plant responses to climate variability, including tolerance to late frost events. A common garden study was conducted to compare the phenology and fitness of plants sourced from three potential regions differing by latitude. After observing low seedling establishment of southern-sourced plants in *Chamaecrista fasciculata*, we compared frost tolerance across sources, generation, and development stage. We expect that if frost tolerance differs by source, southern-sourced seeds will be more susceptible to frost damage or death. Seedlings were planted and allowed to establish to two different developmental stages, after which they were subjected to a simulated frost event. Our best fit model found northern-sourced seedlings to survive at a higher proportion (0.65) than those from the local (0.43) and southern (0.55) sources (GLM, $p < 0.05$). Northern source higher survival was possibly due to local adaptation in their native range. While Southern high slightly better survival than local, it had high mortality in the colder test, implying some frost sensitivity. Local source had high proportion of seedling death, consistent with other studies about local provenance, and suggesting the 'local is best' may not always be the right policy for restoration

7) **Sydney Weil** is studying Biology at Amherst College and is expecting to graduate in 2018



Title: Do hawkmoths (*Hyles lineata*) have an innate preference for plants that produce linalool?
Abstract: Insects have been key drivers of plant diversification for millions of years, with plants co-evolving to make themselves more appealing to pollinators while also developing a wide range of defenses against herbivores. However, in some systems, the relationship between a plant and its insect pollinator may vary from mutualistic to antagonistic, creating a variation in traits in both space and time. For example, the Arkansas River Valley evening primrose, *Oenothera harringtonii* (Onagraceae), is mainly pollinated by the white-lined sphinx moth, *Hyles lineata*, which, in its larval stage, also acts as an herbivore. In this study, we tested to see if *H. lineata* was driving the geographic variation in the production of the scent compound linalool in *O. harringtonii*. We hypothesized that female moths and first instar larvae would prefer plants that did produce linalool, and that larvae would grow better on these plants. To test preference, we conducted experiments in the lab to see which maternal lines adult moths and larvae chose as oviposition sites or as food. Both adult moths and larvae showed preference for specific maternal lines. While some preferences were life stage-specific, there were several lines preferred by both females and neonates, including the line on which neonates grew fastest. Further research will reveal the chemotypes of the tested *O. harringtonii* maternal lines and will allow us to determine if the moths prefer plants that do or do not produce linalool, which will help us to further understand the role of floral scent in mediating plant-insect interactions.

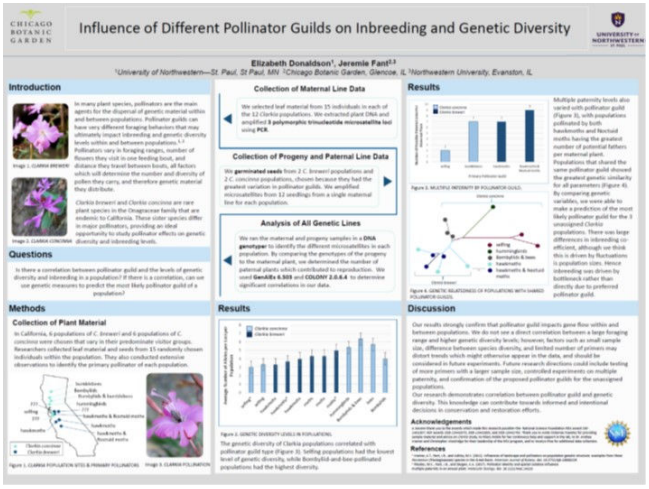
8) **Evana James** is studying Natural Resources and Environmental Science and is expecting to graduate in 2020



Title: How Ex Situ Conservation Can Help to Save Hawaii's Disappearing Flora

Abstract: *Brighamia insignis*, also known as Olulu, Alula, or "cabbage on a stick", is a shrub-like, semi-succulent caudiciform endemic to the Hawaiian islands of Kaua'i and Ni'ihau. *B. insignis* is one of only two species in the Brighamia genus, both being critically endangered in the wild. The main distinguishing feature separating the two species is their differing flower colors. Due to lack of genetic fitness, loss of sole pollinator, the threat of invasive plant and animal species, human interference, and hurricanes, Alula has been brought to near extinction in the wild. The objective is to accumulate international off-site (ex situ) samples from gardens and institutions to test the genetic diversity. Individuals with the most genetic differentiation can be used to reintroduce a fitter generation into the wild, however it is hypothesized the specimens will have high levels of homozygosity and inbreeding between and within the populations. To compare the levels of zygosity of the species within each population, CTAB extraction protocol was used to extract the DNA from plant tissue. The derived DNA underwent polymerase chain reaction (PCR), using microsatellite primers. Later analysis was conducted on a Beckman Coulter genetic analysis system and GenAlEx software. The results suggest that there were high levels of homozygosity amongst the ex situ populations. Probable cause for levels of inbreeding observed is the population bottleneck the species underwent and the resulting inbreeding depression.

