Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-212

Proposal Title: Assessing Minnesota Heritage Trout Lakes for Long-term Protection

Project Manager Information

Name: Daniel Pauly

Organization: Headwaters Project

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Project Basic Information

Project Summary: Assess the status of Minnesota's heritage lake trout lakes through temperature/oxygen profiling, eDNA surveys, and bathymetric mapping to protect these irreplaceable ice-age ecosystems during a time of climate change.

ENRTF Funds Requested: $263,000

Proposed Project Completion: December 31, 2029

LCCMR Funding Category: Small Projects (G)
Secondary Category: Fish and Wildlife (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.

Within the Boundary Waters Canoe Area Wilderness roughly fifty lakes shelter native lake trout populations that have persisted since the last ice age. Designated "heritage" lakes, they represent the greatest concentrated wilderness lake trout fishery in the contiguous United States.

These populations have been genetically isolated for thousands of generations - including between lakes.

These populations face mounting threats. Climate warming is shrinking the cold, oxygenated habitat lake trout require in summer. Non-native warmer water species—particularly smallmouth bass and walleye—are spreading into previously isolated watersheds; recent surveys in the upper Cross River system found smallmouth bass already established across multiple year classes. Flour Lake offers a cautionary example: after walleye introduction, native lake trout vanished, and 30 years of restocking failed to restore a self-sustaining population.

Despite their significance, most heritage trout lakes are critically under-monitored. Survey frequency has been very low and many lakes have been surveyed only once or twice in 50 years, with no long-term systematic water quality or population genetics program exists. Fundamental questions remain unanswered —which lakes still hold self-sustaining native populations, which have been infiltrated by non-native fish, and which can serve as possible genetic reservoirs for stocking other lakes.

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.

This project will undertake the first coordinated, systematic assessment of Minnesota's heritage lake trout lakes, filling critical knowledge gaps and establishing a durable monitoring foundation for long-term protection.

Systematic multiparameter water column profiling (temperature, dissolved oxygen, turbidity) will be conducted across a representative network of heritage lakes three times per season to quantify current habitat and establish baseline data for detecting future change.

The Headwaters Heritage Lake Trout Initiative will deploy emerging environmental DNA (eDNA) technology to rapidly screen lakes for the presence of lake trout, smallmouth bass, walleye, and priority invasive species across approximately 50 heritage and candidate-heritage lakes. eDNA sampling is minimally invasive, consistent with BWCA Wilderness values, and can detect species even at low densities—making it ideal for these remote waters.

Concurrently, the project will conduct hydroacoustic bathymetric sounding of the subset of heritage lakes that currently lack depth maps or have outdated maps, enabling accurate modeling of trout habitat.

Finally, the project will distribute all collected data in publicly available MPCA databases, provide bathymetric data in GIS formats, create lake depth maps available through the MNDNR Lakefinder site, and create updated heritage lake trout status map.

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?

- A multi-year thermal habitat baseline for a heritage trout lakes to detect temperature and dissolved oxygen (TDO) trends under climate warming and identify resilient or vulnerable lakes.

- eDNA-based confirmation of lake trout presence and invasive species status in ~50 heritage and candidate-heritage lakes — the first comprehensive fish population assessment ever for these lakes.

- High-resolution bathymetric maps for unmapped or poorly mapped heritage lakes (Wisini, Strup, Blue Snow, Mora), enabling accurate habitat modeling across the network.

- A public heritage lake trout database and GIS data shared with MN DNR, tribal authorities, and the public.

Activities and Milestones

Activity 1: Temperature and Oxygen Profiling

Activity Budget: $105,200

Activity Description:
Thermal Habitat Volume (THV)—the quantity of cold, well-oxygenated water available to lake trout during summer stratification—is a key determinant of lake trout productivity and long-term viability in a warming climate. Accurate modeling requires both high-resolution bathymetric depth maps and current water temperature-oxygen profiles. Multiparameter water column profiling using YSI sondes (measuring depth, temperature, dissolved oxygen) will be conducted at a network of 50 heritage lakes three times per summer: in mid-May (post-spring mixing), mid-July to August (peak stratification), and late September (pre-fall mixing). This three-point seasonal protocol will quantify current habitat for each monitored lake and establish the multi-year baseline needed to detect climate-driven change. Data will be used to classify heritage lakes by current habiat status and projected climate vulnerability.

