Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2019 ENRTF Work Plan (Main Document)

Today's Date: August 15th, 2018

Date of Next Status Update Report: May 1, 2020

Date of Work Plan Approval:

Project Completion Date: June 30, 2023

Does this submission include an amendment request? __

PROJECT TITLE: Conservation and Monitoring of Minnesota's Rare Arctic Plants

Project Manager: Briana L. Gross

Organization: University of Minnesota Duluth

College/Department/Division: Swenson College of Science and Engineering, Biology Department

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Location: Northeastern MN; St. Louis, Lake, and Cook counties (coastal regions)

Total Project Budget: $135,000

Amount Spent: $0

Balance: $135,000

Legal Citation: M.L. 2019, Chp. xx, Sec. xx, Subd. xx

Appropriation Language:

I. PROJECT STATEMENT:

If you visit the rocky shore of Lake Superior, you will probably see plants that are not found anywhere else in the continental USA, including some of the most endangered species in Minnesota: the arctic relicts. These plants contribute to the charm of the most important tourist area in the state, but they are at risk. Of 48 arctic relicts, at least six species are endangered, four are threatened, and three are of special concern. In addition, our research recently shows that one of these rare species is hybridizing with an invasive relative and is in danger of extinction due to genetic swamping (Zlonis and Gross 2015). It has been 10+ years since the Minnesota Biological Survey (MBS) conducted a comprehensive surveyed these populations. **Our goal is to understand and ultimately learn how to protect this unique community.**

What will we do?

- Collect detailed information on the health of Minnesota's arctic relict plant communities
- Establish plots for long-term monitoring at key locations
- Implement invasive species removal
- Share our findings with managers to protect develop plans for long-term conservation of their habitats

What are arctic relicts? Species referred to as 'arctic relicts' were once common in northern Minnesota when glaciers retreated approximately 10,000 years ago, but are now the last representatives of their kind outside of the arctic. They survive along the North Shore because the lake creates a cold microclimate with disturbances that mimic an arctic environment. These communities include many species of conservation concern, such as:

- Hudson Bay eyebright (*Euphrasia hudsoniana*) (SC)
- Alpine bistort (*Bistorta vivipara*) (TH)
- Spike trisetum (*Trisetum spicatum*) (SC)
- Butterwort (*Pinguicula vulgaris*) (SC)
- Alpine woodsia (*Woodsia alpina*) (TH)
- Smooth woodsia (*Woodsia glabella*) (TH)
- Wild chives (*Allium schoenoprasum*) (EN)
- Auricled twayblade (*Listera auriculata*) (EN)
- Alpine bilberry (*Vaccinium uliginosum*) (EN)
- Small false asphodel (*Tofieldia pusilla*) (EN)
- Knotty pearlwort (*Sagina nodosa*) (EN)
- Northern paintbrush (*Castellija septentrionalis*) (EN)

SC = Special Concern; TH = Threatened; EN = Endangered

Why are they in danger? Suitable habitat mimicking arctic environments is extremely limited for these species along the North Shore. As tourism and development increase and temperatures changes, populations of these unique and beautiful species are in danger and perhaps at risk of extinction. **Our surprising new discovery also indicates that one of these species (*Euphrasia hudsoniana*) is in danger from hybridization with an invasive relative, which compromises the genetic integrity of this rare Minnesota species.** The MBS intensively surveyed plant communities on the North Shore in 1999-2005 and found new occurrences of several rare species. However, we do not have any information on the health or viability of these populations. At least one study conducted since then suggests that the communities are vulnerable to environmental change and land managers have reported the arrival of invasive species and decline of some arctic species.

II. OVERALL PROJECT STATUS UPDATES:

First Update May 1, 2020
Second Update November 1, 2020
Third Update May 1, 2021
Fourth Update November 1, 2021
Fifth Update May 1, 2022
Sixth Update November 1, 2022
Final Report June 30, 2023

III. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1 Title: ***Survey communities and establish six long-term monitoring locations***
Description: We will systematically assess whether and how these communities have changed in the 10+ years since the MBS survey by revisiting survey locations at the same time of year as the original survey and documenting species abundance and richness according to the same methods. We will also establish six locations for long-term monitoring in future years, and will establish guidelines for monitoring efforts. This activity will increase the value of past investments in these plant communities by the state of Minnesota.

