Environment and Natural Resources Trust Fund

2025 Request for Proposal

General Information

Proposal ID: 2025-046

Proposal Title: Are All Walleye Created Equal? Probably Not.

Project Manager Information

Name: Nicholas Phelps

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

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Project Basic Information

Project Summary: Given that walleye are vulnerable to climate change, we will investigate Minnesota walleye strain physiology and disease responses to warming water, and build a tool to guide adaptive management strategies.

ENRTF Funds Requested: $298,000

Proposed Project Completion: June 30, 2027

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.

Warming waters associated with climate change can create stressful conditions for fish, leading to reduced recruitment, physiological changes, and increased susceptibility to infectious diseases. As a cool-water species, walleye are particularly vulnerable to warming temperatures. In Minnesota, genetic strains of walleye are generally associated with major watersheds and are adapted to different thermal regimes. We hypothesize that walleye strains better adapted to higher temperatures may show a greater physiological resilience to warming water and lower susceptibility to opportunistic pathogens. Indeed, recent findings by the Minnesota DNR have shown evidence of adaptations to regional environments, and northern walleye strains stocked in southern lakes and rivers show poor persistence compared to their local counterparts. Differences in thermal tolerances (i.e., adaptations to regional thermal regimes) between strains may be an important contributing factor to variations in strain performance. Recent research linking walleye recruitment failures to short winters and warm summers underscores the urgency of understanding physiological responses and disease susceptibility in relation to temperatures expected in the future. Walleye strains more resilient to warming may play a critical role in climate adaptation of Minnesota walleye populations and inform management trade-offs between conserving local genetic integrity versus assisted migration of resilient populations.

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 a collaboration between an interdisciplinary UMN research team and the MN DNR Walleye Tech Team, we aim to investigate the resilience of Minnesota walleye strains to warming waters to inform long-term management of walleye populations across the state. We will assess strain resilience to warming conditions by evaluating the thermal tolerances and temperature-driven disease susceptibility of three strains native to northern and southern regions of Minnesota: Pike River, Pine River, and the Lower Mississippi. We will conduct experimental trials simulating current and future thermal conditions in the laboratory. During the trials, we will collect baseline data of physiological changes and morbidity/mortality rates of strains, as well as expose strains to an opportunistic pathogen that exhibits higher virulence at elevated temperatures. We will also opportunistically collect samples for a complimentary project exploring walleye subpopulation genetics, informing our understanding of allele-specific differences in thermal tolerances. Finally, we will use the results of our investigation to improve the resolution of previous models predicting walleye population changes due to rising Midwest temperatures. The results will be presented in an online interactive tool that forecasts strain-level population changes across Minnesota and allows users to simulate outcomes associated with a range of management scenarios.

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?

Walleye are vital to ecosystems, hold a special significance to Tribal Nations, are prized by recreational fishers, and the popularity of walleye support fisheries which contribute substantially to local economies. Knowing that walleye are particularly vulnerable to warming water, it is imperative that we explore the consequences and solutions to the future impacts of a changing climate. The resilience of walleye strains to warming waters has direct applications and can inform management strategies aimed at sustaining viable walleye populations. The proposed online tool will make this research accessible for managers, supporting their efforts to maintain walleye in Minnesota waters.

Activities and Milestones

Activity 1: Evaluate the thermal tolerances of three Minnesota walleye strains under current and future climate scenarios

Activity Budget: $102,450

Activity Description:
We will obtain and acclimate walleye fry from selected strains (provided by DNR) to laboratory conditions prior to the start of trials. To assess strain resilience to future warming, we will replicate a 4-month season (May-August) in the laboratory, slowly increasing temperatures under the current normal (~6-22ºC) and potential future conditions (~6-32ºC). During the trial, we will record morbidity/mortality and collect baseline data of key physiological changes that are important indicators of thermal tolerance: growth, stress responses, and immune function. By collecting multiple measures of each physiological indicator, our investigation will capture a range of mechanisms that allow fish to cope with rising temperatures. We will monitor growth patterns by recording the weight and length of individual fish. Measures of stress responses will include cortisol levels, the expression of heat shock proteins, and signs of oxidative stress. We will assess the maintenance of adequate immune defenses under various temperatures with measures of both innate and adaptive immune function (e.g., respiratory burst activity and immunoglobulin expression). Sample collection at regular intervals throughout the 4-month trial will enable us to closely monitor these physiological changes. Tissue collection for the genetics project will occur concurrently with other sampling.

