

**Environment and Natural Resources Trust Fund**

# 2022 Request for Proposal

## **General Information**

**Proposal ID:** 2022-256

**Proposal Title:** Invasive Rock Snot Threatens North Shore Streams

## **Project Manager Information**

**Name:** Mark Edlund

**Organization:** Science Museum of Minnesota - St. Croix Watershed Research Station

**Office Telephone:** (612) 965-6946

**Email:** medlund@smm.org

## **Project Basic Information**

**Project Summary:** We examine the recent spread, origin, cause, and economic and ecological threat of nuisance rock snot formation in North Shore streams and Lake Superior to inform management and outreach.

**Funds Requested:** $197,000

**Proposed Project Completion:** June 30 2024

**LCCMR Funding Category:** Small Projects (H) **Secondary Category:** Aquatic and Terrestrial Invasive Species (D)

## **Project Location**

**What is the best scale for describing where your work will take place?** Region(s): NE

**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.**

A North Shore stream was invaded by rock snot and the time to stop it is now! In 2018, the first nuisance growth of rock snot (Didymospenia geminata or “didymo”) developed in the North Shore’s Poplar River and we don’t know why. Didymo is a freshwater diatom or algae that can form nuisance goo in coldwater streams worldwide, in its native range and where it is invasive. Formation of didymo mats has aesthetic, economic, and recreational impacts. Economic impacts to tourism have exceeded $20M annually following invasions elsewhere, a serious threat to the North Shore $250M summer economy. Didymo disrupts normal community structure and ecosystem function in streams, alter habitat and food webs, impact fish and invertebrate abundance and diversity, and result in major shifts in natural bacterial composition.  
  
Two hypotheses may explain rock snot: 1) The aggressive colonization hypothesis maintains an aggressive strain of didymo is being introduced and invading coldwater streams. 2) The changing environmental conditions hypothesis states environmental conditions (e.g., nitrogen to phosphorus ratios or timing of nutrient delivery) have become favorable to the formation of didymo mats. Understanding which of these models is supported by data is vital to management response.

**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.**

With LCCMR support we will understand:  
1) Distribution, dynamics, and effect of didymo in North Shore streams   
2) Why rock snot formed in the Poplar River and what other streams are at risk?  
3) The source of didymo in North Shore streams–which strain is it? A new invasive? A native gone bad?   
4) Share information and solutions with resource managers, citizen groups, and users to stop the rock snot invasion   
  
While didymo has been documented in the near shore algal community of Lake Superior with increasing frequency since the 1960s, the Poplar River, near Lutsen, is the first stream ever colonized. Didymo is unique because it only blooms in low nutrient waters and recently, mats have been observed more frequently in streams similar to those on the North Shore around the world, including New Zealand, South America, Canada, and the US. Research shows thicker didymo mats have formed along the Superior shoreline annually for over a decade; however, it was only in 2018 that didymo was first observed colonizing North Shore streams as single cells or mat form. It is unclear why the mat formed in the Poplar River and whether didymo is already invading other North Shore streams.

**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?**

We can solve rock snot! If populations in North Shore streams and Lake Superior are not each others closest relatives, efforts for prevention of didymo mat formation will be focused on preventing movement of alien didymo among streams, paralleling practices that prevent the spread of microbes in freshwater systems. Alternatively, if the stream didymo originated from Lake Superior populations, management practices will focus on understanding the specifics that promote mat formation. Regardless, we will fully understand the source and cause of mat formation and broadly communicate the threat, implications, and management response to didymo invasion of North Shore streams.

## **Activities and Milestones**

### **Activity 1: Understand didymo mat formation and distribution in North Shore streams and Lake Superior**

**Activity Budget:** $131,700

**Activity Description:**We will monitor the Poplar River and Lake Superior shoreline near the mouth of the Poplar to determine if a didymo mat reforms in the next two years and monitor the timing and environmental conditions associated with mat formation in the stream and lake. We will similarly sample 3-4 other stream-lakeshore pairs along the North Shore to document changes in the algal community and associated environmental conditions. Sampling will be monthly from July-November 2022 and April-November 2023 and will include sampling of the algal community and chemical (e.g., nutrients, dissolved organic carbon) and physical characteristics of the stream. Temperature, water depth, and flow will be measured continuously throughout the project. During peak didymo growth (late Aug-Sept) a survey will target 20 major North Shore stream-lakeshore pairs to fully assess current didymo presence and susceptibility of North Shore resources. All sampling will adhere to MNDNR protocols for preventing spread of aquatic invasive species.

