

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

Project Title:

ENRTF ID: 054-B

Preventing Fish Kills by Increasing Understanding

Category: B. Water Resources

Total Project Budget: \$ 699,905

Proposed Project Time Period for the Funding Requested: 3 years, July 2017 - June 2020

Summary:

We will 1)map the risk of fish kills in Minnesota lakes and streams and 2)increase knowledge of water quality in southeastern Minnesota through real-time, background and storm event monitoring.

Name: Heidi Rantala

Sponsoring Organization: MN DNR

Address: 500 Lafayette Rd
St. Paul MN 55155

Telephone Number: (651) 259-5241

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Web Address http://www.dnr.state.mn.us/index.html

Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

We will use information about past fish kills and their causes in Minnesota lakes and streams to predict the risk of future fish kills in the state. This information will be used to guide activities that prevent fish kills, such as restoration, educate landowners about buffers, and protect heritage strains of native brook trout.

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



Environment and Natural Resources Trust Fund (ENRTF)

2017 Main Proposal

Project Title: Preventing fish kills by increasing understanding

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I. PROJECT STATEMENT

Mass fish mortalities are becoming more frequent and involve larger numbers of fish, with an estimated 500 events in Minnesota annually. In 2015, a large fish kill occurred on the South Branch of the Whitewater River, leading to an interagency effort to understand the event and highlighted a lack of knowledge about fish kills in general. Prevention of future incidents depends on understanding the distribution and conditions associated with past fish kills events. This can help predict areas that are likely to experience fish kill events in the future, especially given the increased stress that climate change, invasive species, and impaired water quality cause to native fish populations in Minnesota. Such predictions can be based on environmental conditions, history of events within a waterbody, land use, and proximity to waterbodies known to contain disease vectors.

Given the cultural, economic, and ecologic significance of fish communities in the State of Minnesota, understanding the frequency, magnitude, distribution, and conditions associated with fish kills will allow us to respond to incidents more quickly, predict areas that are vulnerable to mass fish mortalities, and prevent fish kills through protection of waterbodies. A focused investigation of water quality data in established DNR Fisheries long-term stream monitoring stations would complement the fish data collected at these stations, enhancing our understanding of fish community dynamics and parallel those data collected in the MNDNR/MPCA Sentinel Lake program. Currently, water quality is not monitored at the DNR Fisheries long-term stream monitoring stations but is a critical component of understanding stream health.

The ultimate goal of this collaborative team is to prevent fish kills in Minnesota with proactive management of risk factors. We will

- 1) **Analyze and map** the risk of fish kills in Minnesota’s waterbodies, and
- 2) **Monitor water quality** at existing MNDNR Fisheries Long-Term stations with a focused investigation in southeast Minnesota.

We will use data from previous fish kills in Minnesota to determine the risk of fish kills at a statewide scale. This model will be scalable to view high risk areas with more detail and indicate which variables (e.g., land use, water quality) make a given area vulnerable to fish kills. We will collect water quality data (i.e., temperature, dissolved oxygen, nutrients, turbidity) in six southeastern MN trout streams in conjunction with long term MNDNR Fisheries research stations. These data will allow us to better understand the relationships between fish communities and water quality, to predict fish kills and assess fish kill responses.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Statewide mapping of the risk of fish kills in Minnesota lakes and streams Budget: \$103,893

We will develop a statewide model that identifies areas most at risk for fish kills. The model will use existing information about previous fish kills in Minnesota, such as the number and species of fishes affected, cause of death, and relevant physical, chemical, and other environmental factors (e.g., water quality characteristics, land use patterns). These data will allow us to identify regions with the combination of factors explaining fish mortality using watershed characteristics across the state to identify areas vulnerable to fish kills. The relative contributions of these factors can be rescaled to focus on high-risk areas. This risk map will be validated by collecting intensive data about fish kills for a year after completion of the initial model. The model output will be shared by state and county agencies, as well as non-government organizations, for their use in preventing, assessing, and responding to fish kills.