Activity Milestones:

Description	Approximate Completion Date
Coordinate with the Minnesota DNR to obtain fry of each selected walleye strain	April 30, 2026
Acclimate walleye fry to laboratory conditions	May 31, 2026
Expose walleye strains to current and future conditions	August 31, 2026
Evaluate differences in physiological responses of walleye strains to current and future conditions	December 31, 2026

Activity 2: Evaluate disease susceptibility of three Minnesota walleye strains under current and future climate scenarios

Activity Budget: $102,450

Activity Description:
We will run a simultaneous trial with an identical experimental design as Activity 1, except here we will introduce the fish to a virulent strain of the bacterium, Flavobacterium columnare. This opportunistic pathogen is known to exhibit higher virulence at elevated temperatures and cause columnaris disease – an important disease increasingly implicated in summer fish kills, including walleye. We will expose a subset of fry from each strain to the pathogen under both current and future conditions, planning the exposure during optimal growth of the bacteria (20-27ºC; disease outbreaks often occur at or above this threshold). Due to more rapid warming, fish experiencing future temperatures will be exposed to the pathogen earlier in the trial compared to those under current conditions. This mirrors the more prolonged period of vulnerability to warmwater pathogens that walleyes are expected to experience with more rapid and extreme spring/summer warming. Following pathogen exposure, sampling will continue to occur at regular intervals to monitor the physiological changes and mortality/morbidity of walleye strains as described in Activity 1. We will also include measures of pathogen shedding rates from infected fry as an additional assessment of disease susceptibility and population-level risk.

Activity Milestones:

Description	Approximate Completion Date
Identify and culture a virulent strain of an opportunistic bacteria	March 31, 2026
Expose walleye strains to an opportunistic pathogen under current and future conditions	July 31, 2026
Evaluate differences in disease susceptibility of walleye strains under current and future conditions	December 31, 2026

Activity 3: Develop an online tool to inform long-term walleye management under current and future climate scenarios

Activity Budget: $93,100

Activity Description:

We will incorporate our data, which will describe strain-specific changes in physiology and disease susceptibility associated with temperature, into existing models predicting temperature-driven changes in walleye abundance. Using tools generated to inform the long-term management of Wisconsin walleye populations as a guide, we will present the product of this activity as an online interactive R-Shiny tool that forecasts strain-level population potential across Minnesota lakes. Our tool will integrate the existing data of walleye population dynamics and lake thermal regimes and include features allowing users to visualize predicted changes in walleye populations and simulate a variety of status quo or new management scenarios (e.g., trade-offs between conserving local genetic integrity versus assisted migration of southern-strain walleye to northern Minnesota) to better understand potential outcomes. Simulated management practices and descriptions of outcomes will be guided by "resist, accept, direct" conservation planning. This will present essential information in a familiar decision framework to direct the selection of management priorities and conservation strategies. The co-development of our tool will be a highly collaborative process involving a close partnership with the MN DNR Walleye Tech Team, composed of fisheries researchers and managers statewide who will provide feedback to improve the tool's effectiveness and user-friendliness.

Activity Milestones:

Description	Approximate Completion Date
Incorporate data describing the physiological changes and disease susceptibility of strains in relation to temperature	January 31, 2027
Integrate existing data of walleye population dynamics and lake thermal regimes into the management tool	February 28, 2027
Evaluate and update tool functionality for fisheries managers and other end users	May 31, 2027
Collaborate with the Minnesota DNR Walleye Tech Team to plan management tool development	June 30, 2027

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Laurel Sacco	UMN	Graduate Student, PhD, Conservation Sciences	Yes
Walleye Tech Team	MN DNR	Advise project development, study design, and tool development to ensure the project meets management needs and the findings are transferable to the real-world. DNR will provide fry from a variety of walleye strains at no cost to the project.	No

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 project was co-developed by UMN researchers and members of the MN DNR Walleye Tech Team to address immediate management questions. This partnership will help ensure outcomes are transferable, informing adaptive management strategies that sustain Minnesota's walleye populations in a changing climate. We may identify a need to investigate additional variables and/or add complexity to the management tool, requiring additional research. Funding to support future research needs will be prioritized and pursued by the project team to build on the expected results of this proposed project.

