CHICAGO BOTANIC GARDEN

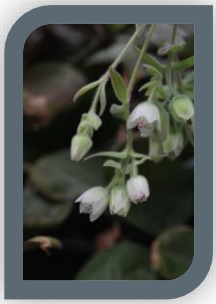
Science Yearbook 2017

Rare magenta form of Pitcher's thistle (*Cirsium pitcheri*)

Compiled by Kayri Havens

2018

EXECUTIVE SUMMARY



The Chicago Botanic Garden's Plant Science and Conservation department had a productive year in 2017. Late in the year we received news that all three of the NSF full proposals we submitted were funded. So several exciting new projects will be starting in 2018, including a study in the Rocky Mountains, "Addressing the missing link: uniting demographic life history theory and pollination biology to understand the ecological consequences of pollinator declines," "Unlocking the evolutionary history of a rapid Hawaiian Islands radiation with extraordinary breeding system diversity" which focuses on the Hawaiian genus *Schiedea* (left), and "Exceptionally well-preserved fossil plants from the Late Jurassic and Early Cretaceous of Mongolia and China."

Amy Iler (in red) and Paul CaraDonna's field site for their pollinator decline study in Colorado

Our Plant Evaluation Program received some nice accolades this year. It has long been recognized as the country's largest and most influential evaluation program at a botanic garden, and it was recently lauded by *Garden Design* in their winter issue. Next year, in a partnership with Conservation Science, evaluation of cultivars for pollinator support gets underway in the Lavin Evaluation Garden. On the left, a honeybee is interested in the new introduction from the Plant Breeding program called *Vernonia* 'Summer's Surrender.'

Andrea Kramer (far right) with Garden colleagues and students on Capitol Hill in February 2017

Our scientists and students are working hard to spread the word about the importance of plants to a diversity of audiences. From the International Botanical Congress in China to the halls of Congress in Washington DC, we have been vocal advocates for plants and plant conservation. A bill authored by the Garden's lobbyist and science team was introduced in the House of Representatives by Congressman Quigley in 2017. The "Botanical Sciences and Native Plant Materials Research, Restoration and Promotion Act" or HR 1054 is garnering bipartisan support, but still has a lengthy road to travel before becoming law!

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RESEARCH PROJECTS AND CONSERVATION PROGRAMS

The Chicago Botanic Garden is a leader in the international effort to conserve and promote global biodiversity. The Garden's plant biology and conservation science program is providing national and international leadership in conservation and training, engaging critical natural resource management research, and offering a world-class science facility for researchers and students. The program aims to help mitigate the loss of plant diversity and to foster an improved relationship between humans and nature. Said another way, the Garden's goal is no less than to help save the planet by helping to save its plants.

To accomplish this goal in 2017, 48 staff, 46 graduate students, 207 interns, and over 300 volunteers in the Garden's plant biology and conservation science program contributed their efforts on the five interrelated research and action areas represented by the columns in the following figure.

Understanding Threats to Plants, Fungi, and Natural Areas	Mitigating Threats	Documenting and Understanding Biodiversity	Building Capacity and Understanding	Using Plants and Fungi for Human Benefit
-Climate change -Invasive species -Habitat loss and fragmentation -Pollinator loss -Population decline -Loss of genetic diversity	-Seed banking -Plant monitoring -Restoration of plants and soils -Assisted migration -Urban greening	-Systematics -Genetic and species diversity -Plant /animal and plant/fungal interactions	-NU Graduate Program -Conservation and Land Management Program -Interns (undergraduate and high school)	-Crop genetics -Ornamental plant breeding and evaluation

The following project summaries are organized under these areas.

RESEARCH PROJECTS AND CONSERVATION PROGRAMS

Understanding Threats to Plants, Fungi, and Natural Areas

Phenology Projects – In 2017, the Garden substantially revised and updated the Project BudBurst website and programming. Now known as **Budburst**, this national citizen science program relaunches in early 2018 and is reimagining what public participation in research can look like. We invite the community to join us on the entire scientific journey from asking questions, to collecting and analyzing data, to drawing conclusions. We still focus on projects that look at the timing of leafing, flowering, and fruiting of plants (*plant phenophases*)—all of which are related to climate, but are also asking specific, time-bound research questions, such as do cultivars of native plants differ from their parent species in phenology and pollinator support (Havens, Schwarz-Ballard, Bryan, CaraDonna, Iler, Finch, and outside collaborators).

Temporal Dynamics of Plant-Pollinator Interaction Networks – Species interactions are the building blocks of ecological communities and play an important role in ecosystem function (e.g., pollination and plant reproduction). Although there is a general appreciation that ecological systems are inherently variable in time, we currently have a poor understanding of the dynamic nature of species interactions along temporal gradients. Furthermore, it remains unclear whether

there are predictable patterns of temporal dynamics of species interactions, especially for plants and pollinators. Understanding these temporal dynamics provides insight into fundamental ecological patterns, and it additional provides practical information that can help guide conservation practices and improve predictions about how communities of plants and pollinators may respond to future climate change. We have been investigating the temporal dynamics of plant-pollinator interactions in the Colorado Rocky Mountains since 2013, finding that at these interactions are highly temporally dynamic and appear to be inherently flexible to change (CaraDonna). A new aspect of this work will be to rigorously investigate temporal variation in the floral resource landscape available to pollinators (CaraDonna and Bain).

Seed Germination and Climate Change – In 2013, we began a project to understand the temperature and moisture tolerance ranges for germination of numerous native species. Seed recruitment is predicted to be one of the most at-risk stages for plant regeneration in a changing climate. This project is focusing on several *Asclepias* species to characterize tolerance ranges for germination, while field trials test the effects of these differences on establishment under natural conditions. By using multiple populations of species representing a gradient of neighborhood sizes, the results should be applicable beyond our study taxa. In 2017, the final component of the work, comparing the genetic structure of our source populations, got underway (Havens, Kramer, Finch, Vitt, and outside collaborators).

Tropical Dry Forest Responses to Altered Precipitation - Tropical forests cycle more CO_2 and water than any other ecosystem, and are considered to be Earth's largest carbon sink. However, these forests will likely experience an unprecedented shift to warmer temperatures and more frequent and intense droughts in the near future; plant and microbial community responses to these changes are largely unknown. To reduce this uncertainty, we installed an experimental rainfall manipulation study in the Yucatán in 2017, and started to examine plant function and soil processes following reductions in rainfall input (microbial communities, water and nutrient cycling, carbon sequestration). This field-based approach will provide detailed information on the potential effects of climate change in tropical dry forests, their long-term vulnerability to a changing climate, and provide information that will improve the long-term accuracy of global climate models (Egerton-Warburton).

Gravel Hill Biodiversity – Much like wetlands, gravel hill prairies represent a microcosm within the tallgrass prairie. The drier conditions support a unique plant community, including a number of important endemic and rare species. With landscape fragmentation, these habitats are becoming increasingly isolated, and many populations are declining and exhibiting reproductive failure. We propose to identify demographic, genetic, and management-related drivers of population decline, and to address identified issues through *ex situ* and later *in situ* experiments. Recommendations will be developed based on findings and past data to ensure that land managers have clear guidance for how to support healthy populations of rare species. Another aspect of this work will investigate the role of community biodiversity in driving population trends for these species (Fant, Kramer, Goad, Jacobi, Zeldin, Bonefont, Gavin-Smyth).

Roof Top Ecosystems – City green spaces are being recognized as important components of the urban ecosystem providing usable habitat for many organisms, including migrating species. Green roofs are just one example of an urban green space, but they are both novel and rapidly increasing in area within North America. Graduate student Kelly Ksiazek has been documenting the ecological services that green roofs provide as well as describing the ecological services found

on the green roofs. Her work has resulted in three publications to date (Ksaizek, Skogen and Fant).

Integrated Crop Pollination Project Database – We have developed an online MySQL database that stores data for the Integrated Crop Pollination (ICP) Project. The ICP project investigates different pollination strategies on various fruit and vegetable crops to identify the impacts on crop performance, economics and farmer perceptions. The pollination strategies investigated include a complete reliance on honey bees, manipulations to farm habitat to enhance suitability for bees and the use of a combination of honey bees and managed native bees. The database stores data collected on bee populations, farm management, fruit yield and non-crop vegetation sampling (Jacobi).

Understanding the consequences of pollinator declines for plant population dynamics – An experimental demography project was established at the Rocky Mountain Biological Laboratory during summer 2017, to understand how changes in the level of pollination affect the ability of plant populations to persist long-term. Widespread evidence from demographic life history research strongly but indirectly suggests that altered pollination may in fact have negligible effects on perennial plant population growth rates. However, the limitations of these analyses for species with complex life histories and the scarcity of empirical data that directly link pollination to plant fitness casts uncertainty on these predictions. The need to link species interactions to their fitness consequences is especially urgent in light of widespread evidence of pollinator declines and the growing need to understand their broader ecological and economic consequences. We established experimental plots for a subalpine perennial, *Hydrophyllum fendleri*, tagged all plants, and applied different pollination treatments: (i) increased pollination, (ii) reduced pollination, (iii) interannually variable pollination, and (iv) an unmanipulated control. These plants will be assessed for four years, and the data used to parameterize integral projection models (IPMs) that can elucidate whether changes in pollination translate into changed plant population dynamics. This project will provide the empirical evidence necessary to bridge conceptual gaps among pollination biology, life history theory, and population dynamics, while providing a framework for understanding and predicting the ecological consequences of pollinator declines (Iler and CaraDonna).

Developing a Coordinated, Multi-State Monarch Conservation Plan – In collaboration with the Association of Fish and Wildlife Agencies and the US Fish and Wildlife Service, we are developing a framework for allocating conservation targets for Monarchs. The USFWS recently announced a short-term goal of restoring sufficient milkweed and nectar plants in the US to support a monarch population of 6 ha in the overwintering habitat in Mexico. We led a Structured Decision Making workshop with USFWS, USGS and state agency partners to develop a framework to allocate milkweed conservation targets among partner states and sectors. We are continuing to refine and expand the allocation framework to a broader geographic scope (Jacobi and outside collaborators).

Using Plant Community Phylogenetics to Inform Restoration of Tallgrass Prairie Ecosystems – We are using emerging analytical tools to incorporate understanding of plant evolutionary history into studies of prairie community change, management, and restoration. We have found that phylogenetic diversity of remnant prairies—how broadly from across the 'Tree of Life' their constituent species are drawn—is an effective indicator of environmental conditions, community change, and management history in remnant prairies. Restored prairies that we have analyzed to date have significantly lower phylogenetic diversity than these remnant prairies, which serve as

targets for restoration. This could be one factor leading to shortfalls in restored prairies' functional equivalency with restoration sites. In 2014, we received a 5-year, collaborative NSF grant to test the effects of phylogenetic diversity on prairie restoration outcomes. Collaborators are based at the University of Minnesota, The Morton Arboretum, University of Toronto-Scarborough, and University of Wisconsin-Eau Claire. With this funding we are investigating patterns of phylogenetic diversity in existing restorations, performing restoration experiments to test the relative effects of phylogenetic and functional-trait diversity on restoration outcomes (including invasibility, supported by an NSF Graduate Research Fellowship to PhD student Ernst), and developing decision-support tools for restoration practitioners. (Jacobi, Williams, Barak, Zeldin, Ernst, and outside collaborators).

Long Distance Gene Flow and Hawkmoth Pollination – Long-distance pollination has widespread implications ranging from limiting population divergence, accelerating the spread of adaptive traits, disrupting gene complexes, and maintaining species cohesion. This is particularly the case for floral traits where long distance pollinators act as agents of selection while also constraining divergence. Since 2008, we have focused on *Oenothera harringtonii*, an endemic to southeastern Colorado, and in 2011, we initiated similar studies on *Castilleja sessiliflora* in Colorado and Illinois. We use a combination of field, greenhouse, and molecular tools to assess long-distance pollination events via hawkmoths, the primary pollinator of both species. Analyses to date show little genetic differentiation range wide in *O. harringtonii,* implying high rates of gene flow among populations. However, data on floral scent shows a geographic pattern whereby populations in the south exhibit different scent compounds than those in the north part of the range. With funding from the grant "NSF Dimensions of Biodiversity: Landscapes of Linalool: Scent-Mediated Diversification of Flowers and Moths Across Western North America," we are working with collaborators from nine institutions to assess patterns of floral diversification in numerous species in the evening primrose family, Onagraceae, [see below under Documenting and Describing Diversity] (Skogen, Fant, Jogesh, Overson, Wenzell, Wickett and outside collaborators).

Plants of Concern – Although the Chicago region is highly urbanized, it contains remnant natural areas that support rare species. Land managers use rare species data in management planning, but they are often unable to collect this data on a scale at which it is needed. Plants of Concern (POC) was founded to address this need, and in 2017, POC completed its seventeenth year of operation. Since this time, POC has trained and engaged 953 citizen scientists who have contributed over 40,000 hours in the field and office. The program has monitored 276 endangered, threatened, and rare species at over 300 sites in 1,349 populations throughout the Chicago Wilderness region. A state-wide monitoring program, modeled after POC, was started in Wisconsin in 2015, but POC continues to coordinate monitoring in northeastern Illinois and northwestern Indiana. A strongly collaborative regional effort, POC has worked with 130 public and private landowners (Appendix 1). For their participation, these landowners receive critical data for use in management planning. In 2017, grant funding from Patagonia supported core programmatic function, while additional funding supported a special focus on monitoring at Midewin National Tallgrass Prairie (for the 15th year), Openlands Lakeshore Preserve, and the Cook County Forest Preserves. Another project has involved development of a rapid vegetation assessment method for the Chicago Park District. Analyses of POC's long-term dataset are yielding critical information on rare species' population trends in relation to management activities on a region-wide basis. POC has become a recognized model citizen science program, and staff have given talks at local, national, and international conferences (Goad, Vitt, Miller, Steffen, Rosenbaum, Yates, interns, and collaborators).

Using Spatial Analysis and GIS to Investigate Patterns in Rare Plants Monitored by the Plants of Concern Program – The Plants of Concern (POC) program monitors endangered, threatened, and rare species in the Chicago region with the goal of assessing long-term trends in response to management and environmental conditions. Using the Conservation GIS Lab at the Garden, rare plant population data from 2001-2017 are being investigated. Spatial and temporal patterns of monitored rare plant populations can be evaluated in relationship to management history, threats, and edaphic factors. Soil data associated with POC populations were recently extracted for use in expanded analyses. Spatial analysis of POC's monitored rare plant data facilitates visualization of patterns and adds a new dimension to already valuable data. Maps, visuals, and data produced from this type of analysis create a medium of communication that can enhance the message of conservation programs such as POC for scientists, collaborating regional land managers, and the general public (Goad, Fant, Yates, Foxx, interns).

North Shore Ravine Restoration and Conservation – Plants of Concern and other CBG staff have been major contributors to a suite of conservation projects focused on Illinois' north shore ravines. POC staff have led efforts to develop a rapid assessment protocol for land managers to use in evaluating ravine plant communities, and the program is working to find additional funding to finalize the tool and use it in comprehensive ravine assessment. In addition, long-term monitoring of rare species by Plants of Concern staff and volunteers is feeding efforts to control invasive plants along the ravines and north shore of Lake Michigan. Starting in 2015, an invasive plant strike team began using invasive plant location data collected by POC as a baseline for control efforts, and POC monitoring in 2016 and 2017 were used to evaluate that effort. Further, POC staff have been a consistent resource for ravine landowners with an interest in conservation, and have collaborated with Alliance for the Great Lakes, an organization in part focused on ravine conservation. To these ends, Goad spoke about Special Flora of the North Shore Ravines at a workshop coordinated by Alliance for the Great Lakes and consulted with ravine homeowners who are working to develop a conservation-focused homeowner's association within their neighborhood. (Goad, Miller, Mueller).

Understanding the Impacts of Buckthorn on Soil Seedbanks to Inform Restoration Seeding Buckthorn (*Rhamnus cathartica)* significantly alters the oak woodlands that it invades, likely including the soil seed bank. However, very little research has been done to understand which species and under what scenarios the soil seed bank may be capable of regenerating a diverse understory of native grasses and forbs when the buckthorn is removed. The objective of this study is to quantify the degree to which invasion by buckthorn alters the seed banks of oak ecosystems in the Chicago region. By comparing the composition, species richness, and seed density of the seed banks of uninvaded sites to the seed banks of invaded sites, this research will shed light on whether the seed banks of invaded oak ecosystems can reliably contribute desirable plant material to the restoration of oak ecosystems. (Lamb, Kramer).

Understanding and Managing Invasive Aquatic Species – Invasive plants and animals pose significant ecological and environmental threats to our aquatic systems. The Garden continued monitoring the nearby Skokie Lagoons for water hyacinth (*Eichhornia crassipes*) and water lettuce (*Pistia stratiotes*), where dense populations of both plants were found by the Garden in fall 2013. After a dense population of the invasive zebra mussel (*Dreissena polymorpha*) was found in the Garden Lakes in fall 2015, the Garden began an aggressive invasive mussel monitoring and remediation program in 2016. Installation of projects to protect critical components of the Garden's infrastructure (building cooling systems and outdoor irrigation) was

completed in 2017 under supervision of the Garden's Maintenance Department. Monitoring for invasive mussels and crayfish populations was conducted during 2017, with the highly invasive quagga mussel (related to the zebra mussel) now confirmed present in the Garden lakes. The quagga mussel has been in the Chicago region for a number of years, and so its discovery at the Garden was not unexpected. Fortunately, the Garden's ongoing zebra mussel remediation strategies are also effective in mitigating quagga mussels. (Kirschner and Nagle). An invasive and "tough" emergent shoreline plant at the Garden, yellow iris (*Iris pseudacrous*), was aggressively managed with repeated herbicide applications during 2017 (Kirschner and Nagle).