Outcome	Completion Date
1. Create risk assessment map of fish kills in Minnesota’s lakes and streams	June 30, 2018
2. Access the accuracy of the model using independent data	June 30, 2019
3. Present results of the activity in the 2019 showcase of the MN Aquatic Invasive Species Research Center and publish a peer-reviewed paper	June 30, 2020



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Activity 2: Enhance DNR Fisheries long term stream monitoring program with intensive water quality sampling Budget: \$593,587

MNDNR Fisheries has 23 long-term, stream monitoring stations in southeast Minnesota. We will increase our understanding of the ecological health in six of these streams by monitoring background water quality, as well as water quality associated with precipitation runoff. Additionally, we will collect real-time water quality data (i.e., temperature, dissolved oxygen, turbidity, nutrients) using in-stream sensors. Sampling sites and variables to be measured will be coordinated with surface water staff from the Minnesota Department of Agriculture and Minnesota Pollution Control Agency. Results of intensive water quality monitoring will be used to predict fish kills and assess responses in a focused area, increasing predictability of the statewide model. Data and results will be shared with other state agencies, and be reported to the public and natural resource managers.

Outcome	Completion Date
1. Collect two years of data that provide an understanding of the dynamics of water quality, as it relates to hydrology	June 30, 2019
2. Publication in a peer reviewed journal, presentation at scientific conference and local meetings, and a final report of results	June 30, 2020

III. PROJECT STRATEGY

A. Project Team/Partners

Partners requesting Trust Funds

- **Dr. Heidi Rantala** (freshwater ecologist, MNDNR) will oversee the project.
- **Dr. Nicholas Phelps** (UMN, College of Veterinary Medicine and MN Aquatic Invasive Species Research Center) is an expert on fish health, and he will mentor one student and lead the modeling effort with consultation from **Dr. Luis Escobar**, an expert in spatial modeling (UMN, College of Veterinary Medicine).
- **Dr. Jim Perry** (UMN, Department of Fisheries, Wildlife, and Conservation Biology) is a freshwater ecologist and expert in climate change adaptation and resource management, and he will mentor one student.

Partners not requesting Trust Funds

- **Dr. Doug Dieterman** (Fisheries Research, MNDNR), **Ron Benjamin** (MNDNR Fisheries, Lanesboro Area Supervisor), **David Tollefson** (MDA, Hydrologist) and **Mike Walerak** (MPCA, watershed pollutant specialist) will be involved in project planning and interpretation of results.

Phelps and Perry will receive ENRTF funds to support one graduate student each for two years. Perry’s student will receive additional funds for travel for field sampling and supplies. MNDNR and MDA will receive money for equipment purchase and water chemistry analysis.

B. Project Impact and Long-Term Strategy

The goal of the project is to prevent fish kills in Minnesota by identifying key areas with increased risk of fish kills and the identifying the factors associated with this increased risk. The results of the water quality monitoring will allow us to better understand dynamics in southeast Minnesota trout populations, including fish health and relate those results to fish kill probability and response. The results of this study will be available to other state agencies, local governments, and non-governmental organizations to plan activities such as protecting sensitive fish populations (e.g., heritage brook trout), selective stocking of fish, providing land-use recommendations, and guiding restoration efforts.

C. Timeline Requirements

This project will require 3 years for completion. The fish kill risk assessment model will be developed the first year and validated the second. We will collect water quality data and fish kill data (for model validation) the first two years. The third year will be required to refine the fish kill model, analyze the water quality data, and develop relationships between water quality and fish kill variables. Final products including theses, peer-reviewed papers, and presentations will be completed in the third year.

