Environment and Natural Resources Trust Fund
2017 Request for Proposals (RFP)

Project Title: **ENRTF ID: 109-D**

Quantifying Spiny Waterflea Threats to Minnesota Walleye Lakes

Category: D. Aquatic and Terrestrial Invasive Species

Total Project Budget: $ 1,690,320

Proposed Project Time Period for the Funding Requested: 4 Years, July 2017 - June 2021

Summary:

The proposed project will quantify the threats posed by established populations of spiny waterflea (Bythotrephes longimanus) to the sustainability of aquatic ecosystems in vulnerable Minnesota walleye lakes.

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Sponsoring Organization: U. S. Geological Survey

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Location

Region: Central, Northwest, Northeast

County Name: Becker, Beltrami, Benton, Carlton, Cass, Clay, Clearwater, Cook, Crow Wing, Hubbard, Itasca, Kanabec, Koochiching, Lake, Lake of the Woods, Mahnomen, Mille Lacs, Morrison, Norman, Otter Tail, Pennington, Pine, Red Lake, Roseau, Sherburne, St. Louis, Todd,

City / Township:

Alternate Text for Visual:

Map of the current Minnesota watersheds that have lakes with established spiny waterflea populations

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%

PROJECT TITLE: Quantifying spiny waterflea threats to Minnesota walleye lakes

I. PROJECT STATEMENT

Our project will quantify the threats posed by established populations of spiny waterflea (*Bythotrephes longimanus*) to the sustainability of aquatic ecosystems in vulnerable Minnesota walleye lakes

GOALS: The goals of this project are to understand how spiny waterflea infestations:

(1) Change energy flow and nutrient cycling in infested lakes,

(2) Affect the growth and recruitment of forage and popular gamefish in infested lakes, and

(3) Alter the frequency and intensity of harmful algal blooms in infested Minnesota lakes

The proposed project will target lake ecosystems located in the heart of spiny waterflea infestations in Minnesota (figure 1). Study lakes include Lake Kabetogama, Namakan Lake, Rainy Lake, and Lake of the Woods, and all study lakes are popular destination fishing and recreation lakes in the Rainy-Lake of the Woods basin. Information obtained will be applicable to all Minnesota lakes vulnerable to spiny water flea invasion. Outcomes from the proposed study will provide information necessary to manage Minnesota lakes in ways that mitigate the effects of spiny waterflea, including sustainability of gamefish and the development of harmful algal blooms.

WHY: Recently-published studies demonstrate that the introduction of spiny waterflea has reduced biomass of native zooplankton by 40 to 60 percent in Rainy, Kabetogama, and Namakan Lakes. These reductions mean less food and poorer quality food for forage fish like cisco and for larval gamefish like yellow perch, sauger, and walleye. Combined reductions in the quantity and quality of zooplankton are predicted to reduce the net flow of energy available for fish growth and may limit the recruitment of juvenile gamefishes to harvestable size classes. For example, a recent study demonstrated that growth rates of first-year yellow perch have declined following infestation by spiny waterflea in Rainy and Kabetogama lakes. Reduced growth rates could negatively affect yellow perch populations by increasing overwintering mortality and reducing recruitment. Yellow perch are important forage for popular gamefish species in the study lakes as well as throughout the zone of vulnerability in Minnesota. As a result, declines in yellow perch growth and recruitment could threaten the sustainability of popular gamefish species in the study lakes as well as in all destination walleye lakes of northern Minnesota.

HOW: Dynamic lake ecosystem models will be developed and used to simulate spiny waterflea-induced changes in net energy flow available to move up the food chain from phytoplankton to fish. Lake models will be integrated with fish bioenergetics models to predict how different densities of spiny waterflea change the carbon and energy flow available to sustain fish growth and recruitment in vulnerable Minnesota lakes.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Predict spiny waterflea impact on energy flow in study lakes **Budget: $1,308,100**

Dynamic lake ecosystem models will be developed for each study lake. The models will predict the amount of food energy available for fish using a dynamic food-web model that simulates how nutrients, algae and zooplankton interact to provide food for larval and juvenile fish. Lake models will be calibrated to current conditions and used to simulate how different densities of spiny waterflea change the food energy available to move from zooplankton to fish.