Genetic Diversity in Rare Species – The maintenance of biodiversity is an important objective of many conservation plans. We are working with a number of institutions to assess the levels of genetic diversity that currently exists in a number of rare species. This includes working with numerous land managers in the Chicago region on the vulnerable *Cirsium hillii* and the federally listed orchid, *Platanthera leucophaea.* Dr. Tom Kaye (Institute of Applied Ecology) on the federally threatened *Castilleja levisecta,* and Dr. Ori Fragman-Sapir (Jerusalem Botanic Garden) on the globally rare *Iris vartanii.* These types of studies allow us to assess populations of critical concern and assist with management decisions (Fant, Kramer, Ellwanger, White, Havens, and collaborators).

Cirsium pitcheri **(Pitcher's thistle)** –We have been studying the demography and genetics of *Cirsium pitcheri*, a threatened species that occurs around Lake Michigan for over 15 years. We found that the species is in decline, and that all monitored populations are below replacement rate due to numerous threats including invasive species, predation by goldfinches, and predation by a biocontrol weevil (*Larinus planus*) that had been introduced to control weedy thistles. In 2011, we began demographic monitoring of the weevil-infested population in Wisconsin to track weevil effects (which has continued to date). Since then our research team has documented several other weevils impacting *C. pitcheri*, including the biocontrol weevils, *Rhinocyllus conicus* and *Cleonus piger,* as well as *Cassida rubiginosa* and a *Baris* species. Currently we are working on finding ways to control weevils without disrupting pollination, possibly by timing of chemical control or by using scent traps. In 2016, we characterized the pollination network in the dune habitat associated with *C. pitcheri*. *C. pitcheri* was found to support more pollinators than any other species in the dune community. We are planning to repeat network studies in several southern populations in 2018 (Havens, Vitt, Rodenius and outside collaborators).

Echinacea angustifolia **(purple coneflower)** –Since 1995, Wagenius has investigated consequences of habitat fragmentation in tallgrass prairie, focusing on *Echinacea angustifolia* and its associated herbivores, pollinators, and competitors. Wagenius and his Team continued measuring fitness in over 10,000 *Echinacea angustifolia* plants in long-term experimental plots and assessing pollination and flowering phenology in several thousand plants in natural prairie remnants in Minnesota. In summer 2017 the team began studies of pollinator and plant communities in the fragmented habitat at the research site. Pollinators were collected in pan traps to assess the quality of nearby habitat for bees and other pollinators. Over 1000 insect specimens were brought to the Botanic Garden to be identified. Flowering plants are hypothesized to compete for pollinators with Echinacea and may influence the timing of their flowering. In the fall interns and citizen scientists assessed seed set in *Echinacea*, *Liatris*, and *Solidago* plants to gauge the outcomes of competition. Wagenius mentored many research interns in 2017: 1 high school student, 10 undergraduates, four recent graduates, and 2 NU graduate students. Eighteen volunteer citizen scientists worked in the lab. NSF will continue to

fund this project through 2026 (Wagenius, Hayes, Kiefer, Nordstrom, and Waananen, with collaborator Ruth Shaw at University of Minnesota).

***Lespedeza leptostachya* (prairie bush clover)** – Since 2000, we have been monitoring populations of this federally threatened gravel hill prairie species at Nachusa Grasslands in Franklin Grove, Illinois and at Harlem Hills Nature Preserve (part of Rock Cut State Park in Rockford, Illinois) to determine best management practices. In 2015, the stewards at Nachusa Grasslands introduced bison to the preserve. We are studying the response of the vegetation, and how the demographic performance and population viability of *Lespedeza leptostachya* changes in response to grazing. Bison increase the spatial heterogeneity of the landscape by grazing and other activities, opening up potential habitat for prairie bush clover. Previous work has shown that *L. leptostachya* experiences an increase in recruitment as a result of short-term experimental grazing combined with fire, leading to an increased population growth rate. Ongoing data collection will determine if bison grazing leads to increasing forb diversity and greater prevalence of *L. leptostachya* on the preserve (Vitt, Havens, and outside collaborators).

Assessing the conservation status of fungi – Efforts to undertake conservation assessments (red listing) of fungi, especially mushrooms and related groups continued. Red list assessments estimate the extinction risk of a species, identify threats to the species, and recommend further steps needed to mitigate the threats. 2017 activities included giving two short courses at international conferences, participating in a red listing workshop with the Forest Service (CA), presenting key note addresses at several conferences, and leading the IUCN Specialist Group on mushroom and related fungi conservation (Mueller).

Assessing the impact on fungal communities and function in plantations of introduced species of trees – Much of the reforestation efforts in south China are based on plantations of introduced pine species, especially *Pinus ellioti* (native to south eastern USA). This project is investigating the differences in the symbiotic fungal communities among native forests, plantations of native pine species, and plantations of introduced pine species. It is also investigating how changes in these communities impact soil ecology by examining a series of extracellular enzymes needed for forest function (PhD candidate Chen, and Mueller).

Mitigating Threats

Seed Banking - The Garden's Dixon National Tallgrass Prairie Seed Bank continues to collect and preserve germplasm of native plant species from the Upper Midwest. In 2017, we added 212 collections of 169 species. Our total holdings include 8009 accessions. In 2017 we made 43 seed collections for the Monarch Seed Collection project in conjunction with the Pollinator Partnership. We shipped 193 associated herbarium vouchers as a gift to the Smithsonian. We continue to be an active partner in the national "Seeds of Success" (SOS) program. Rachel Hosna, hosted by the Bureau of Land Management, coordinates all Seeds of Success activities. The Seeds of Success National Collection contains more than 18,000 seed collections which are stored at the USDA Agricultural Research Service facilities. In addition to long-term conservation storage, SOS collections are available for research, restoration, and rehabilitation. In 2017, we partnered with the Pollinator Partnership, a 501c3 dedicated exclusively to the protection and promotion of pollinators and their ecosystems, to assist implementing the Monarch Wings Across America initiative. We collected seeds from species that provide important resources such as nectar and larval food sources, to support the migration of monarchs (Havens, Vitt, Yates, and Sollenberger).

GIS for Targeted Seed Collection in Midwestern National Forests – The Conservation GIS Lab is utilizing GIS element occurrences of Regional Forester Sensitive Species (RFSS) and topographic map data to create strategies for more efficient targeted seed collection the Shawnee National Forest in southern Illinois. A series of hard-copy maps for field collection created in 2014 continue to be utilized in 2017 in 12 Natural Areas, as well as Trimble Juno GPS files for on-site navigation to targeted sensitive species populations. These collections, many collected along maternal lines, employed GIS targeted seed collection strategies developed in the Conservation GIS Lab, allowing collection to continue efficiently in these forests in subsequent years (Yates, Sollenberger).

Conservation and Restoration in Changing Environments (CARICE) – Garden scientists and graduate students have been working on conservation- and restoration-related research in the arid regions of the western United States since 2002. Much of the native habitat in the western United States is degraded as a result of changes imposed by invasive species, altered fire regimes and land use patterns, and a shifting climate. These changes will only become more prevalent in the future. To ensure the region's unique plant and animal diversity—and that the ecosystem services it provides is resilient in the face of these changes—restoration on a large scale is needed. To help make restoration efforts as efficient and effective as possible, we conduct research to inform native plant materials development and restoration. Most of our work currently occurs on the Colorado Plateau. In 2017, utilized available Seeds of Success collections to establish research trials in the greenhouses and growth chambers at the Garden, continued compiling data from multiple sources on historical use of species and seed sources for restoration, including post-restoration monitoring data to assess outcomes, in order to: 1) identify and help develop appropriate native plant material for restoration, and 2) quantify how species and seed source selection impacts ecosystem function in restored habitats. We use a range of ecological and evolutionary tools and approaches to carry out this research, and we work with the Colorado Plateau Native Plant Program and other partners across the country to ensure our research helps address high-priority restoration needs (Kramer, Foxx, Kucera, Lichtenberger, Williams, Zeldin, Havens, and outside collaborators).

Determining Genetic Diversity of *Ex Situ* Collections - How genetically diverse are *ex situ* collections of rare and endangered plant species? It is important to understand the genetic diversity held by *ex situ* collections to maximize value for the long-term conservation of the species. We are working with collaborators across the country to use molecular genetics to understand how effectively the genetic diversity found in wild populations of threatened species is captured in *ex situ* collections. With this information, we are working with collaborators from the zoological community to understand how to effectively manage genetic diversity in *ex situ* collections in order to maintain genetic diversity. We are working with threatened oak species native to the southeastern United States (*Quercus georgiana and Q. oglethorpensis*), and critically endangered species from Hawai'i (*Brighamia insignis, B. rockii,* and *Hibiscus waimeae subsp hannerae)*. We received an IMLS National Leadership grant to support this work through 2018 (coordinated by the Montgomery Botanical Center, in collaboration with the Morton Arboretum, Brookfield Zoo, and Botanic Gardens Conservation International US), and we received funding from the Eppley Foundation to support the use of genomics to understand the diversity of all remaining *Brighamia insignis* plants in conservation collections. Results will be used to help conservation scientists build and manage genetically diverse *ex situ* collections for these and related species, and will also inform future reintroduction efforts for these species (Havens, Wood, Fant, Kramer, and outside collaborators).

Determining Genetic Limitations to Native Plant Restoration – An important goal of any reintroduction is to provide sufficient genetic variability to buffer against changing selection pressures and to ensure the long-term survival and continued evolution of a species. Genetic erosion during the creation of a reintroduced population can have a large impact on long-term success. Reintroduction of a new species involves many steps, including collecting wild seeds, bulking in seed-increase beds, propagation in a greenhouse, and direct sowing into reintroduction sites, each of which has the potential to create bottlenecks which diminish genetic representation. We are working with a number of rare species, including *Cirsium pitcheri, Cirsium hillii,* and *Castilleja levisecta*, using molecular genetics tools to understand whether and where potential genetic bottlenecks may be occurring during the restoration process. Using an integrated approach we aim to help develop best practices for producing genetically diverse plant materials of these species to increase their usage (White, Fant, Havens and Kramer).

Using Predictive-Provenancing to Help Increase Chances of Restorations Adapting to Climate Change - Locally adapted populations may not be able to keep pace with rapidly changing climatic conditions. It has been proposed that restorations may benefit from assisted gene flow, or using individuals from more southerly locations, within the species range, in an effort to facilitate local adaptation to anticipated future climatic conditions. This broader strategies that mix genotypes from different populations has been articulated in the literature, but currently there are few empirical studies that can aid in making appropriate sourcing decisions in light of climate change. We are working with Lake County Forest Preserves to compare different seed source (North and South of Chicago Region) of five forb species commonly used in tallgrass prairie restorations including *Allium cernuum*, *Chamaecrista fasciculata*, *Lobelia inflata*, *Rudbeckia hirta*, *Sisyrinchium campestre*. The aim of this study is to look at impact and likely success of relaxed selection of source material in anticipation of climate. We use the measurement attained for key life history traits and transitions in demographic models to predict likely long-term success of each population in the mix (Woolridge, Fant, and Kramer).

Designing Context-Dependent Decision Support for Native Plant Sourcing - In January 2017, a meeting of experts from around the country specializing in plant restoration, conservation, ecology, genetics, germplasm selection and environmental decision making was convened by the US Botanic Garden and Mt Cuba Center. At this meeting, a decision analysis framework was outlined that codified expert opinion on selecting seed sources for restoration under a range of different contexts (urban to rural, large to small, disturbed to undisturbed, and common to rare species). This is intended to allow non-expert users to easily identify suitable seed sources for their needs based on their context. Chicago Botanic Garden is taking the lead on finalizing the framework and testing the model using real-time data on accessions of 30 native plant species available to a range of audiences (from restoration practitioners to homeowners). The ultimate goal is to produce a synthesis paper on the current state of recommendations for sourcing native plant material (including the use of cultivars) for restoration and conservation, and an online resource (led by Mt Cuba Center) that is easily understandable for practitioners (including homeowners, nurseries and landscape professionals) undertaking plant restoration and conservation projects. (Kramer, Havens, Jacobi, White, and many outside collaborators).

Designing Decision Support Tools for Invasive Species Management – With a grant from the U.S. Fish and Wildlife Service, we continue to developed internet-based decision support tools for land managers dealing with invasive species that integrate monitoring, management objectives, and actions with predicted outcomes determined through the monitoring efforts—ultimately uniting scientific research with conservation practice. Developed after years of

collaborative work, the tools promote cooperative learning and facilitate more rapid, adaptive management among land managers who would otherwise be dealing with a common problem on their own and learning more slowly. The tools are currently being used by National Wildlife Refuge managers throughout the Great Plains and Prairie Pothole region. For example, projects target developing more effective control of Kentucky blue grass and smooth brome grass that have invaded prairie, improvement of wetland restoration techniques for Prairie Pothole wetlands with a history of agricultural use, and advancement of management practices against invasive plants that affect forest habitats. The tools are also being used by USFWS collaborators and partners to improve management outcome for grassland management, wetland restoration, management of forest invasive species, management of invasive reed canary grass, and prairie reconstructions (Jacobi and Hunt).

Soil Organic Matter Turnover and Carbon Sequestration – Global estimates show that soils store more carbon (C) than the atmosphere and terrestrial vegetation combined. Despite the obvious importance of soil organic carbon (SOC) in the global C cycle, there remain critical gaps in our knowledge of the formation, source, and stabilization of long-lived, recalcitrant SOC stores. Fungi constitute a major portion of belowground biomass and degradation of their tissues is an important contributor to SOC pools but the exact mechanism(s) by which fungal tissue is degraded and the flux of fungal macromolecules to SOC pools remain poorly understood. Our studies have shown that necromass degradation is a temporally and spatially dynamic process in which shifts in the microbial degrader community composition are closely linked to mass loss and alterations in necromass chemistry. Our current research focuses on the microbial controls over mass loss, and the chemical nature and potential flux of fungal OC into the slow turnover SOC pool (Egerton-Warburton, Schreiner, Sheik).

Restoration of Soil Systems as Integral Components of Management Practice – Prairie and woodland restorations are typically assessed solely by their above ground visible characteristics, such as plant diversity and productivity. However, in neglecting to assess belowground ecosystem health, we may be missing half of the picture. The importance of soil ecology has often been overlooked in restoration efforts, and often disregarded as a mere “black box.” This project addresses belowground ecosystem health by examining the effects of restoration treatments and management on woodland and prairie soil quality (fertility, carbon storage, aggregation, and fungal and microbial community composition), and CBG campus soils. These results will better inform restoration practitioners about the outcomes of current management practices particularly with respect to carbon sequestration (Egerton-Warburton, Umek, Tiddens).

Biogeochemistry of Green Roof Ecosystems: Green roof ecosystems are increasingly used to compensate for the loss of green space and biodiversity in many cities. Their ecosystem services and the performance of the aboveground biota have been extensively studied. However, the functioning in the largest and most indispensable component of green roofs, the soil substrate, has long been overlooked. We examined plant species and functional group effects on soil nutrient cycling, and how common green roof plant species and soil microbiota might respond to N deposition. These studies have shown strong spatial heterogeneity in soil chemistry and microbial activity based on plant species' identity but no apparent effect of nitrogen enrichment on microbial communities (Egerton-Warburton, Zhou, Gudmundsen).

Natural Areas Conservation and Management – The Garden’s 225 acres of natural areas, including McDonald Woods, Dixon Prairie, Brown Nature Reserve, Skokie River Corridor, and the Garden Lakes, are managed to enhance habitat quality and increase native floral and faunal

diversity. Invasive plants, in particular, pose significant threats to these ecosystems. Several aggressive native species such as gray dogwood (*Cornus racemosa*) and ash saplings (*Fraxinus spp.)* have become increasingly problematic for our woodland restoration due to recent years' weather conditions not being conducive to controlled burns during the spring and fall burn seasons. Climate change tends to extend the growing season, thereby reducing the window of opportunity for controlled burns. Dead ash trees (caused by the emerald ash borer) and brittle branches continue to impact restoration efforts in McDonald Woods where they pose a threat to restoration workers. Increasing sunlight due to canopy opening from management activity and the rapid loss of the ash trees has resulted in increased growth of some invasive species such as purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), and elecampane (*Inula spp.*). The common reed (*Phragmites australis*) and lesser celandine (*Ficaria verna*), in particular, continue to pose increasingly difficult management challenges within the Garden's shoreline and wetland areas (Kirschner, Steffen, O'Shaughnessy, Nagle, and Jabcon).

Enhancement of the Prairie and in the Skokie River Corridor – Desirable native warm season grasses have been difficult to establish in the Dixon Prairie and the Skokie River Corridor. Soil structure and fertility have been two variables thought to play a role in the failure of grass establishment. A trial, testing this theory, is being conducted. Five plots were established, each with a different soil. The soils in the plots were 6 inches of a gravel/sand mix laid over topsoil, 9 inches of the mix laid over topsoil, 9 inches of the mix laid over subsoil, subsoil with no amendment and existing topsoil with no amendment. In 2017, planting occurred in each of the five plots, with one half of each plot planted with plugs. The other half was seeded. The plants and the seed mix included five native grass species and 12 native forbs. Species' growth and survival and herbivory are being monitored (O'Shaughnessy and Jabcon).

Documenting and Understanding Diversity

Biodiversity of Moths Found Associated with Restored Oak Woodland – Moths are a tremendously diverse group of lepidopterans. In Illinois, there are only 150 known species of butterflies, while there are at least 1,850 species of moths. While most species of moths are herbivores during some part of their life cycle, the majority of them are restricted to one or just a few species of native plants for their survival. Adult moths also are important as pollinators of native plants species as well as serving as a significant food resource for a diversity of other native life forms. It has been documented that a single nest of black-capped chickadees can consume between 7,000-9,000 caterpillars in a single season, most of which are moth larvae. During 2017, work continued on documenting the number of species of moths found in Mary Mix McDonald Woods (an oak woodland undergoing restoration). Thus far, more than 440 species of moths have been identified with some representing the first collections for Illinois. In addition, a project was undertaken to document the relationship between moth populations and oak woodland restoration. Preliminary results suggest a near doubling of moth diversity and abundance with restoration (Steffen).

