

M.L. 2018 Project Abstract

For the Period Ending June 30, 2021

PROJECT TITLE: Preserving Minnesota's Native Orchids - Phase 2

PROJECT MANAGER: David Remucal, Ph.D.

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FUNDING SOURCE: Environment and Natural Resources Trust Fund

LEGAL CITATION: M.L. 2018, Chp. 214, Art. 4, Sec. 02, Subd. 08h

APPROPRIATION AMOUNT: \$259,000

AMOUNT SPENT: \$258,763

AMOUNT REMAINING: \$237

Sound bite of Project Outcomes and Results

Native orchid populations across the state have been stored in a long-term seedbank at the Minnesota Landscape Arboretum, preserving these native jewels. This project also preserved many of the fungal partners that orchids need to survive and establish in the wild.

Overall Project Outcome and Results

This project worked to bank the seed of more of Minnesota's native orchid species, a complex and difficult plant family to conserve because of their complex biology. As part of this seed banking effort, there is a wealth of research that must be done with each species, to determine how best to store seed and propagate them and what the soil fungal partners are and how those fungi can be used to establish these notoriously difficult species, either in display beds for visitors to enjoy or in the wild to establish, augment or protect their presence in or landscapes. There are about 46 native orchid species in Minnesota and understanding how to propagate them and store their seed had not previously been well-established for nearly all of them. This project sought to develop that information for as many of those species as possible. Overwhelmingly successful, multiple populations of these plants were banked for nearly all species and research on nearly all 46 species has been successful and continues. A fungal bank of nearly 500 specimens was also established to grow and work with the fungal partners that orchids need.

This work will not only benefit visitors to the Arboretum, it is already being used by groups across the state, region and country for a variety of projects that would have previously been unthinkable or unsuccessful, including outplantings of native orchids in restored or protected landscapes and transplants and rescues of plants under immediate threat from development or construction. The resulting information we have produced, and continue to produce, is invaluable for any groups wanting to work with these species.

Project Results Use and Dissemination

Orchids brought into the seedbank and propagated at UMLA have been displayed in existing and new display beds with a series of educational brochures. Displaying orchids at UMLA allows visitors to see many species that they would likely never see in person otherwise. We give talks, in person or virtually, and have been able to reach out in a variety of media formats, including a [website](#).

Finally, we have been able to use the techniques, infrastructure and expertise developed during this project to assist a variety of groups in a variety of conservation-aimed projects related to native orchids.



Environment and Natural Resources Trust Fund (ENRTF) M.L. 2018 ENRTF Work Plan (Main Document)

Today's Date: 9/6/2021

Date of Next Status Update Report: NA

Date of Work Plan Approval: 6/5/2018

Project Completion Date: 6/30/2021

Does this submission include an amendment request? No

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Project Manager: David Remucal, Ph.D.

Organization: University of Minnesota Landscape Arboretum

College/Department/Division:

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Location: *Statewide*

Total Project Budget: \$259,000

Amount Spent: \$258,763

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Legal Citation: M.L. 2018, Chp. 214, Art. 4, Sec. 02, Subd. 08h

Appropriation Language: \$259,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota for the Minnesota Landscape Arboretum to expand collection and preservation efforts to enable long-term conservation of at least 25 of the 48 native orchid species in Minnesota and to continue propagation and cultivation research. This appropriation is available until June 30, 2021, by which time the project must be completed and final products delivered.

I. PROJECT STATEMENT:

Expansion of Efforts to Preserve Minnesota Native Orchids

Orchids are a charismatic plant species found in a variety of Minnesota's natural landscapes. Orchids often have many specialized growing requirements, making them more vulnerable to changes in the local environment than most other plant species. Laboratory research on basic orchid biology and observation of introduced populations is essential to comprehending how they are likely to respond to environmental changes. With this understanding it could be possible to develop new ways to detect early declines in Minnesota's ecosystems.

There are roughly 200 species of orchids native to the continental United States, and Minnesota has nearly a quarter of those species. While regarded as the plant family with the most number of species, orchids are never dominant members of a plant community. In fact it is generally accepted that potentially all orchids, even common species, are rare or threatened. Ten of Minnesota's 48 native orchid species are listed on Minnesota's List of Endangered, Threatened, and Special Concern Species and even the "common" species are likely to be the first plant species lost when a natural landscape is disturbed. It is imperative to invest in the long-term preservation of this group of plants that can be found in Minnesota's native forest, wetlands, and prairie.

Since 2015 under ENRTF M.L. 2015 funding, Phase 1 of the Minnesota Landscape Arboretum's (MLA) Native Orchid Conservation Program (NOCP) has worked to preserve Minnesota's native orchid diversity by:

- 1) Collecting and preserving seed and/or live plants of 15 orchid species throughout Minnesota
- 2) Researching the propagation and cultivation of over half of all of Minnesota's species.
- 3) Collecting, identifying and banking the fungal symbionts (necessary for many orchids' survival) of Minnesota orchid species, in partnership with the Smithsonian Environmental Research Center (SERC), and with Dr. Jyotsna Sharma at Texas Tech University (TTU).

A long-term goal of the Native Orchid Conservation Program at MLA is to bring all 48 orchid species – either as seeds or live plants – to the Arboretum for conservation and research. To that end, we have collected seeds from populations from 22 counties across Minnesota (Figure 1). It is our vision to do this work for conservation purposes only, not for commercial breeding. While the landscape preservation efforts are the main means to preserve rare plants, as human activity increasingly reaches even the most protected lands there has been a recognized need for ex situ conservation efforts that function as a bank of a genetic material maintained by organizations like zoos or botanic gardens. In the case of plant conservation, ex situ conservation efforts often manifest as seed banks. These seed banks can serve a dual purpose – to act as a source restoration material for the original source populations and to serve as final bulwarks against the catastrophic loss of the species. Botanic gardens curate these seed banks carefully. Seed is tracked and tested to make sure viable genetic material is stored. Orchids grown from seed under the NOCP are not planted outside of Arboretum grounds. The NOCP has the capacity to partner with groups such as the Minnesota DNR and The Nature Conservancy when requested to aid in orchid restoration projects but we would only partner with groups that have the staffing and expertise to work on a scientifically rigorous restoration.

