

**Environment and Natural Resources Trust Fund
2014 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 004-A

Conserving Minnesotas Freshwater Mussel Legacy: Quantifying Habitat Interactions

Category: A. Foundational Natural Resource Data and Information

Total Project Budget: \$ 356,843

Proposed Project Time Period for the Funding Requested: 3 Years, January 2015 - December 201

Summary:

Healthy native mussel populations improve water clarity and provide habitat for other aquatic organisms. We will define environmental conditions necessary to conserve Minnesota's mussels, engaging local organizations and the public.

Name: Jessica Kozarek

Sponsoring Organization: U of MN

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Location

Region: Statewide

County Name: Statewide

City / Township:

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



Environment and Natural Resources Trust Fund (ENRTF)

2014 Main Proposal

Project Title: *Conserving Minnesota's native mussel legacy: Quantifying habitat interactions*

PROJECT TITLE: Conserving Minnesota's native mussel legacy: Quantifying habitat interactions

I. PROJECT STATEMENT

Freshwater mussel abundance and distribution are inherently linked with their habitat through sediment transport processes in moving waters (i.e. suspended sediment or bed stability). This project seeks to quantify the complex interactions between mussels and their habitat using a combination of field data collection in the Minnesota River Basin and the St. Croix River and controlled laboratory experiments in the Outdoor StreamLab (OSL) and flumes at St. Anthony Falls Laboratory (SAFL). This information is critical to MN's ability to 1) maintain ecosystem services proved by mussels (e.g. improved water clarity and river bed stability), 2) use long term mussel monitoring as an indicator for changes in water quality, 3) to evaluate the suitability of potential mussel reintroduction sites, and 4) to define specific habitat criteria for restoration planning (e.g. pinpoint areas where bank stabilization and decreased sediment load will have the greatest impact on retaining or reintroducing mussels to their historic range).

Native mussels are a valuable part of our river ecosystems but have declined in MN due to over-harvesting, widespread habitat destruction, pollution, land-use change, and/or the introduction of exotic species. For example, in the Minnesota River, where mussel diversity was once greater than that of the St. Croix River, nearly half of the mussel fauna has been lost in the past 50 years. These declines have led to the initiation of programs to propagate and reintroduce rare mussels to maintain the ecosystem services that freshwater mussels provide and to preserve historic biodiversity. Mussels filter an enormous quantity of water each day (up to 12% of the total river discharge in the Upper Mississippi) removing suspended material (see figure). The physical presence of both living mussels and their empty shells stabilizes sediment, creating habitat for other aquatic life including fish, amphibians, insect larvae, and algae (see figure). Large aggregations of mussels can improve water clarity and enhance streambed stability, decreasing sediment re-suspension during high flows and reducing downstream transport of target contaminants such as excess nutrients, suspended solids, and bacteria.

While freshwater mussels are an integral and fascinating part of MN's aquatic ecosystems, since they live on the bottom of our rivers, they are fairly unknown to the general public. The importance of native mussels and river habitat will be disseminated to Minnesotans through a live mussel display at the MN State Fair as part of a broad-based and dynamic set of strategies to reach public audiences. This project integrates Foundational Natural Resource Data and Information and Water Resources research with a public engagement strategy that will supplement ongoing mussel restoration, reintroduction, and rehabilitation efforts where the success of these projects is dependent on the public's understanding of the importance of native mussels to our aquatic resources (e.g. for fishing and swimming).

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Strategic Resampling of Survey Sites: Quantifying Environmental Conditions Budget: \$167,840

A strategic plan will be developed to resample a subset of sites previously sampled by the MN DNR across a gradient of water quality and habitat conditions in the Minnesota River Basin (MRB; see map for existing sites). The St. Croix River will serve as a reference or 'baseline' for comparison to a known healthy and diverse mussel population. Field data collection will focus on flow and sediment stability, important habitat variables in explaining mussel abundance and distributions.

