Environment and Natural Resources Trust Fund

2021 Request for Proposal

General Information

Proposal ID: 2021-055

Proposal Title: Protecting Minnesota's Beneficial Macroalgae: All Stoneworts Aren't Starry

Project Manager Information

Name: Donna Perleberg

Organization: MN DNR - Ecological and Water Resources Division

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Project Basic Information

Project Summary: This statewide inventory will provide baseline data and build in-state knowledge on Minnesota's stoneworts, a diverse group of aquatic plants that are critical for clear lakes and healthy fish habitat.

Funds Requested: $1,081,000

Proposed Project Completion: 2024-06-30

LCCMR Funding Category: Foundational Natural Resource Data and Information (A)

Project Location

What is the best scale for describing where your work will take place?

Statewide

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

During the Project and In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Hidden beneath the surface of most Minnesota lakes, native macroalgae, or "stoneworts", are keeping our waters clear and our fish habitats healthy. These plants occur statewide and represent at least 25% of Minnesota's lake plant diversity but resource managers ignore them because they don't have the technical knowledge to identify them. This would be analogous to bird surveyors not distinguishing the many different warbler species and simply calling them "songbirds". Stoneworts are unique lake plants that serve important ecological roles by stabilizing sediment, absorbing nutrients, purifying water, maintaining high clarity, and providing habitat for muskellunge and other fish and wildlife. The types of stoneworts present tell a lot about the water quality and habitat of each lake. Minnesotans are concerned about the non-native, "starry stonewort," and the potential negative impacts it may have in our lakes including potential competitive interactions with native aquatic plants. As we attempt to limit the spread of starry stonewort, it is essential to also understand the distribution, diversity, and changing patterns of our native stoneworts and how management actions may impact them. Otherwise, in our ignorance, we may be destroying these special plants that keep our lakes pristine.

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

This challenge requires an investment in existing specialized knowledge that can be shared to grow expertise within Minnesota. Four years ago, DNR began adhoc collaboration with Dr. Kenneth Karol, a world-renowned stonewort expert at the New York Botanical Garden (NYBG). Dr. Karol uses a combination of field surveys, microscopic analyses and genetic studies to identify and describe stoneworts. It was Dr Karol who first identified the non-native starry stonewort in Minnesota and has used genetics to confirm all new locations and compare them with other North American and European populations to help understand its mode of spread. His lab has analyzed hundreds of Minnesota stonewort samples and from them, identified dozens of native stonewort species, all at no cost to the state. We now need to expand and fund this collaborative work so that 1) stonewort sampling becomes a routine component of lake surveys 2) Minnesota surveyors gain expertise in stonewort identification and ecology and 3) we build baseline data on stonewort communities across the state. These data can then be used to help prioritize lakes for protection and restoration, monitor changes in lake habitat, and improve lake health assessments statewide.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

1. Creation of in-state expertise in identifying and documenting stoneworts
2. Baseline, statewide, lake specific data on the identity, diversity and distribution of stoneworts
3. Mapping and identification of stoneworts in Leech Lake where they provide critical water quality benefits and muskie spawning habitat and may be threatened by changing lake conditions including non-native species
4. Addition of lake-specific stonewort diversity data in lake management planning

Activities and Milestones

Activity 1: Statewide Inventory and Collection of Stoneworts in Minnesota Lakes Including Focused Searches within Leech Lake Reservation

Activity Budget: $597,900

Activity Description:
In 650 waterbodies across Minnesota, surveyors will search for and collect stoneworts. In at least 10 lakes, including Leech Lake, we will conduct additional intensive, lakewide searches. Searches will be made by wading shorelines and with watercraft. An underwater drone will facilitate deep water searches; this will be less expensive, logistically easier, and faster than SCUBA surveys. Each unique stonewort observed in a lake will be collected along with geographic location and selected water quality and habitat data. Field data will be entered electronically and uploaded daily to a central database. Suspected new locations of starry stonewort will be promptly reported. DNR equipment cleaning protocols will be followed to prevent unwanted spread of non-native species. We expect about 2,000 live collections (average of three species per lake, with fewer species in turbid southern lakes and more species in clear northern lakes.) Three live samples of each stonewort collection will be shipped to New York Botanical Garden for morphological and genetic analysis and a fourth sample will be saved in Minnesota and pressed and dried as a voucher record. This study will also include about 100 historical Minnesota stonewort specimens currently stored at the Bell Museum.