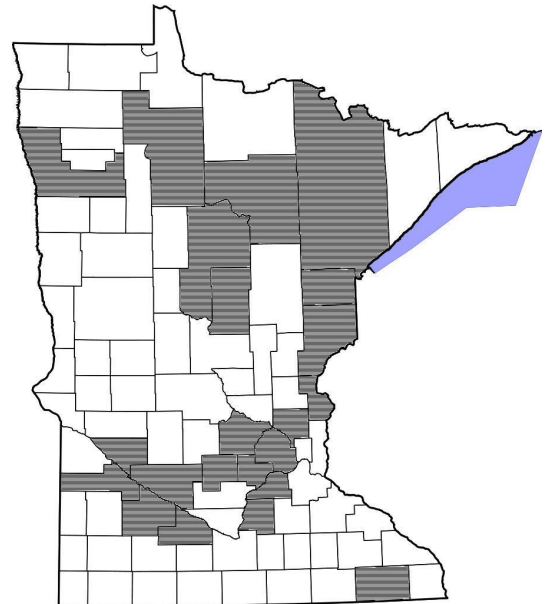


Figure 1. Counties in MN where orchid seeds have been collected/banked for Phase 1 up through the 2017 field season.

These efforts continue under Phase 2 of the NOCP. The Arboretum is in a unique position to continue to advance the knowledge in this field given the strength of its orchid conservation program. Ultimately, this work will be

beneficial not just to the Arboretum but also to all conservation programs around the region and country. Visitors to the Arboretum will also benefit, as they will be able to see and learn about many important plant species native to the state but hard to see in their natural landscapes.

GOALS:

- 1) Expand collection efforts of 15 Phase 1 species to new locations to diversify banks.
- 2) Expand banking, propagation and display efforts by an additional 10 species to a total of **at least 25 species**.
- 3) Complete, as much as possible, fungal symbiont species identification and banking for **38 non-listed orchid species, collecting from listed species when permitted**.

II. OVERALL PROJECT STATUS UPDATES:

First Update January 31, 2019

With increased staffing and experience gained from Phase 1 work, the Native Orchid Conservation Program was able to nearly double the number of individuals banked during the 2018 field season. We were able to both increase the banks for currently covered species and start banks for an additional 10 species; we are on track to complete banking goals for those ten species by the end of the granting period (June 2020). In addition to accelerated success with banking, we have been able to increase production and propagation for many of these species. We have developed protocols able to produce large numbers of some species, which is attracting the interest of several partners seeking to try to relocate or augment orchid populations, including The Nature Conservancy and Minnesota State Parks. We have constructed several new beds for orchid research and display at MLA and our success in orchid work has allowed us to obtain separate funding for an additional set of beds for both research and display. We anticipate in 2019 having a wave of orchid introductions at MLA.

With our success we have developed a larger presence on the web – being able to disseminate our information to an increasing audience which we have supplemented with past and upcoming outreach to metro and non-metro locations. The highlight of our 2018 outreach, though was not even our own doing – we were approached by the Minnesota Lottery to work with them to make a video about how Lottery money supports vital work in the state and the video they produced is truly wonderful.

Second Update June 30, 2019

Propagation research is the main focus during winter months. We continue to collect seed from additional species as well as to successfully propagate new species from seed. We anticipate finishing our collection goals for this two year grant period at the end of the 2019 field season. We have improved and refined our techniques enough to have produced a few thousand seedlings for external orchid reintroduction projects in the spring of 2019. During this time, we upgraded and improved infrastructure, technique and data management systems to allow us to continue to innovate and produce viable conservation and educational material.

As we progress, we have developed and published a more detailed website for the Plant Conservation Program at MLA which includes more information about the Native Orchid Conservation Program and specific projects in which we are involved. Our intention is to use this site to disseminate the information we have developed from this program.

AMENDMENT REQUEST June 30, 2019

We are requesting funds be used for travel for a training in a lab technique directly relevant to the orchid propagation work of this work plan. We have already secured funds for the bulk of the travel and lodging and so only need to request use of LCCMR funds for per diem for approximately 4 days. The work will be with Dr. Larry Zettler at Illinois College, who developed a technique to extract fungi from the roots of orchids. MLA staff will travel to Jacksonville, IL and work with Dr. Zettler for several days to learn this fungal extraction technique. We

will use this technique to extract fungi from the roots of orchids native to Minnesota. This fungi will be used in our propagation and germination research, enabling us to increase the number of species we can work with as well as increase our ability to increase survival of seedlings and adults planted at and rescued from natural areas.

For this amendment request, no funds will need to be shifted between funding categories, the request is to allow for use of travel fund use for an out-of-state event.

Third Update January 31, 2020

We have been able to develop a strong seed bank for native orchids in Minnesota over the course of the five years of funding we have received from ENRTF. By the end of the field season in 2019 we have achieved a basic diverse seed bank for 32 species for this granting period, well over both the current goal of 10 additional species for the timeframe of the current ENRTF grant and the cumulative goal of 25 total species over the five years of combined funding.

Native Orchid Conservation Program seed collectors brought species coverage up to 39 total species from which we have been able to at least begin seedbanks. We have also collected root samples from 14 species. Increased species coverage has included several listed species as well. We continue to develop partnerships with The Nature Conservancy and the Minnesota DNR for restoration and augmentation of valuable orchid populations, extending the orchid seedbank to become an active resource for orchid conservation in the state.

