

**Environment and Natural Resources Trust Fund
2019 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 232-FH

Conservation and Monitoring of Minnesota's Rare Arctic Plants

Category: H. Proposals seeking \$200,000 or less in funding

Sub-Category: F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Total Project Budget: \$ 135,541

Proposed Project Time Period for the Funding Requested: June 30, 2022 (3 yrs)

Summary:

The North Shore houses completely unique plant communities that are in danger of decline. This project will provide critical monitoring and invasive removal to conserve these rare and endangered plants.

Name: Katharine Zlonis

Sponsoring Organization: U of MN - Duluth

Title: Plant Resources Director, Leech Lake Band o

Department: Swenson College of Science and Engineering

Address: 1035 Kirby Drive, SSB 207

Duluth MN 55812

Telephone Number: (218) 260-1250

Email wink0113@d.umn.edu

Web Address

Location

Region: Northeast

County Name: Cook, Lake, St. Louis

City / Township:

Alternate Text for Visual:

Map showing locations of potential study sites along the North Shore, typical habitat of the arctic relicts, and pictures of four representative species.

<input type="checkbox"/>	Funding Priorities	<input type="checkbox"/>	Multiple Benefits	<input type="checkbox"/>	Outcomes	<input type="checkbox"/>	Knowledge Base
<input type="checkbox"/>	Extent of Impact	<input type="checkbox"/>	Innovation	<input type="checkbox"/>	Scientific/Tech Basis	<input type="checkbox"/>	Urgency
<input type="checkbox"/>	Capacity Readiness	<input type="checkbox"/>	Leverage	<input type="checkbox"/>		TOTAL	<input type="checkbox"/> %
<input type="checkbox"/> If under \$200,000, waive presentation?							



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

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 (see figure). 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 (<i>Euphrasia hudsoniana</i>) (SC) | ● Wild chives (<i>Allium schoenoprasum</i>) (EN) |
| ● Alpine bistort (<i>Bistorta vivipara</i>) (TH) | ● Auricled twayblade (<i>Listera auriculata</i>) (EN) |
| ● Spike trisetum (<i>Trisetum spicatum</i>) (SC) | ● Alpine bilberry (<i>Vaccinium uliginosum</i>) (EN) |
| ● Butterwort (<i>Pinguicula vulgaris</i>) (SC) | ● Small false asphodel (<i>Tofieldia pusilla</i>) (EN) |
| ● Alpine woodsia (<i>Woodsia alpina</i>) (TH) | ● Knotty pearlwort (<i>Sagina nodosa</i>) (EN) |
| ● Smooth woodsia (<i>Woodsia glabella</i>) (TH) | ● Northern paintbrush (<i>Castilleja septentrionalis</i>) (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. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Survey communities and establish six long-term monitoring locations **BUDGET: \$49,382**

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.



Environment and Natural Resources Trust Fund (ENRTF)
2019 Main Proposal
Project Title: Conservation and Monitoring of Minnesota's Rare Arctic Plants

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

Activity 2: Determine population growth or decline for three rare arctic species **BUDGET: \$72,698**

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.

Outcome	Completion Date
1. Assessment of the presence, number, and health of rare species across multiple years	June 2022

Activity 3: Remove invasive species threatening a rare species **BUDGET: \$13,461**

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.