Activity Milestones:

Description	Completion Date
Select survey sites, determine lake access points and train surveyors on field methods	2022-06-30
Lakewide surveys of Leech and other selected lakes	2023-09-30
Statewide stonewort searching and collecting in 650 lakes	2023-09-30

Activity 2: Morphological and Genetic Analyses to Identify Minnesota Stoneworts

Activity Budget: $376,200

Activity Description:
All stonewort collections (estimated 2,100) will be shipped to New York Botanical Garden (NYBG) for identification using a combination of expert examination and state-of-the-art genetic analysis and interpretation. A step in the genetic analysis will utilize services provided at the University of Minnesota Genomics Center. At NYBG, each stonewort collection will be cleaned, sorted, and inspected under magnification; tentative identifications will be based on morphology. Three museum quality pressed specimens will be created for each collection. Genomic DNA will be extracted and purified using the Nucleon Phytopure DNA Extraction Kit. Nested polymerase chain reaction (PCR) method will be used to amplify a universal DNA "barcode" for each collection. These barcodes will be sent to the University of Minnesota Genomics Center for sequencing and the resulting electropherograms will be returned to NYBG for assembling and editing. Edited barcodes from each Minnesota collection will be compared to existing data in NYBG's barcode library to confirm or modify initial identifications that were made based on morphology, and to reveal species that are new to science.

Activity Milestones:

Description	Completion Date
Sort, clean, and analyze live specimens and extract DNA	2023-09-30
DNA sequencing	2024-01-31
Interpret DNA sequencing results and match with morphological analyses	2024-04-30

Labels all specimens and update databases	2024-06-30

Activity 3: Educational Outreach and Technology Transfer for Minnesota Lake Managers

Activity Budget: $106,900

Activity Description:
In-state expertise on stonewort identification and ecology will be built through a multi-faceted educational approach that includes student mentorship, hands-on workshops, field identification guide, museum quality reference collections, and data acquisition into lake planning datasets.

Stonewort identification workshops will be held in 2021, 2022 and 2023 for public natural resource organizations. We anticipate 50 participants per workshop with attendance by tribal, federal, state, and county groups. Live specimens will be used to teach participants how to collect, identify and report common, rare and non-native stoneworts. Teaching aids will include botanically accurate line drawings, a key to Minnesota stoneworts, and laminated specimens. A field guide will be available in print and online format.

An estimated 2,100 museum quality specimens with final identifications will be deposited at the Bell Museum with duplicates at NYBG. These specimens and species distribution maps will be an online resource for lake managers and researchers throughout the state and internationally.

Summarized final lake survey data will be added to Minnesota Geospatial Commons for use in lake planning.

Activity Milestones:

Description	Completion Date
Workshop 1 with draft field guide	2021-08-31
Workshop 2 with revised field guide	2022-08-31
Workshop 3 with revised field guide	2023-08-31
Geo-referenced data from study lakes available in MN Geospatial Commons	2024-06-30
Botanical line drawings and final field guide to Minnesota stonewort species completed	2024-06-30
Verified specimens imaged and accessioned into U of MN Bell Museum Herbarium	2024-06-30

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Kenneth G. Karol	New York Botanical Garden	Lead research to collect, analyze, identify, describe and catalog Minnesota stonewort species. Develop, conduct and coordinate laboratory analysis to identify species using morphological and genetic techniques. Organize, interpret and present results. Develop and provide hands-on species identification training to project field teams and workshop participants.	Yes
Dr. Timothy Whitfield, Dr. George Weiblen	University of Minnesota, Bell Museum	Receive final, genetically verified, labeled specimens from NYBG and accession into the University of Minnesota Herbarium. Bell Museum will scan each specimen to create an image for the online virtual herbarium.	Yes
Ms. Katherine Hagsten	Leech Lake Band of Ojibwe Division of Resource Management	Coordinate field surveys conducted on Leech Lake and other lakes within Leech Lake Reservation, supervise Leech Lake Tribal College student interns, and manage electronic and specimen data from those surveys that will be incorporated with the statewide survey data.	Yes
Ms. Melinda Neville	Leech Lake Tribal College	Coordinate Leech Lake Tribal College student internships.	Yes

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this be funded?

The results of this project can stand alone as the initial statewide inventory and assessment of stoneworts and will serve as baseline data for individual lake assessment and for long-term statewide monitoring. Following training, we expect surveyors to include stonewort collecting in their routine lake plant sampling and DNR is committed to providing ongoing technical assistance to surveyors. Museum quality specimens will be publicly available for review and study through existing online virtual herbaria of Bell Museum and NYBG. Geo-referenced species location data will be added to DNR's existing databases for lake management planning.