Project Manager and Organization Qualifications

Project Manager Name: Nicholas Phelps

Job Title: Associate Professor

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

Dr. Nick Phelps is an Associate Professor in the Department of Fisheries, Wildlife, and Conservation Biology at the University of Minnesota and Director of the Minnesota Aquatic Invasive Species Research Center (MAISRC).. His research program focuses on emerging threats to the health and sustainability of aquatic ecosystems, which lie at the intersection of animals, humans and the environment. Dr. Phelps has managed ~$37M in competitive grant funding, led large international collaborations, held numerous outreach and public engagement events, and published ~75 peer-reviewed manuscripts and book chapters. His interdisciplinary lab group currently includes seven graduate students and a post doctoral associate, working on a variety of fish health, invasive species, predictive modeling, citizen science, ecotoxicology, aquaculture, and molecular biology projects - all in close collaboration with diverse teams and end users.

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

Organization Description:

The University of Minnesota's abbreviated mission statement: The University, founded in the belief that all people are enriched by understanding, is dedicated to the advancement of learning and the search for truth; to the sharing of this knowledge through education for a diverse community; and to the application of this knowledge to benefit the people of the state, the nation, and the world. The University's mission, carried out on multiple campuses and throughout the state, is threefold: Research and Discovery, Teaching and Learning, and Outreach and Public Service.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Nick Phelps, Associate Professor		Overall supervision and leadership of all activities			37.1%	0.16		$38,000
Laurel Sacco, Graduate Student		Project management and implementation of all activities			25.1%	1.5		$166,344
Gretchen Hansen, Assistant Professor		Direct involvement with all activities.			37.1%	0.16		$33,900
Undergraduate student support		Fish husbandry, sample processing, and system maintenance.			0%	0.6		$10,000
Denver Link, Research Associate		Provide support for experimental trials, data collection, and analysis.			33.5%	0.16		$12,915
							Sub Total	**$261,159**
Contracts and Services								
University of Minnesota	Internal services or fees (uncommon)	Access to two fish bays in the MAISRC Containment Laboratory. Charged daily rate ($22.20/day) for 270 days.				0		$11,988
							Sub Total	**$11,988**
Equipment, Tools, and Supplies								
	Tools and Supplies	Laboratory supplies	Laboratory supplies and reagents for testing cortisol level and immune function genes, and culturing bacteria.					$12,500
	Tools and Supplies	Laboratory supplies	Supplies for fish husbandry (i.e., food, disinfectants, etc) and sample collection (i.e., rulers, gloves, etc.)					$3,553

	Equipment	24 aquaria and shelving	Necessary aquaria and shelving for experimental trials. Additional aquaria systems will be used from previous research.					$3,600
							Sub Total	**$19,653**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	4 trips, at approx 250 miles each, 1-2 people per trip	Travel to DNR hatcheries to collect walleye fry					$700
							Sub Total	**$700**
Travel Outside Minnesota								
	Conference Registration Miles/ Meals/ Lodging	1 conference, 3 days per diem (location TBD), 1 person	Travel to present research results at a nationally relevant conference	X				$2,500
							Sub Total	**$2,500**
Printing and Publication								
	Publication	peer-reviewed manuscript	Publication of 1 peer-reviewed manuscript to ensure research results are peer-reviewed and widely accessible.					$2,000
							Sub Total	**$2,000**
Other Expenses								
							Sub Total	**-**

							Grand Total	**$298,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	1 conference, 3 days per diem (location TBD), 1 person	Travel to national conference will provide an opportunity for student development, sharing of important findings, and networking with fisheries managers to facilitate adoption of research results.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
In-Kind	University of Minnesota foregone indirect costs	Administrative support of MAISRC activities including payroll and human resources, finance, facilities, and IT.	Secured	$111,564
			State Sub Total	**$111,564**
Non-State				
			Non State Sub Total	**-**
			Funds Total	**$111,564**

Total Project Cost: $409,564

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 9c798784-c4f.pdf

Alternate Text for Visual Component

An overview of the project is outlined, including a description of the problem: future climate conditions will likely impact Minnesota walleye strains differently, but we don't know how or to what degree, resulting in management uncertainty. Three activities are described to fill key knowledge gaps and develop a management tool....

Supplemental Attachments

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

Title	File
MN DNR Support Letter	9cd87ca5-858.pdf
UMN Sponsored Projects Office approval	2f8c0db9-79b.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

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

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

Laurel Sacco, UMN; Gretchen Hansen, UMN; Walleye Tech Team representatives, MN DNR