# Environment and Natural Resources Trust Fund

2025 Request for Proposal

## General Information

**Proposal ID:** 2025-294

**Proposal Title:** Operationalizing State Zooplankton Data to Support Lake Health

## Project Manager Information

**Name:** Jake Walsh

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

**Office Telephone:** (612) 624-3600

**Email:** walsh229@umn.edu

## Project Basic Information

**Project Summary:** We will operationalize valuable statewide monitoring data to understand how zooplankton support Minnesota fisheries and water quality. Results will streamline data collection, management, and preservation, and inform on lake health.

**ENRTF Funds Requested:** $445,000

**Proposed Project Completion:** June 30, 2028

**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.**

Minnesota's lakes are central to our identity and economies. Lake fisheries and water quality are intensively managed to protect this cultural and economic value. Both of these lake services are dependent on and linked by zooplankton – the tiny yet abundant free-floating crustaceans in lakes. Quantifying fundamental links to zooplankton has informed individual lake management cases, revealing the loss of fisheries services (e.g., slower walleye and yellow perch growth) and water clarity (e.g., 3 foot decline totaling millions of dollars in damages) with declines in zooplankton. Such cases highlight the potential benefits of operationalizing these data statewide.

The Minnesota Department of Natural Resources regularly monitors lake zooplankton communities on 35 lakes and has monitored over 300 lakes with the US EPA National Lakes Assessment, resulting in foundational data that could be critical for understanding and managing fisheries and water quality. The rapid, radiating response of zooplankton to stressors (e.g., climate change, invasive species, salt and nutrient pollution, management) make them ideal indicators for lake health, and questions remain regarding these responses to ecological change.

We will leverage these valuable datasets to provide a broader, statewide understanding of the integral but understudied role zooplankton play delivering freshwater ecosystem services.

**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.**

We will operationalize state zooplankton data by linking zooplankton to critical lake ecosystem services. In doing so, we will expand decision-making support at a broader, statewide scale regarding a critical yet poorly understood biological community in Minnesota lakes.

We will use historical and ongoing monitoring data from the MN DNR Sentinel Lakes (25 lakes) and Large Lakes (10 lakes) programs, as well as 315 MN lakes from the semi-decadal US EPA National Lakes Assessment (NLA) program. Such monitoring and the research it fuels have provided cases quantifying the role of zooplankton in supporting fisheries and water quality in individual lakes, as well as the services lost in those lakes when zooplankton communities are threatened.

We will critically evaluate the role of zooplankton in lake water quality and important fisheries through long-term study of regular MNDNR monitoring efforts and a cross-sectional study of US EPA National Lakes Assessment data. We will then develop biotic indices that relate zooplankton community composition to ecosystem services such as water quality and important fisheries.

**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?**

Quantifying the effects of zooplankton on ecosystem services will be broadly relevant lake management. Biotic indices are foundational to the MN DNR Watershed Health Assessment Framework (WHAF), and our results could be integrated into existing databases and public-facing online tools. We will explore these opportunities with DNR WHAF staff. These indices will build on an LCCMR-funded paleolimnological study. Indices based on coarser taxonomy would allow for use of emerging automated analysis technology to increase sample-processing capacity. A byproduct of operationalizing data will be data management plans that protect and potentially expand access to MN DNR zooplankton data.

# Activities and Milestones

## Activity 1: Long-term study of MN zooplankton, fisheries, and water quality monitoring efforts

**Activity Budget:** $296,667

**Activity Description:**

We will collate data from the Large Lakes (10 lakes, 1994 - present) and Sentinel Lakes (25 lakes, 2007 - present) programs at the finest timestep possible. Long-term data and formal time series analysis are powerful tools for identifying potentially causal relationships. For lakes with higher-quality time series, formal time series models will be fit to estimate the relationships between water quality and fisheries, zooplankton, and other covariates (e.g., nutrients and water temperature). Less data-intensive approaches will be used in the broader set of lakes. Model results will be compared to other regional datasets (e.g., 11 NSF long-term study lakes in WI) to reduce uncertainty.

We will use multivariate methods to develop biotic indices that relate zooplankton community composition to ecosystem services such as water quality and important fisheries. We will work with MNDNR to tailor indices to existing programs, databases, and online visualization tools. In particular, we will use results to streamline sample collection and processing (e.g., via testing automated counting and sample analysis).

To ensure this information is preserved, we will develop a data management plan for the datasets used and produced in this project, and create a plan for sample preservation and archival.