ACTIVITY 1 ENRTF BUDGET: $ 49,382

Outcome	Completion Date
1. *Arctic communities visited by the Minnesota Biological Survey in 1999-2005 re-assessed for species composition and compared to previous surveys to document potential changes*	September 2021

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ACTIVITY 2 Title: ***Determine population growth or decline for three rare arctic species***
Description: We will collect detailed information on three plant species that are characteristic of these communities including *Euphrasia hudsoniana* (special concern)*, Pinguicula vulgaris* (special concern), and *Primula mistassinica*. At several locations, we will count individuals and track their reproduction for three years to build models that can project population growth or decline over time. This will help us to determine whether populations are holding steady, increasing, or declining, which can allow managers to prioritize conservation or restoration efforts.

ACTIVITY 2 ENRTF BUDGET: $72,698

Outcome	Completion Date
1. *Assessment of the presence, number, and health of rare species across multiple years*	June 2023

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ACTIVITY 3 Title: ***Remove invasive species threatening a rare species***

Description: An introduced species, *Euphrasia stricta*, is invading habitat occupied by the rare arctic species *Euphrasia hudsoniana*. In 2015, we found genetic evidence of hybridization between the native and non-native species at two locations, which represents a threat to the genetic integrity of the native species. Fortunately, the low level of hybridization suggests that removing *E. stricta* now will leave the native species genetically intact. We have shared this information with managers on the North Shore, but the agencies lack the time and resources necessary to address this pressing issue. We will coordinate with the local community in Grand Marais, including the Cook County Invasives Team and volunteers, to remove *E. stricta* at each of these sites by hand every year for three years, followed by another genetic assessment of hybridization between native and non-native plants during the final year of the project to evaluate the impact of this work. During this process, we will also collect data on the morphology of pure and mixed populations to see how they change over this time period.

ACTIVITY 3 ENRTF BUDGET: $13,461

Outcome	Completion Date
1. *Removal of invasive E. stricta from arctic communities during each summer of funding*	Sept 2022
2. *Hybridization in 2022 measured using genetic techniques and compared to 2015 study*	June 2023

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Second Update November 1, 2020
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IV. DISSEMINATION:

Description:

Sharing with community stakeholders: Plant survey results from Activities 1 and 2 will be provided to the DNR to include in the state's relevé (native plant community) and natural heritage databases. Results from Activities 1, 2, and 3 will be shared with the managers of the arctic plant communities along the North Shore (Cook County Invasives team, Grand Portage Band of Lake Superior Chippewa, US Forest Service, Sugarloaf Cove Nature Center, and the MN DNR) at a meeting that we will host to facilitate discussion and planning for the future based on the results of these activities.

Publicly available genetic data: Genetic data generated in Activity 3 will be made publicly available via the Cyverse Data Commons (http://datacommons.cyverse.org/) or other publicly accessible database; a link to the data will be made available in project updates and upon presentation and publication of results from the genetic study.

Scientific publications: We expect that Activities 1, 2, and 3 will result in at least two peer-reviewed journal articles in the fields of natural resource conservation and plant biology.

The Minnesota Environment and Natural Resources Trust Fund (ENRTF) will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENRTF Acknowledgement Guidelines.

First Update May 1, 2020
Second Update November 1, 2020
Third Update May 1, 2021
Fourth Update November 1, 2021
Fifth Update May 1, 2022
Sixth Update November 1, 2022
Final Report June 30, 2023

V. ADDITIONAL BUDGET INFORMATION:

A. Personnel and Capital Expenditures

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

Explanation of Use of Classified Staff: N/A

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

Enter Total Estimated Personnel Hours for entire duration of project:	Divide total personnel hours by 2,080 hours in 1 yr = TOTAL FTE:
Field Technician: 2,040 (17 wks/year for 3 years)	0.98
Undergraduate Hourly Worker: 2,040 (17 wks/year for 3 years)	0.98
Katharine Zlonis: 300 (2.5 wks/year for 3 years)	0.14

Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: *None*

Enter Total Estimated Contract Personnel Hours for entire duration of project:	Divide total contract hours by 2,080 hours in 1 yr = TOTAL FTE:

VI. PROJECT PARTNERS:

A. Partners outside of project manager's organization receiving ENRTF funding

None

B. Partners outside of project manager's organization NOT receiving ENRTF funding

Name	Title	Affiliation	Role
Chel Anderson	Botanist	MN DNR, MBS	Consultation
Carolyn Rock	Naturalist	MN DNR Gooseberry Falls SP	Outreach
Molly Thompson	Executive Director	Sugarloaf Cove Nature Center	Outreach
Anna Heruth	Forester	MN DNR; Cook County Invasives Team	Invasive removal

VII. LONG-TERM- IMPLEMENTATION AND FUNDING:

The results of all three activities in this project will be provided to the DNR to include in the state's relevé (native plant community) and natural heritage databases, and to the managers of the arctic plant communities along the North Shore (Cook County Invasives team, Grand Portage Band of Lake Superior Chippewa, US Forest

Service, Sugarloaf Cove Nature Center, and the MN DNR) so that they are aware of any changes in the arctic communities, and can prioritize management accordingly. We will host a meeting with all interested parties to facilitate discussion and planning for the future based on the results of our study. This proposal leverages the previous years of surveys by the MBS, and we will seek additional funding for long-term monitoring efforts.

VIII. REPORTING REQUIREMENTS:

- Project status update reports will be submitted May 1 and November 1 each year of the project; these reporting dates match with the seasonal nature of the work conducted over the summer.
- A final report and associated products will be submitted **June 30, 2023.** Note: we are requesting a fourth year for the project (but no extra funding) to allow us to complete work through the full summer of 2022 (past June 30th, 2022), corresponding to the life-cycle of the plants we are studying. We will complete work in the field by fall 2022 and genetic work by winter 2022/2023 to submit a final report by June 30th, 2023.

IX. SEE ADDITIONAL WORK PLAN COMPONENTS:

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

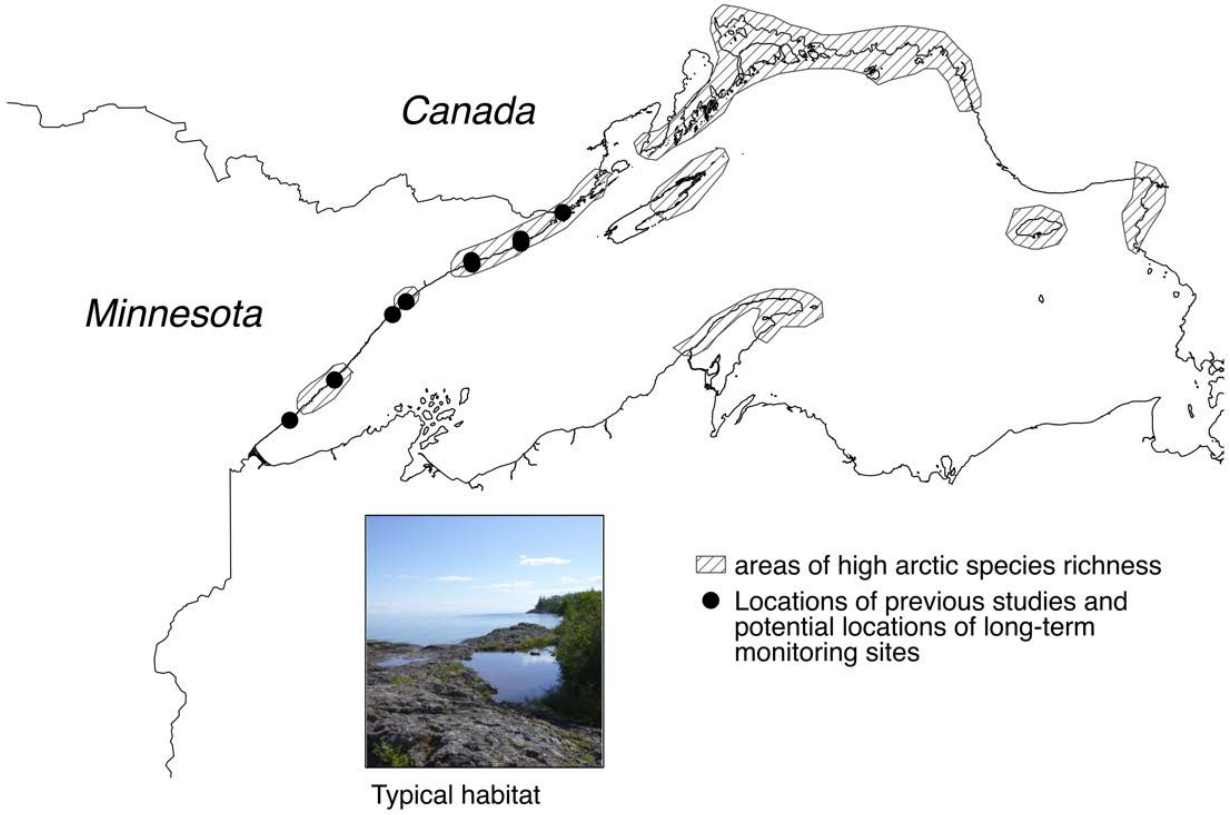
Attachment A:
Environment and Natural Resources Trust Fund
M.L. 2019 Budget Spreadsheet
Legal Citation:
Project Manager: Briana L. Gross
Project Title: Conservation and Monitoring of Minnesota's Rare Arctic Plants
Organization: University of Minnesota Duluth
Project Budget: $135,00
Project Length and Completion Date: 4 years, June 30th 2023
Today's Date: August 15, 2018

