

**Environment and Natural Resources Trust Fund  
2019 Request for Proposals (RFP)**

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**Project Title:**

**ENRTF ID: 089-B**

Assessing Algal Toxins in Fish from Minnesota Lakes

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**Category:** B. Water Resources

**Sub-Category:**

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**Total Project Budget: \$** 350,000

**Proposed Project Time Period for the Funding Requested:** June 30, 2022 (3 yrs)

**Summary:**

Determining concentrations of several algal toxins in fish and water samples from Minnesota lakes will fill current data gaps and raise awareness about potential hazards to ecosystems and human health.

**Name:** Jeffrey Ziegeweid

**Sponsoring Organization:** USGS

**Title:** Hydrologist

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**Email** jrziege@usgs.gov

**Web Address** https://mn.water.usgs.gov/index.html

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**Location**

**Region:** Statewide

**County Name:** Statewide

**City / Township:**

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**Alternate Text for Visual:**

Flow chart illustrating confirmed and potential pathways of algal toxin exposure to humans, dogs, and fish.

<input type="checkbox"/>	Funding Priorities	<input type="checkbox"/>	Multiple Benefits	<input type="checkbox"/>	Outcomes	<input type="checkbox"/>	Knowledge Base
<input type="checkbox"/>	Extent of Impact	<input type="checkbox"/>	Innovation	<input type="checkbox"/>	Scientific/Tech Basis	<input type="checkbox"/>	Urgency
<input type="checkbox"/>	Capacity Readiness	<input type="checkbox"/>	Leverage	<input type="checkbox"/>	TOTAL	<input type="checkbox"/>	%
<input type="checkbox"/>	If under \$200,000, waive presentation?						



**PROJECT TITLE: Assessing Algal Toxins in Fish from Minnesota Lakes**

**I. PROJECT STATEMENT**

***We know that exposures to algal toxins in Minnesota lakes cause dog deaths and human illnesses, but we don't know if algal toxins are harmful to Minnesota fish or to people consuming fish.***

Minnesota contains thousands of lakes used extensively for outdoor recreation activities, but increases in algal toxins throughout the state could affect human health and recreational fisheries that generate substantial economic revenue to the State of Minnesota. Additional studies are needed to fill existing data gaps for understudied algal toxins and for concentrations of algal toxins in fish tissues.

Microcystin is an algal toxin that affects liver function and has been identified in several Minnesota lakes. The algal toxins anatoxin-a (also known as "Very Fast Death Factor") and saxitoxin are potent neurotoxins that bioaccumulate in fish tissues and also have been linked to animal deaths and human illnesses. However, anatoxin-a and saxitoxin data in Minnesota are limited to a single USGS study of Lake Kabetogama that measured high concentrations of anatoxin-a and saxitoxin in water. Therefore, this study is needed to determine whether these algal toxins are present in other Minnesota lakes and whether the toxins reach concentrations in water and fish tissue that could cause consumption concerns.

The goal of this project is to measure algal toxins in water and game fish collected from heavily-used recreation lakes with active cyanobacterial blooms that produce algal toxins. Measured algal toxins will include microcystin, anatoxin-a, saxitoxin, and other toxins if documented cases occur. **We will assess:**

- (1) whether anatoxin-a and saxitoxin are present in fish and water from lakes in Minnesota,***
- (2) whether algal toxin bioaccumulation negatively impacts fish condition and reproduction, and***
- (3) whether algal toxins in fish warrant additional human consumption studies.***

Fish specimens will be obtained from lakes using existing fisheries surveys conducted by the Minnesota Department of Natural Resources (MNDNR). Water samples collected during each fish collection will be used to determine the relation between algal toxin concentrations in fish and water. **Study lakes will meet at least one of the following criteria:**

- (1) Large Walleye lake,***
- (2) Sentinel lake,***
- (3) documented dog death,***
- (4) documented microcystin in water.***

The study design maximizes the likelihood of detectable algal toxin concentrations in water and fish samples. Water and fish samples will be obtained from 6 of 15 candidate lakes. Final lake selection will be based on availability of target fish species from MNDNR surveys and whether surveys occurred during an active bloom. Target fish species include (but are not limited to) black crappie, yellow perch, northern pike, and walleye.