Outcome Activity 1	Completion Date
1. Lake ecosystem models for each study lake that predict how current spiny waterflea populations change food available for fish growth and nutrient cycling	June 30, 2019
2. Model predictions for each lake of how different densities of spiny waterflea change the energy flow available for fish growth and recruitment in study lakes	June 30, 2020
3. Technology transfer to MNDNR and advisory team members	Dec 31 2020
4. Final report to LCCMR and draft USGS Scientific Investigations Report	June 30, 2021

Activity 2: Predict growth and survival of forage and gamefish in study lakes **Budget: $292,220**

Lake models predict how densities of spiny waterflea change the quality and quantity of food (as carbon) available for fish growth and survival. Bioenergetics models take lake model results and predict how larval and juvenile fish growth rates respond to changing food quantity and quality under different levels of spiny waterflea infestation. Results provide guidance on how vulnerable Minnesota lakes will respond to spiny waterflea invasion.

Outcome Activity 2	Completion Date
1. Integrated lake ecosystem and bioenergetics models	June 30, 2019
2. Estimates of juvenile growth and survival bottlenecks for juvenile cisco, yellow perch, sauger, and walleye in all four study lakes for current and future spiny waterflea densities	June 30, 2020
3. Final report on spiny waterflea impacts on fish growth in vulnerable Minnesota lakes	June 30, 2021

Activity 3: Nutrient and phytoplankton modeling to predict biomass of harmful algal blooms **Budget: $90,000**

Spiny waterflea change nutrient cycling and phytoplankton communities because they alter zooplankton grazing rates and nutrient regeneration. Lake models will be used to predict the frequency and intensity of harmful algal blooms under different densities of spiny waterflea.

Outcome Activity 3	Completion Date
1. Model predictions of how different densities of spiny waterflea change the harmful algal bloom biomass in Lake Kabetogama and Lake of the Woods	Dec 31, 2020
3. Final report on spiny waterflea impacts on harmful algal bloom biomass	June 30, 2021

III. PROJECT STRATEGY

A. Project Team/Partners

The Principal Investigators for this project are Drs. Richard Kiesling and Erik Smith, USGS, Dr. Paul Venturelli, UM Department of Fisheries and Wildlife, and Ryan Maki, Voyageurs National Park. Dr. Smith will direct Activity 1, and Dr. Venturelli will direct activity 2. Dr. Kiesling will direct Activity 3 and serve as Project Manager. Project personnel will include two USGS student trainees and one UM Research Associate. The project advisory team includes a MNDNR Invertebrate Biologist, a MNDNR Fisheries Research Biometrician, two MNDNR Fisheries Area Supervisors, and two MNDNR Large Lake Specialists.

B. Project Impact and Long-Term Strategy

This study will synthesize several long-term data sets (water quality, flows, and levels; larval fish; adult fish) obtained through existing monitoring efforts conducted by the National Park Service, the MNDNR, and the USGS. In-kind support is being provided by Voyageurs National Park and MNDNR. In addition, the USGS has allocated $147,000 in matching funds and applied for an additional $300,000 through the USGS/NPS Water-Quality Partnership Program to support this study. Because study lakes are located on the border with Canada, additional funds will be pursued through the International Joint Commission. The results of this study will provide quantitative information that can be used when fisheries managers set sustainable harvest yields in several of the top destination walleye lakes in Minnesota. Also, study results can be used to guide management activities for other Minnesota lakes currently infested with spiny waterflea or vulnerable to future invasion.

C. Timeline Requirements

Four years of funding are being requested for this study. Because model development will be based on existing data collected during ongoing monitoring efforts, additional field data collection will be minimal and used only to support model validation. Because synthesized datasets and the study lakes themselves are large and complex, a substantial amount of staff time will be required to compile data and parameterize the models. Model development and scenario evaluation will occur during the first three years, and the final year will be used to produce reviewed and approved reports