Revision of the Genus *Artocarpus* (Moraceae) - The Garden is working with international collaborators in Southeast Asia to study the distribution and evolution of an economically important group of plants. With approximately 70 species, *Artocarpus* is the third largest genus in the plant family that contains figs and mulberries (Moraceae). *Artocarpus* contains numerous economically important species (grown for timber and fruit) native to Southeast Asia. Two species, jackfruit and breadfruit, are cultivated throughout the tropics. By collecting location data, herbarium samples, and DNA from plants, the goal of this project is to produce a comprehensive taxonomic revision of *Artocarpus* with discussion of character evolution and

ecology, distribution maps, identification keys, and online access to an image database. Information on breadfruit and jackfruit origins and cultivar diversity also will be included in the revision. In 2017, work analysis of DNA from over 300 genes for 99% of *Artocarpus* species was completed. In 2018 the focus will shift to preparing the revision for publication (Zerega, Gardner and outside collaborators).

Pollination in Genus *Artocarpus* (Moraceae) – The Moraceae family (ca. 1,000 species) includes, figs (*Ficus*), mulberries (*Morus*), and breadfruit (*Artocarpus*). Mulberries are wind pollinated, while figs have one of the most fascinating pollination modes, which is often used as a classic example of coevolution between plants and insects. In the obligate mutualism found in all fig species, female fig wasps use the enclosed fig inflorescence as a brood site, laying their eggs in some of the ovules and pollinating others. The offspring hatch and mate inside the fig. The pollinator and host are entirely interdependent on one another for reproduction. Interestingly, very little is known about pollination in the rest of the family, leaving the question, how did such a specialized pollination syndrome evolve from wind pollination? Also, there are very few documented cases of a shift from wind to insect pollination among flowering plants (it was once thought to be impossible), making it an excellent group to understand the significance and mechanisms of such a rare pollination shift. In 2017, work focused on insect behavior experiments and analysis of volatile compounds from flowers of several *Artocarpus* species in Florida, Malaysia, and Indonesia. To date findings indicate pollination in some species may involve a tripartite mutualism between the plant, fungi, and gall midges. Some species may be pollinated by moths, beetles, or small flies. The work so far has resulted in the identification of at least one insect species new to science and newly described pollination mechanism in jackfruit (*A. heterophyllus*), an important crop was accepted for publication (Gardner, Zerega, and outside collaborators).

Diversification of an Underutilized Crop Genus in Borneo - Recent scientific studies have pointed to Borneo as an important global evolutionary and biodiversity hotspot. The genus *Artocarpus* (Moraceae) has many Borneo endemics, making it a good group to investigate the role of Borneo in its diversification. *Artocarpus* also has more than a dozen underutilized crops, including breadfruit and jackfruit, so it is important to understand how this valuable group of plants diversified. Work in 2017 involved using DNA sequence data to reconstruct the evolutionary history of *Artocarpus*. Recently published results based on the research suggest that Borneo represents the ancestral range for the genus and Borneo likely served as a center of diversification (especially during the Miocene epoch), from which *Artocarpus* species dispersed to and diversified in other regions of South and Southeast Asia. The evolutionary history will be useful in identifying crop wild relatives, and the work demonstrates the importance of conservation of areas with high species diversification and endemism (Zerega, Williams, Gardner, and outside collaborators).

Fossil Plants in Mongolia Fossil Plants in Mongolia – Mongolia has an abundance of fossil deposits that date to the Early Cretaceous (approximately 100 to 130 million years ago), when flowering plants first appeared in the fossil record and then rapidly diversified. The fossil record is the best source of evidence to document the origin and early evolution of a group of plants such as the angiosperms. Although much paleontology work has been done in Mongolia on dinosaurs and other vertebrate fossils, very little paleobotanical field work and research has been undertaken in this part of central Asia. This project seeks to document fossil plants from several Early Cretaceous age localities that have exceptional preservation of plant material. The project team includes paleobotanists from the Garden, Oak Spring Garden Foundation, Nanjing Institute of Geology and Paleontology (China), and Niigata University (Japan). For the past four years, a

grant from the National Science Foundation has funding this study. A new grant from NSF will fund an additional three years of research in Mongolia and Inner Mongolia, China. In 2017 our research focused on describing several new and interesting fossil species, field work in Inner Mongolia, and presenting the results of this work at the International Botanical Congress in Shenzhen China. We have published several papers on this project in 2017 and others are in preparation (Herendeen, Herrera).

Evolutionary Relationships and Diversity in the Legume Family – The legume family, which includes numerous important crop plants (e.g., beans, peas, and soybean) and many other economically important species is the third largest plant family with approximately 730 genera and 19,400 species found in all parts of the world. In addition to being the source for economically important plants, the family is also important ecologically because legumes dominate many tropical ecosystems. For several years, an international team of botanists has been working to develop a better understanding of the diversity and evolutionary relationships in this important family. In 2017 a large team of collaborators (over 100) authored a new subfamily classification, under the group name "Legume Phylogeny Working Group" to recognize the fact that these efforts are the culmination of extensive collaboration and sharing of materials and data among group members. This paper is the first publication with group authored taxonomic names (Herendeen).

Biodiversity of Symbiotic and Lignin-Degrading Fungi in Seasonal Dry Tropical Forests – Seasonally dry tropical forest systems are globally and regionally threatened by urbanization, land use change, and climate change. While documentation of plant community diversity in these forests is limited, there are even fewer records for fungi. Over the last five years, we have documented the seasonal and inter-annual variations in lignin-degrading and arbuscular mycorrhizal fungal community composition in tropical dry forests of the Yucatán Peninsula. Analyses show taxonomically-rich fungal communities in which species richness and abundance correlates strongly with season, site, and local soil nutrient availability, and we established a role for both traditional lignin decomposer and ectomycorrhizal fungal taxa in lignin utilization (Egerton-Warburton, Morgan, Ross).

Biodiversity, Biogeography, and Conservation of *Laccaria* – *Laccaria* has been used as a model group to study fungi that form ectomycorrhizas (beneficial symbionts of forest trees). Activities in 2017 included further data generation and analyses and the publication of a book chapter presenting data on biogeography (Mueller, Wilson, and colleagues in Australia and Japan).

Investigating the role of symbiotic fungi and host tree on the distribution of the rare and threatened Ghost Orchid (*Dendrophylax lindenii*)--The Ghost Orchid is an epiphytic, leafless growing on a few species of trees in the swamps of southwest Florida and the karst area of the western tip of Cuba. We are testing the hypothesis that its restricted distribution is due at least in part to the distribution of symbiotic fungi in its roots. We are also examining how dependent epiphytic orchids are on symbiotic fungi for nutrition. The study is being undertaken as part of an international team focused on conserving this and other rare and threatened epiphytic orchids of south Florida and Cuba. Two trips to Cuba were undertaken that resulted in the signing of a MOU with Sorora Orchid Botanic Garden, collaboration with scientists at Pinar Del Rio University, and agreements to undertake research in two national (PhD candidate Johnson, Mueller and colleagues).

Macrofungi of Neotropical High Elevation Oak Forests -- Fungi are essential components in all ecosystems. Yet, knowledge of their diversity, distribution, and conservation status remains fragmentary at best, especially in the tropics. In collaboration with botanists at Kew Gardens and scientists in Costa Rica, Panama, and Colombia, this project investigates these issues in the unique and threatened Neotropical High Elevation Oak Forests that are restricted to isolated patches above 1900 meters elevation in Costa Rica, Panama and Colombia. Despite the biodiversity value, restricted range, and increasingly fragmented distribution of these forests, understanding of what drives and maintains this diversity is low, and their role in the conservation of biodiversity is largely unacknowledged. Previous fieldwork in some of these forest patches has documented high fungal diversity, but many of these taxa remain unidentified, recent work has uncovered numerous additional taxa, and the patterns of distribution and factors influencing such patterns remain to be studied. Additionally, collection and analysis of fungal and plant data have not been integrated, greatly limiting our understanding of these forests. This multiyear project proposes to sample mushrooms and other fungi with *sporocarps easily seen without magnification,* from multiple sites in each country. Sporocarp sampling will be complimented with environmental sampling for root-associated fungi (especially ectomycorrhizal species) and new and previously collected sporocarps will be DNA barcoded to foster identification, enable phylogenetic / biogeographic analyses, and generate a sequence library for identifying environmental samples. Activity in 2017 focused on developing the project, generating preliminary data documenting the success of bar coding older herbarium specimens, and building the team (Mueller and an international team).

The Origin and Diversification of Plants on Land – Approximately 470 million years ago, the first plants to inhabit land arose from aquatic, green algal ancestors. Those earliest land plants subsequently gave rise to the hundreds of thousands of terrestrial plants species that exist today. As part of a collaboration with the 1KP Project (a multidisciplinary consortium of plant biologists, statisticians, and computer scientists led by researchers at the University of Alberta, BGI-Shenzhen, and the University of Georgia), we developed methods to process large amounts of DNA sequence data to better understand the diversification of land plants throughout their long evolutionary history. The results of this project have changed the consensus view of land plant evolution and have resulted in numerous publications that describe the evolution and diversity of plants and plant genes. (Wickett, Johnson, and outside collaborators).

Building the Moss Tree of Life – There are approximately 13,000 species of moss, distributed throughout the world on all continents. However, the diversity of species is not evenly distributed among the major groups of mosses. Much of the diversity of mosses is disproportionately found in a group call the Pleurocarps. Pleurocarps are characterized by a creeping, feathery growth form, with reproductive structures found on short branches. The extraordinary diversity of pleurocarps is thought to be a result of an explosive radiation during the Jurassic, at a time when flowering plants began to dominate many terrestrial environments. The speed at which these mosses diversified has made it difficult to understand the relationships of species within pleurocarps, either from DNA data or morphological data. In 2013, we began work on an NSF-funded project, Assembling the Pleurocarpous Moss Tree of Life, which uses cutting-edge techniques in DNA sequencing to better understand the evolution of this diverse group of plants. In 2017 we published several papers and presented our work at international conferences. This project has led to the development of new software that allows researchers to rapidly analyze hundreds to thousands of genes that can be used to reconstruct the evolutionary history of any group of organisms (Wickett, Johnson, and outside collaborators).

Diversification of Diatoms, a Hyperdiverse Group of Photosynthetic Marine Algae – Diatoms account for roughly 20% of global primary production, while making up less than 0.2% of primary producer biomass. Additionally, they are the key drivers of biogeochemical silica cycling and have acquired a diverse set of metabolic pathways including a complete urea cycle (previously only known from animals), iron-concentrating mechanisms, and polyamine biosynthesis. Surprisingly, these diverse functional traits may have been enabled by the acquisition of genes transferred horizontally from bacteria. Despite their diversity and importance to aquatic ecosystems, aspects of their evolutionary history are still unknown and the genetic resources necessary for their study are relatively lacking. In 2017 we reconstructed the evolutionary history of diatoms using the largest data set addressing this question to date. These data and analyses resulted in several publications that describe diatom relationships and the impact of whole genome duplications (the doubling of chromosomes) throughout their evolutionary history. Additionally, we used cutting-edge DNA sequencing technologies to sequence the genome of *Psammoneis japonica*, a species that occupies a critical evolutionary position for understanding the diversity of diatoms, as well as four, potentially symbiotic, bacterial genomes that are new to Science. We are currently preparing manuscripts describing both of these findings, with an emphasis on how bacterial genes may have contributed to diatom evolution (Wickett, Parks, and outside collaborators).

Diversification in Floral Color of *Castilleja spp.* – Understanding the factors that contribute to the maintenance of polymorphisms and divergence in traits is key to informing our understanding of speciation. Changes in floral color have the potential to attract novel pollinators that exert novel selective pressures on other floral traits, and ultimately promote reproductive isolation in closely related individuals. The hemiparasitic genus *Castilleja* has over 200 species in North America, which has multiple shifts in floral color and form. A Midwest native, *Castilleja coccinea*, has bracts which range from yellow, orange and orange-red, with different color morphs being found within close proximity to each other and even within the same population. Meanwhile, *Castilleja affinis* which grows in Coastal California, a floristic hotspot, has three subspecies growing within a small geographic area. Finally *Castilleja sessiliflora* has a very broad distribution which is predominately in areas outside hummingbird ranges, however where they do overlap there has been a transition for white to pink flowers. All of these examples represent cases of sympatric divergence and isolation, associated with floral trait polymorphisms (Wenzell, Fant, Skogen, and outside collaborators).

Dimensions of Biodiversity - Landscapes of Linalool: Scent-Mediated Diversification of Flowers and Moths Across Western North America – We commonly think of floral scent for its role in attracting pollinators, but it can also be a cue for floral and seed predators. This project integrates chemical ecology and comparative genomics to explore the impact of past selective pressures on current patterns of diversity in non-model organisms: evening primroses, hawkmoths, bees, and micromoths. This project focuses on how chemically-mediated interactions between flowering plants, pollinators, and enemies affect diversification at the population, species, and higher taxonomic levels. Onagraceae (evening primrose family) is one of the most species-rich families of night-blooming plants in North America. Many Onagraceae, particularly species in tribe Onagreae, produce floral scent that likely dictates the primary biotic drivers impacting plant fitness, including legitimate pollinators (hawkmoths, bees) and floral and seed predators (*Mompha* moths). The same floral characteristics (color, shape, scent) that attract pollinators are also suspected to attract floral antagonists to host plants. *Mompha* is one such moth genus that specializes on Onagraceae. A thorough survey of these micromoths associated with Onagreae in western North America will result in a more accurate assessment of diversity in

this group. Three dimensions of biodiversity will be integrated through studies of: 1) floral trait variation, 2) its genetic basis, and 3) their roles in driving patterns of diversity in Onagreae and *Mompha*. The identification of "hot" and "cold" spots of selection will provide a test of the role of scent in the creation and maintenance of biodiversity across landscapes and time (Skogen, Fant, Wickett, Jogesh, Overson, Carter, Gruver, Bechen, Andrews, and outside collaborators).

Discovering Unknown Diversity of Micro-Lepidopteran Moths in the Genus *Mompha*. 45 species of *Mompha* have been recorded in North America, though additional, undescribed and cryptic species are likely to exist, as is true for most microlepidopteran groups. The primary food plant preference for most *Mompha* in North America are members of the Onagraceae (evening primrose family), with additional but fewer *Mompha* host-specific on members of the Lythraceae and Cistaceae/Rubiaceae. Because adults visit at night, associations between *Mompha* and host plant species are commonly determined by larval presence (using larval feeding patterns or rearing larvae to adults to examine morphology). *Mompha* larvae are specialist internal feeders (stem, flower or fruit borers; leaf miners), relatively sessile and as such, parasitism frequency is easily assessed. However, larvae are often difficult and/or impossible to identify based on morphology alone and it is known that the current number of described species is an underestimate/ Relatively little is known of the basic biology, ecology and diversity of many North American members of this diverse group and few barcode sequences exist for species-identification and comparative purposes. Because *Mompha* is the only Lepidopteran group known to specialize on Onagraceae, we anticipate that a thorough survey of *Mompha* associated with key members of Onagraceae in western North America (where the majority of New World species are concentrated) will result in a more accurate assessment of the true functional (representation of stem, flower, and fruit borers), taxonomic, and phylogenetic diversity in this group. Combined with data on *Oenothera* floral traits (morphology, nectar, scent chemistry, CO_2, etc.) and community context (plant and insect), this project will provide insight into the processes that lead to the contemporary diversity in *Mompha*. In addition, at present genomic data other than COI (barcodes) is virtually non-existent at the species level (Skogen, Fant, Wickett, Overson, Jogesh, Bruzzese, and outside collaborators).

Molecular Phylogeny and Evolution of *Oenothera* Sect. *Calylophus* (Onagraceae) - Global biodiversity is declining at increasing and alarming rates as a result of human activities. Moreover, mounting evidence indicates that climate change is shifting the climatic envelopes and geographic distributions for may plant species globally. It is now more important than ever to document biodiversity and develop species-specific management strategies. Next-Generation Sequencing (NGS) and associated statistical tools that efficiently sequence and analyze massive amounts of DNA can provide increased support for species delineation and aid conservation initiatives. In addition, problematical evolutionary relationships at all taxonomic levels can now be addressed, and may provide important insights into the evolution of specialization and adaptions associated with past climatic changes. In this project, we will estimate phylogenetic relationships in *Oenothera* sect. *Calylophus (Onagraceae)* using targeted NGS. Diversity in this group of plants is not well understood and species relationships are unresolved. Rapid diversification producing a pattern of reticulate relationships has complicated attempts at phylogenetic resolution in *Calylophus*, making it an ideal study system with which to test NGS and phylogenomic methods for species tree estimation (Skogen, Cooper, Wickett, Overson, and outside collaborators).

Measuring Pollinator Effectiveness: In many plant species, pollinators are the main agents for the dispersal of genetic material. Pollinators vary in foraging ranges, a number of flowers they

visit in one feeding bout, and the distance they travel between bouts, which are all factors that determine the number and diversity of pollen they carry. As a consequence, the preferred pollinator can alter the rate of inbreeding and genetic diversity within the resulting progeny. In a previous study, we characterized the impacts of hawkmoth and small bees on paternity in *Oenothera harringtonii*. In that study we found pronounced differences in the number of paternal sires as a function of pollinator identity: on average, the primary pollinator (hawkmoths) facilitated mating with nearly twice as many pollen donors relative to the secondary pollinator (solitary bees). We plan to replicate this study in *Clarkia breweri* and *Clarkia concinna* are rare plant species in the Onagraceae family that are endemic to California. These sister species differ in major pollinators, providing an ideal opportunity to study pollinator effects on genetic diversity and inbreeding levels. To do this we are allowing flowers to be visited by a single pollinator. We are then going to genotype the offspring from that pollination event and using paternity analysis determine the number of pollen donors was carried by the pollinator (Fant, Skogen, Noble).