**II. PROJECT ACTIVITIES AND OUTCOMES**

**Activity 1:** *Analyze water and fish samples for algal toxins.*

Water samples and 20 fish of 2-3 target species from each of the 6 study lakes will be analyzed for microcystin, anatoxin-a, and saxitoxin using either enzyme-linked immunosorbent assays or liquid chromatography with tandem mass spectrometry. Fish weights and lengths will be measured prior to dissection. Muscle tissue will be analyzed for all three algal toxins, livers will be analyzed for microcystin, and brains will be analyzed for anatoxin-a and saxitoxin. Gonads will be weighed, and the proportion of gonad weight to total weight will be calculated to examine correlations between algal toxins and reproductive potential.

**ENRTF BUDGET: \$ 200,000**

Outcome	Completion Date
1. Water samples (1-3 per lake) and 360 fish (3 species/lake, 20 fish/species, 6 lakes) obtained from MNDNR Surveys for analysis of 3 or more algal toxins	December 31, 2019



**Environment and Natural Resources Trust Fund (ENRTF)  
2019 Main Proposal Template**

2. Water results will be compared to standards set by the World Health Organization (WHO), muscle tissue results will be relevant to human consumption, and liver and brain results will connect to mode of toxicity for each algal toxin.	December 31, 2020
3. Proportional gonad weight will be correlated to algal toxin concentration as a way to assess potential for negative effects on fish reproduction.	June 30, 2021

**Activity 2:** Publish data, conduct statistical analyses, and submit a draft report to the LCCMR.

**ENRTF BUDGET: \$ 150,000**

<b>Outcome</b>	<b>Completion Date</b>
1. All collected data will be published in a publicly available USGS database.	June 30, 2021
2. Relations between lake locations, lake characteristics, and algal toxin concentrations in water and fish will be examined using statistical analyses.	December 31, 2021
3. The draft report will be reviewed and published as a USGS Series Report or peer-reviewed journal article that can be referenced by state agencies interested in improving their understanding of algal toxin extent and exposure pathways.	June 30, 2022

**III. PROJECT PARTNERS:**

**A. Partners receiving ENRTF funding**

<b>Name</b>	<b>Title</b>	<b>Affiliation</b>	<b>Role</b>
Jeffrey Ziegeweid	Hydrologist	USGS Upper Midwest Water Science Center (MN)	Principal Investigator: coordinate completion of project tasks, lead publication processes, and <b>provide USGS Cooperative Water Funds that cover USGS indirect costs.</b>
Victoria Christensen	Research Hydrologist	USGS Upper Midwest Water Science Center (MN)	Co-Principal Investigator: Provide subject-matter expertise and participate in statistical analysis, interpretation, and report writing.

**B. Partners NOT receiving ENRTF funding**

<b>Name</b>	<b>Title</b>	<b>Affiliation</b>	<b>Role</b>
Dr. Heidi Rantala	Natural Resource Consultant	MNDNR Fisheries	In-kind coordination of specimens from MNDNR survey crews; data analysis and interpretation

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:**

This project will help fill existing data gaps related to algal toxins in Minnesota lakes and will provide baseline data that could inform future studies to further examine the duration and toxicity of algal toxins in fish. Information relating algal toxins in fish to algal toxins in water could be incorporated into a real-time algal toxin water exposure map application that other researchers recently proposed to develop.

**V. TIME LINE REQUIREMENTS:**

The project duration will be from July 2019 through June 2022. Fish collections from the MNDNR will occur from July through October 2019. A contract laboratory with the analytical capabilities required for dissection of fish specimens and analysis of algal toxins will be selected through a competitive bidding process. Statistical analyses and report writing will be completed in one year. The total time requested will be 36 months.

**VI. ADDITIONAL PROPOSAL COMPONENTS:**

A. Proposal Budget Spreadsheet, B. Visual Component, F. Project Manager Qualifications and Organization Description

## 2019 Proposal Budget Spreadsheet

**Project Title:** Assessing Algal Toxins in Minnesota Waters and Fish

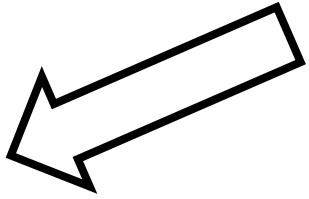
### IV. TOTAL ENRTF REQUEST BUDGET: 3 years