Project Manager and Organization Qualifications

Project Manager Name: Donna Perleberg

Job Title: Research Scientist II / Aquatic Plant Ecologist

Provide description of the project manager's qualifications to manage the proposed project.

Donna Perleberg is the DNR's Aquatic Plant Ecologist. She has over thirty years of research experience in lake and wetland plant ecology and holds a M.S. in Biology from the University of Wisconsin and a B.S. in Biology from the University of Pittsburgh. She is responsible for leading lake plant monitoring projects throughout Minnesota and provides technical assistance to other natural resource managers involved in aquatic plant identification and surveys. She has developed and led floristic surveys on hundreds of Minnesota lakes including the four year lakewide plant inventory of Leech Lake in collaboration with Leech Lake Band of Ojibwe. Her research includes evaluating statewide patterns of change in lake plant communities, assessing change in lakes after the introduction of non-native species and other human caused disturbances, and identifying lake areas that provide critical habitat to fish and wildlife. She has coauthored papers and technical reports on the distribution and ecology of lake plant communities in Minnesota and has developed manuals on lake plant survey methods. Donna continues to be amazed at the beauty and diversity of species within Minnesota lakes and strives to share that knowledge and wonderment with others.

Organization: MN DNR - Ecological and Water Resources Division

Organization Description:
The Minnesota Department of Natural Resources' (DNR) mission is to work with Minnesotans to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life. The specific vision of the Division of Ecological and Water Resources is healthy lands and waters throughout Minnesota. To help achieve this, the Lake Ecology Unit systematically collects, interprets and delivers baseline and long-term data on lake plant communities and critical lake and shoreland habitat. We provide training and technical assistance to other DNR Programs and natural resource agencies involved in aquatic habitat inventory and management. Data we collect and organize are used annually to develop DNR's Lakes of High Biological Significance and to guide decisions in MPCA's Watershed Assessment and other lake management planning.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Natural Resource Specialist Intermediate		help design sampling, lead field survey team, process samples, data analysis, assist with development of educational guides			20%	2		$200,000
Natural Resource Specialist		lead survey team			20%	1		$90,000
Student Intern		assist with field surveys			20%	0.5		$20,000
Student Intern		assist with field surveys			20%	0.5		$20,000
Student Intern		assist with field surveys			20%	0.5		$20,000
							Sub Total	**$350,000**
Contracts and Services								
New York Botanical Garden (NYBG)	Professional or Technical Service Contract	NYBG will conduct genetic analysis, identify, and create museum specimens for 2,100 stonewort collections, create field guide, train surveyors, develop and instruct workshops. Personnel: $270,000 (Researcher and Lab Technician, 42% fringe), supplies: $40,000, 3 workshops: $30,000 (includes annual travel to MN for 2-3 instructors). Justification below.		X		3.51		$342,200
Leech Lake Band of Ojibwe Division of Resource Management (LLDRM)	Professional or Technical Service Contract	LLDRM will lead surveys on lakes within Leech Lake Reservation. Personnel: $65,500 (Plant Biologist and Field Technician, 30% fringe), travel: $9,500 (mileage and gas), shipping: $1,000, field supplies: $4,500, equipment: $19,500 (microscope, water quality meter, underwater drone; justification below for ipad and boat motor.)		X		2.3		$100,000
University of Minnesota Bell Museum	Professional or Technical	Funding will expedite the acquisition of specimens into Bell herbarium and online website. Personnel: $16,320 (curator, 36% fringe and student intern, no				0.6		$29,900