Developing Genomic Resources in an Underutilized Crop – Although nearly 7,000 plant species have been cultivated at some point in human history for food consumption, approximately 95% of human food needs worldwide are met by about 90 crops. Shockingly, more than 50% of human food needs are met by only three of those crops: corn, wheat, and rice. Plant genetic resources are the basis for food security, and the diversity they encompass will be the fodder for adaption to climate change and the stresses that may come with it. Realizing the potential of locally grown underutilized perennial crops (which require less energy input than annuals) can reduce energy use in the agriculture sector and increase food security in vulnerable areas, many of which lie in the tropics. Genomic resources are a vital part of the toolkit for improving and broadening our agricultural base worldwide, yet very few genomic resources exist for underutilized crops. Breadfruit, *Artocarpus altilis,* is a staple starch crop that is a major component of many traditional agroforestry systems in the tropical South Pacific Islands, and it compares favorably to major staples in both yields and nutritional content. Work in 2017 continued to focus on assembling and analyzing transcriptome data from breadfruit and its wild relatives and revealed information about genes that may be under positive selection. Work also focused on developing a draft genome of the wild relative of breadfruit, *A. camansi* (Laricchia, Zerega, Johnson, Gardner, and Wickett).

Diversity of Underutilized Tree Crops and their Wild Relatives – The genus *Artocarpus* contains numerous economically important species (grown for timber and fruit) native to Southeast Asia. Two species, jackfruit and breadfruit, are cultivated throughout the tropics, but several others are important on more regional scales. Work in 2017 focused on analyzing data from collections made during previous fieldwork in Malaysia as well as collecting new specimens in Sarawak to broaden the sampling. Genetic data from the underutilized crop cempedak (*A. integer*) and its putative wild ancestor bangkong (*A. integer* var. *sillvestris*) were analyzed. Also, genetic data from the underutilized crop terap (*A. odoratissimus*) and its putative wild ancestor were analyzed. Findings are being submitted for publication (Wang, Gardner, Zerega, and outside collaborators).

Conservation plan and IUCN Red List Assessment for *Artocarpus annulatus*, a wild relative of jackfruit – With funding from the Mohamed bin Zayed fund, Zerega and Gardner focused on the conservation of *Artocarpus annulatus*, a narrowly endemic tree of Padawan limestone forests in Sarawak, Malaysia in Borneo. It was first described in 1975 and appears to be a lost species known from only seven collections made between 1960 and 1980. No IUCN assessment has been attempted, but based on existing data, *A. annulatus* could be classified as Critically Endangered

because the known extent of occurrence (<2km^2) is less than 100 km^2. Its known habitat consists of only two hills in the Padawan limestone area, which itself encompasses only 435km^2 (6). More data are required for a formal assessment. Additionally, Zerega has recently found that *A. annulatus* is the only truly wild member of the lineage containing jackfruit and cempedak, both valuable underutilized crops, making its conservation especially critical. In 2017 genetic analysis began on samples previously collected in Sarawak. From these data, a conservation plan and red listing assessment will be developed (Zerega, Gardner, and outside collaborators).

Research Collections – The Biological Research Collections continues to add information to its website (Rosenbaum), allowing public access to information on all samples held at Chicago Botanic Garden. Currently we have accessioned 20,422 herbarium samples (Zerega), 6,062 genetic samples, and over 9000 seed collections (Vitt, Yates, and Sollenberger). Plans are also underway to begin to add important rare species and research samples that will increase the value of this collection (Fant and Rosenbaum). The herbarium continues to work toward digitizing its entire collection. The herbarium serves as a resource for scientists, students, and conservation practitioners and hosts numerous visitors throughout the year. The seed bank continues to create high-resolution microscope images of all incoming seed collections (Sollenberger, Yates, and volunteers) and x-ray images for assessment of seed viability (Sollenberger and volunteers) to be displayed in the public Research Collections database.

Building Capacity and Understanding

Conservation and Land Management Intern Program – A total of 514 applications were received for 2017 CLM Internship positions and a total of 137 interns were hired for 2017 CLM Internship positions. Sixteen interns who were hired in 2016 had their internships extended into 2017, , bringing the total number of interns working in 2017 to 153. The majority of the internships were with the BLM (123). One interns was hired by the NPS, 10 by USFS, 1 by USGS, and 2 by USFWS. In 2017, CLM interns worked a total of **152,088.5** hours or 19,011 work days or 864 work months (there are 22 days in a CLM work-month). The majority of CLM internships have focused on botanical or wildlife-related fields, or combinations that have involved monitoring or assessing threatened and endangered species. In 2016, the majority (78%) of internships focused on botany, 11% focused on botany and wildlife, and 1% focused on wildlife projects. Seven internships focused on recreation, three on GIS, two on hydrology and one internship focused on archaeology (Skogen, Johnson, Woolridge, and Havens).

Research Experiences for Undergraduates (REU) –In 2017 we received a total of 303 applications and nine interns were hired for NSF-funded REU positions at the Garden. In addition, 7 other affiliate interns, including College First alumni and those funded by Northwestern University, NSF funded REU supplements, and other sources also participated in the REU experience. Interns conducted research under the mentorship of Garden and Northwestern University scientists and graduate students on topics spanning genetic to ecosystem levels of plant biology and conservation (Fant, Kramer, Noble and Woolridge).

Graduate Programs –The joint graduate program with Northwestern University continues to attract top students to conduct plant conservation research. In 2017, the program welcomed eight new MS thesis students, three new MS internship students, and two new PhD students. At the end of 2017, the program had 19 PhD and 18 MS students. Seven MS students and three PhD students graduated in 2017. Students continue to be successful at procuring grants, including a prestigious NSF Postdoctoral Research Fellowship. Research topics of recent graduates included the role of green roofs in conservation, pollination biology in underutilized crops, and seed

sourcing for restoration projects. Student fieldwork has taken place in the Chicago region, Wisconsin, Minnesota, the Colorado Plateau, Mexico, Costa Rica, Malaysia, China, and India.

Chicago Wilderness Priority Plants and Fungi Initiative – The goal of the initiative is to use a small number of selected plants and fungi to serve as spotlights to highlight the region's high biodiversity and need to appropriately manage it. This is a community wide initiative covering 8 Illinois counties, plus Southeast Wisconsin, Northwest Indiana, and the southwest corner of Michigan. Mueller and Goad co-chaired the initiative which brought together botanists and naturalist from throughout the region to develop the list of priority species. Work on the species will begin in 2018 (Mueller and Goad).

Building Capacity for the Conservation of Mushrooms and Related Fungi – Fungi are rarely included in discussions or action plans for conservation. This is due to insufficient communication about the critical role that fungi play and the threats that they face, as well as an insufficient focus on research to obtain the needed data to better understand how fungi are responding to anthropogenic and other threats. Significant progress was made to address this problem in 2017. Mueller taught two short courses, gave three key note addresses, and participated in several workshops on red listing. Mueller obtained funding from the Mohamed bin Zayed Species Conservation Foundation for this initiative. Mueller worked with the IUCN Global Species program to limited funding for fungal conservation through the IUCN - Toyota Partnership. Mueller chairs the IUCN Specialist Group on "Mushrooms, Brackets, and Puffballs" and serves on the IUCN SCC Steering Committee. These efforts will continue in 2018 (Mueller and international collaborators).

Plant Conservation Alliance – The Garden continues its leadership of the Non-Federal Cooperator (NFC) committee of the Plant Conservation Alliance, a public/private partnership dedicated to the conservation of our native flora. In 2017, the Garden organized advocacy efforts for maintaining plant conservation funding for important government programs, and worked with this network of Cooperators to support the funding and implementation of the National Seed Strategy. Related to these efforts, the Garden organized a group of organizations involved in conservation, botanical sciences, and native plant issues to draft proposed legislation (The Botanical Sciences and Native Plant Materials Research, Restoration and Promotion Act) which was introduced to the House of Representatives (HR1054) in February 2017) in support of these goals. The Garden also continues to manage a website for this group (www.plantconservationalliance.org) that increases coordination and collaboration among NFC cooperators (Havens, Kramer, Williams, Rosenbaum, and outside collaborators).

Using Plants and Fungi for Human Benefit

Plant Breeding – The program continues to develop and evaluate new perennial plants for introduction to the horticulture industry and gardeners alike. A total of 1,678 seed was obtained from 23 of the 35 hybrid crosses attempted with stock plants at the Garden. 800 seed was removed from long term storage for germination to reinitiate two earlier breeding projects. An additional 1,000 seed was obtained from the USDA, for a total of 3,478 seed turned over to production for germination. The plants that will result from the sown seed will bloom in 2018-2019, and the best will be selected for continued breeding and possible introduction. Three *Symphyotrichum* (*Aster*) hybrids and two *Veronica* hybrids were propagated to be planted out in 2018 as trial blocks for potential introduction and patent data collection. 87 plants representing 28 cultivars were obtained from commercial sources and added to the program for evaluation as potential breeding stock and for comparative data required for patent applications (Ault).

Plant Evaluation – The program evaluates herbaceous and woody plants in comparative trials, ultimately recommending the top performers to gardeners and the horticulture industry. In 2017, 880 taxa representing 22 comparative genera trials were evaluated in the Lavin Plant Evaluation Garden, the Green Roof Gardens, and Rose Trial Garden. The comparative trial of tender perennial sages (*Salvia* spp.) competed the second year of a three year trial; 110 different taxa are being tested as annual seasonal plants in the Upper Midwest. A comparative trial of 37 species and hybrid cultivars of sneezeweeds (*Helenium* spp.) was initiated in 2017. In all, 171 new taxa were added to existing trials, such as *Asclepias*, *Baptisia*, *Coreopsis*, *Hibiscus*, *Persicaria*, and *Salvia*. The majority of new plants were donated by nurseries and plant introduction programs such as Blooms of Bressingham, Darwin Perennials/Ball Horticultural, Intrinsic Perennials, Plants Nouveau, and Walters Gardens. The relationship with *Fine Gardening* continued, with four articles in the Plant Trials Series published this year. Three articles have been submitted for publication in 2018 (Hawke).

Chicagoland Grows® Plant Introduction – The program markets itself and its plants to the horticulture industry with the goal of introducing new plants to the trade and to gardeners while providing income to the Garden. Two plants developed by the breeding program (*Vernonia* 'Summer's Swan Song' and *Vernonia* 'Summer's Surrender') were distributed to the program's licensed nurseries for evaluation and propagation. Four more perennial plants also developed by the breeding program were propagated for distribution to the licensed nurseries in 2018. In total, over 2,200 stock plants and unrooted cuttings were shipped to the licensed nurseries. The program was promoted through trade booth exhibitions at four trade shows, by a presentation at one conference, through an electronic media promotion, and through onsite tours. Five patents were approved by the US Patent and Trademarks office for *Phlox* `Strawberries and Cream` PP28,762; Phlox `Running With Scissors` PP28,738; Phlox `Early Bird` PP28,737; Vernonia `Summer's Swan Song` PP28,556; and Vernonia `Summer's Surrender` PP28,475. All five of these plants were developed at Chicago Botanic Garden. Royalty income for the year was $207,124.56 (not all nurseries have reported in), which was a 2.1% increase over the previous year's final income of $202,881.67 (Ault).

GRANTS AND CONTRACTS ACTIVE IN 2017

The Chicago Botanic Garden's research activity was supported by 37 grants, whose total awards reached $12,089,235. Many are multi-year grants in partnership with scientists, organizations, and research institutions in Chicago and around the world.

Grantor/*Title*	Awardee	Amount
Bureau of Land Management *CLM Conservation and Land Management Internship Program*	Havens, Skogen	$3,350,000
Bureau of Land Management *Rare Plant Climate Envelope Modeling and Restoration on the Colorado Plateau*	Havens, Kramer	$750,000
Chicago Park District *Developing a Rapid Vegetation Assessment*	Goad	$30,000

Method		
Eppley Foundation *Harnessing the power of genomics to inform conservation and support restoration of a critically endangered Hawaiian plant*	Fant	$25,000
Forest Preserves of Cook County *Rare Plant Monitoring in the Cook County Forest Preserves*	Goad	$25,000
Institute of Museum and Library Services *Safeguarding our Plant Collections*	Fant, Havens, Kramer, Wood *(led by Montgomery BG)*	$439,070
Mt Cuba Center *Developing and Testing a Context-Dependent Decision Support Tool for Native Plant Sourcing*	Kramer, Havens, Jacobi	$5,938
Michigan State University *Integrated Crop Pollination Database Development*	Jacobi	$9967
Mohamed bin Zayed Species Cons. Fund *Support for International Fungal Red Listing Workshop*	Mueller	$15,000
Mohamed bin Zayed Species Cons. Fund Conservation plan development and IUCN *Red List assessment for Artocarpus annulatus, a crop wild relative*	Zerega	$6,000
National Fish and Wildlife Foundation *Rare plant monitoring to assess effectiveness of an invasive plant strike team*	Goad	$12,321
National Park Service *CLM Conservation and Land Management Internship Program*	Havens, Skogen	$22,000
National Science Foundation – DDIG Evolutionary transitions: pollination biology and domestication of *Artocarpus* (Moraceae)	Zerega, Gardner	$17,882
National Science Foundation – DEB *Collaborative Research: AToL: Assembling the Pleurocarp Tree of Life: Resolving the rapid radiation using genomics and transcriptomics*	Wickett	$428,278

National Science Foundation – DEB *Dimensions of Biodiversity: Collaborative Research: Landscapes of linalool: scent-mediated diversification of flowers and moths across western North America*	Skogen, Fant, Wickett and outside collaborators	$1,555,383
National Science Foundation - DEB *Exceptionally well-preserved Early Cretaceous seed plants from Mongolia*	Herendeen	$465,366
National Science Foundation - DEB *Dissertation Research: Systematics, biogeography and taxonomy of the pantropical legume genus Cynometra s.l*	Herendeen	$20,111
National Science Foundation - DEB *A workshop to explore enhancing collaboration between US and Chinese researchers in systematic biology*	Herendeen	$78,001
National Science Foundation – DEB *Testing the effects of phylogenetic diversity on restoration outcomes in tallgrass prairie*	Larkin, Williams	$318,738
National Science Foundation – DEB *Reproductive isolation, asynchrony, and incompatibility*	Wagenius	$200,000
National Science Foundation – DEB *Collaborative Research: The Interplay of genetic and numerical dynamics in fragmented prairie populations of Echinacea angustifolia*	Wagenius, Shaw	$225,000
National Science Foundation – DEB *Collaborative Research: LTREB: Feedbacks between evolution and demography in severely fragmented prairie populations of the purple coneflower, Echinacea angustifolia*	Wagenius, Shaw	$250,000
National Science Foundation – DEB *Collaborative Research: Evaluating the contributions of horizontally transferred bacterial genes and endogenous duplication events to the diversification of diatoms*	Wickett	$300,322
National Science Foundation - MRI. *MRI: Acquisition of a Ploidy Analyzer*	Ault, Kramer, Fant, Havens, et al.	$101,048

National Science Foundation – REU *Research Experiences for Undergraduates*	Fant, Kramer	$330,307
National Science Foundation – REU *Summer field research experience for an undergraduate student*	Wagenius	$6,600
National Science Foundation – REU *Summer field research experience for an undergraduate student*	Wagenius	$6,600
Openlands *Biological Monitoring by Plants of Concern*	Goad	$15,695
Patagonia *Patagonia Env. Grant for Plants of Concern*	Goad	$6,500
Royalty Income From Plant Introduction Program	Ault	$207,125
U.S. Department of the Interior/ Bureau of Land Management *Seed Banking for Resiliency in the Eastern US*	Havens	$2,500,000
USDA Forest Service *Conservation and Land Management Internship Program*	Havens, Skogen	$110,000
USDA Forest Service/Midewin *Rare Plant Monitoring at MidewinNTP*	Goad	$20,989
US Fish and Wildlife Service *Adaptive Science*	Jacobi, Hunt	$101,440
US Fish and Wildlife Service *Native Prairie Adaptive Mgmt Decision support tool*	Jacobi, Hunt	$11,074
US Fish and Wildlife Service *Integrated Waterbird Management*	Jacobi	$30,000
US Fish and Wildlife Service *Conservation and Land Management Internship Program*	Havens, Skogen	$92,480

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Papers, Book Chapters and Books

J. Ault

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F. Herrera

Herrera F., R.C. Moran, G. Shi, N. Ichinnorov, M. Takahashi, P.R. Crane, P.S, Herendeen. 2017. An Exquisitely-Preserved Filmy Fern (Hymenophyllaceae) From the Early Cretaceous of Mongolia. American Journal of Botany 104(9): 1370-1381. http://www.amjbot.org/content/early/2017/09/28/ajb.1700246.abstract
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Herrera, F., G. Shi, P. Knopf, A. B. Leslie, N. Ichinnorov, M. Takahashi, P. R. Crane, and P. S. Herendeen. 2017. Cupressaceae conifers from the Early Cretaceous of Mongolia. International Journal of Plant Sciences 178:19–41.

