



# Environment and Natural Resources Trust Fund

M.L. 2024 Approved Work Plan

## General Information

**ID Number:** 2024-036

**Staff Lead:** Noah Fribley

**Date this document submitted to LCCMR:** June 6, 2024

**Project Title:** Reconstructing Historical Wild Rice to Understand Its Future

**Project Budget:** \$200,000

## Project Manager Information

**Name:** Lienne Sethna

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

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## Project Reporting

**Date Work Plan Approved by LCCMR:** June 20, 2024

**Reporting Schedule:** June 1 / December 1 of each year.

**Project Completion:** June 30, 2026

**Final Report Due Date:** August 14, 2026

## Legal Information

**Legal Citation:** M.L. 2024, Chp. 83, Sec. 2, Subd. 03b

**Appropriation Language:** \$200,000 the second year is from the trust fund to the Science Museum of Minnesota for the St. Croix Watershed Research Station to 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.

**Appropriation End Date:** June 30, 2027

## Narrative

**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.

**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 Psín 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

## Project Location

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

Region(s): NW, NE, SE, SW, Central,

**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

## 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
Collect monthly water samples from five study lakes 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 dated at the Science Museum of Minnesota's St. Croix Watershed Research Station (SCWRS). About twenty increments that represent the last 150 years will 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
Examine controls on wild rice abundance using MNDNR data and findings from this project	April 30, 2026
Organize workshops to present data, receive community input, and develop management goals	May 31, 2026
Synthesize results into reports and presentations by the end of project year 2.	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

## Dissemination

**Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.**

We will work closely with Red Lake DNR to implement our research methods and use our results to inform tribal community questions. Our work depends on the knowledge of wild rice abundance and health held by Indigenous communities; therefore, we have worked closely with Red Lake to develop research questions and methods and will center Red Lake goals in all monitoring and reporting efforts. We will directly engage with the Red Lake community through workshops focused on sharing results of our eDNA method and ensuring the long-term and widespread use of the technique in other paleo-studies of wild rice abundance. These workshops will be coordinated with Red Lake DNR and will be focused on improving tribal understanding and engagement with our project methods.

We will also share our research outside of the Red Lake community using the educational and outreach capabilities of the Science Museum of Minnesota (SMM). The SMM regularly travels to all 87 counties in Minnesota offering programs and hands-on STEM learning for K-5 classes. School assemblies gather up to 250 students for a facilitated program of science fun and demonstrations. School residencies bring hands-on activities led by SMM teachers into individual classrooms. SMM has programs dedicated to the subject of "water" and this LCCMR project proposal would provide funds for those to be modified to provide local examples of water science and environmental justice focused on wild rice. For example, results from this work could be used to expand the sediment core model used by the SMM Lending Library to demonstrate the effects of humans on the environment. The sediment core model could include data collected from our sampling lakes showing changes in wild rice abundance with changes in various environmental variables, as a result of human impact. These programs will be made available for SMM hosted events and to Minnesota schools as in-person programming or as virtual content.

Finally, we will prepare reports detailing our results for Red Lake DNR, the Red Lake community, and other project stakeholders with a specific focus on management strategies that could protect and restore wild rice beds into the future. The protection and restoration of wild rice is a multi-faceted issue, as many environmental factors influence its health and abundance. Our research seeks to characterize the effects of organic matter accumulation and composition on wild rice, but also informs future work in the areas of changing water levels, warming temperatures, invasive macrophytes, and changing trophic dynamics.

## 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.

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
Assistant Scientist		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%	0.5		\$33,000
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
							<b>Sub Total</b>	<b>\$69,000</b>
<b>Contracts and Services</b>								
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 of sediment cores collected from five study lakes (\$800/core)				0		\$4,000
SCWRS	Internal services or fees (uncommon)	Sediment total phosphorus and phosphorus fraction analysis on 5 cores, one from each study lake. (\$2,200/core)				0		\$11,000
University of Regina or competitive bid	Professional or Technical Service Contract	Fossil pigment analysis to reconstruct historical algal community composition (\$140/sample, 20 samples per core for 5 cores)				0		\$14,000
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	Sub award	Analysis of surface water samples including nitrogen, phosphorus, carbon, and chlorophyll. (\$350/sample, 20 samples total including monthly measurements from 5 lakes during a 4-month growing season)				0		\$7,000
Red Lake DNR	Sub award	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
							<b>Sub Total</b>	<b>\$102,000</b>
<b>Equipment, Tools, and Supplies</b>								
	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
							<b>Sub Total</b>	<b>\$9,000</b>
<b>Capital Expenditures</b>								
							<b>Sub Total</b>	<b>-</b>
<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	<b>-</b>
<b>Travel In Minnesota</b>								
	Miles/ Meals/ Lodging	Travel to 5 lakes for coring including Bemidji and Red Lake regions (For each trip, estimate 500 miles at \$0.585/mile, 2 nights in a hotel for 3 people at	Costs to cover travel associated with sediment core collection. Budget for one 2-night trip per sample lake, including milage, lodging, and per					\$6,000

		\$98/night, 3 days of per diem for 3 people at \$36/day)	diem = \$1204.50 per sample lake, \$6,022.50 total					
	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					\$8,000
							<b>Sub Total</b>	<b>\$14,000</b>
<b>Travel Outside Minnesota</b>								
							<b>Sub Total</b>	-
<b>Printing and Publication</b>								
	Publication	Journal article publication (2)	Publication of study results in open-access journals					\$6,000
							<b>Sub Total</b>	<b>\$6,000</b>
<b>Other Expenses</b>								
							<b>Sub Total</b>	-
							<b>Grand Total</b>	<b>\$200,000</b>

## 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....

### Supplemental Attachments

#### *Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other*

Title	File
SMM_LoS	<a href="#">63314e5d-20d.pdf</a>
Red Lake_LoS	<a href="#">173686a7-739.pdf</a>
Research Addendum revised 2024-036_final	<a href="#">e2a17b29-6a5.pdf</a>

### Difference between Proposal and Work Plan

#### *Describe changes from Proposal to Work Plan Stage*

We have re-allocated funds within the budget to account for changes in salary rates, analysis costs, and the availability of existing monitoring efforts and data. The total budget is still \$200,000 and we have not changed any of the project milestones or deliverables.

## Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

**Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?**

N/A

**Do you agree travel expenses must follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?**

Yes, I agree to the Commissioner's Plan.

**Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?**

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 pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing \$10,000 or more or large-scale stream or wetland restoration?**

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 as "the provision of care, treatment, education, training, instruction, or recreation to children")?**

No