



Environment and Natural Resources Trust Fund

2024 Request for Proposal

General Information

Proposal ID: 2024-036

Proposal Title: Reconstructing Historical Wild Rice to Understand Its Future

Project Manager Information

Name: Lienne Sethna

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

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Project Basic Information

Project Summary: We will characterize environmental drivers contributing to the decline of wild rice using lake sediment cores to reconstruct historical wild rice abundance in relation to lake and watershed stressors.

Funds Requested: \$200,000

Proposed Project Completion: June 30, 2026

LCCMR Funding Category: Small Projects (H)

Secondary Category: Foundational Natural Resource Data and Information (A)

Project Location

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

Region(s): NW

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.

Native wild rice (*Zizania palustris*), known as manoomin in Ojibwe and Psíj in Dakota, is a culturally significant crop for the peoples across the upper Great Lakes Region and is central to food sovereignty for Indigenous communities. The health and abundance of wild rice is in decline across Minnesota lakes due to a number of environmental stressors such as increasing sulfate concentrations, lake eutrophication, and increasing sedimentation rates. While previous research has examined some of these stressors, particularly the impacts of sulfate, significant knowledge gaps remain in understanding the coinciding and cumulative effects of environmental change on wild rice populations. The research we propose seeks to fill these knowledge gaps by pairing existing monitoring data on wild rice populations with measurements of current and historical water quality and wild rice abundance. We will sample surface waters and collect sediment cores from lakes with extirpated, stressed, and abundant wild rice stands representing a gradient of population health and abundance. Using paleolimnological techniques, we will reconstruct sedimentation rates, nutrient concentrations, organic matter quantity and composition, and wild rice abundance through time to determine the mechanisms influencing modern and historical wild rice population health.

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

With any management plan, it is important to have a basic understanding of natural fluctuations within the system. Long-term data sets (>30 years) are generally not available for most aquatic systems, making it difficult to relate historic disturbances to current ecological change. However, through the use of paleolimnological techniques, quantitative environmental reconstructions, and incorporation of traditional, indigenous knowledge, we can estimate past conditions and natural environmental variability, identify timing of ecological changes, and determine rates of change and recovery in lakes and wetlands. The primary aim of this project is to use paleolimnological analysis of radioisotopically dated sediment cores from lakes used to harvest wild rice to reconstruct the abundance and extent of wild rice in relation to nutrient concentrations and organic matter accumulation. Analyses will focus on two primary objectives: (1) reconstructing the ecological history of the lake using geochemical analyses, fossil algal pigments, and organic matter composition; and (2) characterizing the historical abundance of wild rice using sedimentary DNA and enumeration of wild rice macrofossils. Additionally, we will leverage data collected as part of the MN DNR's Wild Rice Monitoring Project to expand our understanding of the environmental drivers affecting wild rice abundance and population health.

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?

Our research aims to:

- Leverage existing datasets on the abundance and distribution of wild rice to identify lakes across a gradient of wild rice health and abundance
- Characterize the relationship between wild rice abundance and environmental variables such as nutrients, sulfate, and sedimentation
- Improve methodology for identifying wild rice DNA in sediments using primers, which will help in the identification and characterization of historic wild rice populations in future studies
- Help stakeholders identify and characterize historical and modern wild rice abundance
- Identify management strategies that align with tribal values to protect and restore the health of wild rice stands

Activities and Milestones

Activity 1: Identify study lakes valuable to cultural and tribal traditions that represent a gradient of wild rice abundance and health

Activity Budget: \$20,000

Activity Description:

We will consult with Red Lake partners, wild rice harvesters, and the MN DNR wild rice monitoring database and sampling plan to identify study lakes that are (a) culturally and economically relevant to stakeholder’s rice harvest, and (b) represent a gradient of wild rice abundance and health. In this way, our study will address specific environmental concerns related to each study lake and provide a broad assessment of environmental drivers of wild rice decline that can be applied to lakes around Minnesota. Identifying study lakes that are also part of the MN DNR’s monitoring network will allow us to leverage existing data on contemporary lake water quality and wild rice health and abundance. We will work closely with project partners to discuss potential study lakes, gather historic information about each site, and document any knowledge of land use change and wild rice history. Local knowledge on the history of lake water quality, wild rice abundance and harvests, and watershed-scale changes to the landscape will be imperative to understanding any ecological shifts in each study lake. We can then pair these data with the sediment core chemistries we analyze as part of Activity 2.