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Survey all major North Shore streams for presence of didymo and invasion susceptibility during peak | December 31 2023 |
| Describe algae and environmental conditions in 4-5 paired Lake Superior shoreline and North Shore tributaries | March 31 2024 |
| Communicate findings and solutions to resource managers and citizens through presentations, signage, social media, publications | June 30 2024 |

### **Activity 2: Genetic variability in Minnesota didymo populations and the associated bacterial community**

**Activity Budget:** $65,300

**Activity Description:**We will collect genetic information on North Shore tributary and Lake Superior coastal didymo populations to determine if the populations in the Poplar River and other North Shore streams are most closely related to didymo populations in Lake Superior or to other didymo populations in North America. We will use whole-genome sequencing of pools of individuals to genotype multiple didymo populations from the Poplar River and Lake Superior, didymo populations encountered in any North Shore streams, and populations from the US and Canada. We will characterize the bacterial communities using 16S rRNA gene sequencing from total DNA extracted from the periphyton mat samples to predict broader ecological consequences of didymo and learn how nuisance blooms are triggered in ultra-clean waters.

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Determine genetic structure of the microbial mat community among lake and stream pairs | March 31 2024 |
| Sequence genetics of North Shore didymo populations to determine source of rock snot | March 31 2024 |
| Communicate results to inform management through meetings, signage, and presentations to resource managers and stakeholders | June 30 2024 |

## **Project Partners and Collaborators**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Organization** | **Role** | **Receiving Funds** |
| Heidi Rantala | Minnesota Department of Natural Resources | Dr. Rantala will coordinate and participate in fieldwork, deployment of samplers, data analysis, outreach and communication, and project reporting. | No |
| Robert Pillsbury | University of Wisconsin-Oshkosh | Dr. Pillsbury has worked on Lake Superior didymo and will provide specialized molecular analysis of algae mats. | Yes |
| Teofil Nakov | University of Arkansas | Dr. Nakov is an expert on didymo genetics and will provide specialize molecular analysis to identify source populations of didymo in North Shore streams. | 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?**We will share the findings of this study with resource managers (MNDNR, including state parks; MPCA; watershed groups) and stakeholders throughout the study period through meetings and personal communication. Edlund and Rantala are periodically invited to give presentations within their organizations and to outside groups, and they will present this work upon invitation. We will communicate the findings of this study with the public through signage, fact-sheets, and social media (Twitter and Facebook) accounts associated with their agencies. We plan on publishing the results of this work as two peer-reviewed publications in relevant scientific journals.

## **Other ENRTF Appropriations Awarded in the Last Six Years**

|  |  |  |
| --- | --- | --- |
| **Name** | **Appropriation** | **Amount Awarded** |
| Tracking and Preventing Harmful Algal Blooms | M.L. 2016, Chp. 186, Sec. 2, Subd. 04a | $500,000 |
| Determining Risk of a Toxic Alga in Minnesota Lakes | M.L. 2018, Chp. 214, Art. 4, Sec. 2, Subd. 06f | $200,000 |

## **Project Manager and Organization Qualifications**

**Project Manager Name:** Mark Edlund

**Job Title:** Senior Scientist

**Provide description of the project manager’s qualifications to manage the proposed project.**Dr. Mark Edlund has been a Senior Scientist at the St. Croix Watershed Research Station of the Science Museum of Minnesota since 2007. He has also held the position of adjunct Professor of Water Resources Science/Earth Sciences at the University of Minnesota since 2004. Dr. Edlund has a 20-year record of federal, state, and local project management in his areas of expertise: aquatic biology, limnology, paleolimnology, and phycology; environmental drivers of ecological change; lake sediment records to understand short- and long-term environmental change; and has authored or co-authored more than 100 publications on the subjects. Dr. Edlund's current research focuses on biomonitoring of lakes in Great Lakes Region National Parks; water quality in Lake of the Woods; and understanding and predicting harmful algal blooms (HABS).

**Organization:** Science Museum of Minnesota - St. Croix Watershed Research Station

**Organization Description:**The Science Museum of Minnesota (SMM) is a private, non-profit 501(c)3 institution dedicated to encouraging public understanding of science through research and education. The St. Croix Watershed Research Station is the environmental research center of the SMM with the mission “we do the science that helps make our rivers and lakes clean” through research and outreach. The SCWRS supports an active year-round program in environmental research and graduate-student training, guided by a dedicated in-house research staff with direct ties to area universities and colleges. It collaborates closely with federal, state, tribal, and local agencies with responsibility for managing the St. Croix and upper Mississippi rivers and is a full partner with the National Park Service for resource management in parks of the western Great Lakes region. Its research has played a central role in setting management policy for the St. Croix and Mississippi rivers, for establishing water-quality standards for Minnesota lakes and for developing long-term monitoring plans for the National Park Service.