Fungal extraction of roots has been very successful with early successes in using these fungi for seed germination. Continued research on this fungi will lead to the development of these fungi as a very effective tool for both propagation and establishment of these orchids, greatly increasing the success of recovery efforts for these species.

AMENDMENT REQUEST January 31 2020

We are requesting excess travel funds be transferred to use for supplies. Due to the timing of the end of the funding cycle, travel funds planned for continued seed collection for the 2020 field season will be better utilized if partially repurposed. Much of the spring travel would have been done to search for new populations to bank; however, given the grant period ending on June 30, field work will be better focused on root collection. This will allow for fewer field trips, but more intensive work during the remaining trips. Therefore, we request moving \$2,700 from travel to supplies to allow for increased supplies needed for the work described.

We have also recently reorganized and improved technology options for printing and as a result can realize significant savings. For the brochure, with funds already expended, we can accomplish the desired four-color informational brochure for only \$1,300, so we request moving \$1,934 from printing to supplies. This additional supply funding will be used for planting orchids in display and research beds.

Amendment Approved by LCCMR **2/21/2020**

Fourth Update June 30, 2020

We continue to make strides in propagation efforts, with an increased focus on fungal symbionts. Through collection efforts we have fungal isolates from 22 species which we have been or will be testing on both seed germination and on adult plants for utility in growing from seed and increasing survival for outplanting/transplanting.

Coronavirus pandemic travel restrictions at the University have limited field work during 2020, but we anticipate this number of species to grow by the end of the field season in 2020. As we start to come out of site and travel restrictions, we also anticipate being able to finish our display and communication goals, as these are ready to complete but just need a return of staff and volunteers to bring all of the assembled parts together.

AMENDMENT REQUEST June 30 2020

We are requesting an extension of the project end date to June 30, 2021. Because of coronavirus travel restrictions, we have not been able to do as much field work as we had anticipated to complete our project. With the rest of the 2020 field season and, given phenological timing issues, potentially the early 2021 field season will allow us to complete the project as planned.

Because of timing issues Outcome 2 of Activity 1 will be pushed back to December 2020, allowing us to increase the functional fungal library we are building. Outcome 4 of Activity 2 will also be pushed back from a completion time of Spring 2020 to Summer 2020 as the pamphlet is in final draft stages and nearly ready for print but the coordinating this printing has been delayed because of coronavirus issues.

Our original appropriation goes through the end of June 30, 2021 so we do not need to request extension of any budget. This spring, coronavirus restrictions causing additional logistic and personnel issues have caused us to expend more money on travel than expected. We need to move \$270 from salaries to travel to cover this increased budgetary need.

Amendment Approved by LCCMR **9/10/2020**.

Fifth Update January 31, 2021

While pandemic slowed down our field work, we were able to make great use of the root samples we did collect. We were able to collect roots from 9 more species. From all root samples collected we were able to isolate more than 400 fungal samples, we are currently working on testing the fungi with orchid seeds and seedlings as well as partnering with a local college (Crown College) to identify the fungi.

We anticipate using these fungi immediately in the conservation work we are doing, including out planting projects as well as display for education and research at the Arboretum. Most importantly this work on fungi will help other groups working with orchids.

Final Update August 15, 2021

This project worked to bank the seed of more of Minnesota's native orchid species, a complex and difficult plant family to conserve because of their complex biology. As part of this seed banking effort, there is a wealth of research that must be done with each species, to determine how best to store seed and propagate them and what the soil fungal partners are and how those fungi can be used to establish these notoriously difficult species, either in display beds for visitors to enjoy or in the wild to establish, augment or protect their presence in or landscapes. There are about 46 native orchid species in Minnesota and understanding how to propagate them and store their seed had not previously been well-established for nearly all of them. This project sought to develop that information for as many of those species as possible. Overwhelmingly successful, multiple populations of these plants were banked for nearly all species and research on nearly all 46 species has been successful and continues. A fungal bank of nearly 500 specimens was also established to grow and work with the fungal partners that orchids need.

This work will not only benefit visitors to the Arboretum, it is already being used by groups across the state, region and country for a variety of projects that would have previously been unthinkable or unsuccessful, including outplantings of native orchids in restored or protected landscapes and transplants and rescues of

plants under immediate threat from development or construction. The resulting information we have produced, and continue to produce, is invaluable for any groups wanting to work with these species.

III. PROJECT ACTIVITIES AND OUTCOMES

ACTIVITY 1: Expand collection/preservation to at least 25 species

Description: The Arboretum will greatly increase the intensity and pace of these efforts with seed collection trips growing from 21 per field season to at least 50. Two new collectors will be employed as well, one contractor is a known regional orchid expert and one a new seasonal field staff with familiarity with farther corners of the state. Both will be able to access land more difficult for staff permanently based at MLA. This expansion will allow for collection in an increased geographic range across the state where there are both new populations of currently banked species and new species to bank. To continue to advance preservation goals, the Arboretum will increase banked species from 15 to 25 and will seek to complete initial acquisition of seed for propagation protocol development for all 48 species. The Arboretum also will complete collection of root samples for as many non-listed orchid species as possible. Root samples are sent to partners at Texas Tech University and the Smithsonian Environmental Research Center to identify, isolate and bank fungal associates.

Each winter, locations are vetted for continued banking, and subsequent year location determinations will be made during the winter in order to adequately prepare and obtain necessary permits. Permits for collection of listed species will be obtained from the Minnesota Department of Natural Resources. Other permits for non-listed orchids will be properly obtained under Minnesota Statutes 2010, Chapter 18H.18. MLA has worked with the Minnesota DNR and The Nature Conservancy, among other groups, to collect seed from populations on TNC preserves, State Parks, State Scientific and Natural Areas and Wildlife Management Areas across the state. All plants and seeds are brought to the Arboretum and tracked, and genetics are not mixed between populations. Seed lots are kept separate by the individual maternal sources, stored in the MLA Seed Bank and tracked in the NOCP database. That way, if we are called upon to use our seed banks, we can produce the most genetically diverse restoration material possible.