Outcome	Completion Date
1. Spatial Data Collection (water quality, flow rate, land use, etc. from MN DNR, PCA, USGS)	April 2015
2. Resampling plan to document environmental conditions and mussel populations in MRB. This plan will provide MN DNR with a resampling methodology to apply to other watersheds in MN to detect changes in native mussel populations due to changes in environmental conditions.	September 2015
3. Report detailing the changes in mussel populations, environmental variables, and mussel physiological response in each watershed. Results will be presented in Activity 3.	September 2017



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Activity 2: Quantifying Mussel Response to Changes in Environmental Conditions **Budget: \$165,016**

To quantify native mussel response to the range of environmental conditions in the MRB and St. Croix, laboratory experiments will examine the physiological response and physical reaction (changes in feeding, movement, burial, etc.) of mussels to different levels of suspended sediment and bed instability over a range of flow rates. Experiments will be conducted in the OSL (see figure) and flumes at SAFL.

Outcome	Completion Date
1. Physiological response of mussels in the MRB and St. Croix (as a report and Activity 3)	October 2015
2. Physiological response of mussels to suspended sediment (as a report and Activity 3)	March 2016
3. Physical reaction of mussels to bed stability (as a report and Activity 3)	April 2017

Activity 3: Engaging the MN Public in Native Mussel Conservation

Budget: \$23,988

We will 1) equip our student researchers to give talks to the public (including place oriented groups such as local civic and religious institutions), 2) generate digital content through social media platforms (i.e. River Talk blog (<http://riverlife.umn.edu/rivertalk/>), Facebook and Twitter), and 3) actively develop a network of networks to engage directly with programs such as the ENRTF funded Urban Wilderness Canoe Adventure to have the results and significance of our research reach the audiences that have been already developed.

Outcome	Completion Date
1. Reach 20,000+ people per day at the MN State Fair historic DNR building with a native mussel display including signage, video, tank and hands on materials led by student researchers	August 2016, 2017
2. Directly reach 50+ people in place-oriented groups and others indirectly through word of mouth. Students serve as teachers by giving 3 public talks.	September 2017
3. Records of engagement and virality, the sharing and discussion of posted information in Social Media (measure incoming links and visits to blog posts, Twitter mentions, etc.)	End of project

III. PROJECT STRATEGY

A. Project Team/Partners

University of MN, St. Anthony Falls Laboratory - Dr. Jessica Kozarek (Research Associate): Project Manager, Outdoor StreamLab and laboratory experiments; Dr. Amy Hansen (Postdoctoral Research Associate) : spatial data collection; development of resampling plan; Dr. Miki Hondzo (Professor): experimental setup; Undergraduate students (laboratory and field experiments), **Department of Fisheries, Wildlife, and Conservation Biology** - Mark Hove (Research Fellow): field data collection, experimental setup; mussel physiology, **River Life, Institute for Advanced Study**— Dr. Patrick Nunnally and Joanne Richardson: Public engagement

Macalester College, Department of Biology - Dr. Daniel Hornbach (Professor): field data collection and mussel physiology; **Department of Geology** - Dr. Kelly Macgregor (Associate Professor): habitat characterization; Undergraduate Research Team (2 seasons: Assist with field data collection)

B. Timeline Requirements

This project is dependent on three full summer seasons for field data collection and Outdoor StreamLab experiments. Three years of work are planned beginning in January 2015 to December 2017.

C. Long-Term Strategy and Future Funding Needs

This proposal is the result of at least three interdisciplinary meetings hosted by SAFL to discuss potential mussel research that will benefit ongoing mussel conservation efforts attended by academia, state and federal agencies MN DNR, US FWS, US ACE, NPS, and Macalester College. This proposal was developed in discussion with the MN DNR to supplement their freshwater mussel conservation efforts. Future funding will be sought to further examine the relationships between stream and river dynamics and freshwater mussel microhabitat and feeding, and reproduction.