## **Budget Summary**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Category / Name** | **Subcategory or Type** | **Description** | **Purpose** | **Gen. Ineli gible** | **% Bene fits** | **# FTE** | **Class ified Staff?** | **$ Amount** |
| **Personnel** |  |  |  |  |  |  |  |  |
| Dr. Mark Edlund, Project Director and Senior Scientist at Science Museum of Minnesota |  | Project direction, periphyton analysis, diatom identification |  |  | 43.7% | 0.5 |  | $57,000 |
| 2 Interns, Science Museum of Minnesota |  | Field work, lab tech |  |  | 12% | 0.4 |  | $13,642 |
| Communication Specialist, Science Museum of Minnesota |  | Communication, outreach, social media |  |  | 43.7% | 0.04 |  | $2,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$72,642** |
| **Contracts and Services** |  |  |  |  |  |  |  |  |
| TBD | Professional or Technical Service Contract | Bacterial Genetic Analysis: 200 samples @ $130.80/sample (Total $26,160; University of Wisconsin-Oshkosh or competitive bid) |  |  |  | - |  | $26,160 |
| TBD | Professional or Technical Service Contract | Didymo Genetic Analyses: 200 samples @ $149.10/sample (Total $29,820; University of Arkansas or competitive bid) |  |  |  | - |  | $29,820 |
|  |  |  |  |  |  |  | **Sub Total** | **$55,980** |
| **Equipment, Tools, and Supplies** |  |  |  |  |  |  |  |  |
|  | Equipment | Stream Gauging Equipment: five 13-foot water levels @ $495 each; software $75; communication cable $249 | Equipment for stream gauging |  |  |  |  | $2,799 |
|  | Tools and Supplies | Consumable Supplies: $4,000 field supplies; $1,320 microbial DNA extraction kits | Consumable supplies for field work and microbial DNA extraction |  |  |  |  | $5,320 |
|  |  |  |  |  |  |  | **Sub Total** | **$8,119** |
| **Capital Expenditures** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Acquisitions and Stewardship** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Travel In Minnesota** |  |  |  |  |  |  |  |  |
|  | Miles/ Meals/ Lodging | Travel for Field Work: Round-trip drive from St. Croix Watershed Research Station to Grand Marais, MN for 2 employees: 18 days each FY20 and FY21 ($16,000 over two yrs) | Travel for Field Work |  |  |  |  | $16,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$16,000** |
| **Travel Outside Minnesota** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Printing and Publication** |  |  |  |  |  |  |  |  |
|  | Publication | Cost of open access publication in e.g. PLOS ONE peer-reviewed open access scientific journal ($699) | Publication of article on this project's research |  |  |  |  | $699 |
|  |  |  |  |  |  |  | **Sub Total** | **$699** |
| **Other Expenses** |  |  |  |  |  |  |  |  |
|  |  | Water Chemistry Analyses | Water chemistry analyses, St. Croix Watershed Research Station, $198/sample (10 analytes) |  |  |  |  | $43,560 |
|  |  |  |  |  |  |  | **Sub Total** | **$43,560** |
|  |  |  |  |  |  |  | **Grand Total** | **$197,000** |

### **Classified Staff or Generally Ineligible Expenses**

|  |  |  |  |
| --- | --- | --- | --- |
| **Category/Name** | **Subcategory or Type** | **Description** | **Justification Ineligible Expense or Classified Staff Request** |

### **Non ENRTF Funds**

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| --- | --- | --- | --- | --- |
| **Category** | **Specific Source** | **Use** | **Status** | **Amount** |
| **State** |  |  |  |  |
| In-Kind | MN Department of Natural Resources | Contribution of portion of Rantala Salary: FY23 10% of time (208 hr), salary $36.32/hr, fringe $8.99/hr; FY24 10% of time (208 hr), salary $37.63/hr, fringe $9.39/hr (Total $19,205 over 2 years) | Secured | $19,205 |
|  |  |  | **State Sub Total** | **$19,205** |
| **Non-State** |  |  |  |  |
| In-Kind | UW-Oshkosh | Genetic Laboratory Fees are provided in-kind by Pillsbury at UW-Oshkosh ($1,744 total over 2 years) | Secured | $1,744 |
| In-Kind | Science Museum of Minnesota | Indirect Costs for the project are provided in-kind by the Science Museum of Minnesota (federally negotiated indirect rate 40.09% on all direct costs = $78,977) | Secured | $78,977 |
|  |  |  | **Non State Sub Total** | **$80,721** |
|  |  |  | **Funds Total** | **$99,926** |

## **Attachments**

### **Required Attachments**

#### ***Visual Component***

File: [6318615d-5d2.pdf](https://lccmrprojectmgmt.leg.mn/media/map/6318615d-5d2.pdf)

#### ***Alternate Text for Visual Component***

We examine the recent spread, origin, cause, and economic and ecological threat of nuisance rock snot formation in North Shore streams and Lake Superior to inform management and outreach....

### **Optional Attachments**

#### ***Support Letter or Other***

|  |  |
| --- | --- |
| **Title** | **File** |
| Letters of Support\_Rocksnot | [08a7a5e7-598.pdf](https://lccmrprojectmgmt.leg.mn/media/attachments/08a7a5e7-598.pdf) |

## **Administrative Use**

**Does your project include restoration or acquisition of land rights?**   
 No

**Does your project have potential for royalties, copyrights, patents, or sale of products and assets?**   
 No

**Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?**   
 N/A

**Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?**   
 N/A

**Does your project include original, hypothesis-driven research?**   
 Yes

**Does the organization have a fiscal agent for this project?**   
 Yes