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

III. PROJECT PARTNERS:

A. Partners receiving ENRTF funding - N/A

B. Partners 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

IV. 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.

V. TIMELINE REQUIREMENTS: Three years.

2019 Proposal Budget Spreadsheet

Project Title: Conservation and Monitoring of Minnesota's Rare Arctic Plants

IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel:	\$ 103,946
Project manager, Katharine Zlonis - .05 FTE (100% salary/0% fringe) Coordinate project, field visits and provide field training, analysis, report writing. Salary over 3 years.	\$ 8,250
Field technician - .33 FTE (79% salary/21% fringe) Arrange and conduct community surveys, population health, invasive removal. Salary and fringe for 3 summers.	\$ 62,717
UMN Duluth undergraduate hourly worker - .33 FTE (100% salary/0% fringe) Assist field technician with surveys and invasive plant removal. Salary for 3 summers.	\$ 32,979
Professional/Technical/Service Contracts:	\$ 9,973
UMN Genomics Center - Genotyping-by-sequencing services (enzyme optimization, DNA digestion and ligation, and Illumina sequencing) = genetic data generation for assessment of hybridization, \$51.51/sample for 188 samples + 3% inflation (work will occur at the end of the three-year grant)	\$ 9,973
Equipment/Tools/Supplies:	\$ 1,721
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
Acquisition (Fee Title or Permanent Easements):	N/A
Travel: All estimates are based on standard rates for the University of Minnesota.	\$ 19,689
Camping fees, per diem, car rental and mileage for travel to North Shore sites from Duluth, MN, for three summers for surveys and invasive species removal.	\$ 19,163
Mileage for land managers to attend group meeting to discuss findings at the conclusion of the project.	\$ 526
Additional Budget Items:	\$ 212
Expenses for group meeting of land managers to discuss findings at the conclusion of the project (parking, modest food allowance)	\$ 212
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 135,541

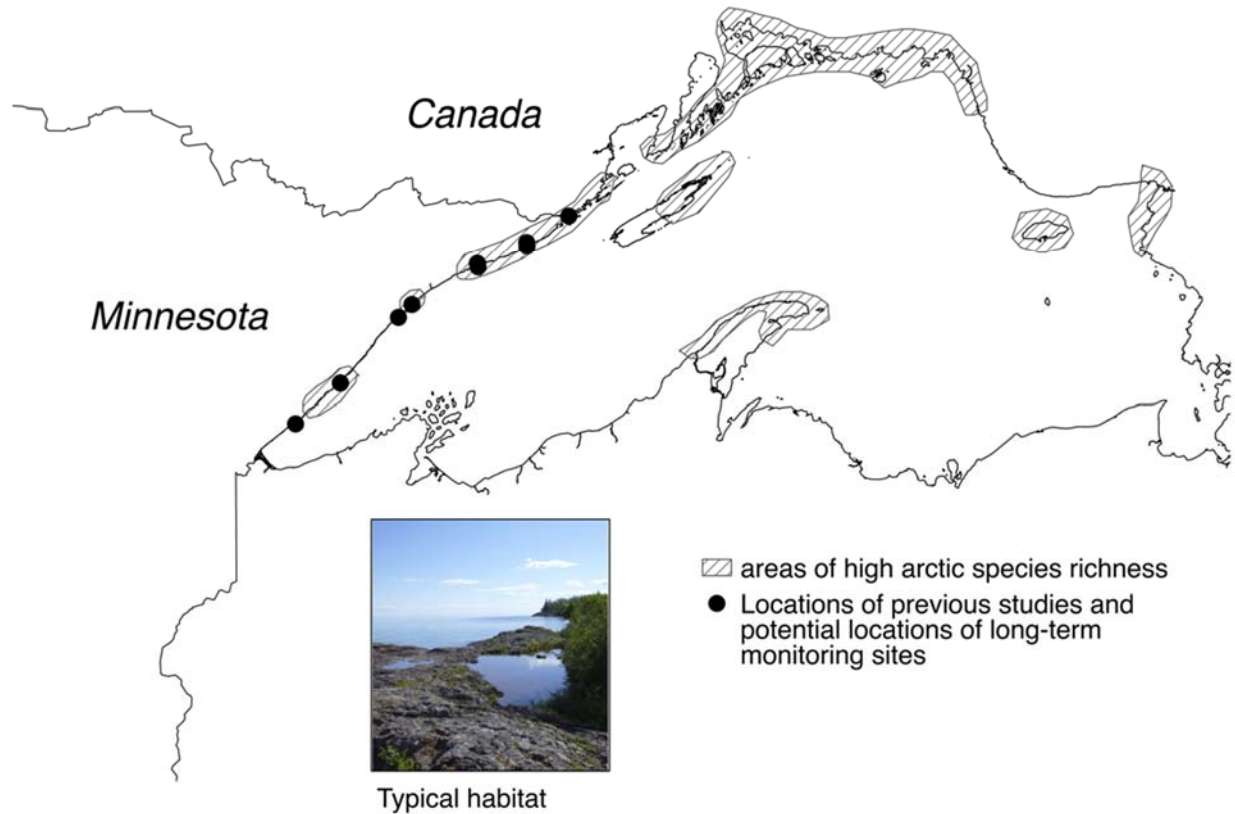
V. OTHER FUNDS (This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ To Be Applied To Project During Project Period:	N/A	
Other State \$ To Be Applied To Project During Project Period:	N/A	
In-kind Services To Be Applied To Project During Project Period:	\$ -	
Etterson/Gross (1/2 month salary during academic year x 3 years for project advisement and data analysis)	\$ 26,691	<i>Secured</i>
Unrealized indirect cost return from this proposal	\$ 73,192	<i>Secured</i>
Past and Current ENRTF Appropriation:	N/A	
Other Funding History: Completed project funded by the MN DNR Minnesota Lake Superior Coastal Program through NOAA to assess hybridization between <i>E. hudsoniana</i> and <i>E. stricta</i> ; initiated in 2015. Publication in 2018: "Genetic structure, diversity, and hybridization in populations of the rare arctic relict <i>Euphrasia hudsoniana</i> (Orobanchaceae) and its invasive congener <i>Euphrasia stricta</i> ." Conservation Genetics doi: 10.1007/s10592-017-0995-x.	\$ 7,000	<i>Completed</i>