2017 Detailed Project Budget

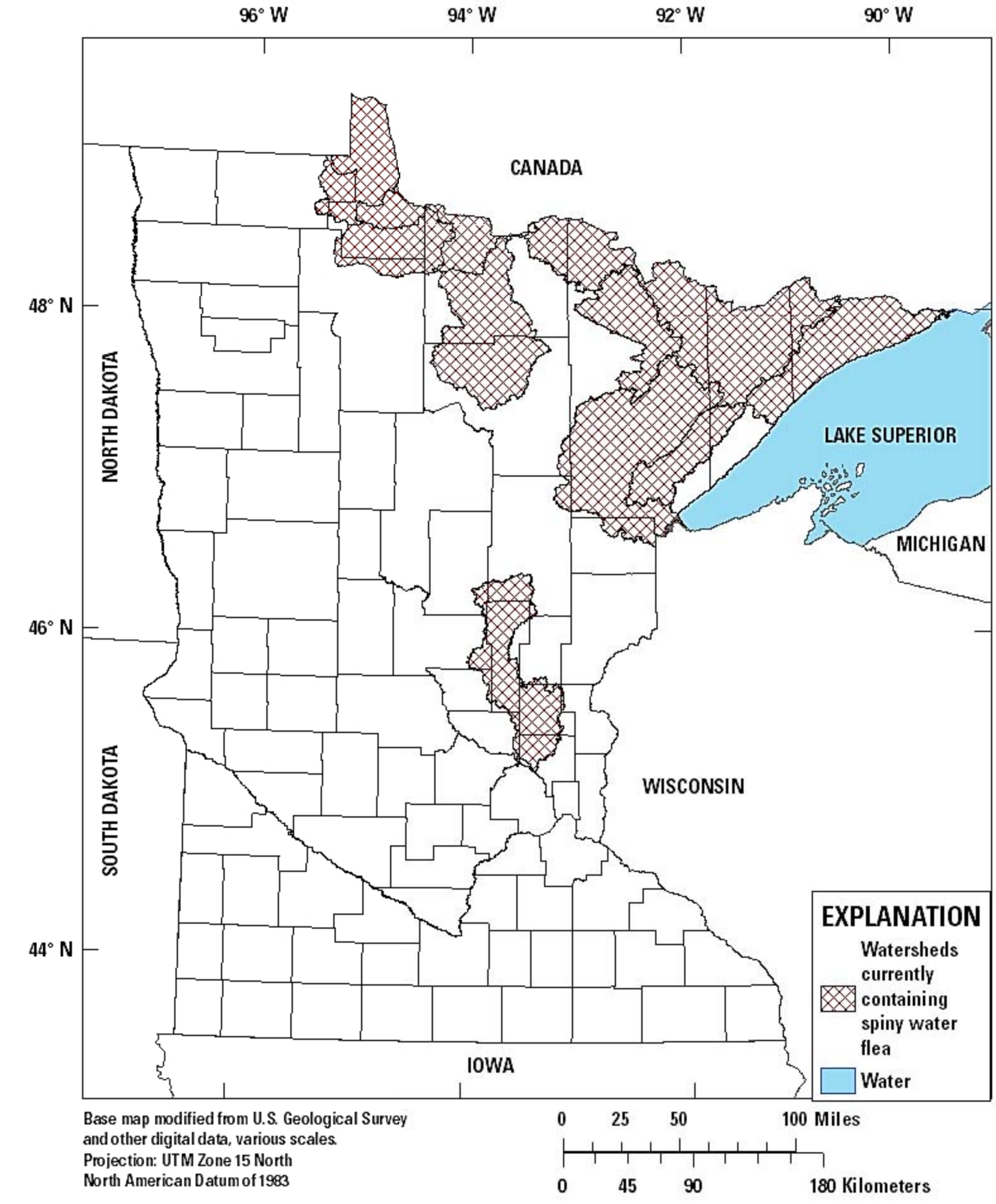
Project Title: Quantifying spiny waterflea threats to Minnesota walleye lakes

IV. TOTAL ENRTF REQUEST BUDGET - 4 years

BUDGET ITEM	AMOUNT
Personnel:	
USGS: One limnologist and project manager (75% salary, 25% benefits) 25% FTE for 4 years	$ 134,000
USGS: Two GS 12 hydrologists (70% salary, 30% benefits), 50% FTE for 4 yrs	$ 477,000
USGS: Two GS 5 career-path student trainees (65% salary, 35% benefits) 50% FTE for 4 yrs	$ 131,800
USGS: One GS 12 GIS spatial analyst (70% salary, 30% benefits), 10% FTE for 4 yrs	$ 54,400
USGS: One GS 6 Database programmer (70% salary, 30% benefits), 25% FTE for 4 yrs	$ 49,300
USGS: One GS 8 Budget analyst (68% salary, 32% benefits), 20% FTE for 4 yrs	$ 64,400
University of Minnesota: Post-doctoral research associate (66% salary, 34% fringe) 100% FTE for two years	$ 135,710
University of Minnesota: Assitant Professor (66% salary, 34% fringe) 12 weeks of summer salary	$ 36,510
Professional/Technical/Service Contracts: Software development contract with Portland State University to fully integrate bioenergetics computer code into CE-QUAL-W2 ($100,000); contract with USGS Enterprise Publishing network for editorial services and printing ($20,000)	$ 120,000
Equipment/Tools/Supplies: General office and computer supplies	$ 2,500
Acquisition (Fee Title or Permanent Easements):	$ -
Travel: In-state travel to regional MNDNR offices and to Voyageurs National Park Offices to coordinate database development and model development. Travel once a year to project workshop.	$ 7,500
Additional Budget Items: Shipping	$ 200
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 1,690,320