Shi, G., F. Herrera, P. S. Herendeen, A. B. Leslie, N. Ichinnorov, M. Takahashi and P. R. Crane. 2017. Leaves of *Podozamites* and *Pseudotorellia* from the Early Cretaceous of Mongolia: stomatal patterns and implications for relationships. Journal of Systematic Palaeontology. http://dx.doi.org/10.1080/14772019.2016.1274343

Pérez-Consuegra, N., A. Cuervo-Gómez, C. Martínez, C. Montes, F. Herrera, S. Madriñán, and C. Jaramillo. 2017. Paleogene *Salvinia* (Salviniaceae) from Colombia and their paleobiogeographic implications. Review of Palaeobotany and Palynology 246 (2017) 85–108 http://www.sciencedirect.com/science/article/pii/S0034666716302007

A. Iler

Iler, A.M., D.W. Inouye, N.M. Schmidt, & T.T. Høye. 2017. Detrending phenological time series improves climate-phenology analyses and reveals evidence of plasticity. *Ecology* 98: 647–655.

A. Kramer

Kramer A.T., Wood T.E., Frischie S., Havens K. 2017. Considering ploidy when producing and using mixed-source native plant materials for restoration. Restoration Ecology online early: doi: 10.1111/rec.12636.

G. Mueller

Mueller, G.M. 2017. Progress in conserving fungi: engagement and red listing. BGjournal 14: 30-33.

Tripp, E.A., N. Zhang, H. Schneider, Y. Huang, G.M. Mueller, Z. Hu, M. Haggblom, and D. Bhattacharya. 2017. Reshaping Darwin's tree: Impact of the symbiome. TREE: DOI: http://dx.doi.org/10.1016/j.tree.2017.05.002

Wilson, A.W., T.W. May, G.M. Mueller. 2017. Biogeography of the Ectomycorrhizal Mushroom Genus Laccaria, pages 273-297 in L. Tedersoo (ed.), Biogeography of Mycorrhizal Symbiosis, Ecological Studies 230, DOI 10.1007/978-3-319-56363-3_13

Zhang, R. G.M. Mueller, X-F Shi, PG Liu. 2017. Two new species in the *Suillus spraguei* complex from China. Mycologia Vol. 109 , Iss. 2,2017

K. Skogen

Rhodes, Matthew K. **++**, Jeremie B. Fant, Krissa A. Skogen (2017) Pollinator identity and spatial isolation influence multiple paternity in an annual plant. Molecular Ecology 26 (16) 4296–4308

Jogesh, T., R. P. Overson, R. Raguso, and **K. A. Skogen**. 2017. Herbivory as an important selective force in the evolution of floral traits and pollinator shifts in a clade of evening primroses, *Oenothera* sect. *Calylophus* (Onagraceae). AoB Plants. 9(1) doi:10.1093/aobpla/plw088 Open Access.

P. Vitt

Vitt, P., T.M. Knight, M. Schutzenhofer, W. Kleiman, K. Havens and TR. Bittner. 2017. Experimental and Simulated Grazing in a Prairie Ecosystem Benefits Rare Forb. Natural Areas Journal 37: 161-169.

N. Wickett

Parks, MB, T Nakov, E Ruck, NJ Wickett, AJ Alverson. 2017. Phylogenomics reveals an extensive history of genome duplication in diatoms (Bacillariophyta). American Journal of Botany. https://doi.org/10.1101/181115

Medina, R, MG Johnson, Y Liu, N Wilding, T Hedderson, NJ Wickett, B Goffinet. 2017. Evolutionary dynamism in bryophytes: Phylogenetic inferences confirm rapid radiation in the moss family Funariaceae. Molecular Phylogenetics and Evolution. https://doi.org/10.1016/j.ympev.2017.12.002

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Briscoe, LRE, NJC Zerega, HT Lumbsch, M Stech, E Kraichak, MJ Von Konrat, JJ Engel, NJ Wickett. 2017. Molecular, morphological, and biogeographic perspectives on the classification of Acrobolboideae (Acrobolbaceae, Marchantiophyta). Phytotaxa 319(1): 056-070.

Carvalho-Silva, M, M Stech, LH Soares-Silva, WR Buck, NJ Wickett, Y Liu, PEAS Camara. 2017. A molecular phylogeny of the Sematophyllaceae s.l. (Hypnales) based on plastid, mitochondrial, and nuclear markers, and its taxonomic implications. Taxon 66(4): 811-831.

N. Zerega

Briscoe, L.R.E., N.J.C. Zerega, H.T. Lumbsch, M. Stech, E. Kraichak, M.J. von Konrat, J.J. Engel, and N. Wickett. 2017. Molecular, morphological, and biogeographic perspectives on the classification of Acrobolboideae (Acrobolbaceae, Marchantiophyta). *Phytotaxa* 319 (1): 056–070. http://mapress.com/j/pt/article/view/phytotaxa.319.1.2/12195

Gardner, E.M., P. Sarraf, and N.J.C. Zerega. 2017. Phylogeny and biogeography of *Maclura* (Moraceae) and the origin of an anachronistic fruit. *Molecular Phylogenetics and Evolution.* https://doi.org/10.1016/j.ympev.2017.06.021

Williams, E.W., E.M. Gardner, R. Harris III, A. Chaveerach, J.T. Pereira, and N.J.C. Zerega. 2017. Out of Borneo: Biogeography, phylogeny, and divergence date estimates of *Artocarpus* (Moraceae). *Annals of Botany* 119(4):611-627. doi: https://doi.org/10.1093/aob/mcw249

Bulletins

Ault, J. 2017. Five New Spring Phlox Selections. Plant Release Bulletin #43, Chicagoland Grows®, Inc.

DeRose, D. 2017. Plants of Concern: Citizen Science: A Social Science. *Prairie Telegraph:* July-September.

DeRose, D. 2017. Plants of Concern: *Malvastrum hispidum*. *Prairie Telegraph:* October-December.

Goad, R., and J. Miller. 2017. Plants of Concern Volunteer Manual.

Shearer, K. and J. Ault. 2017. The Morton Arboretum Elms. Plant Release Bulletin # 44, Chicagoland Grows®, Inc.

Reports

Goad, R., 2017. Permit reports to Illinois DNR and Illinois Nature Preserves Commission, Forest Preserve and Conservation Districts for 2016 monitoring and research work at their sites.

Goad, R., and A. Green. 2017. Plants of Concern 2004-2017: Annual Report to the Forest Preserves of Cook County.

Goad, R., and A. Reyneri. 2017. Patagonia Environmental Grant: Final Report.

Goad, R. and D. DeRose. 2018. Rare Plant Monitoring at Midewin National Tallgrass Prairie 2001-2017. Annual Report to United States Forest Service at Midewin National Tallgrass Prairie.

Goad, R., and J. Miller. 2017. Lake Michigan Watershed Early Detection Invasives Strike Team: Effectiveness of Strike Team Control on Threats to Rare Plant Populations within Target Areas. Report to Lake County Forest Preserve District for National Fish and Wildlife Foundation.

Goad, R., J. Miller, D. DeRose, and A. Green. 2018. Plants of Concern: The Chicago Botanic Garden's Rare Plant Monitoring Program Annual Report, January 2017.

Goad, R., J. Miller, and J. Steffen. 2018. Openlands Lakeshore Preserve Monitoring Program: 2017 Report.

Havens, K. P. Vitt, A. Hakes. 2017. Threat Assessment and Mitigation in Dune Landscapes: Pitcher's Thistle, Invasive Plants, and Control of Biocontrol Weevils. Performance Report to the Wisconsin Depart. of Natural Resouces. 2017.

Havens, K. 2016. Report on conservation activities to Center for Plant Conservation.

Yates, E., and D. Sollenberger. 2017. Dixon National Tallgrass Prairie Seed Bank. Annual Report to the National Seeds of Success Program, December 2017.

Media and General Outreach

P. Herendeen & F. Herrera. A temporary exhibit on the Mongolian fossil plant project has been installed in the Granger Gallery of the Rice Plant Science Center. This exhibit explains the significance of this paleobotanical research project and displays a variety of fossil plant specimens to illustrate the research and explain what these fossil plants are telling us about the evolutionary history of these plants and the environments of central Asia approximately 100-130 million years ago.

Iler, A. Speaker & Panelist at The Chicago Network event for high school women: "Female Scientists from Plants to Planets"

Kirschner, R. Numerous print and television media coverages relating to the significant flood event that occurred at the Garden in July 2017.

Kramer, A. BBC Radio, Costing the Earth – guest on The World's Toughest Plants. Aired May 30, 2017. http://www.bbc.co.uk/programmes/b08rq6dx

Mueller, G.M. Fungi and Invertebrates: Understudied but key components of our natural areas Forest Preserves of Cook County Biodiversity Symposium , Chicago Botanic Garden (Co-Organizer of the event).

Mueller, G.M. *Progress on Fungal Conservation*, Illinois Mycological Society, 3 September.

Mueller, G.M. Participant in Climate Change Symposium organized by Senator Schneider, Earth Day, Chicago Botanic Garden.

Mueller, G.M. Several presentations as part of Priority Plants and Fungi Chicago Wilderness Initiative.

Mueller, G., Interviewed for several newspaper and magazine articles

Skogen, K. Soho House Pollinator Awareness Event Panelist. Co-hosted by the Pollinator Partnership, SproutModern, and Soho House. Chicago.

Skogen, K. Girl Scouts of Greater Chicago and Northwest Indiana. Panelist. Imagine your future – Environmental Scientist Edition. Discussed my career in science and research with 4^{th}-8^{th} grade girls to increase exposure to careers in science.

Skogen, K. Project Exploration – Sisters4Science. STEM Scientist Instructor. After school program for young girls from underrepresented communities in Chicago elementary and middle school. Each session is led by a female scientist who emphasize leadership development through scientific exploration. www.projectexploration.org
Discussed my career background, a day in the life of a scientist, and lead a hands-on experiment focused on flowers and pollinators.
Carter G. Woodson North Middle School, Chicago, IL. (96% Black, 3% Hispanic. 97% low income. 20% diverse learners)
Frederick Funston Elementary School, Chicago, IL. (91% Hispanic, 9% Black. 96% low income. 18% diverse learners. 42% limited English)

Skogen, K. Oak Terrace Elementary School (Dual language school. 75% Hispanic. 70% low income. 62% limited English.
- Ecology Club - Discussed my career background, a day in the life of a scientist, and assisted in the development of a pollinator-friendly native plant garden.
- Kindergarten - Developing hands-on activities for outdoor classroom

Wickett, N., Interviewed for the Northwestern Undergraduate Research Journal

Yates, E. Book Review for University of Chicago Press – "The book of seeds" by Paul Smith, February 2017

AWARDS AND INVENTIONS

- Lauren Audi (MS Student) was awarded a $5,000 grant from the Resnick Family Social Impact Program.
- Lauren Audi (MS Student) was awarded $2,500 for the 2017 GCA Summer Scholarship in Field Botany
- Lauren Audi (MS Student) received a grant from the Alumni of NU grants for $2,165 for her research
- Justin Bain (PhD student) – Received a $500 travel award to present his work at The Annual Meeting of the American Society of Naturalists (Asilomar, CA).
- Rebecca Barak (PhD 2017) selected as a Smith Post-Doctoral Fellow for her research "Effective seed mix design for ecological restoration" under the academic mentorship of Dr. Lars Brudvig at Michigan State University and in partnership with Dr. Kayri Havens at the Chicago Botanic Garden.
- Rebecca Barak Ton Damman Award for outstanding student talk, ESA Vegetation Section ($500).
- Anita Cisternas-Fuentes (PhD Student) The Alumnae Society of Northwestern University ($4,344)
- Anita Cisternas-Fuentes (PhD Student) Native Plant Society of New Mexico, Jack & Martha Carter conservation fund
- Anita Cisternas-Fuentes (PhD Candidate) received a grant from the Alumni of NU grants for $4,344 for her research
- Jessa Finch (PhD Student) Botanical Society of America, International Botanical Congress Travel Award
- Jessa Finch (PhD Candidate) received a grant from the Alumni of NU grants for $1,769 for her research
- Elliot Gardner (PhD candidate) selected as an NSF Postdoctoral Fellow. Elliot will be studying "Convergent evolution of biotic pollination in wind pollinated angiosperm lineages: a functional and genomic exploration of a rare transition."

- P. Herendeen elected President of the International Association for Plant Taxonomy (2017-2023)
- P. Herendeen was appointed to the position of Chair of the International Association of Botanical and Mycological Societies (IABMS)
- F. Herrera-was elected to the position of Secretary for the Paleobotanical Section, Botanical Society of America
- Mary Patterson (MS Student) received a $2,500 award from Garden Club of America
- Katherine Wenzell (PhD student) received an NSF-GRFP for her research
- Colby Witherup (PhD Candidate) selected as a Nicholson Fellow, awarded PhD Stipend and Tuition for one academic year from The Graduate School at Northwestern University.
- Colby Witherup (PhD Student) Botanical Society of America Graduate Student Research Award
- Colby Witherup (PhD Student) American Society of Plant Taxonomists Graduate Student Research Grant
- Jordan Wood (MS Student) received a $4500 award from The Catherine H. Beattie Fellowship in Conservation Horticulture awarded by The Garden Club of America
- N. Zerega, Ver Steeg Outstanding Graduate Faculty Award 2017**,** this award recognizes two outstanding Northwestern University graduate faculty members each year for excellence in work with graduate students in The Graduate School, May 2017, $3,000.

PRESENTATIONS AND WORKSHOPS

J. Ault

Chicagoland Grows plant introduction program. Staffed display booth and discussed program and plant introductions with attendees during trade show. iLandscape: The Illinois Landscape Show, Schaumburg, Illinois. February 1-3, 2017.

Chicagoland Grows plant introduction program. Staffed display booth and discussed program and plant introductions with attendees during trade show. Cultivate16 Trade Show, Columbus, Ohio. July 16-18, 2017.

Chicagoland Grows plant introduction program. Staffed display booth and discussed program and plant introductions with attendees during Illinois Landscape Contractors Association (ILCA) Summer Field Day, Glen Ellyn, Illinois. August 10, 2017.

Chicagoland Grows plant introduction program. Staffed display booth and discussed program and plant introductions with attendees during trade show. Farwest Trade Show, Portland, Oregon. August 23-25, 2017.

Chicagoland Grows New Plant Introductions. International Plant Propagator's Society Meeting, Grand Rapids, Michigan. October 14, 2017.

R. Barak

Barak, RS, E Lonsdorf, DJ Larkin, Seeing the prairie through the seeds: Seed mix design for restoration of biodiversity in the tallgrass prairie. Ecological Society of America, Portland, OR, Aug 5 – 11.

Barak, RS, EW Williams, DJ Larkin, Tallgrass prairie restoration from seeds to communities, Society for Ecological Restoration, Midwest Great Lakes. Grand Rapids, MI, Mar 24 – 26.

Barak, RS, EW Williams, DJ Larkin. Seed Mixes to Sites: Tallgrass Prairie Composition and Biodiversity. Wild Things: A Chicago Wilderness conference for people and nature, Chicago, IL, Feb 18.

Barak, RS, E Lonsdorf, DJ Larkin. Mixing and matching: Composition and diversity of commercially available seed mixes compared with remnant and restored tallgrass prairies. National Native Seed Conference, Washington, DC, Feb 13 – 16.

P. CaraDonna

CaraDonna, P. An examination of time and topology in plant-pollinator interaction networks. *Invited talk and working group member.* Temporal Networks Working Group Meeting, Freiburg Institute of Advanced Studies, Freiburg, Germany.

CaraDonna, P. An examination of time and topology in plant-pollinator interaction networks. *Invited talk.* Ecology Society of America 102nd Annual Meeting, Portland, OR

CaraDonna, P. and Waser, N. Transformation, abstraction, and reassembly of information: an art-science exchange informs perceptions of nature. *Invited talk.* Ecology Society of America 102nd Annual Meeting, Portland, OR

Invited seminar speaker. University of Illinois Urbana-Champaign, PEEC Departmental Seminar, Urbana, IL

Invited seminar speaker. Morten Arboretum, Tree Talks Seminar, Lisle, IL

Invited working group member. Trap-nest Food Webs and Plant Diversity Working Group Meeting, University of Freiburg, Freiburg, Germany.

L. Egerton-Warburton

Organized and ran Symposium 'Beautiful gardens begin with healthy soil: soil quality assessment and innovative soil care as adaptive management tools in botanic gardens' at the American Public Gardens Association Annual Meeting, Hamilton, ON, Canada.

Dynamics of lignin-degrader communities in a dry seasonal tropical forest, DOE- JGI Users meeting, Walnut Creek, CA.

Soil aggregation and organic matter stabilization in green roof systems and implications for C sequestration, Soil Ecology Society meeting, Ft. Collins, CO.

Plant species and functional group effects on soil properties in a green roof community, Soil Ecology Society meeting, Ft. Collins, CO.

Inoculating Plants with Mycorrhizal Fungi: an Essential or Excessive Practice? American Public Gardens Association Annual Meeting, Hamilton ON, Canada.

Ectomycorrhizal fungi in the tropical dry forests of the Yucatan Peninsula, Association for Tropical Biology and Conservation, Annual Meeting, Merida, Mexico.

Dynamics of lignin-degrader communities in a dry seasonal tropical forest. Association for Tropical Biology and Conservation, Annual Meeting, Merida, Mexico.

Seasonal dynamics of arbuscular mycorrhizal communities in tropical dry forests. International Conference on Mycorrhizas, Prague, Czech Republic.

Fungi in fossilized roots from the Early Cretaceous of Mongolia, Midwest Paleobotanical Colloquium.

Seasonality drives arbuscular mycorrhizal fungal diversity in Mexican dry seasonal tropical forests. Mycological Society of America Annual Meeting, Athens GA.

Assembly of lignin-degrader communities in a dry seasonal tropical forest. Mycological Society of America Annual Meeting, Athens GA

Coupled metagenomic-chemical analyses of degrading fungal necromass: implications for microbial contributions to soil organic carbon, International Society for Environmental Biogeochemistry meeting, Cairns, Australia.

J. Fant

Presenter at a Conservation Horticulture Workshop at University of Minnesota (2017). Tasked with helping the EEB Department develop a new core course for undergraduate students.

