



Environment and Natural Resources Trust Fund

2021 Request for Proposal

General Information

Proposal ID: 2021-126

Proposal Title: Are Fish Mercury Concentrations Higher in Winter?

Project Manager Information

Name: Ted Ozersky

Organization: U of MN - Duluth - Large Lakes Observatory

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Project Basic Information

Project Summary: Toxic mercury levels may be higher in fish during winter. We will perform the first full-year study of mercury in Minnesota lakes. Results could strengthen Minnesota fish consumption guidelines.

Funds Requested: \$387,000

Proposed Project Completion: 2024-06-30

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.

Mercury is a potent environmental toxin that negatively impacts human health. The main way Minnesotans are exposed to mercury is consumption of game fish from our lakes and rivers. Much of the fishing in our state is done under ice, but there is currently very little information on cycling of mercury in the environment or its levels in fish during winter.

Mercury levels in fish are affected by: (1) geochemical processes that make mercury available to aquatic organisms; (2) food web dynamics that move mercury up the food chain; (3) physiological uptake and elimination of mercury. There are many good reasons to believe that seasonal variation in these intertwined factors causes elevated mercury levels in some Minnesota lakes during winter.

We propose to study the full-year seasonality of mercury in the food webs of several ecologically different Minnesota lakes. This will be the first comprehensive study of winter mercury in seasonally frozen lakes in Minnesota and the world.

Results will: (1) identify which types of Minnesota lakes have elevated winter mercury levels; (2) advance understanding of toxic mercury cycling in the environment; (3) help determine if monitoring by state agencies needs to consider seasonal variation in fish mercury levels.

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

Researchers from UMD will work with citizen-scientists to study the seasonality of mercury in 11 diverse Minnesota lakes.

UMD researchers will measure mercury in water, lower food web organisms and fish (minnows, yellow perch, northern pike) from 6 Minnesota sentinel lakes. Study lakes encompass the diversity of Minnesota fishing lakes: 2 lakes are “green” (eutrophic), 2 are “blue” (oligotrophic) and 2 are “brown” (high tannins). In each color category, 1 lake is deep and 1 is shallow.

In Year 1 of the project, study lakes will be sampled 4 times per year (May, August, November, February). This approach will determine whether some lakes are more susceptible to winter mercury bioaccumulation and identify which factors drive seasonal variation of mercury in fish.

Sampling will be supplemented with a citizen-science program on 5 popular ice-fishing lakes. In years 1 and 2 of the project, researchers will travel to 2 ice-fishing tournaments to interact with ice fishers and obtain fish samples for mercury analysis. Researchers will also work with lake associations to collect winter samples from 3 additional lakes. The citizen-science program will focus on northern pike, comparing winter results from ice fishers to summer data collected by Minnesota state agencies.

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 better understanding of exposure of Minnesota fishers to mercury is a key project outcome. Results will provide foundational knowledge that could form the basis for more effective monitoring and consumption advice.

This project addresses several funding priorities including A1 (acquisition of foundational natural resource data and information) and B2.I (understanding impacts of contaminants on health of humans and aquatic species). Results are also relevant to priority B2.III (advancing development of contaminant standards) by helping determine whether

seasonal variation in mercury dynamics needs to be considered by state agencies that test fish mercury levels and set consumption guidelines.

Activities and Milestones

Activity 1: Assess seasonal variation and drivers of mercury concentrations in water and food webs of 6 Minnesota sentinel lakes.

Activity Budget: \$346,826

Activity Description:

Researchers from UMD (project PIs and graduate students) will sample 6 Minnesota sentinel lakes through a full annual cycle.

Sampling will include water column measurements of basic limnological variables (temperature, oxygen, nutrients) and collection of water and biological samples for mercury concentration and food web measurements. Mercury levels will be measured in water from different depths, particulate organic material (base of food web), zooplankton, benthic organisms and 3 fish species with different diets (minnows, yellow perch, northern pike). We will determine the abundance, taxonomic composition and size distribution of zooplankton and benthic organisms, and use stable isotopes to evaluate seasonal changes to food web structure in the study lakes.

Results will describe the seasonal variation of mercury levels in different parts of lake food webs and allow us to evaluate our hypotheses about seasonality of mercury in fish. Results will also form the basis for predictive relationships between seasonal environmental conditions, lake types and fish tissue mercury concentrations. This will allow extrapolation of our results to other lakes.

Activity Milestones:

Description	Completion Date
Sentinel lake sample collection	2022-09-30
Analysis of nutrient, stable isotope and mercury samples	2023-07-31
Analysis and interpretation of data	2023-12-31

Activity 2: Implement citizen-science program to collect winter-period fish samples from popular ice-fishing lakes.