Activity Milestones:

Description	Approximate Completion Date
Conduct 2027 TDO data on approximately 50 heritage trout lakes three times annually	October 31, 2027
Conduct 2028 TDO data on approximately 50 heritage trout lakes three times annually	October 31, 2028
Conduct 2029 TDO data on approximately 50 heritage trout lakes three times annually	October 31, 2029

Activity 2: Comprehensive eDNA Status Assessment of Heritage and Candidate-Heritage Lake Trout Lakes

Activity Budget: $105,200

Activity Description:
Many heritage lake trout lakes in the BWCA have not been surveyed in decades. Traditional netting surveys require multiple days of professional staff per lake, limiting coverage across remote terrain. Environmental DNA (eDNA) technology—collecting water samples to detect trace genetic material shed by organisms—enables efficient, minimally-invasive screening of multiple species simultaneously, consistent with Wilderness management values and validated for lake trout and other target species.

Trained field crews will conduct eDNA sampling at approximately 50 heritage and candidate-heritage lakes over two field seasons. Each visit will collect water samples from multiple depths and locations, filtered on-site and preserved for laboratory polymerase chain reaction (PCR) analysis targeting lake trout, smallmouth bass, walleye, spiny water flea, and rainbow smelt.

Where results suggest lake trout absence in a designated heritage lake, or previously undetected invasive species presence, findings will be flagged for follow-up netting verification by MN DNR. All results will be compiled into a comprehensive database, updated heritage lake status assessment report, and GIS map.

Activity Milestones:

Description	Approximate Completion Date
Conduct initial eDNA assessment on 50 heritage trout lakes and candidate lakes	November 30, 2027
Process samples from first eDNA sampling	November 30, 2027
Analyze data from first eDNA sampling for second-round intensive sampling	March 31, 2028
Conduct confirming eDNA tests on lakes of particular interest for fish and invertebrate populations.	September 30, 2028

Create and distribute comprehensive report on eDNA assessment, provide to MNDNR and USFS.	June 30, 2029

Activity 3: Heritage Lake Trout Lakes Bathymetric Mapping

Activity Budget: $52,600

Activity Description:

Several heritage lakes (including Wisini, Strup, and Blue Snow) have never been bathymetrically mapped; others have only low-resolution pre-GPS maps, some dating to Civilian Conservation Corps surveys from the 1930s and 1940s that contain known errors. Headwaters Project has already acquired professional hydroacoustic sounding equipment equivalent to that used by MNDNR and has received sounding guidelines from MNDNR staff. This activity will deploy hydroacoustic sounding equipment to map the bathymetry of at least 8 priority unsounded or poorly-mapped heritage lakes during BWCA canoe expeditions in Year 1 and Year 2. Resulting digital depth maps will be shared with MNDNR for publication via LakeFinder.

Activity Milestones:

Description	Approximate Completion Date
Conduct hydroacoustic sounding on key unsounded heritage lakes - Wisini, Strup, Blue Snow	October 31, 2027
Conduct hydroacoustic sounding on three additional lakes with poor depth maps and/or high interest.	October 31, 2028
Conduct hydroacoustic sounding on three additional lakes with poor depth maps and/or high interest.	August 31, 2029
Process and release data to MNDNR and others for LakeFinder and other purposes	October 31, 2029

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.
All Heritage Trout Lakes are within the boundaries of the 1854 Treaty of La Pointe, and signatories retain fishing rights in the Heritage Trout Lakes. All data (TDO, eDNA, bathymetric, etc.) will be provided to tribal natural resource managers as well as the MN DNR and MPCA (the latter for surface water database, as described below).

Headwaters Project already contributes to the MPCA Surface Water database for BWCA lakes, and that data is being used by MN DNR for establishing cold water lake quality standards. We will continue to provide all of our data in a timely fashion to the MPCA and MN DNR for their near and long term management decisions.

Our eDNA results will be distributed to MN DNR, in particular to Dr, Loren Miller, MN DNR research scientist and fisheries geneticist who coordinates eDNA work on aquatic invasive species. Dr. Miller provided advice on our eDNA pilot work and reviewed the results.