2014 Detailed Project Budget

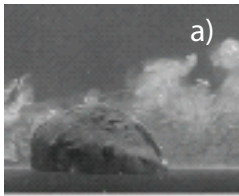
Project Title: Conserving Minnesota's native mussel legacy: Quantifying habitat interactions

IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel:	
Research Associate: Jessica Kozarek (33.6% benefits, 20% time yrs. 1-3)	\$ 49,553
Professor: Miki Hondzo (33.6% benefits, 8% time yr 2)	\$ 18,036
Instrumentation Specialist: (33.6% benefits, 2% time yrs. 1-3)	\$ 8,259
Technician (36.8% fringe, 1.7% time yrs. 1-3)	\$ 4,228
Post-doc: Amy Hansen (20.4% benefits, 10.5% hrs yrs, 1-3)	\$ 16,746
Undergraduate research assistants (7.4% benefits, 25% time yrs. 1,3, 70% yr 2)	\$ 27,439
River Life Coordinator: Patrick Nunnally (33.6% benefits, 2% time yrs 1-3)	\$ 5,772
Info Tech Professional: Joanne Richardson (36.8% benefits, 6% time yrs 1-3)	\$ 13,716
Contracts:	
Macalester College (Activity 1: Field data collection): Dan Hornbach (Professor), Kelly Macgregor (Associate Professor), Mark Hove (Research Associate), Undergraduate students Cost includes: Personnel (68%), Travel to field sites (13%), Supplies - SCUBA and field equipment maintenance (5%), supplies for DNR booth in MN State Fair (1%), and cost of assays (14%)	\$ 180,514
Equipment/Tools/Supplies:	
Activity 2 flume experiments: supplies including gape sensors, laboratory equipment for measuring suspended sediment, and Outdoor StreamLab equipment (velocity, bed elevation)	\$ 12,500
Activity 3: Materials for film/video and handouts	\$ 3,500
Travel:	
in-state (2, 2-day trips for 1 reasarcher, yrs 1 and 3, 400 mi at \$0.565, \$77 lodging, \$46 per diem)	\$ 1,580
Additional Budget Items:	
Hemolymph measurement (\$30/mussel to measure stress response)	\$ 15,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 356,843

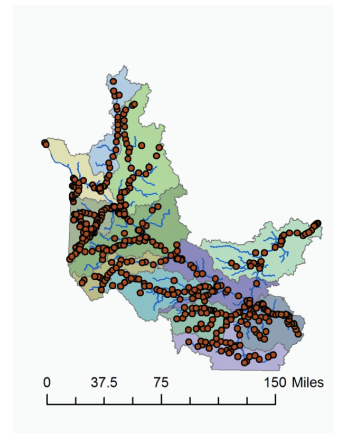
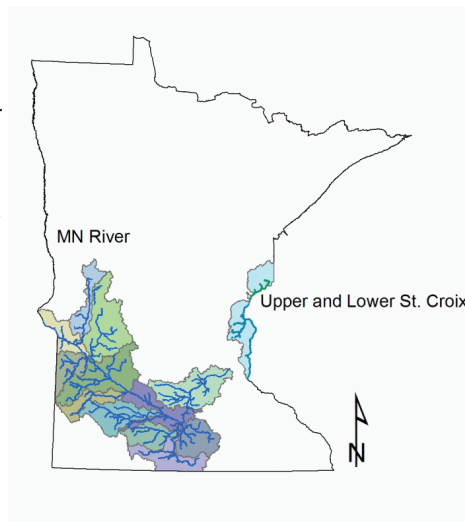
V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Funding History:		
ENRTF through LCCMR, D. Hornbach and M. Hove (Macalester): Freshwater Mussel Resources in the St. Croix River. 7/1999-6/2001	\$ 58,000	
National Park Service, M. Hove and D. Hornback (Macalester) Community analysis of the mussel population downstream of the St. Croix Falls hydropower dam. 2000-2002.	\$ 40,900	
National Park Service, M. Hove and D. Hornbach (University of Minnesota) Mussel communities in the St. Croix National Scenic Riverway community population monitoring and distribution surveys. 2000-2005.	\$ 56,266	
National Park Service, K. MacGregor and D. Hornbach (Macalester): Monitoring Sediment Dynamics in the St. Croix River and the Impact on Federally Endangered Mussels. 4/2008-12/2010	\$ 148,824	



Large aggradations of freshwater mussels (mussel beds) a) interact with flow and sediment transport to b) provide stable habitat for fish and other aquatic organisms, and c) provide ecosystem services by filtering large volumes of water and removing suspended material.