National Tropical Botanical Garden Seminars (2017). What botanic gardens can learn from the zoo community about conserving plants in living collections.

UICN- Conservation Genetics Specialist Group strategy meeting (2017) in Antwerp Belgium.

R. Goad

Goad, R. 2017. *Rare, Endangered, and Local: Plants of Concern in Illinois*. Friends of the Green Bay Trail Meeting. Glencoe, IL. February 9.

Goad, R. 2017. *When Endangered Species Aren't Anymore: What De-listing Means for Rare Species, and the Role of Citizen Science*. Wild Things Conference. University of Illinois, Chicago. February 18.

Goad, R. 2017. *Plant Conservation*. Guest lecture for The Nature of Plants class at Northwestern University. Evanston, IL. February 23.

Goad, R. 2017. *Botanical Citizen Science in a Changing World.* Flora of the Chicago Region Symposium. April 8.

Goad, R. 2017. *Special Flora of North Shore Ravines*. Glencoe Ravine Homeowners Workshop. April 27.

Goad, R. 2017. *Rare Plants in the Urban Jungle*. Teen Conservation Leadership Conference. Brookfield Zoo. June 13.

Goad, R., and H. Bernardo. 2017. *Using Long Term Citizen Science Monitoring Data to Decrease Extinction Risk of Rare Plants in the Chicago Region*. Natural Areas Association Conference. Fort Collins, CO. October 10-12. (Talk presented by H. Bernardo)

Goad, R. 2017. Plant Conservation. Guest lecture for The Nature of Plants class at Northwestern University. Evanston, IL. November 7.

Goad, R. 2017. *Botanical citizen science, its impacts, and how to get involved*. Nature Speaks Series by the Prospect Heights Natural Resources Commission. November 30.

K. Havens

When Does Local Matter? Participated in a workshop to develop a seed sourcing tool. Mt. Cuba Botanical Center, DE, 2017.

Consequences of Fecundity Reduction in Invasive Plants and Implications for Biocontrol – Departmental Seminar, Case Western Reserve University, Cleveland, OH, 2017.

Cultivating Plant Conservation for the Future, Arbor Day Address, Holden Arboretum, Cleveland, OH, 2017.

The Role of Botanic Gardens in Native Seed Research and Use, National Adaptation Forum, Minneapolis, MN, 2017.

The importance of Cirsium pitcheri, a rare plant species, as a pollinator resource, Botanic Gardens Conservation International Congress, Geneva, Switzerland, 2017.

Considerations in Plant Reintroduction and Restoration, Botanic Gardens Conservation International Congress, Geneva, Switzerland, 2017.

Seed sourcing: How to make the best decisions about what seed provenances to collect and where to use them in restoration, Society for Ecological Restoration Congress, Iguasu Falls, Brazil, 2017.

The role of botanic gardens in native seed research and use, Society for Ecological Restoration Congress, Iguasu Falls, Brazil, 2017.

Advocacy for Native Plants and Restoration, Society for Ecological Restoration Congress, Iguasu Falls, Brazil, 2017.

Prairie restoration: How to make the best decisions about what seed provenances to collect and where to use them, Plenary Address, NASSTEC Conference, Kew, London, England, 2017

Organized and moderated a symposium "Timing is Everything" on plant phenology at Chicago Botanic Garden.

Co-organized symposium on advocacy and hill visits for attendees at the National Native Seed Conference. Washington, DC.

R. Hawke

Proven Perennials. InVigorateU Conference and Trade Show, Bloomington-Normal, IL; January 16, 2017.

Top-performing Perennials. Porter County MG Gardening Show, Valparaiso, IN; January 28, 2017.

Comparative trial of *Hydrangea paniculata* Cultivars. Porter County MG Gardening Show, Valparaiso, IN; January 28, 2017.

Sustainability Practices in Plant Evaluation. Green Matters Symposium, Bethesda, MD; February 24, 2017.

When Pretty Isn't Enough: Comparative trials at Chicago Botanic Garden. Illinois Master Gardeners Conference, Rockford, IL; March 4, 2017.

Proven Perennials for Northern Gardens. Illinois Master Gardeners Conference, Rockford, IL; March 4, 2017.

When Pretty Isn't Enough: Comparative trials at Chicago Botanic Garden. Spring Symposium, Fernwood Botanical Garden, Niles, MI; March 18, 2017.

Chicago Botanic Garden's Plant Evaluation Program. Master Gardeners' Recognition Luncheon, Chicago Botanic Garden, Glencoe, IL; April 26, 2017.

Four-Star Perennials. BRG 2017 Expo, Minneapolis, MN: August 1, 2017.

Fall-blooming Perennials. Wellfleet Gardeners, Cape Cod, MA; October 18, 2017.

Proven Perennials. Chicago Botanic Garden Woman's Board Meeting, Glencoe, IL: November 2, 2017.

P. Herendeen

Herendeen, P.S., E.M. Friis, K.R. Pedersen, P.R. Crane. 2017. Palaeobotanical Redux: Revisiting the age of the Angiosperms. Botany 2017. http://2017.botanyconference.org/engine/search/index.php?func=detail&aid=55

Shi, G., F. Herrera, P.S. Herendeen, N. Ichinnorov, M. Takahashi, and P.R. Crane 2017. Diversity of corystosperms from the Early Cretaceous of Mongolia. International Botanical Congress, Shenzhen, China, July, 2017.

Herrera, F., G. Shi, N. Ichinnorov, M. Takahashi, E. Bugdaeva, P.S. Herendeen, P.R. Crane. 2017. The presumed ginkgophyte Umaltolepis has seed-bearing structures resembling those of Peltaspermales and Umkomasiales. International Botanical Congress, Shenzhen, China, July, 2017.

Herrera, F., G. Shi, N. Ichinnorov, M. Takahashi, E. Budgaeva, P.R. Crane, and P.S. Herendeen. 2017. Floristic composition of an Early Cretaceous swamp from Mongolia and the implications for seed plant evolution. International Botanical Congress, Shenzhen, China, July, 2017.

F. Herrera

Shi, G., F. Herrera, P.S. Herendeen, N. Ichinnorov, M. Takahashi, and P.R. Crane 2017. Diversity of corystosperms from the Early Cretaceous of Mongolia. International Botanical Congress, Shenzhen, China, July, 2017.

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Herrera, F., G. Shi, N. Ichinnorov, M. Takahashi, E. Budgaeva, P.R. Crane, and P.S. Herendeen. 2017. Floristic composition of an Early Cretaceous swamp from Mongolia and the implications for seed plant evolution. International Botanical Congress, Shenzhen, China, July, 2017.

Buiser, A.M.S.; F. Herrera; L. Egerton-Warburton; G.M. Mueller; P.R. Crane, P.. Herendeen. 2017. Fungi flora in fossilized roots from the Early Cretaceous of Mongolia. Midcontinent Paleobotanical Colloquium, Ann Arbor, Michigan. May, 2017.

Herrera F., G. Shi, N. Ichinnorov, M. Takahashi, E. Bugdaeva, P.S, Herendeen, and P.R. Crane. 2017. The presumed ginkgophyte *Umaltolepis* has seed-bearing structures resembling those of Peltaspermales and Umkomasiales. Midcontinent Paleobotanical Colloquium, Ann Arbor, Michigan. May, 2017.

J. Jabcon

Dixon Prairie Tour. Lake Forest Open Lands interns. June 2017

A. Iler

Iler, A.M., A. Blazquez-Castro, H. Steltzer. *Phenology, flower albedo, and soil microclimate: a positive feedback between vegetation and climate change*? Ecological Society of America Annual Meeting. Portland, OR. August 2017.

Featured speaker at the JMP Symposium: The Impacts of Changes in Phenology, Chicago Botanic Garden. *Ecological consequences of shifted flowering times under climate change*. June 2017.

Invited seminar speaker. University of Illinois Urbana-Champaign, PEEC Departmental Seminar, Urbana, IL. November 2017.

Invited seminar speaker. Morten Arboretum, Tree Talks Seminar, Lisle, IL. March 2017.

R. Kirschner

But What Will the Neighbors Think? Creating Native Shoreline Landscapes That Are Easy on the Eye AND Great for the Environment! Keynote Address for the annual meeting of the Indiana Lakes Management Society. Bloomington, Indiana. February 2017.

But What Will the Neighbors Think? Creating Native Shoreline Landscapes That Are Easy on the Eye AND Great for the Environment! Keynote Address for the annual meeting of the Illinois Lake Management Association. Crystal Lake, Illinois. March 2017.

What's Black and White and Spread All Over?. Presentation on the Garden's Zebra Mussel Mitigation Program to the Garden's Corporate Roundtable on Sustainability. March 2017.

But What Will the Neighbors Think? Creating Native Shoreline Landscapes That Are Easy on the Eye AND Great for the Environment! Presentation to the Chicago Botanic Garden's Roadside Flower Sale volunteers. May 2017.

But What Will the Neighbors Think? Creating Native Shoreline Landscapes That Are Easy on the Eye AND Great for the Environment! Presentation for the Chicago Botanic Garden's Master Gardeners. July 2017.

But What Will the Neighbors Think? Creating Native Shoreline Landscapes That Are Easy on the Eye AND Great for the Environment! Presentation for the Crystal Lake Park District's annual "State of the Lake Meeting." Crystal Lake, Illinois. October 2017.

A. Kramer

Kramer, A., S. Still, N Talkington*, and T. Wood. 2017. *Using past seeding treatments to inform future sourcing in the Colorado Plateau.* Colorado Plateau Native Plant Program annual conference. Monticello, UT. February 28, 2017.

Kramer, A., S. Still, N Talkington*, and T. Wood. 2017. *Using past seeding treatments to inform future sourcing in the Colorado Plateau.* National Native Seed Conference. Washington, DC. February 15, 2017.

Organized multi-speaker symposium on *Seeing the trees for the forest: overcoming plant blindness with outreach.* National Native Seed Conference. Washington, DC. February 15, 2017.

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G. Mueller

Fungal Conservation: Science, Engagement, Action. Key Note, North American Mycological Association Annual Meeting. Wisconsin.

Desafíos y Oportunidades para la Conservación de Hongos (Challenges and Opportunities for Mushroom Conservation). Key Note Address, VIII Latin American Mycological Congress. Lima, Peru.

Role of mycorrhizal fungi in the nutrition and fine scale distribution patterns of epiphytic orchids. University of Pinar del Rio 40th Anniversary Symposium, Pinar del Rio, Cuba.

Ectomycorrhizal fungi: Key Components of Forest Ecosystems. University of Pinar del Rio 40th Anniversary Symposium, Pinar del Rio, Cuba

Challenges and Opportunities for Fungal Conservation. IUCN SSC Public Symposium. Cartagena, Colombia.

Fungal Conservation and Botanic Gardens. Global Botanica Garden Conference. Geneva, Switzerland.

Bridging Botanic Gardens & Restoration Professionals: The Conservation & Land Management Internship Program. Global Botanica Garden Conference. Geneva, Switzerland.

Funding the Inititive. North American Mycoflora Workshop. Athens, Georgia.

J. O'Shaughnessy

Dixon Prairie Tour, Teacher Training Program, Chicago Botanic Garden. July 2017.

Dixon Prairie Tour, Veteran Internship Program, Chicago Botanic Garden. August 2017

Dixon Prairie Tour, Veteran Project, October 2017

K. Skogen

Wenzell*+, K., J. Fant, and K. Skogen 2017. Range-wide variation in floral traits and local pollinator assemblages in *Castilleja sessiliflora* (Orobanchaceae). Ecological Society of America. Portland, Oregon. Poster.

Patsis*+, A., R. Overson, M. Johnson, K. Skogen, W. Wagner, R. Raguso, N. Wickett, and R. Levin. 2017. Elucidating the evolutionary history of *Oenothera* sect. *Pachylophus* using phylogenomics. Botanical Society of America. Fort Worth, Texas.

Vergara*+, M., K. Skogen, T. Jogesh, and K. Kay. 2017. Do herbivores prefer flower buds over leaves? Evaluating caterpillar preferences in evening primroses (Onagraceae). Botanical Society of America. Fort Worth, Texas. Poster.

Havens, K., A. Kramer, K. Skogen*, and E. Williams. 2017. Advocacy for native plants and restoration: 'Botany Bill', H. R. 1054 – the Botanical Sciences and Native Plant Materials Research, Restoration and Promotion Act. Botanical Society of America. Fort Worth, Texas. Poster.

Skogen*, K., T. Jogesh, E. Lewis+, A. Gruver+, G. Broadhead+, R. Overson, and R. Raguso. 2017. Is floral scent at the nexus of interactions among plants, pollinators and herbivores in the evening primroses (Onagraceae)? Botanical Society of America. Fort Worth, Texas.

D. Sollenberger

Sollenberger, D., E. Yates and P. Vitt. The Evolution and Acquisition of the Restoration Collection at the Dixon National Tallgrass Prairie Seed Bank National Native Seed Conference. February 13-16, 2017. Washington D.C.

J. Steffen

Introduction to moth identification and ecology. Wildflower Preservation and Propagation Symposium. McHenry County College. February 2017.

McDonald Woods (tour). Dominican High School. September 2017.

McDonald Woods (tour). Northwestern University Undergraduates. September 2017.

McDonald Woods (tour). Lake Forest Open Lands Interns. June 2017.

P. Vitt

Vitt, P. and K. Havens. Perspectives on Seed Provenance – A Local, and Global, Issue. Southern Rockies Seed Network 2017 Conference, Fort Collins, CO. November 28, 2017.

Zhang, T., A. Fettes, R. Fiegener, P. Vitt. Bee There or Be Square: Promoting Pollinator Habitats in Landscape Architecture. A four-speaker cooperative panel presentation to the American Association of Landscape Architects, Los Angeles, CA. October 20, 2017.

Vitt, P., P.N. Belamaric, R. Book, and M. Curran. From Species Reintroductions to Assisted Migration: A continuum of conservation strategies. – Symposium on Assisted Migration. Society for Ecological Restoration, Brazil, August 2017.

Sollenberger, D., E. Yates and P. Vitt. The Evolution and Acquisition of the Restoration Collection at the Dixon National Tallgrass Prairie Seed Bank National Native Seed Conference. February 13-16, 2017. Washington D.C.

N. Wickett

Using phylogenomics to resolve species and functional histories in diverse non-model organisms. University of Arizona, December 4, 2017.

Exploring bryophyte relationships in the age of high-throughput phylogenetics. 64th Annual Fall Symposium (Next Generation Biology: From Species to Ecosystems), Missouri Botanical Garden, October 14, 2017.

Phylogeny and uncertainty in the genomic age: An example from mosses (and more). Rancho Santa Ana Botanic Garden, April 28, 2017.

E. Yates

Yates, E. *Maps for Plants: GIS Enhances Plant Conservation at the Chicago Botanic Garden.* Society for Conservation GIS annual meeting, Asilomar Conference Center, Monterey, CA, July 2017

N. Zerega

Zerega, N.J.C. and *E. Gardner. Domestication, diversity, and distribution history of breadfruit (*Artocarpus altilis*, Moraceae), a priority underutilized staple crop. Plant Animal Genome Conference, San Diego, CA. January 15, 2017.

"Evolving food: Exploring food biodiversity across the tree of life." Keynote address at *Tasting the*

Tree of Life campus wide event, The College of New Jersey, Feb. 28, 2017.

Student Presentations:

Barto, A. and S. Wagenius. 2017. Effect of style age, relative floret position, and pollination in *Echinacea angustifolia*. Arkansas IDeA Network of Biomedical Research Excellence (INBRE) Research Conference, Univeristy of Arkansas, Fayetteville, AR. 28 October.

Gardner, E.M., J.T. Pereira, A.S.A. Puad, and N.J.C. Zerega. The origin and diversity of tarap (*Artocarpus odoratissimus*, Moraceae), an underutilized tree crop from Borneo: insights from HybSeq and SSRs. Poster at International Botanical Congress, Shenzhen, China, July 23-29, 2017.

Gudmundsen, C.* and Egerton-Warburton, L.M. *Soil aggregation and organic matter stabilization in green roof systems and implications for C sequestration,* Soil Ecology Society meeting, Ft. Collins, CO. *Undergraduate intern.

Ison, J., L. Prescott, A. Waananen, S. Nordstrom, S. Wagenius. 2017. The early flower attracts the bee: consequences and mechanisms of phenological isolation in plants. Evolution 2017. Portland, OR. 27 June.

Morgan, B. and Egerton-Warburton, L.M. *Seasonality drives arbuscular mycorrhizal fungal diversity in Mexican dry seasonal tropical forests.* Mycological Society of America Annual Meeting, Athens GA

Patterson, M. and A.T. Kramer. 2017. Meeting multiple management priorities with limited resources when making post-fire management decisions in the Intermountain West. Natural Areas Conference, Ft Collins, CO. October 2017.

Patsis, A., R. Overson, M. Johnson, K. Skogen, W. Wagner, R. Raguso, N. Wickett, and R. Levin. 2017. Elucidating the evolutionary history of *Oenothera* sect. *Pachylophus* using phylogenomics. Botanical Society of America. Fort Worth, Texas.

Richardson, L. 2017. Flowering effort and timing predict seedset in a common tallgrass prairie species. Midwest Ecology and Evolution Conference (MEEC). University of Illinois at Urbana-Champaign. 19 March.

Ross, J. and Egerton-Warburton, L.M. *Assembly of lignin-degrader communities in a dry seasonal tropical forest.* Mycological Society of America Annual Meeting, Athens GA.

Seglias, A.* and A. Kramer. 2017. *Does frozen storage change the germination performance of native Southwestern forb species?* National Native Seed Conference. Washington, DC. February 15, 2017. February 16, 2017.

Wenzell, K., J. Fant, and K. Skogen 2017. Range-wide variation in floral traits and local pollinator assemblages in *Castilleja sessiliflora* (Orobanchaceae). Ecological Society of America. Portland, Oregon. Poster.