Our high-resolution bathymetric maps for unmapped Heritage Trout Lakes will be provided to the MN DNR, including with Josh Knopik, the MN DNR Ecological and Water Resources Division, who has assisted in providing guidance on having our hydro acoustic survey work follow MN DNR protocols.

The Headwaters Project will continue to recruit student participants from Minnesota universities and colleges, a program we piloted in 2025 with expense-paid four-day trips. These trips have served as an opportunity to provide an introduction to field work as well as wilderness camping. This effort broadens awareness of these unique lakes and their inhabitants to a broader audience of future wilderness researchers and conservation workers.

We anticipate being able to undertake online seminars with conservation groups and sporting organizations to share our work and the stories of the Heritage Trout Lakes.

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?
This comprehensive survey will provide immediate, actionable data that can inform management decisions, including angling rules, stocking plans (especially outside the BWCA), possible rules relating to bait transfer, etc. In addition, the Headwaters Project intends to continue long term activities monitoring TDO across the seasons on a subset of "Headwaters Lakes" comprising a loop from Bat Lake to Gabimichigami and through Gillis. Thus, this grant will allow for building a much broader data set on what is already being gathered, and then after this baseline three year assessment we will continue the long term study with UMD and other students.

Project Manager and Organization Qualifications

Project Manager Name: Daniel Pauly

Job Title: Headwaters Project Executive Director

Provide description of the project manager's qualifications to manage the proposed project.
- Degree in Chemistry with limnology studies, water chemistry, environmental science.

- Prior environmental consultant in private practice.
- Active on BWCA environmental issues (owner of BWCA mapping company (Voyageur Maps), author of Exploring the Boundary Waters, prior board member of Friends of the Boundary Waters. Deep experience leading groups in all seasons to the BWCA.
- Worked with MNDNR in 2023 to undertake advanced lake mapping in the BWCA of unmapped Elm Lake, a potential undocumented lake trout lake. Project included collaborating on systematic mapping routes, data gathering and post-research processing. Data included depth, aquatic vegetation, and bottom structure.
- Worked with MNDNR in 2025 to gather remote data for temperature and dissolved oxygen (TDO) of remote BWCA lakes in peak stress season for new standards development of impaired cold water lakes. Activity included reaching and assessing remote lakes that had previously been unreachable efficiently by MN DNR researchers.
- Conducted small-scale pilot eDNA field work in 2025 for heritage lake trout lakes with input from MN DNR fisheries geneticist, including sampling of lakes with known lake trout populations and those without lake trout populations.
- Recruited and trained small group of undergraduate and graduate students for spring and summer 2025 field work to gather cold water TDO data on 30+ lakes, work undertaken in conjunction with MNDNR. Effort provided important educational and professional development for the student participants, in addition to valuable data.
- Undertook first known winter deepwater assessments of TDO in two of Minnesota's most important Heritage Trout Lakes (Gabimichigami - deepest, and Gillis - important for historic fish hatchery brood stock).

Organization: Headwaters Project

Organization Description:
The Headwaters Project is a Minnesota-based conservation initiative focused on understanding and protecting the state's rare "heritage" lake trout populations — wild strains of Salvelinus namaycush that have survived since the last ice age, roughly 10,000 years ago, in the remote, cold, and pristine lakes of the Boundary Waters Canoe Area Wilderness (BWCA).
Nestled within the Superior National Forest, approximately 50 deep, isolated lakes sit near the continental divide and serve as critical cold-water refuges for these native fish. Because many of these lakes can only be reached by multi-day canoe and portage routes, and due to constrained DNR budgets and staffing, most have been surveyed only once or twice in the last 50 years — some never at all.

The project seeks to close that knowledge gap through temperature and oxygen monitoring, eDNA data collection, and updated lake depth mapping. These efforts aim to determine which lakes still harbor native lake trout, assess threats from invasive species like smallmouth bass and walleye, evaluate the impact of climate-driven warming on thermal habitat, and propose long-term management strategies.