VI. 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.



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.



VI. F. Project Manager Qualifications and Organization Description

Project Manager: Katharine Zlonis has extensive experience both with project management and this ecological system. She has a MS in Integrated Biosciences from the University of Minnesota and is currently pursuing her PhD in the same program. She has researched the arctic disjunct plants of the North Shore of Lake Superior in Minnesota since 2014. Past projects include measuring traits to assess population differences along the shore for multiple species (*Pinguicula vulgaris*, *Primula mistassinica*, and *Euphrasia hudsoniana*), a population genetics project assessing genetic diversity of *Euphrasia hudsoniana* in Minnesota, and testing whether *E. hudsoniana* is hybridizing with a non-native species, *Euphrasia stricta*, which was a conservation concern raised by MN DNR. The results of the population genetics and hybridization study were published in 2017 in the journal *Conservation Genetics* and shared widely with managers and naturalists who work on the North Shore. We will continue this work in 2018 studying the population genetics of *Primula mistassinica* in Minnesota. Funding for each of these projects was awarded by Minnesota's Lake Superior Coastal Program to Zlonis, Gross, and Eттerson. Zlonis was the project manager for each project, carried out project and budget administration in coordination with UMD Financial staff, conducted all field work and data collection, completed analyses, and synthesized results in reports and a publication. In addition, Zlonis has worked with the DNR as a student worker plant ecologist, as the project manager for a \$1 million dollar grant, Project Baseline, at the University of Minnesota, and, in addition to pursuing her PhD, currently holds a full time position as the Plant Resources Director for the Leech Lake Band of Ojibwe. Through these positions she has gained additional experience in project management, research and management of native plants, including rare species of conservation concern, and has managed crews of field workers or students to meet project goals. Through her research and work she has developed connections with multiple agencies including USFS, MN DNR (including personnel within the Minnesota Biological Survey, Ecological and Water Resources, and Parks and Trails), the Cook County Invasives Team, the Sugarloaf Cove Nature Center, and Grand Portage Band of Lake Superior Chippewa. These contacts and experiences will be critical to successfully coordinating with land managers in the field and communicating results for maximum impact. Finally, Zlonis, Gross, and Eттerson have a long history of collaboration, having worked together on numerous projects over nearly a decade, and this relationship will further ensure the success of this project.

Organization Description: The University of Minnesota Duluth Swenson College of Science & Engineering supports excellence in research & education at the undergraduate & graduate levels. The Department of Biology in particular comprises over 15 research active faculty & attracts hundreds of majors each year. Research focusing on Minnesota's natural areas is a prominent component of our department's teaching & research practices.