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 103,405	$ -	$ 103,405
Research consultant: $8,250 (100% salary/0% fringe) 4% FTE for 4 years.			
Field technician: $53,655 (79% salary/29.5% fringe) 23% FTE for 4 years.			
MS graduate student: $21,500 (82.3% salary/17.7% fringe) 18% FTE for 3 years			
Undergraduate hourly worker: $20,000 (100% salary/0% fringe) 20% FTE for 4 years.			
Professional/Technical/Service Contracts			
UMN Genomics Center - Genotyping-by-sequencing services (enzyme optimization, DNA digestion and ligation, and Illumina sequencing) = genetic data generation for assessment of hybridiztion, $51.51/sample for 188 samples + 3% inflation (work will occur at the end of the grant)	$ 9,973	$ -	$ 9,973
Equipment/Tools/Supplies			
General field equipment (leaf pressing supplies, surveyor's tape, field flagging, write-in-the-rain notebooks, kneepads, envelopes for samples; $653), and 2 GPS units + batteries ($1068)	$ 1,721	$ -	$ 1,721
Travel expenses			
Camping fees, per diem, car rental and mileage for travel to North Shore sites from Duluth, MN, for surveys and invasive species removal per UMN Policy.	$ 19,163	$ -	$ 19,163
Mileage for land managers to attend group meeting to discuss findings at the conclusion of the project.	$ 526	$ -	$ 526
Other			
Expenses for group meeting of land managers to discuss findings at the conclusion of the project (parking, modest food allowance)	$ 212	$ -	$ 212
COLUMN TOTAL	$ 135,000	$ -	$ 135,000

OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State: N/A		$ -	$ -	$ -
State: N/A		$ -	$ -	$ -
In kind: Etterson/Gross (1/2 month salary during academic year x 3 years for project advisement and data analysis)	Secured	$ 26,691	$ -	$ 26,691
In kind: Unrealized indirect cost return from this proposal	Secured	$ 67,500	$ -	$ 67,500
PAST AND CURRENT ENRTF APPROPRIATIONS	**Amount legally obligated but not yet spent**	**Budget**	**Spent**	**Balance**
Current appropriation: N/A		$ -	$ -	$ -
Past appropriations: N/A		$ -	$ -	$ -

IX. B. Visual Component or Map:

Map of Lake Superior (top) showing areas of high arctic species richness and past study sites, which may be used as long-term monitoring sites (adapted from Given and Soper, 1981). Although these unique species assemblages extend to the shore of Lake Superior in Canada, **all survey and monitoring locations for this proposal will be in Minnesota.** Representative photos (bottom) of four arctic relict species.



Typical habitat

Photos of four arctic relicts found in Minnesota. There are 48 recognized arctic relict species.

Knotty pearlwort (*Sagina nodosa*) **Endangered**

Small false asphodel (*Tofieldia pusilla*) **Endangered**

Hudson Bay eyebright (*Euphrasia hudsoniana*) **Special Concern**

Bird's eye primrose (*Primula mistassinica*)

Photos of knotty pearlwort and small false asphodel by Peter M. Dziuk, photo of Hudson Bay eyebright by Katharine Zlonis, and bird's eye primrose by Jessica Le.