Activity Budget: \$22,587

Activity Description:

We will involve the broader Minnesota community in a citizen-science program in which ice fishers will collect samples of fish for mercury analysis. This will allow us to increase the geographical scope of our sampling program while directly including Minnesotans in research.

In winter of Year 1 of the project, UMD researchers will travel to 2 ice fishing tournaments (Island Lake Reservoir and Mille Lacs Lake). They will interact with ice fishers, discussing issues relating to mercury pollution and aquatic research in Minnesota and demonstrate limnological sampling methods. Researchers will also collect samples of northern pike tissue from ice fishers for mercury analysis. We will also work with lake association and fishing outfitters on 3 additional lakes (Leech, Upper Red, Waconia) to obtain samples of winter-caught northern pike.

Our goal is to analyze 20 fish from each of the five citizen-science lakes (100 fish total). Results of mercury analysis from winter citizen-scientist samples will be compared to summer data available for the same lakes from routine state

sampling programs and to results from sentinel lake sampling (Activity 1). We will track submitted samples and report the results of mercury analysis to each citizen scientist that submits a sample.

Activity Milestones:

Description	Completion Date
Visit ice fishing tournaments on Island Lake and Lake Mille Lacs to conduct outreach and collect fish tissue samples	2022-02-28
Work with lake associations on Upper Red Lake, Lake Waconia and Leech Lake to collect fish samples from citizen-scientists	2023-02-28
Analyze mercury concentrations in fish tissue samples collected by citizen scientists and integrate with results	2023-05-31

Activity 3: Communicate study findings to research community, state agencies and Minnesotans.

Activity Budget: \$17,587

Activity Description:

This study will produce results that will advance the scientific community’s understanding of mercury dynamics in lakes that freeze. Results will also have the potential to inform management actions by state agencies to help protect the health of Minnesotans.

We will publish our findings in peer-reviewed scientific publications under open-access licensing to enable broad access to the study results. Data generated in the project will be made freely available to other scientists through data repositories. We will attend regional or national conferences and present our findings to a broad audience of scientists and ecosystem managers. We will also share our findings directly with Minnesota state agencies, including MN DNR, MPCA and MNDH.

We will communicate information about our research and findings to Minnesotans through local media outlets (newspaper, TV) and community outreach, including at ice fishing tournaments. We will also ensure that results get back to the citizen scientists who helped gather fish tissue samples.

Activity Milestones:

Description	Completion Date
Communication and reporting of results to state agencies and other stakeholders (LCCMR, Minnesota residents)	2024-06-30
Preparation of peer-reviewed manuscripts and scientific conference presentations based on study findings, depositing results in data repositories	2024-06-30

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Marte Kitson	University of Minnesota Sea Grant Program	Marte Kitson is an Environmental Literacy Extension Educator at Minnesota Sea Grant. She has extensive experience with environmental education and extension activities, including work with the public, media and K-12 educators. She will help coordinate outreach and extension activities associated with this project.	Yes
Thomas Hrabik	University of Minnesota Duluth; Biology Department	Dr. Thomas Hrabik is a professor in the department of Biology (University of Minnesota Duluth). He has extensive experience studying freshwater fish and food webs, including the dynamics of mercury. Dr. Hrabik will lead the fisheries portion of this work.	Yes
Nathan Johnson	University of Minnesota Duluth; Civil Engineering	Dr. Nathan Johnson is an associate professor in the department of Civil Engineering at the University of Minnesota Duluth. He is a biogeochemist with experience studying mercury transformations in lakes and the dynamics of mercury in aquatic food webs. Dr. Johnson will lead the biogeochemistry portion of this work.	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 be funded?

The proposed work will be the first detailed assessment of full-year mercury concentrations and dynamics in Minnesota lakes. Results showing elevated winter mercury levels could serve as impetus for more detailed seasonal monitoring of game fish mercury levels by state agencies and as preliminary data for future research proposals to federal research funding agencies.

Communication of results to scientific audiences will contribute to better understanding of aquatic contaminant cycling. The citizen science and outreach components of the project will engage Minnesotans in environmental research and inform them about work supported by the ENRTF.

Project Manager and Organization Qualifications

Project Manager Name: Ted Ozersky

Job Title: Assistant Professor

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

Dr. Ted Ozersky is an assistant professor of biological limnology at the University of Minnesota Duluth where he is cross-appointed between the Large Lakes Observatory and the Biology Department. He has more than 10 years of research experience on the topics of food web structure, contaminant dynamics (including mercury) and winter ecology of diverse lakes in Minnesota and elsewhere.

Dr. Ozersky has led several funded projects (~\$790,000 total funding) and has experience with project management, supervision of graduate students and communications of scientific results to professional audiences and the broader public.