When live plants are collected, either an appropriate garden location at the Arboretum will be used to house them, or they will be grown in appropriately controlled environments. When populations or colonies are established on Arboretum grounds, from seed-grown plants or transplants, regular demographic monitoring will be performed in conjunction with monitoring of environmental factors such as soil moisture and temperature to analyze changes. Some of the current plant populations at the Arboretum come from rescue/salvage operations at construction sites. The Arboretum would be prepared for future opportunities permitted by the Minnesota Department of Natural Resources to rescue native orchid populations. As the program grows and species are brought to the Arboretum, it continues to be vital to engage the public –to educate them on the importance of native orchid conservation, especially in the context of larger general native and rare plant conservation. Classes on native orchids have been developed and made available at MLA as a result of this work and will continue to be refined.

ENRTF BUDGET: \$142,132

Outcome	Completion Date
1. Begin collection for finalized list of 10 Phase 2 orchid species for seed bank.	December 2018
2. Complete collection as much as possible of root samples from 38 non-listed orchid species, with listed species collected when permitted, samples sent to Texas Tech University (fungal identification) and The Smithsonian (propagation and banking).	December 2020
3. Complete seed bank collection goal of 3 populations for each of the 10 Phase 2 species.	December 2019

First Update January 31, 2019

With increased staffing supported by this grant, collection and preservation have increased to both expand coverage of Phase 1 species and to establish banks for Phase 2 species. Below is the current list of Phase 2 species for which we will likely complete by the end of the granting period:

- Amerorchis rotundifolia* (round-leaved orchid)
- Calypso bulbosa* var. *americana* (fairy-slipper)
- Corallorhiza trifida* (early coral-root)
- Cypripedium arietinum* (ram's-head lady's-slipper) – state listed
- Cypripedium parviflorum* var. *pubescens* (large yellow lady's-slipper)
- Liparis liliifolia* (lily-leaved twayblade)
- Liparis loeselii* (Loesel's twayblade)
- Malaxis unifolia* (green adder's-mouth)
- Platanthera praeclara* (western prairie fringed orchid) – state and federally listed
- Spiranthes cernua* (nodding ladies'-tresses)

MLA staff exceeded expectations and to this point the orchid seed bank has collection seed from over 255 accessions from over 1709 individual plants. In addition to reaching more species and populations, this collection activity has also reached more of the state with 35 of 87 counties now covered, and banking efforts reach nearly to the far NE, SE, SW and NW corners of the state (Fig. 2).

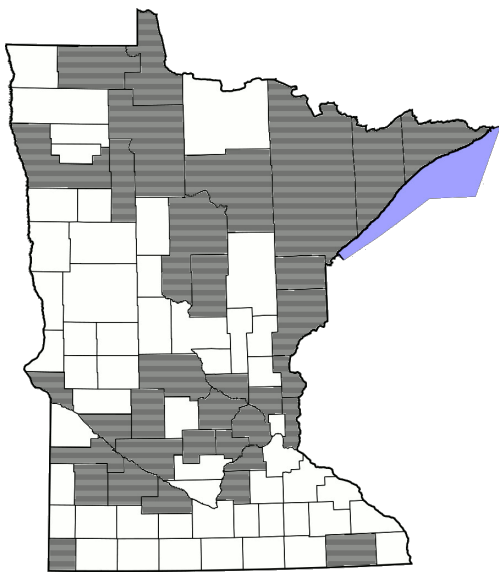


Figure 2. Counties in MN where orchid seeds have been collected/banked for Phases 1 and 2 through the 2018 field season.

Locations for orchid seed collection again have come from a variety of location types (from both public and private landowners) but state protected lands continue to be some of the higher quality sites and often contain multiple species of orchids. As we continue this research, we have learned more about the ecology of this group of plants, and among our findings is that predicting the timing of fruit set from their flowering period is hard to do. A second, and important finding, is that for many species that are regarded as “common”, or at least are not

currently listed, there may be only two or three large populations in the state, and the remainder of the populations are much smaller.

Second Update June 30, 2019

The Native Orchid Conservation Program expanded and upgraded its storage and record keeping capacity, which accounted for the successful collection pace of during the field season. As our banking program matures we have increased need for a larger and more sophisticated infrastructure and database to manage the bank as well as the accompanying field and laboratory data generated from the seed collection and management.

In addition to our banking and propagation research, the Native Orchid Conservation Program is gearing up to start working with the fungi that work symbiotically with our native orchids. Our lab will train in the techniques of recognizing and extracting the fungi from orchid roots to be able to use the fungi for the few species we have not successfully propagated and to assist in transplant and reintroduction projects.

Third Update January 31, 2020

As the program works to complete as much collection as possible prior to the end of LCCMR funding, the total number of species we have been able to bank in some capacity grew to 39 by the end of the field season in 2019. What remains of the species list are either the hardest to find species or a few species that may have been inaccurately reported as having existed in the state (i.e. they may not ever have been in the state). Total accession number has reached 385 now with seed having been collected from over 2661 individuals.