Activity Milestones:

Description	Approximate Completion Date
Create a list of potential sample lakes used to harvest wild rice with stakeholder input	July 31, 2024
Identify overlap with MN DNR’s Wild Rice Monitoring database or sampling plan	August 31, 2024
Finalize site list and gather historic information from Red Lake DNR and other stakeholders	December 31, 2024
Work with project partners to collect monthly water samples during wild rice growing season	September 30, 2025

Activity 2: Collect and analyze sediment cores to reconstruct relationships between wild rice abundance, nutrients, and organic matter

Activity Budget: \$150,000

Activity Description:

We will collect sediment cores from each of the sample lakes to understand historical changes in environmental conditions and wild rice abundance. Analyses will focus on two primary objectives:

1. Reconstructing the ecological history of each lake using geochemistry, sediment accumulation, and algal pigments as biological indicators.
2. Characterizing the historical abundance of wild rice in each lake using sedimentary DNA (sedDNA) techniques as well as the enumeration of wild rice macrofossils.

The core will be divided into evenly spaced increments and dated at the Science Museum of Minnesota’s St. Croix Watershed Research Station (SCWRS). Each increment will then be analyzed for geochemical composition (organic and inorganic matter, nutrient concentrations), pore water dissolved organic matter composition, and wild rice abundance. Organic and inorganic matter concentrations in cores help characterize the sediment composition and the availability of nutrients such as phosphorus and silicon. Analysis of fossil algal pigments will help us understand potential changes in trophic status (e.g., becoming eutrophic). Dissolved organic matter composition will be assessed from the optical properties of sediment porewaters and indicate processes affecting organic matter accumulation and lake browning. Finally, we will use qPCR techniques to reconstruct the historic abundance of wild rice.

Activity Milestones:

Description	Approximate Completion Date
Collect four sediment cores per lake to ensure we capture extent of wild rice	February 28, 2025
Radiometrically date sediment core sections and analyze ecological and geochemical properties	April 30, 2025
Analyze sediment pore waters from each core section to determine organic matter composition	May 31, 2025
Extract sediment eDNA from core and conduct qPCR analyses to quantify historic wild rice	December 31, 2025

Activity 3: Characterize relationships between wild rice abundance, nutrient availability, and organic matter composition to identify effective management strategies

Activity Budget: \$30,000

Activity Description:

Using data from our sediment core analysis and contemporary monitoring data, we will model the relationships between environmental variables and wild rice abundance through time. We expect to observe strong relationships between increasing organic matter concentrations and declines in the abundance of wild rice. Increasing organic matter concentrations will likely be related to increasing nutrient concentrations and sedimentation rates; however, changes in the relative proportions of terrestrially- and phytoplankton-derived organic matter might differ across a gradient of wild rice abundance, indicating processes such as land use change or eutrophication are driving declines in abundance. Increases in terrestrially-derived organic matter may correspond with warming and specific changes in land use or management, such as agriculture, logging, or development while increases in phytoplankton-derived organic matter may relate to changes in lake biogeochemistry, such as increased nutrient availability or temperature. Identifying the mechanisms affecting the abundance and health of wild rice stands will help us develop strategies for effective and sustainable management that targets lake-specific impairments.

Activity Milestones:

Description	Approximate Completion Date
Model relationships between environmental variables (organic matter, nutrients, trophic state) and wild rice abundance	April 30, 2026
Organize workshops to present data, receive community input, and develop management goals	May 31, 2026
Synthesize data into reports, presentations, and publications for broader dissemination	June 30, 2026

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Shane Bowe	Red Lake Department of Natural Resources	Compiling historical information about wild rice abundance and health in Red Lake Nation lakes. Assisting in Red Lake community forums and disseminating project results.	Yes
Joshua Jones	Red Lake Department of Natural Resources	Identifying Red Lake study areas of interest. Assisting in the field collection of surface water samples and surveying Red Lake community interests. Using results to help inform management and reseeding strategies for community stakeholders.	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 work be funded?

We will work closely with Red Lake DNR to implement our research methods and use our results to inform community questions. We will engage with stakeholders by presenting results and offering programming in collaboration with Red Lake DNR. We will also prepare reports detailing our results and work to identify management strategies that could protect and restore wild rice beds into the future. Finally, we will collaborate with the MN DNR and stakeholder groups to expand the wild rice monitoring network and, with the permission of Red Lake, will share pertinent information about wild rice abundance and population health.

Project Manager and Organization Qualifications

Project Manager Name: Lienne Sethna

Job Title: Postdoctoral Fellow

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

Dr. Lienne Sethna has worked as a research scientist for the past year at the Science Museum of Minnesota’s St. Croix Watershed Research Station (SCWRS) and has 6 years of prior experience in water quality monitoring. She has a Ph.D. in Environmental Science and a B.S. in Earth Sciences. During her doctoral studies, she led several field projects to monitor ecosystem health and function in streams and lakes. She is currently working as a postdoctoral fellow at SCWRS under the supervision of Dr. Adam Heathcote, who has previously led and successfully completed ENRTF projects focusing on water quality and ecosystem function in Minnesota lakes. Dr. Sethna is an aquatic biogeochemist and ecologist with a specific focus on nutrient management, organic matter processing, and community-driven science. She is committed to the broad dissemination of scientific results via open-access peer-reviewed publication, public forums, traditional and social media, and direct stakeholder engagement.