White, A.*, J. Fant, and A. Kramer. 2017. *Restoring species diversity: uncovering gaps in the native seed market.* National Native Seed Conference. Washington, DC. February 15, 2017.

Woolridge, C*., E. Dangremond, J. Fant, and A.T. Kramer. 2017. *Predictive provenancing: can southern-sourced seeds be used in Midwest restoration efforts?* National Native Seed Conference. Washington, DC. February 15, 2017.

Woolridge, C*., J.B. Fant, and A.T. Kramer. 2017. *Predictive provenancing: can southern-sourced seeds be used in Midwest restoration efforts?* Natural Areas Conference, Ft Collins, CO. October 2017.

Vergara, M., K. Skogen, T. Jogesh, and K. Kay. 2017. Do herbivores prefer flower buds over leaves? Evaluating caterpillar preferences in evening primroses (Onagraceae). Botanical Society of America. Fort Worth, Texas. Poster.

Zeldin, J.*, J. Fant, and A.T. Kramer. 2017. *Thinking outside the box when producing materials to restore locally rare plant species: micropropagation of* Cirsium hillii *in the Chicago Region.* Natural Areas Conference, Ft Collins, CO. October 2017.

Zhou, K. and Egerton-Warburton, L.M. *Plant species and functional group effects on soil properties in a green roof community.* Soil Ecology Society meeting, Ft. Collins, CO.

TEACHING AND MENTORING

J. Ault

CLG 31 Years of Plant Development and Introduction for Midwestern Landscapes. Guest lecture for College of Lake County course, Introduction to Horticulture. *Oct. 16, 2017*.

Committee member for graduate student:

Rob Hevey (PhD, Northwestern University)

P. CaraDonna

BIOL-SCI 109 The Nature of Plants (Fall 2017), Northwestern University

Visual Design Principles for Scientists (one day workshop, Summer 2017), Rocky Mountain Biological Laboratory

ENVR-SCI 390 The Ecology of Climate Change (Spring 2017), Northwestern University

BIOL-SCI 109 The Nature of Plants (Winter 2017), Northwestern University

Undergraduate students advised:

Emma Hirte (Lake Forest College)
Rachel Dickson (University of Montana)

Graduate students advised or committee member:

Justin Bain (advisor PhD at NU)
Andrea Gruver (advisor, MS at NU)
Lea Richardson (committee member, PhD at NU)
Katherine Andrews (committee member, MS at NU)
Drake Mullet (committee member, MS at NU)

L. Egerton-Warburton

Making observations from micro- to macro-scales: an interactive class examining plant morphology from pollen to whole flower (Wheeling High School)

CBG Soils Initiative Workshops, presenter and instructor

High school students mentored:

Isabella del Muro (Northbrook High)
Dheya Pio (Wheeling High School)
Hannah Waguespack (Washington Community High School, Peoria)
Madison Custer (Washington Community High School, Peoria)
Jocelyn Garcia (Wheeling High School)
Matthew Killian (Wheeling High School)
Kaitlyn Kerr (Chillicothe High School)

Undergraduate students mentored:

Allison May Buiser (Knox College)
Cam Gundersman (Lake Forest College, Graduated 2017)
Nathanael Williams (Ferris State University)

Graduate students advised or committee member:

Jessica Ross (BS/ MS, NU; Advisor, Graduated 2017)
Lauren Umek (PhD NU; Advisor)

Benjamin Morgan (PhD NU; Advisor)
Kaiyue Zhou (MS, NU; Advisor)
Lynnaun Johnson (PhD NU; Committee)
Chen Ning (PhD NU; Committee)
Frank Anderson (PhD UIC; Committee)

J. Fant

Co-PI, Research Experiences for Undergraduates (REU) site Program in Plant Biology and Conservation

Conservation Genetics (Spring 2014), Northwestern University

Field and Laboratory Methods in Plant Biology and Conservation (Fall 2014), Northwestern University

Postdoctoral Fellow Advised:

Tania Jogesh
Rick Overson

Graduate students advised or committee member:

Kat Andrews (Comm. Member, current MS , NU)
Kris Bonefort (Advisor, current MS, NU)
Anita Cisternas-Fuentes (Advisor, current PhD, NU)
Jessamine Finch (Comm. Member, current PhD, NU)
Kelly Ksiazek (Comm. Member, current PhD , NU)
Eun Sun Kim (Comm. Member, current PhD, UIC)
Drake Mullett (Advisor, current MS, NU)
Katie Wenzell (Co-Advisor, current PhD, NU)
Abbey White (Co-Advisor, current MS, NU)
Jordan Wood (Co-Advisor , current MS, NU)
Chris Woolridge (Co-Advisor, current MS, NU)
Jacob Zelden (Comm. Member, current MS, NU)
Matt Wang (Advisor, current MS, NU)

Undergraduate students advised

Corina Godoy (Humboldt State University)
Ana Flores (Florida International University)
Evana James (University of Illinois at Urbana-Champaign)
Elizabeth Donaldson (University of Northwestern - St. Paul)
Marina Malone (Loyola University Chicago)
Justyn Carrasco (Illinois State University)
Stephanie Roh (Cornell University)
Katherine Chiass (Stevenson HS)

R. Goad

Co-taught with J. Miller four Plants of Concern Volunteer Training workshops throughout the region

Co-taught with J. Miller two Botany 101 Training Workshops for Chicago Park District volunteers and employees who will participate in Rapid Assessment

Coordinated and mentored group volunteer monitoring field forays throughout the season at:

Illinois Beach State Park, Ivanhoe South Preserve, Lake in the Hills Fen, Braidwood Dunes, and Hickory Creek Barrens.

Students and interns mentored

Chicago Park District Intern MacConnell Wilson

Cristo Rey Work Study Intern Daisy Lazcon

K. Havens

Conservation and Land Management Intern Training Workshop. Chicago Botanic Garden.
Seed Collection and Processing Workshop. Chicago Botanic Garden for Pollinator Partnership.
Post Doctoral Fellow mentored:

Rebecca Barak

Graduate students advised or committee member:

Jessamine Finch (advisor, PhD at NU)
Rinnie Rodenius (co-advisor, PhD at NU)
Jordan Wood (co-advisor, MS at NU)
Rebecca Barak (PhD at NU)
Nathan Lamb (MS at NU)
Nora Gavin Smyth (MS at NU)
Abbey White (MS at NU)
Alex Seglias (graduated 2017 MS, NU)

Undergraduate students advised:

Imena Valdes
Jalen Holloway
Daniel Sandazc

R. Hawke

Students and interns mentored

Alexander Almodovar, University of Illinois, Champaign-Urbana

P. Herendeen

Plant Evolution and Diversity: Northwestern University (Winter 2017).
Graduate students advised or committee member:

Aleksandar Radosavljevic (PhD at NU)
Elliot Gardner (PhD at NU)
Rui Zhang (PhD at NU)

F. Herrera

Undergraduate students advised:

Allison Buiser (Knox College), summer and fall semester, 2016, 2017
Plant Anatomy and Morphology, Elmhurst College (Fall 2017)

A. Iler

PBC 402/Biosci 349 Plant Community Ecology (Spring 2017), Northwestern University
REU students advised:

A. Sarah Walwema (Northwestern University)

Undergraduate students advised:

A. Sarah Walwema, Senior Thesis Advisor (Northwestern University)

Graduate students advised or committee member:

Samantha Danguilan (advisor MS at NU)
Marie Faust (advisor, MS at NU)
Lea Richardson (committee member, PhD at NU)
Alicia Foxx (committee member, PhD at NU)
Katie Wenzell (committee member, PhD at NU)

R. Kirschner

Lake and Pond Shorelines: Controlling Erosion and Enhancing Habitat. Full-day workshop taught for the School of the Chicago Botanic Garden. July 2017.

A. Kramer

PBC 450 Field & Laboratory Methods in Plant Biology & Conservation*, Seed Biology Module Instructor.* Northwestern University, Evanston, IL. Fall 2017

Graduate students advised or committee member

Alicia Foxx (current PhD, NU) Advisor
Adrienne Ernst (current PhD, NU) Advisor
Katie Kucera (current MS, NU) Advisor
Nathan Lamb (current MS, NU) Advisor
Taran Lichtenberger (current MS, NU) Advisor
Alex Seglias (graduated 2017 MS, NU) Advisor
Abbey White (graduated 2017 MS, NU) Co-advisor
Chris Woolridge (graduated 2017 MS, NU), Co-Advisor
Jacob Zelden (graduated 2017 MS, NU), Advisor
Jordan Wood (current MS, NU), Comm Member
Nora Gavin-Smyth (current MS, NU) Comm Member
Becky Barak (graduated 2017 PhD, NU) Comm Member
Jessamine Finch (current PhD, NU) Comm Member

REU Student Co-Mentor

Ana Flores (with J. Fant and C. Woolridge)
Brooke Allen (with A. Foxx)
Jalen Holloway (with K. Havens and N. Lamb)
Renata Poulton Kamakura (with A. Ernst)

College First Co-Mentor

Isaiah Spears, Giovanie Lozano, Kyrel McDavid, Raymond Diaz, Ra'ell Moore-Wilson (with Jeremie Fant, Olga Kildisheva, Alicia Foxx, Adrienne Ernst, Nathan Lamb, Brooke Allen, Ana Flores, Renata Poulton Kamakura)

G. Mueller

Taxonomía, Ecología, y Conservación de Basidiomycota (Agaricomycetes). Precongress short course, VIII Latin American Mycological Congress. Lima, Peru.

Fungal Conservation. Precongress short course, VIII Latin American Mycological Congress. Lima, Peru.

Graduate students advised or committee member

Lynnaun Johnson (PhD NU; Major Advisor)
Chen Ning (PhD NU; Major Advisor)
Rui Zhang (PhD, NU; Major Advisor)
Emma Leavens (MS, NU; Major Advisor)
Lauren Umek (PhD NU; committee member)
Benjamin Morgan (PhD NU; committee member)
Jessica Ross (MS, NU; commmittee member)
Kaiyue Zhou (MS, NU; committee member)

K. Skogen

Conservation and Land Management Internship Program – Training Workshop. Chicago Botanic Garden. June 8th-14th, 2017. 84 interns and ten instructors attended this week-long workshop

PBC 451/Biol Sci 355 Critical Topics in Ecology & Conservation, *Instructor* Northwestern University, Evanston, IL, Fall 2017

PBC 450 Field & Laboratory Methods in Plant Biology & Conservation*, Co-Instructor* Northwestern University, Evanston, IL. Fall 2017

Postdoctoral Fellows Advised:

Tania Jogesh
Matt Johnson
Rick Overson

Graduate students advised or committee member

Katherine Andrews (MS, NU), Major Advisor
Anita Cisternas-Fuentes (PhD, NU)
Susan Deans (PhD, NU), Major Advisor
Elliot Gardner (PhD, NU)
Kelly Ksiazek (PhD, NU) Major Advisor
Katie Wenzell (Co-Advisor, PhD, NU), Major Advisor

Undergraduates mentored:

Raudel Cabral (Northwestern University - NSF Dimensions of Biodiversity REU)
Victoria Luizzi (Amherst College)
Amanda Pastis (Amherst College)
Melissa Vergara (UC-Santa Cruz)

Mentored research assistants:

Lindsey Bechen
Hailey Carter
Andrea Gruver

D. Sollenberger

Botany for Botanical Artists (Fall 2017) School of the Botanic Garden

Seeds of Success workshop for CLM internship training at Chicago Botanic Garden. Led ~40 interns in seed collecting techniques in the field.

J. Steffen

Introduction to Bird Watching, School of the Chicago Botanic Garden, May2017.

Introduction to Sedge Identification and Ecology, School of the Chicago Botanic Garden, June 2017.

Introduction to Entomology Workshop. Northwestern University. November 2017.

Mite Identification. Service for professor at MSU, Marjorie Weber. With Joan Palincsar.

Graduate Student Committee member

P. Vitt

Graduate students advised:

Robert Hevey
Nora Gavin Smyth
Rinnie Rodenius (co-advise)

Undergraduate and REU students Advised:

Finote Gijsman (Northwestern University)

Kenneth Jops (Northwestern University)
Jalen Holloway (Humboldt State University – REU)
Benjamin Barteau (Northwestern University)
Daniel Sandazc (Lawrence University)

S. Wagenius

Quantitative Methods in Ecology and Conservation (Winter 2017), Northwestern University
Conservation Genetics (Spring 2017) with J. Fant, Northwestern University
Faculty mentor for Mentored Discussions of Teaching Program, Center for the Integration of Teaching, Research, and Learning, Northwestern University (Winter 2017)
Advisor for graduate student:
Lea Richardson (PhD, Northwestern University)
Kristen Manion (MS, Northwestern University)
Committee member for graduate students:
Alicia Foxx (PhD, Northwestern University)
Nora Gavin-Smyth (MS, Northwestern University)
Lauren Audi (MS, Northwestern University)
Anita Cisternas-Fuentes (PhD, Northwestern University)
Rob Hevey (PhD, Northwestern University)
High School students advised:
Anna Vold (Minneswaska Area High School, Glenwood, MN)
Undergraduate students advised:
Ashley Barto (U. Central Arkansas)
Wes Braker (St. Olaf College, MN)
Samuel Hamilton (Northwestern University)
Leah Prescott (College of Wooster, OH)
Will Reed (University of Minnesota)
Sarah Walwema (Northwestern University)
Post-graduate students advised:
Alexander Hajek (College of Wooster, OH)
Scott Nordstrom (William and Mary, VA)
Tracie Hayes (U. North Carolina)
Amy Waananen (St. Olaf College, MN)

N. Wickett

BIOL SCI 378 Functional Genomics, *Instructor* Northwestern University, Evanston, IL, Winter 2016
Postdoctoral Fellows Advised:
Matt Johnson
Rick Overson
Matt Parks
Graduate students advised or committee member
Colby Witherup (PhD, NU), Major Advisor
Ben Cooper (MS, NU)
Elliot Gardner (PhD, NU)
Dan Bruzzese (MS, NU)
Ben Morgan (PhD, NU)
Lynnaun Johnson (PhD, NU)
Undergraduate students mentored:
Ani Wang (Florida State University)

E. Yates

Field and Laboratory Methods in Plant Biology and Conservation, PBC 450 (Fall 2017), Northwestern University, GIS and spatial analysis instructor.

Conservation and Land Management Intern Training Workshop. Chicago Botanic Garden, June 2017.

Chicago Public Schools Student Science Fair, Judge – Botany Section
Museum of Science and Industry, March 2017

N. Zerega

Spring Flora (PBC 415/BIO 316), Spring quarter 2017 at Northwestern University (15 students)

Field and Lab Methods in Plant Biology and Conservation (PBC 450), Fall 2017 quarter at Northwestern University (9 students)

Major advisor for graduate students:
Elliot Gardner (PhD, Northwestern University, graduated 2017)
Lauren Audi (MS, Northwestern University, expected graduation 2018)

Committee member for graduate students:
Aleksandar Radosavljevic (PhD, Northwestern University)
Rui Zhang (PhD, Northwestern University)
Dawson White (University of Illinois, Chicago, expected)
Natalka Iwanycki (University of Cophenhagen, graduated 2017)

Additionally, researchers at the Chicago Botanic Garden mentored ten students from Professor Lynn Westley's Plant Biology Class at Lake Forest College for 4-week internships in Nov & Dec 2016.