Most importantly, the Phase 2 goal of 10 more species with at least 3 populations banked was exceeded with the following species reaching that milestone in 2019:

Amerochis rotundifolia (round-leaved orchid)
Calypto bulbosa var. *americana* (fairy-slipper)
Corallorhiza maculata var. *occidentalis* (western spotted coral-root)
Corallorhiza striata (striped coral-root)
Corallorhiza trifida (early coral-root)
Cypripedium arietinum (ram's-head lady's-slipper)*
C. parviflorum var. *pubescens* (large yellow lady's-slipper)
Liparis liliifolia (lily-leaved twayblade)
L. loeselii (Loesel's twayblade)
Malaxis monophyllos var. *brachypoda* (white adder's-mouth)*
M. unifolia (green adder's-mouth)
Platanthera aquilonis (northern green bog-orchid)
Platanthera flava var. *herbiola* (tuberclad rein-orchid)*
Platanthera hookeri (Hooker's orchid)
Platanthera lacera (ragged fringed orchid)
Platanthera praeclara (western prairie fringed orchid)*
Spiranthes casei var. *casei* (Case's ladies'-tresses)*
Spiranthes cernua (nodding ladies'-tresses)

Of note is that five of these banked species are state and/or federally listed species. We have also been able to extract and bank fungi from 15 orchid species, and have demonstrated successful use of these fungi for germination and/or growth of seedlings in almost half of these species already.

Springtime appears to be a more ideal time to collect roots with viable fungal symbionts inside them, so we expect to collect the majority of our useful fungal samples in the spring of 2020.

Fourth Update June 30, 2020

Winter and springtime typically are not favorable times for seed collection with the exception of just a couple of species. Fortunately, we had been able to collect enough seed from one species to add that to our list of species for which we've approached our goal of three populations banked – *Listera cordata* (heartleaf twayblade).

While University travel restrictions and safety concerns due to the COVID-19 pandemic severely reduced the spring field season, we were able to collect roots and successfully isolate important fungi for several species of orchid in Minnesota. We are still working on banking, propagating and testing these fungi but we are very hopeful that we have multiple fungi for multiple orchid species that we will be able to use for both the propagation and conservation of these species around the state.

Fifth Update January 31, 2021

Through collection and laboratory work, we added roots samples from 9 more orchid species we now have isolated fungi from 31 species in the state, giving us a fungal library of roughly 500 samples. Not all of those fungi will be functional in regards to assisting orchid germination and establishment, but we are in the process of testing the most promising candidates and we have already found several fungi which at least aid in germination and early growth of their paired species. As we vet fungi, we store good candidate species in our long-term fungal bank.

We are anticipating adding a few more key orchid species to sample and test in the spring of 2021 as well as resample species for which no viable fungal candidates were isolated. While the fungal work was initially a secondary goal of this project, it has grown in importance and has been one of the crowning achievements of this phase of the project.

Final Update August 15, 2021

The UMLA orchid seed bank will have seed from 45 Minnesota species by the end of the 2021 field season. Approaching the end of external funding for the project, we focused on getting seed from the remaining hard to obtain species rather than, in some cases, increasing the number of populations banked for species we already have banked. We can continue to expand the bank for each species in future years, but the sooner we get seed from each species banked, the sooner we can begin the research phase of the project for those species.

Activity 2: Continue propagation and cultivation research

Description: Propagation work will increase to include nearly all of Minnesota's native orchid species in MLA's effort to develop an understanding of how to best grow each native orchid species. As the bank itself is only useful if it is understood how to germinate the seed and create propagules, propagation efforts will continue and have a dual purpose: 1) to advance the scientific work of establishing techniques for understanding how to best use the MLA and other seed banks; and 2) to allow MLA to grow specimens to use for display that will assist in broadening public support and educational outreach – both of which are vital to the long-term survival of conservation programs and the species MLA is working to conserve. A germination test, which has been lacking for orchids, will be developed in conjunction with other orchid researchers around the country.

Nearly all orchids grown by people are grown from seed and started in labs. MLA has developed the expertise to do this. Most seed propagation in orchids is done without fungal associates but MLA is working with several partners around the country to collect and identify each orchid species' fungal associates and to develop techniques to utilize them to germinate seeds. For example, Dr. Jyotsna Sharma, a professor at Texas Tech University, who works on orchid mycorrhizal associations, has been partnering with MLA to identify the fungal associations for each species and the Smithsonian Environmental Research Center is assisting MLA with fungal propagation and storage.

Orchids grown for this propagation research from the seed collected under Activity 1 will be planted only for conservation and display purposes and will only be housed at the Arboretum (in appropriate gardens or greenhouse/conservatory locations).

ENRTF BUDGET: \$116,868

Outcome	Completion Date
1. Begin construction of display beds at the Arboretum for currently produced native orchid species.	October 2018
2. Increased website presence of orchid conservation program on Arboretum website.	October 2018
3. Evaluation of developed propagation methods for orchid species from Phases 1 and 2. Prepare for publication.	December 2019
4. Produce pamphlet detailing program accomplishments and goals to site visitors and produce scientific publication.	Spring 2020Summer 2020

First Update January 31, 2019

We have been able to work quickly on display beds, the website and dissemination of our propagation methods. Orchid bed production has begun, with the help of a fantastic team of volunteer carpenters led by Marvin Grimm of Carver, MN. With matching funding to allow for some additional beds for non-orchid rare plants, they will be placed in a new research location at the Horticultural Research Center where we will be placing and displaying several populations of orchid seedlings. As a direct result of our success with our orchid program, we have also been able to secure matching funding from the Stanley Smith Horticultural Trust for construction of a set of experimental raised orchid boxes that we will be able to use in conjunction with these other beds for display at the Arboretum. The first set of beds is already constructed and waiting to be installed in the spring and the second set of orchid boxes will likely be finished by then as well. We should be able to have beds and interpretation set up for the summer growing season and already have commitments to lead tours.

The Plant Conservation Program has developed a new website, located at ArbConservation.cfans.umn.edu. The Native Orchid Conservation Program features prominently at this site and will be linked to directly from the Arboretum’s main website. This website will allow us to more quickly share updated information and photographs.

To address the sharing of our propagation research, we have been part of a new project with Longwood Gardens to collate and share the propagation information of orchid programs at public gardens around the country.