BUDGET ITEM (See "Guidance on Allowable Expenses")	AMOUNT
<b>Personnel:</b> USGS salaries are covered by "soft money" and are all 65% salary and 35% benefits: 1 USGS Hydrologist/Project Manager at 13% FTE each year for 3 years; 1 USGS Research Hydrologist at 10% FTE each year for 3 years; 1 USGS Water-Quality Specialist at 2% FTE each year for 3 years; 1 USGS Administrative Support Staff at 2% FTE each year for 3 years.	\$150,000
<b>Professional/Technical/Service Contracts:</b> Contract laboratory for the processing and analyses of collected fish specimens and water samples. Specific laboratory TBD through competitive bidding process. Contract laboratory will have the capability to store, dissect, and analyze fish tissues and analyze water samples. Laboratory also will have QA/QC procedures that meet USGS publication standards.	\$ 188,000
<b>Equipment/Tools/Supplies:</b> Sampling supplies for fisheries field crews to collect and process water samples associated with fish collections, and coolers to ship fish specimens.	\$ 4,000
<b>Acquisition (Fee Title or Permanent Easements):</b> N/A	---
<b>Travel:</b> Within-Minnesota travel to meet with project personnel and present findings at local meetings. \$129 per day hotel and meals at State rate x 2 people x 12 days each, plus additional costs for vehicle gas and mileage related to travel to field locations and in-state cooperator meetings.	\$ 4,000
<b>Additional Budget Items:</b> Shipping of fish and water samples to the contract laboratory. \$100 per fish sample cooler, \$100 per water sample cooler, at least 3 fish sample coolers and 1 water sample cooler per lake, 6 lakes.	\$ 4,000
<b>TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =</b>	<b>\$ 350,000</b>

### V. OTHER FUNDS (This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)

SOURCE OF FUNDS	AMOUNT	Status
<b>Other Non-State \$ To Be Applied To Project During Project Period:</b>		
USGS Cooperative Matching Funds - federally appropriated dollars <b>used to cover indirect costs.</b>	\$ 90,000	<i>Pending</i>
USGS-NPS Water-Quality Partnership Program technical assistance funds used to collect fish and water samples for analysis of algal toxins in Kabetogama Lake, Voyageurs National Park.	\$ 50,000	<i>Pending</i>
Water Resource Research Institute (WRI) Proposal for using neural networks to predict future algal bloom occurrence (competitive process)	\$ 250,000	<i>Pending</i>
<b>Other State \$ To Be Applied To Project During Project Period:</b> N/A	\$ -	<i>N/A</i>
<b>In-kind Services To Be Applied To Project During Project Period:</b> Collection of fish and water samples by MDNR Fisheries survey crews for algal toxin analysis.	\$ 15,000	<i>Secured</i>
<b>In-kind Services To Be Applied To Project During Project Period:</b> Support time for Heidi Rantala to coordinate between DNR and USGS and assist with data analysis and report writing.	\$ 5,000	<i>Secured</i>
<b>Past and Current ENRTF Appropriation:</b> N/A	\$ -	<i>N/A</i>
<b>Other Funding History:</b> N/A	\$ -	<i>N/A</i>