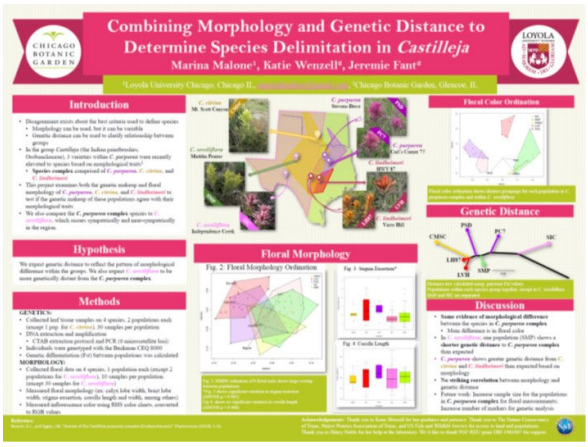
9) **Elizabeth Donaldson** is studying Biology at University of Northwestern - St. Paul and is expecting to graduate in 2019



Title: Influence of different pollinator guilds on inbreeding and genetic diversity

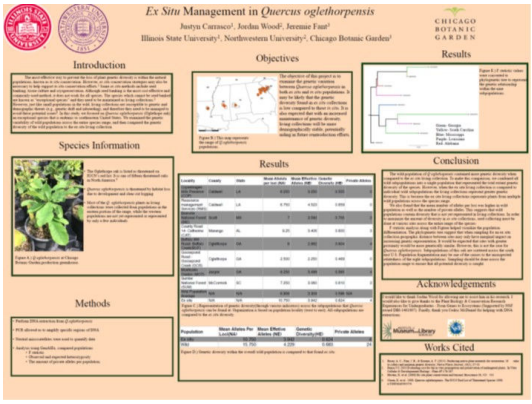
Summary: Variations in pollinator guilds foraging behavior may influence the amount and diversity of pollen that plants will receive, and therefore genetic makeup of offspring. Our research considers the correlation between the genetic diversity and inbreeding in plant populations and the foraging characteristics of their primary pollinators. We analyzed maternal and progeny genotypes of Clarkia concinna and Clarkia breweri populations with differing primary pollinators. Preliminary results show some correlation between pollinator guilds and genetic characteristics, which can be confirmed with further research. Levels of inbreeding and genetic diversity were shown to vary between species and to correlate with pollinator guilds. These results suggest that pollinator guilds do influence the gene flow within and between populations and therefore should be considered as an important factor in conservation study

10) **Marina Malone** is studying Computer Engineering and is expecting to graduate in 2020



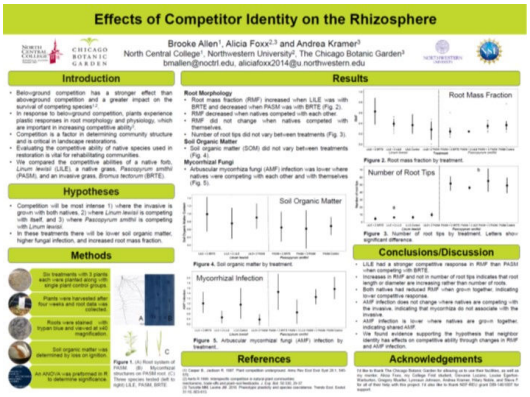
Title: The Genetics Behind the *Castilleja purpurea* Complex
Project Outline: In the genus Castilleja (the Indian paintbrushes; Orobanchaceae), 3 varieties within C. purpurea were recently elevated to species, creating a species complex consisting of *C. purpurea*, *C. citrina*, and *C.lindheimeri*. Because the taxonomic change was based on morphology, which is a variable standard, understanding the genetic distance between groups can help clarify their correct taxonomic placement. Therefore, this research examines both the species' genetic makeup and flower morphology to test if the genetic makeup of these populations agree with its morphological traits to identify them as separate species. Using leaf tissue samples and floral collections, we compare the genetic composition and quantified floral traits of these populations with the aid of microsatellite markers and image processing programs.

11) **Justyn Carrasco** is studying Plant Biology at Illinois State University and is expecting to graduate in 2020



Title: Ex situ management of *Quercus oglethorpensis*
Summary: *Quercus oglethorpensis* is an endangered species of oak native to the southeastern part of the United States. This project primarily focuses on looking at the genetic variation amongst *Q. oglethorpensis* populations in the wild, and then comparing it to what is currently found in living populations. It is expected that populations in the wild will have more diversity than those in living collections. We used neutral microsatellite markers to estimate the genetic structure and calculate the expected heterozygosity as well at the amount of inbreeding that is happening with in these populations (using GenAlex). Initial results are showing that living collections have less diversity than the wild populations, and that many individuals are genetically related, thus increasing the chance of inbreeding, which may impact how useful they will be for reintroduction. From this data, we can identify sources missing from current collection and ensure we can demographically improve the value of living collections.

12) **Brooke Allen** is studying Biology at North Central College and is expecting to graduate in 2018/



Title: Investigating the Effects of Inter- and Intraspecific Competition on Soil, Root Morphology, and Mycorrhizal Associations in Plants Native to the Colorado Plateau
Summary: Competition is a prominent factor in determining community structure and is, therefore, a potentially important factor in landscape restorations. Roots contribute significantly to competitive outcomes and can exhibit plastic morphological and architectural changes in response to below-ground competition. Plastic responses are important in increasing competitive ability, and root morphology has a role in biotic interactions in the rhizosphere which may impact nutrient acquisition. Here we tested how the identity of a competitor alters root morphology in a focal plant, and soil components including moisture content, organic matter, and mycorrhizal associations. We collected biomass and morphology data on four-week old perennial native forb and grass species *Linum lewisii* and *Pascopyrum smithii*; both in competition with individuals of the same species, the alternate native species, and an invasive grass, *Bromus tectorum*. We hypothesize that competition will be more intense 1) in treatments where the invasive plant is grown with both native plants, 2) where Linum lewisii is competing with itself, and 3) where Pascopyrum smithii is competing with the other species. In these more intense competition treatments we hypothesize that there will be lower soil organic matter and soil moisture content, higher fungal associations, and increased root length, root tissue density, and root mass fraction. This would suggest plasticity and variation in competitive intensity based on neighbor identity.