**Activity Milestones:**

| Description | Approximate Completion Date |
| --- | --- |
| Collate statewide zooplankton, fisheries, and water quality monitoring data; meet regularly with MNDNR staff | June 30, 2026 |
| Assess role of zooplankton in the provisioning of lake ecosystem services, prepare products for publication | June 30, 2028 |
| Zooplankton biotic indices of lake ecosystem services, work with MNDNR to explore integration into programs | June 30, 2028 |
| Data management plan for zooplankton monitoring programs and plan for sample preservation | June 30, 2028 |
| Webinar for MN lake associations to discuss findings. | June 30, 2028 |
| Present findings at Native American Fish & Wildlife Society Conference (Dr. Walsh is a member). | June 30, 2028 |

## Activity 2: Space-for-time study of US EPA National Lakes Assessment data

**Activity Budget:** $148,333

**Activity Description:**

We will evaluate the role of zooplankton in lake water quality using a cross-sectional study of US EPA National Lakes Assessment (NLA) data (315 MN lakes, ~150 per assessment; assessments in 2007, 2012, 2017, 2022). Data for all key response variables and covariates from Activity 1 are collected in the NLA, and we will use a similar multilevel structural equation modeling approach to estimate the effects of zooplankton on water quality. We will test and further develop biotic indices that relate zooplankton community composition to water quality. Zooplankton are a key biological indicator of lake health in the NLA.

Some lakes in the NLA have been resampled with new assessments. In these cases, we will estimate the relationship between changes in zooplankton communities and changes in lake water quality between assessments. Estimating drivers of change is a better tool for inferring causal relationships than correlation among lakes within assessments.

While the NLA does not collect fisheries-related data, a comprehensive, regional fish catch dataset (collation led by Dr. Hansen) could provide enough cases where fisheries data was collected from a lake in an assessment year to expand Activity 2 into important MN fisheries.

**Activity Milestones:**

| Description | Approximate Completion Date |
| --- | --- |
| Collate USA EPA National Lakes Assessment Zooplankton data | June 30, 2026 |
| Investigate the relationship between zooplankton and lake services both within and between NLA assessments | June 30, 2028 |
| Test and refine zooplankton biotic indices, working with MNDNR to integrate into programs | June 30, 2028 |
| Work with MN PCA and MNDNR Zooplankton Specialist to develop data management plan | June 30, 2028 |

## Project Partners and Collaborators

| Name | Organization | Role | Receiving Funds |
|------|-------------|------|-----------------|
| Gretchen Hansen | UMN Department of Fisheries, Wildlife, and Conservation Biology | Assistant Professor. Co-PI. | Yes |
| Heidi Rantala | MN DNR Division of Fisheries and Wildlife | Fisheries Research Scientist. Co-PI. | 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?**
These results can be implemented into existing MN DNR staffing and programming. Many outputs could be tailored to existing MNDNR databases and outward facing data visualization tools (e.g., WHAF). The zooplankton indices and data management plans will provide long-term benefits to the MN DNR Statewide Zooplankton Specialist. The results here will generate hypotheses and research questions for experiments regarding the role of zooplankton in lake management. Such work would be funded through LCCMR as well as through the Minnesota Aquatic Invasive Species Research Center, the Midwest Climate Adaptation Science Center, and the Midwest Glacial Lakes Partnership.

## Project Manager and Organization Qualifications

**Project Manager Name:** Jake Walsh

**Job Title:** Postdoctoral Associate

**Provide description of the project manager's qualifications to manage the proposed project.**
Dr. Jake Walsh is a postdoctoral associate in the President's Postdoctoral Fellowship Program in the UMN-TC Department of Fisheries, Wildlife, and Conservation Biology. PPFP associates are expected to develop a research program as a component of transitioning to tenure-track faculty in their departments. He will be evaluated for an assistant professorship that would start in fall of 2025.

Dr. Walsh publishes regularly on ecological and economic relationships in lakes and has explored how invasive zooplankton impact water quality and important fishes in the Upper Midwest (18 publications, 8 lead author). Prior to Dr. Walsh's position at UMN, he worked for three years as the Research & Grants Coordinator for the MN DNR's Invasive Species Program.

Through these research and MN DNR program management positions, Dr. Walsh's background and professional experience includes:
1) Three years coordinating research internally and externally in the MN DNR,
2) One year co-leading research on the ecological and economic impacts of invasive Eurasian watermilfoil under current and future climate scenarios at the Minnesota Aquatic Invasive Species Research Center, and
3) Nine years of co-leading research (6 doctoral, 3 postdoctoral) at the NSF-funded North Temperate Lakes Long Term Ecological Research program (University of Wisconsin-Madison) focusing on long-term study of zooplankton

communities in the context of lake food webs, fisheries, and water quality. Dr. Walsh worked closely with LTER data managers and UW-Madison Zoological Museum to use and contribute to zooplankton databases and sample collections.

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

**Organization Description:**
The UMN College of Food, Agricultural, and Natural Resources Sciences (CFANS) works to advance Minnesota as a global leader in food, agriculture, and natural resources management through extraordinary education, science-based solutions, and dynamic public engagement that nourishes people and enhances the environment in which we live. This work will be conducted in the UMN CFANS Department of Fisheries, Wildlife, and Conservation Biology. FWCB provides multidisciplinary research to advanced informed natural resources decision-making about animal populations and the habits and landscapes they depend on.