Second Update June 30, 2019

Several new species were successfully propagated, including, importantly *Calypso bulbosa* (fairy slipper) which is an orchid in Minnesota that is very hard to find.

We are also beginning a new project partnering with the Smithsonian to bring orchids to grade school classrooms in several parts of the United States. We will likely be involved with helping classrooms in Minnesota as well as other midwestern states. We are working with the Education Department at the Arboretum to adapt curricula to our local species and fit it to Minnesota’s educational standards and guidelines.

The Horticultural Research Center display/research beds have been installed and the public display beds will be installed later in the summer of 2019 at the Arboretum proper. Once the irrigation and shading systems have been installed, we will begin planting them for display and research. The beds will be available for public viewing

immediately, but likely will not have plants showing aboveground until the spring of 2020. Interpretive signs will be placed in the fall of 2019 with a planned printing of a brochure for visitors talking about the Native Orchid Program and the various species that could be found at the Arb.

Third Update January 31, 2020

We have begun working with the fungi that the orchid feed on in the soil. In 2019 we introduced these techniques to our lab and have been successful in extracting fungi from several orchid species. Several of these fungi have been successful in germinating fungi.

We have 27 species of orchids prepared for introduction in display beds. This stage is in many ways the culmination of research for each species, determining how to reestablish these plants from seed to natural (or simulated natural) landscapes. We will be doing this work both with the fungi and without, trying to find both the best and most cost-effective methods for each species. This is part of the mission of the Native Orchid Conservation Program, bringing orchid restoration not just to those with our level of infrastructure or resources, but to those who do not have it as well.

Fourth Update June 30, 2020

We have been able to successfully wrap up, or nearly wrap up, our goals for this activity.

- We are in the final stages of prepping display and research beds for introduction of our orchid conservation efforts to the visiting public at the Arboretum.
- We have established a strong presence detailing our work on our website.
- We have been continually evaluating our propagation efforts from Phase 1 and 2 and now are determining our best methods for publishing that information. We would like our work to benefit both the scientific community and the applied conservation community, so likely we will publish information in a scientific journal (or journals) as well as more easily digested material on our website.
- We have a pamphlet in the pre-production final draft stage that will be passed out to visitors

We have received multiple requests for both our help with orchids as well as with information about our methods in propagation. This speaks very highly of the choice LCCMR made in funding this work as this young program is already contributing to the knowledgebase and conservation of orchids, both in Minnesota and around the country.

Fifth Update January 31, 2021

As mentioned, we increased use of fungal candidates in our propagation work. In addition to the publication of the asymbiotic propagation material we've developed for Minnesota's native orchids species, we hope to add information about symbiotic propagation and cultivation as we analyze our results from that work.

Final Update August 15, 2021

We continue to educate the public, both at UMLA and across the state, about orchid conservation and plant conservation in general. The orchid family has proved a charismatic way of educating Minnesotans about the need for a focus on plant conservation and the value of Minnesota native plants. We also continue to have more of our seed grown plants flower every year and as these plants continue to be brought in front of the public we anticipate increased interest in these topics.

IV. DISSEMINATION:

Description:

Live transplanted orchids will continue to be kept in greenhouse or conservatory areas as we determine whether and how an appropriate garden location is available or can be constructed. While orchids are on display in the conservatory, the Arboretum will continue to provide educational information on each species and specific opportunities for the public to engage with this effort. The Arboretum will also use its website (<http://www.arboretum.umn.edu/>) as a good location for dissemination of general information about the Native Orchid Conservation Program as well as, for example, which species in the collection are currently in bloom.

In addition, working through the statewide Master Gardeners Network, the Arboretum will continue to disseminate information on a very local level for Master Gardeners who are more interested in learning and sharing information about native orchids with local communities. This train-the-trainer work will continue during field work to each of the collection sites throughout the state during the summer months of the program.

Public education will continue to include activities like those held over the Phase 1 portion of the grant: For National Public Garden Day in May, Dr. David Remucal will again talk about the Arboretum's Native Orchid Conservation Program and bring examples of the progress of our lab propagated seeds to show people throughout the day. We will also again bring in a few hundred Orchid-gami, which are paper orchid models, that can be given to visitors and constructed over conversations about the program. This is a great opportunity for us to promote the program to the public as well as answer questions people have about our state's native orchids.

We will also pursue publicity opportunities similar to those from Phase 1 to advance outreach efforts and education on orchid conservation: giving talks with diverse regional groups including the U of MN Extension Educators, Native Plant Society, and Garden Clubs; offering interviews to MPR/local press; the U of MN College of Food, Agriculture, and Natural Resource Sciences staff; and responding to speaking requests from regional newspapers, community, garden and interest groups.

We will update and promote the pamphlet previously created about the Native Orchid Conservation Program both at the Arboretum and across the U of MN where appropriate, and we will increase the program's presence on the Arboretum's website and social media platforms (<http://www.arboretum.umn.edu/> and <https://www.facebook.com/MnArboretum>).

First Update January 31, 2019

While the fall is a quiet time for publicity, given the flowering period for most orchids, we have developed more speaking opportunities for the spring 2019, including more outside of the metro area than we have had in the past. In the previous section we outlined our website strategies more but notably, we anticipate more interaction with the public as a result of this updated website. Spring is also a busy time where we are given many opportunities to interact with visitors and present them with orchids of various stages.

Second Update June 30, 2019

Our program gave a public talk at the Agassiz Environmental Learning Center in Fertile, MN. We also were featured in a newsletter for the Center for Plant Conservation in June of 2019 (<https://saveplants.org/2019/06/17/june-2019-news>), which has a national distribution to conservation groups and scientists. Increasing the breadth of our audience, we also had our part in a Wisconsin orchid introduction project highlighted for an article produced by Stantec (<https://ideas.stantec.com/creativity-innovation-program/building-on-our-community-roots-to-help-north-american-orchid-conservation>). As we give these and more talks and classes at the Arboretum and beyond, we continue to connect people to plants and show people the value of Minnesota's native species.