	Service Contract	fringe), supplies and archival cabinet: $9,080, and equipment: $4,500 (light box and camera for imaging station).						
University of Minnesota Genomics Lab	Professional or Technical Service Contract	University of Minnesota Genomics Laboratory will conduct DNA sequencing (10,000x reactions for Classic Sanger sequencing reactions, including PCR clean-up and quantification for 5,000 template DNA samples) and return data to NYBG for editing and interpretation.				0		$68,000
Leech Lake Tribal College (LLTC)	Professional or Technical Service Contract	Leech Lake Tribal College will direct and mentor two interns to assist Leech Lake Band DRM and DNR with field surveys. Personnel: $26,400 (Science Director 35% fringe; 2 interns 8% fringe). Travel: $3,000 (lodging/meals for students).				0.5		$29,400
Scientific Illustrator (TBD)	Professional or Technical Service Contract	Professional, botanically accurate, detailed black and white line drawings will be created for an estimated 30 species of Minnesota stoneworts. Completed line drawings will be used to create field identification fact sheets and made available online. Contract will be through competitive bid to botanical illustrator with demonstrated qualifications and skills.				0		$15,000
							Sub Total	**$584,500**
Equipment, Tools, and Supplies								
	Tools and Supplies	field and lab supplies for 3 DNR teams (2 years) to collect stoneworts (boots, pfds, kayaks, gps, bags, trays, coolers, plant press, archival pressing supplies, laminator)	supplies to collect and preserve stoneworts in lakes					$15,533
	Equipment	3 water chemistry meters (one per DNR field team)	Each field team will collect water quality data at each collection site.					$6,900
	Equipment	2 iPads with waterproof cases and accessories	All field data will be entered electronically in the field to expedite data entry	X				$1,600
	Equipment	3 underwater drones (one per DNR field team)	Underwater drones will be used to rapidly search deeper water of clear lakes. This is cheaper, faster, more efficient, and requires less training than SCUBA surveys.					$7,800

							Sub Total	**$31,833**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	In-state travel to conduct surveys. 2 Vehicles for 8 months, lodging and meals for estimated 340 travel days for up to 6 field staff in accordance with the Commissioner's Plan.	Surveys will be conducted throughout the state and about 50% of field work will require overnight stays.					$68,500
							Sub Total	**$68,500**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Printing	300 printed and bound copies of field identification guide to Minnesota stoneworts	Printed copies of field guide will be provided to training workshop participants, DNR Area offices and other Minnesota natural resource organizations.					$2,000
							Sub Total	**$2,000**
Other Expenses								
		Shipping	Express shipping of live specimens through State of MN Contract @ $30 per shipment. See justification for shipping below.	X				$12,000
		DNR Direct and Necessary Costs	Direct and necessary costs to cover HR support (~$7,475), Safety Support					$32,167

			(~$1,388), Financial Support (~$5,764), Communication Support (~$1,324), IT Support (~$15,068), and Planning Support (~$1,149).					
							Sub Total	**$44,167**
							Grand Total	**$1,081,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Contracts and Services - New York Botanical Garden (NYBG)	Professional or Technical Service Contract	NYBG will conduct genetic analysis, identify, and create museum specimens for 2,100 stonewort collections, create field guide, train surveyors, develop and instruct workshops. Personnel: $270,000 (Researcher and Lab Technician, 42% fringe), supplies: $40,000, 3 workshops: $30,000 (includes annual travel to MN for 2-3 instructors). Justification below.	Dr. Kenneth G. Karol is the national expert on identification of stoneworts. He has over 30 years of specific research on this group and is uniquely qualified to conduct lab research, instruct workshops and develop field guide. His specific knowledge, existing specimen database and DNA barcode library at NYBG are required to conduct this research. This work requires express shipping of samples to U of MN Genomics Lab (~$2,500). Workshop require Dr. Karol and 1-2 associates to assist with workshop instruction; costs include annual travel to MN, travel costs within state, collecting supplies, and workshop materials; participant registration fee will cover workshop facility and workshop meals. **This is a single source contract.**
Contracts and Services - Leech Lake Band of Ojibwe Division of Resource Management (LLDRM)	Professional or Technical Service Contract	LLDRM will lead surveys on lakes within Leech Lake Reservation. Personnel: $65,500 (Plant Biologist and Field Technician, 30% fringe), travel: $9,500 (mileage and gas), shipping: $1,000, field supplies: $4,500, equipment: $19,500 (microscope, water quality meter, underwater drone; justification below for ipad and boat motor.)	Leech Lake DRM will provide a boat dedicated to this project for 2 years but require funding ($9,000) for replacement motor to reliably and safely conduct surveys. A field iPad with waterproof cover ($800) is required to electronically enter data in the field database. When unique stoneworts are discovered, express shipping to NYBG is required. **This is a single source contract.**
Equipment, Tools, and Supplies		2 iPads with waterproof cases and accessories	Electronic data entry reduces costs by greatly reducing the need for post survey manual data entry. It also reduces paper use, minimizes data transcription errors and expedites data acquisition. Data are downloaded and backed up daily. DNR has successfully used iPads for this type of field survey for several years.
Other Expenses		Shipping	This study requires express shipment of live plant samples to NYBG for morphological and genetic analyses. DNR has an existing shipping contract with UPS that discounts express shipping by 70%.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
In-Kind	Game and Fish (M.S. Ch. 97A.055)	DNR will provide two boats, 1 field iPad, GPS for use on this project and will utilize existing office and laboratory space, microscopes and office computers.	Secured	$25,000
Cash	Game and Fish Fund (M.S. Ch. 97A.055)	Research Scientist (80% time for 3 years): project manager, field survey design, survey team lead and statewide coordination of field work.	Secured	$288,000
In-Kind	University of Minnesota Bell Museum	University indirect costs not covered by grant.	Pending	$16,150
			State Sub Total	**$329,150**
Non-State				
In-Kind	Leech Lake Band of Ojibwe Division of Resource Management	Leech Lake Band will provide boat, gps, office space and office computers in-kind.	Pending	$10,000
In-Kind	Leech Lake Tribal College	25% cost share for 2 student internships at Leech Lake Tribal College and 50% cost share for Science Director (1 month per year for 2 years)	Pending	$13,250
In-Kind	New York Botanical Garden	Laboratory space and equipment use are provided in-kind. NYBG will fund about 50% of Dr. Karol's time on this project for three years.	Pending	$100,000
			Non State Sub Total	**$123,250**
			Funds Total	**$452,400**