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 (SCWRS) 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, 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. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Postdoctoral Fellow		Project manager, requesting 0.2 FTE/year to lead overall project design, assist in fieldwork, serve as scientific advisor for outreach efforts, and assist in synthesis of results and data management.			26%	0.4		\$22,000
Director, SCWRS		Requesting 0.02 FTE/year to assist in project design and advise in sampling and analysis logistics		X	26%	0.04		\$4,000
Senior Scientist, SCWRS		Requesting 0.02 FTE/year to assist in sediment core sampling and analysis.			26%	0.04		\$4,000
Environmental research technician		Responsible for surface water quality monitoring and assisting with sediment core collection			26%	0.66		\$28,000
							Sub Total	\$58,000
Contracts and Services								
SCWRS	Internal services or fees (uncommon)	Radioisotope dating of sediment cores from five study lakes (\$3000/core for 5 cores)				0		\$15,000
SCWRS	Internal services or fees (uncommon)	Loss-on-ignition analysis on 20 cores collected from five study lakes (4 cores per lake, \$800/core)				0		\$16,000
SCWRS	Internal services or fees (uncommon)	Sediment total phosphorus and phosphorus fraction analysis on 5 cores, one from each study lake. (\$2,000/core)				0		\$10,000
University of Regina or competitive bid	Professional or Technical Service Contract	Fossil pigment analysis to reconstruct historical algal community composition (\$135/sample, 15 samples per core for 5 cores)				0		\$11,000
SCWRS	Internal services or fees (uncommon)	Analyzing the optical characteristics of sediment pore waters to reconstruct historical organic matter composition (\$150/sample, 20 samples/core for 5 cores)				0		\$15,000

Jonah Ventures or competitive bid	Professional or Technical Service Contract	qPCR analysis of wild rice sedDNA (\$55/sample, 20 samples per core, 5 cores)				0		\$6,000
RMB Laboratories	Professional or Technical Service Contract	Analysis of surface water samples including nitrogen, phosphorus, carbon, and chlorophyll. (\$350/sample, 2 samples monthly for 5 sample lakes during a 4-month growing season)				0		\$14,000
Red Lake DNR	Professional or Technical Service Contract	Supporting the time of Red Lake DNR staff who are co-PIs on the project and will be assisting in efforts to compile historical data, identify study sites, survey community interests, and disseminate results. This amount includes a 26% fringe benefit on salary				0.32		\$30,000
							Sub Total	\$117,000
Equipment, Tools, and Supplies								
	Tools and Supplies	Supplies for collecting water quality samples on 5 lakes during the summer growing season	Field supplies, including bottles for water samples, GF/C and 0.4 µm filters, Millipore hand pump ad filtration kit, etc					\$3,000
	Tools and Supplies	Supplies for core sampling of 5 lakes (4 cores per lake)	Sediment core collection - 20 cores total, including sediment core tubes, sectioning cups, and sample vials.					\$6,000
							Sub Total	\$9,000
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel to 5 lakes for coring including Bemidji and Red Lake regions (2010 miles at \$0.585/mile, 10 nights in a hotel for 3 people at \$98/night, 15 days of per diem for 3 people at \$36/day)	Costs to cover travel associated with sediment core collection					\$6,000

	Miles/ Meals/ Lodging	Travel to Bemidji for workshops with Red Lake and other stakeholders (2010 miles at \$0.585/mile, 5 nights in a hotel for 3 people at \$98/night, 5 days of per diem for 3 people at \$36/day)	Gathering community data and interests, presenting results					\$4,000
							Sub Total	\$10,000
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Publication	Journal article publication (2)	Publication of study results in open-access journals					\$6,000
							Sub Total	\$6,000
Other Expenses								
							Sub Total	-
							Grand Total	\$200,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Personnel - Director, SCWRS		Requesting 0.02 FTE/year to assist in project design and advise in sampling and analysis logistics	This funding would be only for research conducted specific to this proposed project. This is a partially grant-funded position.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	-
Non-State				
			Non State Sub Total	-
			Funds Total	-

Attachments

Required Attachments

Visual Component

File: [b2707f5e-56f.pdf](#)

Alternate Text for Visual Component

There are many environmental stressors affecting the abundance of wild rice in Minnesota. We will use sediment cores to reconstruct the historical abundance of wild rice and its relationship with changes in water quality and watershed land use. This study will help protect and restore wild rice....

Optional Attachments

Support Letter, Photos, Media, Other

Title	File
SMM_LoS	63314e5d-20d.pdf
Red Lake_LoS	173686a7-739.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?

No

Does your project include the design, construction, or renovation of a building, trail, campground, or other capital asset costing \$10,000 or more?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services, as defined in Minnesota Statutes section 299C.61 Subd.7?

No