The Plant Conservation Program, the umbrella program for the Native Orchid Conservation Program, has a new active website (<https://ArbConservation.cfans.umn.edu>) where more information about the orchid conservation work we do is available. It is through this website that we plan to make available the research that we have been doing as a result of ENRTF funding.

Third Update January 31, 2020

We are beginning to gather information compiled over the course of the work under our ENRTF grants to publish on our website. We also are beginning to put together a brochure, in both printed and digital form, that we can share with visitors. The goal of this brochure will be to educate about Minnesota's native orchids as well as inspire visitors to learn more and participate in the conservation of native plants.

We continue to reach out and share our research with garden clubs, social groups, NGOs and government entities.

Fourth Update June 30, 2020

The COVID-19 pandemic has slowed our ability to present our orchids for display, but we have everything ready to go as soon as we have access to more staffing and volunteers to assist with the planting.

Our pamphlet reaching out to visitors with information both about our conservation work and research and about Minnesota orchids is in the final stages in preparation for printing. We plan on printing 3000 copies for visitors to have once the Arboretum is fully back open, with a commitment to keep publishing the brochure if it is as popular as we hope.

Fifth Update January 31, 2021

Beds are ready for planting in the spring, with several orchid species ready to be planted and signage ready for the public.

We also have 3000 brochures printed and ready for visitors once the beds are planted and the signs installed.

We continue to give talks educating public groups and students about the orchid conservation work we are doing.

Final Update August 15, 2021

We continue to bring orchid plants and information to the public, available to those that visit in person and those that visit virtually through the websites. More information about our orchid conservation work continues to be available through the media as well, all helping to bring focus to native plant conservation in our state.

V. PROJECT BUDGET SUMMARY:

A. Preliminary ENRTF Budget Overview: See attached budget spreadsheet

Explanation of Capital Expenditures Greater Than \$5,000: N/A

Explanation of Use of Classified Staff: N/A

Total Number of Full-time Equivalent (FTE) Directly Funded with this ENRTF Appropriation:

Enter Total Estimated Personnel Hours: 6865.6	Divide by 2,080 = TOTAL FTE: 3.301
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Total Number of Full-time Equivalent (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:

Enter Total Estimated Personnel Hours: 80	Divide by 2,080 = TOTAL FTE: .038
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B. Other Funds:

SOURCE OF AND USE OF OTHER FUNDS	Amount Proposed	Amount Spent	Status and Timeframe
Other Non-State \$ To Be Applied To Project During Project Period:			
Minnesota Landscape Arboretum Foundation	\$13,531	\$13,531	Arboretum personnel will be provided in-kind including: Director of Operations (0.05 FTE) for supervision of Curator of Endangered Plants (\$8,911), Arboretum curator (100 hours) for production and placement of plant labels (\$4,630). In addition, the Arboretum is actively fundraising from private philanthropic sources to support this work.
Other State \$ To Be Applied To Project During Project Period:			
	\$	\$	
Past and Current ENRTF Appropriation:			
M.L. 2015, Chp. 76, Sec. 2, Subd. 08c (6/15/15 – 6/30/18)	\$ 167,000	\$155,999	
Other Funding History:			
Helen Clay Frick Foundation	\$25,000	\$25,000	
Stan Smith Horticultural Fund	\$16,000	\$16,000	
Mid-American Orchid Congress	\$1,600	\$1,600	

VI. PROJECT PARTNERS:

A. Partners receiving ENRTF funding

Name	Title	Affiliation	Role
NA			

B. Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role
Minnesota Department of Natural Resources	--	--	The DNR has been vital in providing recommendations for, location information for and access to orchid populations

Dr. Jyotsna Sharma	Associate Professor of Plant Ecology & Conservation	Texas Tech University	Dr. Sharma is working with NOCP to identify MN orchid fungal associates
Jay O'Neill, Dr. Dennis Whigham, Dr. Lawrence Zettler	Head Technician, Senior Scientist	Smithsonian Environmental Research Center	Mr. O'Neill and Dr. Whigham are working with NOCP to isolate, propagate and bank fungal associates of MN orchids. Mr. O'Neill has recently retired and Dr. Lawrence Zettler at Illinois College as taken over his duties.
North American Orchid Conservation Center	--	--	MLA is a participating institution in NAOCC and as such has access to the collective knowledge of all other member organizations for assistance in orchid storage and propagation.

VII. LONG-TERM- IMPLEMENTATION AND FUNDING:

The Arboretum’s Native Orchid Conservation Program is part of a long-term strategy to establish the Arboretum as a premier center for ex situ (off-site) plant conservation and plant conservation research. This kind of conservation is a vital complement to in situ conservation efforts that protect landscapes where native populations reside.

The Minnesota Landscape Arboretum is uniquely positioned to carry-out this effort. Botanic gardens:

- Keep records (accessions) on their collections;
- Manage accessions (grow and contain);
- Have greenhouse and garden space for display and experiments;
- Possess in-house horticultural expertise;
- And ultimately have a public mission to connect people to plants.

The Arboretum’s first step in this effort was to establish itself as a participating institution with the Center for Plant Conservation (CPC). As an official CPC organization, the Arboretum is now charged with actively managing long-term propagule storage for several endangered species. In 2019 this work has included collecting seeds and/or live plants from the following species, which, as of 2018, included three orchids:

- *Besseyia bullii* (kittentails)
- *Chrysosplenium iowense* (Iowa golden saxifrage)
- ***Cypripedium arietinum* (ram’s head lady’s slipper)**
- ***Cypripedium candidum* (small white lady’s slipper)**
- *Erythronium propullans* (dwarf trout lily)
- *Oxytropis campestris* var. *chartacea* (Fassett's locoweed)
- ***Platanthera praeclara* (western prairie fringed orchid)**
- *Polemonium occidentale* ssp. *lacustre* (western Jacob's ladder)
- *Rhodiola integrifolia* ssp. *leedyi* (Leedy's roseroot)

The next step was to become an early member of the North American Orchid Conservation Center, an organization similar in spirit to the CPC but focused exclusively on orchid species, being very forward looking by including all orchid species, not just those currently endangered. As a member of the Midwest Regional group in NAOCC, the young Native Orchid Conservation Program at MLA is already a leading voice and contributing member of NAOCC.