Organization: U of MN - Duluth - Large Lakes Observatory

Organization Description:

The research team is based at the University of Minnesota Duluth. Our team includes experts in winter ecology, mercury biogeochemistry, fisheries biology, and science extension and outreach, making us uniquely qualified to undertake this pioneering work.

In addition to strong expertise, our organization has the logistical capability to execute the proposed work. The laboratories of Drs. Ozersky, Johnson and Hrabik have sampling gear for collection of water, plankton, benthos and fish samples. A wide range of laboratory and analytical equipment is available to the project researchers, including microscopes, balances, elemental and stable isotope analysis systems, and the ability to prepare samples for mercury analysis (which will be performed at an external laboratory). The University of Minnesota Duluth has several graduate programs that will host graduate students working on this project.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
PI - Ozersky		PI			27%	0.08		\$12,023
Co-I - Johnson		Co-I			27%	0.08		\$15,331
Co-I - Hrabik		Co-I			27%	0.08		\$16,468
2 Grad student		MS students			44%	1.24		\$100,388
LLO Lab Tech		1 months in Y2 lab technician to assist with processing of water chemistry and bulk stable isotope sample analysis in year 2 of project			24%	0.08		\$4,933
Field tech		2 months in Y1 field technician to assist with field portion of the work			24%	0.17		\$9,584
Co-I - Kitson		1 month in Y1-2 to coordinate citizen science component			27%	0.16		\$15,175
							Sub Total	\$173,902
Contracts and Services								
							Sub Total	-
Equipment, Tools, and Supplies								
	Tools and Supplies	Winter field gear	Purchase of specialized gear for winter fieldwork (ice shelter, sleds, augers, chisels, etc.)					\$2,000
	Tools and Supplies	Filters	Purchase of various filters for sample collection and processing					\$3,000
	Tools and Supplies	Containers	Purchase of containers (bottles, bags) for storage of samples.					\$5,000
	Tools and Supplies	EtOH and other chemicals	Purchase of ethanol and other chemicals for sample preservation and processing.					\$1,000
	Tools and Supplies	Misc. supplies	Purchase of miscellaneous small items (gloves, tape, pens, markers) needed for field and lab work					\$2,000

5/18/2020

	Tools and Supplies	Citizen science kits	Purchase of supplies for citizen scientist sample collection kits (scalpels, single use forceps, storage bags, labels).					\$1,000
							Sub Total	\$14,000
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel to field sites	Cost of travel to field sites for sample collections, based on current mileage rate of \$0.575/mile					\$4,600
	Miles/ Meals/ Lodging	Accommodations for field work	Overnight accomodations for 4 researchers during sample collection trips (2 rooms per visit, 6 lakes, 4 visits to each lake).					\$4,800
	Miles/ Meals/ Lodging	Per diem for field travel	Per diem (meals) for 4 researchers during fieldwork.					\$5,472
	Miles/ Meals/ Lodging	Travel to citizen-science lakes	Travel to lakes where citizen-science activities will take place. Includes travel to fishing tournaments for outreach and sample collection and to collect samples from lake associations.					\$1,000
							Sub Total	\$15,872
Travel Outside Minnesota								
	Conference Registration Miles/ Meals/ Lodging	Conference attendance	Registration, travel, accommodations for 1 PI and 2 students in Year 3	X				\$4,000
							Sub Total	\$4,000

Printing and Publication								
	Publication	Open access cost	Costs to cover open-access publication fees (2 papers), making research broadly available to scientific community and other stakeholders.					\$6,000
							Sub Total	\$6,000
Other Expenses								
		Sensor calibration/ service	Calibration of water quality sensors before start of fieldwork					\$1,500
		State water chem "bundle"	Analysis of water chemistry samples from study lakes, including various forms of P and N, chlorophyll, DOC.					\$6,480
		Foodweb C/N SIA "bundle"	Analysis of carbon and nitrogen stable isotope composition in phytoplankton, zooplankton, benthic organisms and fish to determine trophic level and food web structure.					\$9,246
		Mercury analysis	Cost of mercury analysis in environmental samples, including water, seston, zooplankton, benthic organisms and fish (both samples collected by researchers and citizen scientists). 1200 samples @ \$130/sample					\$156,000
							Sub Total	\$173,226
							Grand Total	\$387,000

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	Conference attendance	Costs for 2 graduate students to attend regional conference and communicate results of research to scientific audiences and stakeholders.

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: [25704954-b12.pdf](#)

Alternate Text for Visual Component

Visual component shows a map of proposed study sites and the approach to integrating field and citizen scientist sampling with research hypotheses and outcomes.

Optional Attachments

Support Letter or Other

Title	File
Transmittal Letter	874b1d04-98a.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have patent, royalties, or revenue potential?

No

Does your project include research?

Yes

Does the organization have a fiscal agent for this project?

No