In the Minnesota River, where mussel diversity was once greater than that of the St. Croix River, nearly half of the mussel fauna has been lost in the past 50 years. The Minnesota River Basin is a focus of this study (see inset). Red dots mark site locations for the MN DNR statewide mussel survey.



To quantify the interactions of native mussel populations (density and diversity) with their habitat, experiments will be conducted in St. Anthony Falls Laboratory flumes and Outdoor StreamLab (OSL). The OSL is an experimental stream located across from downtown Minneapolis. It is fed by Mississippi River water under valve control so that both water flow rate and sediment transport can be controlled.

PROJECT MANAGER QUALIFICATIONS

Jessica L. Kozarek, Research Associate and Outdoor StreamLab Research Program Coordinator, National Center for Earth Surface Dynamics, St. Anthony Falls Laboratory, University of Minnesota

Current Responsibilities (May 2010-present):

- Manage Outdoor StreamLab research projects including undergraduate student research assistants and visiting researchers
- Conduct and report on research on physical, chemical, and biological experiments in the OSL
- Plan for future OSL research projects in key research areas including in-stream habitat, channel/floodplain interactions, and stream restoration
- Develop regional and national stream restoration and in-stream habitat partnerships

Education:

The Pennsylvania State University	Chemical Engineering	B.S., 2002
Virginia Tech	Biological Systems Engineering	M.S., 2006
Virginia Tech	Biological Systems Engineering	Ph.D., 2011

Select Publications:

Resop, J.P., J.L. Kozarek, and W.C. Hession. 2012. Terrestrial Laser Scanning for Delineating In-stream Boulders and Quantifying Habitat Complexity Measures. *Photogrammetric Engineering and Remote Sensing*. 78(4): 363-371.

Kozarek, J.L., W.C. Hession, C.A. Dolloff, and P. Diplas. 2010. Hydraulic Complexity Metrics for Evaluating In-Stream Brook Trout (*Salvelinus fontinalis*) Habitat. *Journal of Hydraulic Engineering*. 136(12): 1067-1076.

Select Presentations:

Kozarek, J.L. C. Hill, S. Kang, A. Khosronejad, D. Baker, K. Guentzel, M. Hondzo, and F. Sotiropoulos. 2012. Combining field and laboratory experiments with numerical simulation to inform stream restoration design. Upper Midwest Stream Restoration Symposium, March 4-March 7, 2012, Minneapolis, MN.

Kozarek, J.L. and W.C. Hession. 2007. Linking fluvial morphology and aquatic ecosystems. Professional workshop: Introduction to Fluvial Geomorphology, VA/WVA Water Resources Conference, Blacksburg, VA.

ORGANIZATION DESCRIPTION

St. Anthony Falls Laboratory (SAFL) is an interdisciplinary fluid mechanics research facility of the College of Science and Engineering at the University of Minnesota. SAFL research focuses on environmental, energy, and health challenges. The Outdoor StreamLab at SAFL is a unique facility with state-of-the-art instrumentation in a field-scale experimental stream. This facility is ideally suited for experiments on flow/sediment/biota interactions.

Macalester College is a top-ranked liberal arts college. The Environmental Studies program, chaired by Dan Hornbach, offers a number of opportunities for student-faculty research including previous research to assist the Minnesota DNR and National Park Service in developing management plans for endangered freshwater mussels.

River Life, a program at the University of Minnesota uses social media, a digital atlas, and case study reports to develop and share knowledge on the science and professional practices that create inclusive, sustainable rivers.