To conduct plant conservation on this level requires a long-term commitment. To successfully conduct seed storage the institution must be committed to the on-going collection of seeds as well as to the regular monitoring of the seeds in storage, as not all seeds can be stored indefinitely. Also in the case where live specimens of species are collected and grown in a controlled environment and then replanted at the Arboretum, there is an interest in seeing whether or not these plants could then survive in their native habitats over time, which requires continued propagation and monitoring.

While MLA develops the ability to grow more and more of Minnesota's native orchids, the NOCP continues to dialog with the MN DNR and TNC, both of which we are already working closely to bank seed and develop restoration projects. This funding will not cover restoration work like this, and this next step in development of an effective conservation program cannot be done without developing close partnerships. The conservation program at MLA has already partnered with both the Minnesota and Wisconsin DNR for rare plant restoration/translocation projects, and the knowledge gained by all parties in these projects will be invaluable for future potential orchid restoration projects.

VIII. REPORTING REQUIREMENTS:

- **The project is for 3 years, will begin on 7/1/18, and end on 06/30/2021.**
- **Periodic project status update reports will be submitted 1/31 and 6/30 of each year.**
- **A final report and associated products will be submitted between June 30 and August 15, 2021.**

IX. SEE ADDITIONAL WORK PLAN COMPONENTS:

- A. Budget Spreadsheet**
- B. Visual Component or Map**
- C. Parcel List Spreadsheet**
- D. Acquisition, Easements, and Restoration Requirements**
- E. Research Addendum**

**Environment and Natural Resources Trust Fund
M.L. 2018 Budget Spreadsheet**

Project Title: Preserving Minnesota's Native Orchids - Phase 2

Legal Citation: M.L. 2018 179-F

Project Manager: David Remucal, PhD

Organization: University of Minnesota Landscape Arboretum

College/Department/Division:

M.L. 2018 ENRTF Appropriation: \$259,000

Project Length and Completion Date: 3 years, June 30, 2021

Date of Report: 09/06/2021



ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	REVISED BUDGET 6/30/2020	AMOUNT SPENT	TOTAL BALANCE
BUDGET ITEM			
Personnel (Wages and Benefits) - Overall	\$200,279	\$200,278	\$1
<i>Curator of Endangered Plants David Remucal (MLA Program Manager, 0.5 FTE, Salary 75%, Benefits 25% for FY19 and FY20) (Total estimated amount \$81,877)</i>			
<i>Conservation Program Associate (0.5 FTE, Salary 79%, Benefits 21% for FY19 and FY20) (Total estimated amount \$61,461)</i>			
<i>Gardener Ricky Garza (Gardener, Orchid Program, 0.14 FTE, Salary 79%, Benefits 21% for FY19 and FY20)(Total estimated amount \$16,623)</i>			
<i>Field Technician (seasonal 0.5 FTE, Salary 79%, Benefits 21% for FY19)(Total estimated amount \$24,458)</i>			
<i>Student intern (summer season, 10 weeks, Salary 93%, Benefits 7% for FY19 and FY20)(Total estimated amount \$12,320)</i>			
<i>Communications Associate, Barb Kastens (0.02 FTE, Salary 79%, Benefits 21% for FY19 and FY20)(Total estimated amount \$1,500)</i>			
Professional/Technical/Service Contracts			
<i>Contract, Jason Husveth (seed collection and population surveys in private and commercial lands difficult to gain access by MLA/state staff, 8 days per year @ contractor rate of \$1040/day plus travel for 5 trips/year @ 250 roundtrip miles and 0.535/mile reimbursement - FY19)</i>	\$8,989	\$8,989	\$0
Equipment/Tools/Supplies - Overall	\$15,941	\$15,705	\$236

<i>Lab supplies: Chemicals, glassware, growth media, greenhouse supplies, sterilization equipment. Includes external soil testing lab work and postage for sending samples to TTU and SERC (Total estimated amount \$6,144)</i>			
<i>Greenhouse supplies: Including soil and lumber for garden bed maintenance, common garden construction, and shade structure construction, fertilizers, caging material (Total estimated amount \$7,421)</i>			
<i>Water deionization system- Asymbiotic orchid propagation requires very precise control of nutrients and substrates. Distilled water must be used in most steps to ensure that known quantities of chemical compounds are being used. Often in propagation in this manner well or tap water is fatal to plants. Cost is for lease and maintenance of the system (Total estimated amount \$2,376)</i>			
Printing			
<i>Printing for brochure: 5 panel, folded, 2-sided, 4-color, 3K quantity</i>	\$1,566	\$1,566	\$0
Travel expenses in Minnesota - Overall	\$32,225	\$32,225	\$0
<i>Food and lodging during seed and/or live plant collection trips in Greater Minnesota more than 200 miles round trip for 2 people - \$133/day x 40/days per yr x 2 years. Reimbursed based on University of Minnesota plan. (Total estimated amount \$19,580)</i>			
<i>Mileage reimbursement for seed and/or live plant collection trips - .535 per mile x 250 miles per trip x 50 round trips per yr x 2 years. Reimbursed based on University of Minnesota plan. (Total estimated amount \$12,645)</i>			
COLUMN TOTAL	\$259,000	\$258,763	\$237