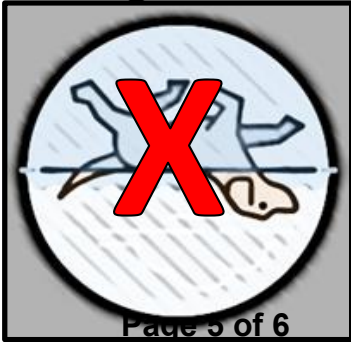
## Known Effects Pathways



### Contact Exposures



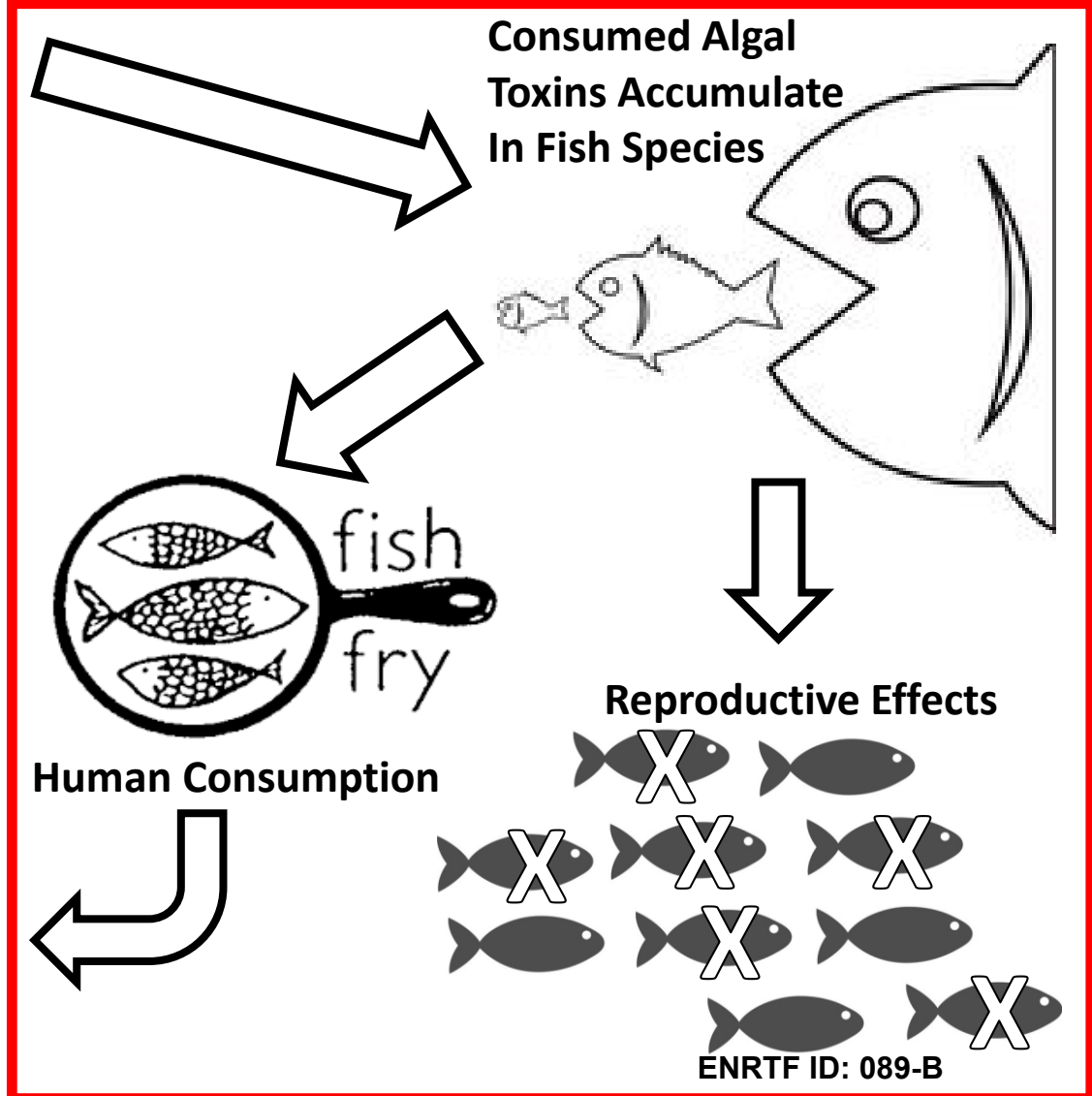
### Dog Deaths



### Human Illness



## Unknown But Potential Effects Pathways



## **PROJECT MANAGER QUALIFICATIONS AND ORGANIZATION DESCRIPTION**

Jeffrey Ziegeweid is a Hydrologist with the Minnesota office of the U.S. Geological Survey (USGS) Upper Midwest Water Science Center. He has a M.S. in Forestry and Natural Resources (Fisheries Emphasis) from the University of Georgia. Jeff also received his B.S. degree from the University of Wisconsin-La Crosse, with majors in Biology (Aquatic Science Concentration) and Chemistry and a minor in Mathematics. Currently, Jeff supervises the Sediment Program in the Minnesota USGS office and also serves as a project chief for several interdisciplinary USGS studies that link physical and hydrologic changes to biological responses in Minnesota lakes and streams. Currently Jeff is leading a statewide effort with the Minnesota Pollution Control Agency (MPCA) to identify hydrologic and aquatic life metrics that quantify the effects of altered hydrology on biological communities in Minnesota streams.

The **USGS** is a non-regulatory science agency that works as a partner with state agencies to collect and analyze myriad water-quality data. The project team has extensive experience identifying and quantifying the presence of algal toxins in northern Minnesota lakes, has state-of-the-science expertise, and access to the most current science and technology related to algal toxin research from USGS scientists nationwide. This study will be included as part of a larger effort of the USGS to provide information to help resource managers understand how to effectively minimize potential risks to the health of humans and other organisms exposed to algal toxins through recreation, drinking water, and other exposure routes. These collaborations and access to technology makes the USGS uniquely positioned to carry out the work for this project.