## Budget Summary

| Category / Name | Subcategory or Type | Description | Purpose | Gen. Ineli gible | % Bene fits | # FTE | Class ified Staff? | $ Amount |
|---|---|---|---|---|---|---|---|---|
| **Personnel** | | | | | | | | |
| Principal Investigator | | Manage project, advise graduate student | | | 37.1% | 0.69 | | $145,277 |
| Co-Principal Investigator, Dr. Gretchen Hansen | | Consult on fisheries-related research aims | | | 37.1% | 0.12 | | $25,992 |
| Graduate Student Research Assistant | | Collect and analyze data, work with team to design research and outputs, prepare reports, publications, and data products | | | 25.1% | 2.25 | | $254,534 |
| | | | | | | | **Sub Total** | **$425,803** |
| **Contracts and Services** | | | | | | | | |
| | | | | | | | **Sub Total** | - |
| **Equipment, Tools, and Supplies** | | | | | | | | |
| | | | | | | | **Sub Total** | - |
| **Capital Expenditures** | | | | | | | | |
| | | | | | | | **Sub Total** | - |
| **Acquisitions and Stewardship** | | | | | | | | |
| | | | | | | | **Sub Total** | - |
| **Travel In Minnesota** | | | | | | | | |
| | Conference Registration Miles/ Meals/ Lodging | Estimate example: travel to Duluth, MN for a five-day conference. Conference Registration: $500; Mileage: 0.67*151*2 = $202.34; Lodging: 4 nights * 300 = $1,200; Meals: 2 days at 0.75 per diem, 3 days | Present results at in-state, practitioner-focused conference | | | | | $4,516 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | at full per diem = 2*0.75*79 + 3*1*79 = $355.50. Total: $2,257.84 per person x 2 people = $4,515.68 | | | | | | |
| | | | | | | | Sub Total | $4,516 |
| **Travel Outside Minnesota** | | | | | | | | |
| | Conference Registration Miles/ Meals/ Lodging | Estimate example: travel to Sault St. Marie, MI for 2023 NAFWS Great Lakes Regional Conference. Conference Registration: $500; Flights: $1,000; Lodging: 4 nights * 160.50 = $642; Meals: 2 days at 0.75 per diem, 3 days at full per diem = 2*0.75*59 + 3*1*59 = $265.50. Total: $2,407.50 | Present results at Native American Fish & Wildlife Society National or Great Lakes Regional Conference. | X | | | | $2,408 |
| | | | | | | | Sub Total | $2,408 |
| **Printing and Publication** | | | | | | | | |
| | Publication | 4 open access publications at ~$3,068 each (one fish and one water quality publication for each of Activities 1 and 2). | Disseminate research findings | | | | | $12,273 |
| | | | | | | | Sub Total | $12,273 |
| **Other Expenses** | | | | | | | | |
| - | | | | | | | Sub Total | - |
| | | | | | | | Grand Total | $445,000 |

## 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 | Estimate example: travel to Sault St. Marie, MI for 2023 NAFWS Great Lakes Regional Conference. Conference Registration: $500; Flights: $1,000; Lodging: 4 nights * 160.50 = $642; Meals: 2 days at 0.75 per diem, 3 days at full per diem = 2*0.75*59 + 3*1*59 = $265.50. Total: $2,407.50 | Fisheries and water quality related results will be important for Tribal natural resources managers. Many regional and Minnesota Tribal managers attend the NAFWS National Conference. |

## Non ENRTF Funds

| Category | Specific Source | Use | Status | Amount |
|---|---|---|---|---|
| **State** | | | | |
| In-Kind | Game and Fish Fund | Minnesota DNR Fisheries Research Scientist Heidi Rantala will provide 104 hours of in-kind support of this project for each of three years, for a value of $16,755. Dr. Rantala will contribute to project design, compile existing MNDNR data, perform statistical analyses, and help create reports and outreach materials for the project. She will lead and participate in outreach events and act as liaisons for the project to fisheries managers and MNDNR leadership. This project will provide an opportunity to utilize the large MNDNR zooplankton dataset to better understand Minnesota lakes and fisheries. | Secured | $16,755 |
| | | | **State Sub Total** | $16,755 |
| **Non-State** | | | | |
| - | | | **Non State Sub Total** | - |
| | | | **Funds Total** | $16,755 |

**Total Project Cost: $461,755**

**This amount accurately reflects total project cost?**

    Yes

## Attachments

### Required Attachments

*Visual Component*

File: [5d16549c-8b3.pdf](5d16549c-8b3.pdf)

*Alternate Text for Visual Component*

The Visual Component includes (from top to bottom) the project title, a diagram showing the importance of zooplankton for supporting fisheries and water quality, a project statement related to leveraging state monitoring data, and a list of four project goals....

### Supplemental Attachments

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

| Title | File |
|---|---|
| Partner letter for Heidi Rantala | [af4ee926-1cb.pdf](af4ee926-1cb.pdf) |
| Endorsement Letter from UMN Sponsored Projects Administration | [f270f611-11a.pdf](f270f611-11a.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:**

Dr. Gretchen Hansen (UMN), Dr. Heidi Rantala (MN DNR), Kylie Cattoor (MN DNR), Patrick McDonald (UMN), Kelsey Grachek (UMN)