The Headwaters Project brings together private and public partners to safeguard an irreplaceable natural legacy before it is lost.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Seasonal Field Technicians		Assist with eDNA collection, water profiling, sounding, and data entry (three technicians for 1/3 of a year each for three years)			25%	3		$156,000
							Sub Total	**$156,000**
Contracts and Services								
TBD	Service Contract	DNA laboratory PCR analysis; scientific advisor for study design, data analysis. (50 lakes, 8 samples per lake, $155 per sample)				0		$62,000
							Sub Total	**$62,000**
Equipment, Tools, and Supplies								
	Equipment	Three YSI ProSolo handheld and TDO probes ($2500 per handhold/probe combo, plus $500 for cases, chargers, etc.)	Used for temperature and oxygen profiling					$8,000
	Equipment	Lowrance bathymetric sounders: 3x (HDS 7 live ($1100) batteries ($200), chargers ($100) cases ($100, mounts ($100)) + $200 data cards and misc.	Used to perform hydroacoustic surveys					$5,000
	Tools and Supplies	eDNA field sampling supplies (filters, sample bottles, cold packs, preservation solution; 400 samples x $20 per sample) + miscellaneous supplies.	Required for eDNA screening of approx. 65 lakes over 2 field seasons					$8,500
	Tools and Supplies	Field supplies (PPE, dry bags, data sheets, waterproof notebooks, compasses, GPS, misc.)	General field equipment for wilderness expeditions.					$4,200
							Sub Total	**$25,700**
Capital Equipment								
							Sub Total	**-**
Acquisitions and Stewardship								

							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel to-from BWCA entry points, generally from UMD.	Reimbursement for travel.					$2,000
	Miles/ Meals/ Lodging	Reimbursement for automotive travel to and from BWCA entry points - 15 trips per year, 250 miles each, 3 years	Reimburse for transport to and from entry points.					$2,800
							Sub Total	**$4,800**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Printing	Costs related to field manuals, lake depth map test outputs, record sheets, reports, etc.	For providing data to partners and third parties, such as MNDNR					$1,000
							Sub Total	**$1,000**
Other Expenses								
		Food and consumables for field technicians and student assistants on BWCA trips - 25 trips per year for 4 days with 4 people per trip, $10 per person per day, three years.	Food and consumables for field team on overnight camping for field work					$12,000
		BWCA reservation and permit fees - $7 per reservation, $16 per person, 25 trips per year with four people per trip	Necessary BWCA permit fees.					$1,500
							Sub Total	**$13,500**
							Grand Total	**$263,000**

Classified Staff or Generally Ineligible Expenses

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

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	**-**
Non-State				
In-Kind	Project Management by Headwaters Project Executive Director	Coordinate and participate in TDO assessment, eDNA study and analysis, mapping. 0.5 FTE times three years at $37.3K per year.	Secured	$112,000
In-Kind	Headwaters Project	Headwaters Project Student Participants to help staff field techs. Provide field work help - transportation, data collection, etc. 25 trips per year, 4 days per trip, 3 students per trip, 8 hours per day, $16 per hour for three years.	Secured	$115,200
In-Kind	Headwaters Project Field Camping Equipment and Supplies	Canoes, paddles, packs, cooking gear, tents, etc.	Secured	$10,000
			Non State Sub Total	**$237,200**
			Funds Total	**$237,200**

Total Project Cost: $500,200

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: e11cd246-ff8.pdf

Alternate Text for Visual Component

The Headwaters Project is studying Minnesota's Heritage Lake Trout in the BWCA — the only native inland lake trout in the continental U.S. Using water-column profiling, eDNA sampling, and bathymetric mapping, they're building foundational data to protect this rare species from climate threats and inform future management decisions....

Financial Capacity

Title	File
Headwaters 990 Letter	37fe74e8-2c0.pdf
Headwaters Project IRS Non-Profit Confirmation	197cfd96-a1d.pdf
MN Sec of State Good Standing	56ff9fff-2af.pdf

Board Resolution or Letter

Title	File
Headwaters Board Resolution	4fe11017-971.pdf

Supplemental Attachments

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

Title	File
Support Letter from Friends of the Boundary Waters	82d5013d-57f.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Do you understand that travel expenses are only approved if they 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 understand the Commissioner's Plan applies.

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?

No

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

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this proposal:

Mark Edstrom, Headwaters Board Chair.

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

Yes, I understand