2017 Detailed Project Budget

Project Title: Preventing fish kills by increasing understanding

IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel:	\$ -
Professional/Technical/Service Contracts:	\$ -
Nicholas Phelps, Collaborator (75% salary, 25% benefits); 0.05 FTE for 2 years 2.5 weeks/yr; mentorship for graduate research assistant, logisitics, and data analysis support	\$ 13,663
Graduate Research Assistant, School of Veterinary Medicine (56% salary, 44% benefits); 0.50 FTE for 2 years; directly involved in all Activity 1 duties	\$ 84,650
Graduate Research Assistant, Department of Fisheries, Wildlife, and Conservation Biology (54% salary, 46% benefits); 0.50 FTE for 2 years; directly involved in all Activity 2 duties	\$ 82,902
U of M graduate student travel associated with water quality sampling (per trip, 2 days each): \$250 food and lodging, \$135 vehicle (U of M rates); \$385 per trip, total; 30 annual trips; \$11,550/yr; 2 years	\$ 23,100
U of M graduate student travel associated with collecting samples from fish kills (per trip): \$93 vehicle (U of M rates); \$93 per trip, total; 30 annual trips; \$2790/yr; 2 years	\$ 5,580
Expendables for use by U of M grad student; new, amber-colored water bottles (360 bottles @ \$12 each; \$4320), labels, ice, coolers, field notebooks	\$ 5,000
Minnesota Department of Agriculture, Laboratory Services Division, Saint Paul, MN; analysis of stream water for water chemistry parameters to include nutrients and pesticides, 30 sampling dates at each of 6 stream reaches annually; 180 annual water samples for 2 years. \$125/sample for nutrient analysis, \$800/sample for agricultural chemicals (includes 135 chemicals);	\$ 333,000
Equipment/Tools/Supplies:	\$ -
Datalogging water quality sensors, ability to read dissolved oxygen, nutrients, pH, conductivity, and turbidity, with telemetry capability; \$12,165/sensor, 6 total; software and 2 hand-held computers to communicate with sensors; \$2265/instrument, 2 total; to be used for continued sampling by MNDNR after funding expires	\$ 77,520
Automated water sampler, with capability to be accessed remotely, 6 samplers @ \$12000 each; to be used for continued sampling by MNDNR after funding expires	\$ 70,000
Travel:	
Additional Budget Items:	\$ -
MNDNR Direct & Necessary Costs: Direct and necessary expenses: Financial Support (~\$2,065, Communications Support (~\$1,316), Planning support (~\$912) & Procurement Support (~\$197) necessary to accomplish funded project.	\$ 4,490
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 699,905

V. OTHER FUNDS

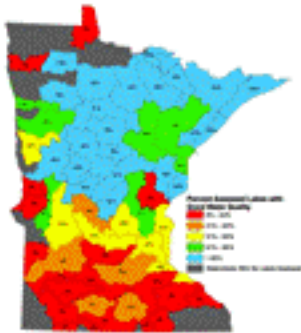
SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ To Be Applied To Project During Project Period:	NA	
Other State \$ To Be Applied To Project During Project Period: University of Minnesota faculty salaries. Jim Perry 0.10 FTE per year, salary plus fringe, 2 years, \$32,500. Accounting and administrative staff \$4,000 over 2 years.	\$ 50,000	<i>Secured</i>
In-kind Services To Be Applied To Project During Project Period: Indirect costs (52% MTDC) associated with the University of Minnesota's Facilities and Administrative costs	\$ 97,633	<i>Secured</i>
Heidi Rantala, MNDNR salary, 0.10 FTE per year, salary plus fringe, 3 years.	\$ 25,197	<i>Secured</i>
Funding History:	NA	
Remaining \$ From Current ENRTF Appropriation:	NA	

Preventing Fish Kills in Minnesota by Increasing Understanding

Fish Kills



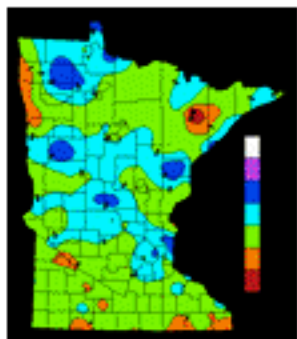
Causative Factors



Water Quality



Land use/
Human Activities



Climate

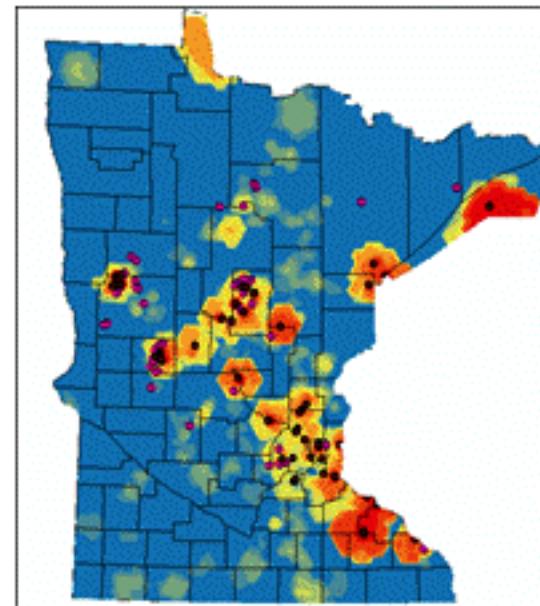
...and others

New Data

Water Quality
Fish Kills and Causes

Refine and Validate

Risk Map



Example predictive model/risk map for the invasion of zebra mussels. Produced by Phelps Lab, U of M.