Attachments

Required Attachments

Visual Component

File: 390faea0-4cd.pdf

Alternate Text for Visual Component

This visual emphasizes the importance of stoneworts in Minnesota lakes (image of boaters on clear lake, moose eating stoneworts, fish spawning in stoneworts). Photos summarizing how we can improve knowledge about these plants (surveyor searching for stoneworts, collecting, identifying with microscope, participants at workshop). A map shows 650 stonewort study lakes distributed across entire state with a focus on Leech Lake in north central Minnesota.

Optional Attachments

Support Letter or Other

Title	File
Leech Lake Association letter of support	4245e2b4-da2.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have patent, royalties, or revenue potential?

No

Does your project include research?

Yes

Does the organization have a fiscal agent for this project?

No

Protecting Minnesota's Beneficial Macroalgae: All Stoneworts Aren't Starry

PROBLEM

Stonewort research focuses on the invasive Starry Stonewort and we've ignored native stoneworts because we lack technical expertise to identify species.

To protect these stoneworts and the ecological services they provide, we need baseline data on their identity and statewide distribution.

SOLUTION

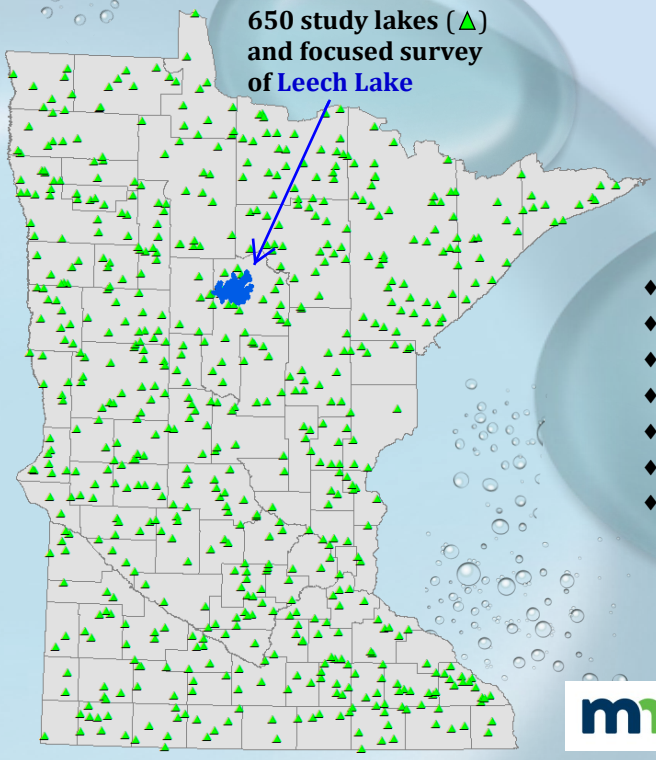
Build expertise in Minnesota so that stonewort data are included in management decisions.

Surveying

Collecting

Identifying

Training



OUTCOMES

- Baseline stonewort data for 650 lakes
- Report new starry stonewort lakes
- Newly trained surveyors (~150) with stonewort expertise
- New data on Leech Lake musky habitat
- New online museum reference collections (~2,100)
- New guide to Minnesota's stoneworts
- Discover species new to MN and science!

PARTNERS

Leech Lake Band of Ojibwe
Leech Lake Tribal College
New York Botanical Garden
U of MN Bell Museum
U of MN Genomics Center

DEPARTMENT OF NATURAL RESOURCES