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
Other Non-State $ To Be Applied To Project During Project Period: $147,000 USGS Cooperative Water Program (pending); $100,000 USGS/NPS Partnership funds (secured); $300,000 USGS/NPS partnership funds (pending)	$ 547,000	*pending*
Other State $ To Be Applied To Project During Project Period:	$ -	
In-kind Services To Be Applied To Project During Project Period: MNDNR - $29,650 total in-kind support; National Park Service - $45,701 total in-kind support	$ 75,351	*Secured*
Funding History: USGS received ENRTF support for Sentinel Lakes Phase 2 Bio-physical modeling through the MN DNR	$ 197,000	Complete 6/30/2016
Remaining $ From Current ENRTF Appropriation:	$ -	


96° W
94° W
92° W
90° W
48° N
46° N
44° N
CANADA
NORTH DAKOTA
SOUTH DAKOTA
LAKE SUPERIOR
MICHIGAN
WISCONSIN
IOWA
EXPLANATION
Watersheds currently containing spiny water flea
Water
Base map modified from U.S. Geological Survey and other digital data, various scales.
Projection: UTM Zone 15 North
North American Datum of 1983
0 25 50 100 Miles
0 45 90 180 Kilometers

LCCMR Project Manager Qualification: Richard L Kiesling, Ph. D.

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Dr. Kiesling is a hydrologist and limnologist with the U.S. Geological Survey. He holds a B.S. in Biology from the University of Minnesota (1980) and a Ph.D. in Ecology from the University of Michigan (1990) with specialization in limnology and community ecology. He is currently the Lake and Water Quality Specialist with the USGS Minnesota Water Science Center.

Dr. Kiesling will function as the project manager for the proposed study. He will coordinate the work of USGS, University of Minnesota, and National Park Service scientists with the in-kind contributions from the Minnesota Department of Natural Resources. Dr. Kiesling has over twenty-five years of research and applied research project management experience in lake and reservoir studies, including lake modeling studies in Minnesota.

Relevant Selected Publications:

Smith, E.A., Kiesling, R.L., Galloway, J.M., and Ziegeweid, J.R., 2014, Water quality and algal community dynamics of three deepwater lakes in Minnesota utilizing CE-QUAL-W2 models: U.S. Geological Survey Scientific Investigations Report 2014–5066, 73 p., http://dx.doi.org/10.3133/sir20145066.

Christensen, V.G., Maki, R.P., and Kiesling, R.L., 2013, Evaluation of internal loading and water level changes: implications for phosphorus, algal production, and nuisance blooms in Kabetogama Lake, Voyageurs National Park, Northern Minnesota: Journal of Lake and Reservoir Management 209: 202-215. doi:10.1080/10402381.2013.831148

Christensen, V.G., Maki, R.P., and Kiesling, R.L., 2011, Relation of nutrient concentrations, nutrient loading, and algal production to changes in water levels in Kabetogama Lake, Voyageurs National Park, northern Minnesota, 2008–09: U.S. Geological Survey Scientific Investigations Report 2011–5096, 50 p.

Kiesling, R.L. with A.M.S. McFarland, and C Pearson. 2001. Lake Waco – Characterization of a central Texas reservoir with emphasis on factors influencing algal growth. Texas Institute for Applied Environmental Research, Tarleton State University, Stephenville, Texas, TR104 .

Kiesling, R.L. with J. F. Flowers, and L.M. Hauck. 2001. Water Quality Modeling of Lake Waco Using CE-QUAL-W2 for Assessment of Phosphorus Control Strategies. Texas Institute for Applied Environmental Research, Tarleton State University, Stephenville, Texas, TR0114.

Organization Description:

As the Nation's largest water, earth, and biological science and civilian mapping agency, the U.S. Geological Survey (USGS) provides scientific understanding about natural resource conditions, issues, and problems through joint studies with local, state, tribal and federal partners. The diversity of our scientific expertise enables us to carry out large-scale, multi-disciplinary investigations and provide impartial scientific information to resource managers, planners, and other customers.