PROFESSIONAL SERVICE

J. Ault

Chicagoland Grows®, Inc. Plant Introduction Program
Director (1995-present) and Manager (2008-present)

Herbaceous Ornamental Crop Germplasm Committee (HOCGC-USDA)
Member (1999-206; 2015-present)

Ornamental Grower's Association of Northern Illinois (OGA)
Liaison to board and general member's committees (2008-present)

P. CaraDonna

Proposal reviewer
Swiss National Science Foundation (SNF)

Manuscript Reviewer
Ecology Letters
International Journal of Plant Sciences
Journal of Animal Ecology
Oikos

L. Egerton-Warburton

National Science Foundation
Served on Ecosystems Panels and ad-hoc reviewer for other programs

Soil Science Society of America

Member, Applied Soil Science Committee
Member, Women in Soil Science Committee
Editor*, Restoration Ecology*
Editorial Board, *Geoderma Regional*
Manuscript Reviewer
Agronomy
Applied Soil Ecology
Canadian Journal of Soil Science
Forests
Fungal Biology
Fungal Ecology
Geoderma Regional
Journal of Ecology
Peer J
Restoration Ecology
Sustainability
Northwestern University, MS Admissions committee Plant Biology and Conservation

J. Fant
Illinois Endangered Species Protection Board
Member (2014 – present)
IUCN Conservation Genetics Specialist Group,
Member (2014 – present)
DePaul Institutional Biosafety Committee
Committee Member (2009-present)
Manuscript reviewer
American Journal of Botany
Annales Botanici Fennici
Annals of Botany
Applied Vegetation Science
Aquatic Botany
Botanical Bulletin of Academia Sinica
Folia Geobotanica
International Journal of Plant Science
Molecular Ecology
Plant Systematics and Evolution
Preslia
Restoration Ecology
Telopea
Proposal reviewer
National Science Foundation

R. Goad
Citizen Science Association
Inaugural Member
Illinois Native Plant Society
Secretary – State Association
Midewin National Tallgrass Prairie Stakeholders Alliance
Attending Member

K. Havens

American Public Gardens Association
Conservation Committee (1999-present)
Botanical Society of America
Public Policy Committee (2011-present)
Botanic Gardens Conservation International
US Board of Directors (2005-present)
Chicago Wilderness
Member, Global Climate Change Task Force (2007-present)
Center for Plant Conservation
Member of genetic collection guidelines team
Fairchild Tropical Botanical Garden
Research Associate
Illinois Endangered Species Protection Board
Member of Scientific Review Panel (1999-present)
Invasive Plant Council of Illinois
Co-founder (2002-present)
Illinois Native Plant Society
Past President
Midwest Invasive Plant Network
Board member and Treasurer (2002-2014)
North American Botanic Garden Conservation Strategy
Team member.
Plant Conservation Alliance
Non-federal Cooperator Committee Chair
Plant Biology and Conservation (PBC) committees at Northwestern University
PBC Admissions Committee
World Conservation Union (IUCN) Species Survival Commission,
Conservation Breeding Specialist Group, Intensively Managed Populations (2010-present)
U.S. Fish and Wildlife Service Endangered Species Recovery Team member for *Asclepias meadii, Cirsium pitcheri, Platanthera leucophaea*
Manuscript reviewer
American Journal of Botany
Biological Conservation
Conservation Biology
Evolution
International Journal of Plant Sciences
New Phytologist
Proposal reviewer
National Science Foundation
External dissertation reviewer
University of Western Australia

R. Hawke

All-America Selections Perennials Trial Program
Trial Manager
American Public Gardens Association
Member, Plant Collections Section

Member, Plant Nomenclature & Registration Section
Chicagoland Grows®, Inc. Plant Introduction Program
Member, New Plant Committee

P. Herendeen
International Journal of Plant Sciences (University of Chicago Press)
Editor in Chief
Aliso: A Journal of Systematic and Evolutionary Botany (Rancho Santa Ana Botanic Garden)
Editorial Board
International Association for Plant Taxonomy
Secretary, Nomenclature Committee on Fossil Plants
President, IAPT (July-December, 2017)
PhytoKeys (open access journal)
Subject Editor (paleobotany, legume systematics), July 2011 – present
Manuscript Reviewer
American Journal of Botany
Annals of Botany
Annals of the Missouri Botanical Garden
Grana
International Journal of Plant Sciences
Systematic Botany
Plant Biology and Conservation (PBC) committees at Northwestern University
PBC Curriculum Committee

F. Herrera
Secretary, Paleobotanical Section, Botanical Society of America
Manuscript Reviewer
American Journal of Botany
Journal of Systematics and Evolution
Review of Palaeobotany and Palynology

A. Iler
Associate Editor
Journal of Ecology (2015–2018)
Proposal reviewer
National Geographic Society
Manuscript Reviewer
Ecology Letters
American Journal of Botany
Journal of Animal Ecology
Advisory Board
WiSTEM (Women in STEM), Chicago Lab School

R. Kirschner
Chicago Regional Biodiversity Council (Chicago Wilderness)
Executive Council (alternate)
Review Committee Member, Force of Nature Awards Program
Friends of the Green Bay Trail
Scientific Advisor

Metropolitan Water Reclamation District
Member, Vision Plan for Robbins Phase II Flood Control Advisory Committee
North American Lake Management Society
Host and Coordinator, Mid-Term Board of Directors Meeting

A. Kramer
Colorado Plateau Native Plant Program
Member, Technical and Research Committees (2012-present)
Manuscript reviewer
Restoration Ecology
Plant Biology and Conservation, Northwestern University
Non-thesis track internship committee
Plant Conservation Alliance
With K Havens as Non-federal Cooperator Committee Chair

G. Mueller
International Union for the Conservation of Nature (IUCN) Species Survival Commission
Member, SSC Steering Committee
SSC Regional Vice Chair for North America and the Caribbean
Chair, Mushrooms, Brackets, and Puffballs Specialist Group
Member, Key Biodiversity Areas Standards and Appeals Committee
International Society for the Conservation of Fungi, Board Member
International Advisory Committee for VII Latin American Mycological Congress
Mycological Society of America
Member Research Awards Committee
Member Conservation Committee
Prairie Research Institute (Consolidated Illinois Surveys)
Member, Advisory Committee
Illinois Nature Conservancy
Member, Science Advisory Council
Illinois Mycological Association
Co-Scientific Advisor
Chicago Wilderness
Member Executive Council
Member Executive Advisory Committee
Member CW Trust Board
Member Priority Species, Animals Advisory Committee
Co-Chair, Priority Species, Plants Advisory Committee
Forest Preserves of Cook County Next Century Conservation Plan
Member, Nature Committee
Member, Steering Committee
Observer, Conservation Council
City of Chicago
Member of Mayor's Nature and Wildlife Committee
Chicago Council for Science and Technology (C2ST)
Member of Board
Morton Arboretum
Center for Tree Science, Advisory Committee
Manuscript reviewer

Numerous journals as well as pre-reviews for colleagues

Proposal reviewer

National Science Foundation, National Geographic, others

K. Skogen

Botanical Society of America.

Public Policy Committee, co-chair

Northwestern University Student Chapter – faculty representative

Manuscript reviewer

AoB Plants

Ecology

Annals of Botany

Plant Biology and Conservation, Northwestern University

Curriculum committee member

P. Vitt

Chicago Wilderness

Member, Global Climate Change Task Force

Member, Data Focus Area Advisor

Chicago Climate Action Plan

Adaptation Advisory Committee

International Union for the Conservation of Nature (IUCN) Species Survival Commission

Orchid Specialist Group, Social Media Co-lead

U.S. Fish and Wildlife Service Endangered Species Recovery Team member for Lespedeza leptostachya, Platanthera praeclara

Manuscript reviewer

American Journal of Botany

Biological Conservation

Conservation Biology

Ecology Letters

Journal of Nature Conservation

University of Chicago Press

Journal of Coastal Conservation

Proposal reviewer

National Science Foundation

S. Wagenius

Natural Resources Commission of City of Highland Park, IL

Vice-Chair

Minnesota Ornithologists' Union

Member

Panel Peer Reviewer

National Science Foundation

Manuscript reviewer

American Journal of Botany

N. Wickett

Botanical Society of America

Member

American Bryological and Lichenological Society
Member
American Society of Plant Taxonomists
Member
Applications in Plant Sciences (Journal)
Associate Editor
Manuscript Reviewer
BMC Genomics
PLOS ONE
PNAS
Genome Research

E. Yates
GIS Certification Institute (GISCI)
Certified Geographic Information Systems Professional (GISP)
Natural Resources Commission, City of Highland Park, IL
Commissioner
Association of American Geographers
Member & Annual Meeting presenter, *Topics in Biogeography* section
Book Reviewer
University of Chicago Press
Northwestern University Press

N. Zerega
Committee Member at Northwestern University
Environmental Science, Engineering, and Policy Committee
Environmental Policy and Culture Committee
Curriculum Committee for Plant Biology and Conservation
Admissions Committee for Plant Biology and Conservation
The Graduate School Advisory Council on Academic Affairs
Manuscript Reviewer
American Journal of Botany
Economic Botany
Frontiers in Ecology and Evolution
Molecular Phylogenetics and Evolution
New Zealand Journal of Botany
Phytokeys
PLoSONE
Proceedings of the National Academy of Sciences
Systematic Botany
Annals of Botany
Willdenowia
Board Membership
Trees That Feed Foundation

COLLABORATIONS

J. Ault

Kris Bachtell and Kim Shearer (The Morton Arboretum), Ornamental Growers Association of Northern Illinois (OGA), 125-plus nurseries evaluating/growing the breeding program and other Chicagoland Grows®, Inc. plant introductions.

P. CaraDonna
Laura Burkle (Montana State University), Judith L. Bronstein (University of Arizona), Jessica Forrest (University of Ottawa), Jochen Fründ (Freiburg University), Amy Iler (Chicago Botanic Garden), David Inouye (Rocky Mountain Biological Laboratory), Tiffany Knight (German Centre for Integrative Biology), Tom E.X. Miller (Rice University), Jane E. Ogilvie (Florida State University), William K. Petry (ETH Zürich), Mary V. Price (Rocky Mountain Biological Laboratory), Nathan J. Sanders (University of Vermont), Diego Vazquez (Instituto Argentino de Investigaciones de las Zonas Aridas), Nickolas M. Waser (Rocky Mountain Biological Laboratory).

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J. Fant
Mary Ashley (University of Illinois Chicago), Alona Banai (Loyola University), Tim Bell (Chicago State University), Justin Borevitz (Australian University), Marlin Bowles (Morton Arboretum), Diane Byers (Illinois State University) Julie Etterson (University of Minnesota, Duluth), Pam Geddes (NEIU), Patrick Griffith (Montgomery Botanical Center), Terry Harrison (University of Illinois, Urbana-Champaign) Chrystal Ho Pao (Trinity International Univ.), Sean Hoban (Morton), Kristina Hufford (University of Wyoming, WY), Kathleen Kay (University of California Santa Cruz), Tom Kaye (Inst of Ap. Ecology), Tiffany Knight (Washington University, St Louis), Rachel Levin (Amherst College) Joyce Maschinski (Fairchild Tropical Botanic Garden), Geoff Morris (University of Chicago), Christal Niederer (Creekside Center for Earth Observation), Peggy Olwell (BLM), Christopher Preston (Centre of Ecology and Hydrology, UK), Rob Raguso (Cornell Univ.), Eric Ribbens (WIU), David Tank (U. Idaho), Jeff Walck (Middle Tennessee State University, TN), Seana Walsh (NTBG).

R. Goad
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landowner-partners of Plants of Concern, from federal, state, and local public agencies and private landowners.

K. Havens
James Aronson (Missouri Bot. Gard.), Mary Ashley (University of Illinois Chicago), Todd Bittner (Cornell Plantations, NY), Stephen Blackmore (RBG Edinburgh), Bill Brumback (New England Wildflower Society, Framingham, MA), Taylor Callicrate (Brookfield Zoo), John Clark (Center for Plant Conservation), Patricia DeAngelis (U.S. Fish and Wildlife Service, Arlington, VA), Kingsley Dixon (Curtain Univ., Perth, AUS), Don Falk (University of Arizona, Tucson, AZ), Jeremie Fant (CBG), Peggy Fiedler (UC Reserves), Patrick Griffith (Montgomery Botanical Center), Ed Guerrant (Portland State University, Portland, OR), Alyssa Hakes (Lawrence Univ., Appleton, WI), Siti Hidayati (Middle TN State U), Abby Meyer (BGCI-US), Kent Holsinger (University of Connecticut, Storrs, CT), Claudia Jolls (East Carolina University, NC), Tom Kaye (Institute for Applied Ecology, OR), Bruce Kendall (UC Santa Barbara), Tiffany Knight (iDiv, Germany), Andrea Kramer (CBG), Bob Lacy (Brookfield Zoo), Porter Lowry (MO Bot Gard), Julie Marik (East Carolina Univ., NC), Mike Maunder (Eden Project, UK), Kathryn McEachern (US Geological Survey, CA), Jim Miller (MO Bot. Gard.), Sara Oldfield (Cambridge, UK), Peggy Olwell (Bureau of Land Management, Washington DC), Noel Pavlovic (US Geological Survey, IN), Peter Raven (Missouri Botanical Garden, St. Louis, MO), Shannon Still (UC Davis), Jennifer Schwarz (CBG), Krissa Skogen (CBG), Dave Sollenberger (CBG), Marshall Sundberg (Emporia State University, KS), Pati Vitt (CBG), Stuart Wagenius (CBG), Jeff Walck (Middle Tennessee State University, TN), Seana Walsh (National Tropical Botanical Garden), Evelyn Williams (CBG), Emily Yates (CBG).

R. Hawke
Allen Bush (Jelitto Perennial Seeds, Germany), Evan Elenbaas (Walters Gardens, Zeeland, MI), Dan Heims (Terra Nova Nurseries, Portland, OR), Chris Kelleher (Blooms of Bressingham, England), Michael Marriott (David Austin Roses, England), Karl Batschke (Ball Horticultural, North Chicago, IL), Angela Palmer (Plants Nouveau, Charleston, SC), Paul Westervelt (USDA North Central Plant Introduction Station, Ames, IA), Steve Castorani (North Creek Nurseries, Landenberg, PA), Kerry Meyers (Proven Winners, St. Thomas, MO).

P. Herendeen
Anne Bruneau (University of Montreal), Eugenia Bugdaeva (Far Eastern Branch of the Russian Academy of Sciences, Vladivostok), Peter Crane (Oak Spring Garden Foundation), Else Marie Friis (Swedish Museum of Natural History), Vicki Funk (Smithsonian Institution) , Bente Klitgaard (Royal Botanic Gardens, Kew), Matthew Lavin (Montana State University), Gwilym Lewis (Royal Botanic Gardens, Kew), Melissa Luckow (Cornell University), Richard Lupia (University of Oklahoma), Susana Magallon (Universidad Nacional Autónoma de México*)*, Steven Manchester (University of Florida), Lucinda McDade (Rancho Santa Ana Botanic Garden), Toby Pennington (Royal Botanic Garden Edinburgh), Karen Redden (Smithsonian Institution), Gongle Shi (Nanjing University), Doug Soltis (University of Florida), Masamichi Takahashi (Niigata University, Japan), Scott Wing (Smithsonian Institution), Martin Wojciechowski (Arizona State University).

F. Herrera
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Whitten (University of Florida), Richard Abbott (Missouri Botanical Garden), Camila Martinez (Cornel University), Gongle Shi (Nanjing University).

A. Iler
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S. Jacobi
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K. Skogen
Shane Heschel (Colorado College), Kent Holsinger (University of Connecticut, Storrs), Terry Harrision (University of Illinois, Urbana-Campaign), Diane Ikeda (Forest Service, CA), Kathleen Kay (University of California – Santa Cruz), Jean-Francois Landry (Canadian National Collection of Insects, Arachnids, and Nematodes, Ontario), Rachel Levin (Amherst College), Mike Moore (Oberlin College), Peggy Olwell (Bureau of Land Management), Robert Raguso (Cornell University), Ann Sakai (University of California – Irvine), Sara Scoles (US Geologic Survey), Shannon Still (University of CA - Davis Arboretum); David Tank (University of Idaho), David Wagner (University of Connecticut), Warren Wagner (Smithsonian Institution), Steve Weller (University of California – Irvine).

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P. Vitt
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Wildflower Society, Framingham, MA), Melissa Curran (Stanec Environmental, WI), Kingsley Dixon (Kings Park & Botanic Garden, AUS), Jeremie Fant (CBG), Rachel Goad (CBG), Ed Guerrant (Berry Botanic Garden), Megan Haidet (Seeds of Success, Bureau of Land Management), Alyssa Hakes (Lawrence Univ., Appleton, WI), Marion Harris (North Dakota State University), Kay Havens (CBG), Siti N. Hidayati (Middle Tennessee State University), Kent Holsinger (University of Connecticut), Claudia Jolls (East Carolina University, NC), Michael Kane (University of Florida), Bruce Kendall (University of California Santa Barbara), Bill Kleiman (TNC), Tiffany Knight (IDiv, Germany), Steve Leonard (Ridges Sanctuary, WI), Julie Marik (East Carolina Univ., NC), Susanne Masi (CBG), Mike Maunder (Eden Project, UK), Kathryn McEachern (US Geological Survey, CA), Peggy Olwell (Bureau of Land Management), Noel Pavlovic (US Geological Survey, IN), Jim Reinhartz (University of Wisconsin), Nancy Sather (Minnesota DNR), Dave Sollenberger (CBG), Michelle Schutzenhofer (McKendree University, IL), Larry Stritch (US Forest Service, Washington DC), Nigel Swarts (University of Tasmania, AUS), Kathryn Theiss (California State University), Stuart Wagenius (CBG), Jeff Walck (Middle Tennessee State University, TN), Christina Walters (USDA National Plant Germplasm System, Fort Collins, CO), Arthur Weis (University of Toronto), Emily Yates (CBG).

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APPENDIX 1: Plants of Concern Partnerships

Andrew Blackburn
Bartmes Family
Boone Creek Watershed Alliance
Burlington Township
Cary Park District
Conservation District of McHenry County
Chicago Park District
Citizens for Conservation
City of Elgin
City of Lake Forest
City of Waukegan
City of Woodstock
Civic Center Auth of I&M Canal Natl Herit Corridor
Commonwealth Edison
Dale Shriver
Dawson Family
Deerfield Associates
Dewitt Family
Downers Grove Park District
Dundee Township
FPD Cook County
FPD DuPage County
FPD Kane County
FPD Kendall County
FPD Lake County
FPD Will County
Giannakas Family
Glenview Park District
Heidi and Dan Natura
Highland Park/Park District
Illinois Department of Natural Resources
Illinois Department of Transportation
Indiana Department of Natural Resources
Jerry Kolar
John Clemetsen
Johns Manville
Joliet Park District
Keenan Family
Lakowski Family
Libertyville Township
Lockport Township Park District
Lorna Gladstone
Loyal Order of Moose
Loyola University
Marianne Hahn
Marsh Family
Marty Papanek
Masi/D'Alessandro Family
Metropolitan Water Reclamation District
Midwest Generation
Mohar Family
Naperville Park District
National Park Service
Nelson Family
Nicole Williams & Larry Becker
North Shore Sanitary
North Shore School District 112
Northeastern IL Univ
Oak Lawn Park District
Oakton Community College
Openlands
Palatine Park District
Perle Olsson
Plainfield Park District
Rendl Family
Rich Township
Save the Dunes
Save The Prairie Society
Shaw Family
Shirley Heinze Land Trust
Sig Weiler
Sue Tauck
Surfside Condominium Association
The Joliet Diocese of the Catholic Church
The Land Conservancy of McHenry County
The Long Grove Park District
The Nature Conservancy
Town of Fort Sheridan Master Homeowners Association
U.S. Forest Service
University of Illinois at Chicago
US Department of Energy
Village of Barrington
Village of Lake in the Hills
Village of Lincolnshire
Village of Oakwood Hills
Village of Park Forest
Village of University Park
Waukegan Park District
Wilmette Park District
Wisconsin Department of Natural Resources
Zion Park District