Model

Distribute tools to stakeholders

Management

Fish Kill Response
Landuse Guidance
Habitat Restoration/Protection
Protection of Heritage Fish Strains
Fish Stocking/Reintroduction

ENRTF ID: 054-B



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Heidi M. Rantala

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Education:

Ph.D., 2009, Biological Sciences, The University of Alabama

Master of Science, 2005, Water Resources Science, University of Minnesota

Bachelor of Science, 1997, Biology and Geology, The University of Wisconsin-Eau Claire

Professional Experience:

2015-Current Water Quality Consultant, Minnesota Department of Natural Resources, Section of Fisheries, Saint Paul, MN

2009-2015 Postdoctoral Fellow, Department of Zoology and Center for Ecology, Southern Illinois University, Dr. Matt R. Whiles, Mentor

2010, 2014 Lecturer, Department of Zoology, Southern Illinois University Carbondale, Stream Ecology

2000-2003 Limnologist II, State Hygienic Laboratory, University of Iowa

Recent Publications:

- Rantala, H. M., D. Glover, J. Garvey, Q. Phelps, D. Herzog, R. Hrabik, J. Crites, and M. Whiles. 2015. Ecological responses to a floodplain reconnection during the 2011 Mississippi River flood. *River Research and Applications*. DOI: 10.1002/rra.2932
- Jackson, K. E., M. R. Whiles, W. K. Dodds, J. D. Reeve, J. M. Vanermyde, and H. M. Rantala. 2015. Influences of patch-burn grazing on the ecological integrity of tallgrass prairie streams. *Journal of environmental quality* 44:1148-1159.
- Scholl E.A., H.M. Rantala, M.R. Whiles, and G.V. Wilkerson. 2015. Using macroinvertebrate structural and functional responses to water velocity gradients to guide a river restoration. *River Research and Applications*. DOI: 10.1002/rra.2882
- Rantala, H. M., A. R. Nelson, J. N. Fulgoni, M.R. Whiles, R.O. Hall, Jr., W.K. Dodds, P. Verburg, A.D. Huryn, C.M. Pringle, S.S. Kilham, C. Colon-Gaud, A.T. Rugenski, S.D. Peterson, K. Fritz, S. Connelly, and K.R. Lips. 2015. Long-term changes in ecosystem structure and function in a Panamanian headwater stream following a disease-driven amphibian decline. *Freshwater Biology* 60:575-589.
- Dodds, W. K., Collins, S.M., Hamilton, S.K., Tank, J. L., Johnson, S., Webster, J. R., Simon, K. S., Whiles, M. R., Rantala, H. M., McDowell, W. H., Peterson, S.D., Riis, T, Crenshaw, C. L., Thomas, S. A., Kristensen, P. B., Cheever, B. M., Flecker, A. S., Griffiths, N.A., Crowl, T. , Rosi-Marshall, E. J., El-Sabaawi, R., Martí, E. 2014. You are not always what we think you eat: selective assimilation across multiple whole-stream isotopic tracer studies. *Ecology* 95:2757-2767.
- Thompson, R. M., Brose, U., Dunne, J. A., Hall, R. O., Hladyz, S., Kitching, R. L., Martinez, N. D., Rantala, H., Romanuk, T. N., Stouffer, D. B., Tylianakis, J. M. 2013. Food webs: reconciling the structure and function of biodiversity. *Trends in Ecology & Evolution* 12:689-697.

Organizational Description:

The mission of the Minnesota Department of Natural Resources (DNR) is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life. Within the DNR, the division of Fish and Wildlife bears primary responsibility for managing, protecting, and regulating the State's fisheries and wildlife resources. As a part of the Division's mission, it will promote habitat protection and development of private and public lands. The DNR has extensive experience administering and coordinating projects funded by the ENRTF.