



Environment and Natural Resources Trust Fund (ENRTF) M.L. 2014 Work Plan

Date of Report: January 15, 2013
Date of Next Status Update Report: July 1, 2015
Date of Work Plan Approval:
Project Completion Date: June 30, 2018
Does this submission include an amendment request? No

PROJECT TITLE: Conserving Minnesota’s Native Freshwater Mussels

Project Manager: Jessica Kozarek
Organization: St. Anthony Falls Laboratory, University of Minnesota
Mailing Address: 2 Southeast 3rd Ave
City/State/Zip Code: Minneapolis, MN 55414
Telephone Number: (612) 624-4679
Email Address: jkozarek@umn.edu
Web Address: <http://www.safl.umn.edu/facilities/osl>; <http://www.macalester.edu/~hornbach/>

Location: Minnesota River Basin; St. Croix River; Macalester College; St. Anthony Falls Laboratory, University of Minnesota

Total ENRTF Project Budget:	ENRTF Appropriation:	\$350,000
	Amount Spent:	\$0
	Balance:	\$350,000

Legal Citation: M.L. 2014, Chp. 226, Sec. 2, Subd. 05k

Appropriation Language:

\$350,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota in cooperation with Macalester College to document native freshwater mussel abundance and distribution, quantify environmental conditions necessary to conserve Minnesota's native freshwater mussels, and conduct outreach to local organizations and the public. This appropriation is available until June 30, 2018, by which time the project must be completed and final products delivered.

I. PROJECT TITLE: Conserving Minnesota’s Native Freshwater Mussels

II. PROJECT STATEMENT:

Native freshwater mussels are a valuable part of our river ecosystems but mussel populations have declined in Minnesota (MN) due to widespread habitat destruction, pollution, land-use change, over-harvesting, 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 historical biodiversity. Mussels filter an enormous quantity of water each day removing suspended material. The physical presence of both living mussels and their empty shells stabilizes sediment, and creates habitat for other aquatic life including fishes, amphibians, insect larvae, and algae. Large aggregations of mussels can improve water clarity and enhance streambed stability, decrease sediment re-suspension during high flows and reduce downstream transport of target contaminants such as excess nutrients, suspended solids, and bacteria.

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 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).

While native mussels are an integral and fascinating part of MN’s aquatic ecosystems, they live on the bottom of our rivers, and are fairly unknown to most people. The importance of native mussels and river habitat will be disseminated to Minnesotans through a 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 swimming and fishing).

III. PROJECT STATUS UPDATES:

Project Status as of January 1, 2015:

Project Status as of July 1, 2015:

Project Status as of January 1, 2016:

Project Status as of July 1, 2016:

Project Status as of January 1, 2017:

Project Status as of July 1, 2017:

Project Status as of January 1, 2018:

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Strategic Resampling of Survey Sites: Quantifying Environmental Conditions

Description: This activity focuses on quantifying mussel population response to changing environmental conditions. A strategic plan will be developed to resample a subset of sites previously sampled by the MN DNR (DNR) as part of the Statewide Mussel Survey (http://www.dnr.state.mn.us/nhnrp/mussel_survey/index.html) across a gradient of water quality and habitat conditions in the Minnesota River Basin (MRB). The St. Croix River will serve as a reference or ‘baseline’ for comparison to a known healthy and diverse mussel community. Mussel species diversity in the MRB has declined compared to historical levels while the St. Croix serves as a refuge for state and federally endangered mussel populations. Spatial data including the DNR statewide mussel survey data, existing information on stream flow and water quality will be used to select field sites across a gradient of high, moderate, and low impact of recent environmental alterations. Sites will be selected in consultation with the DNR. Field data collection will focus on mussel surveys, flow and sediment stability, and important habitat variables in explaining mussel abundance, diversity and distribution. Mussel surveys will be conducted per DNR protocol surveying a large area and a variety of habitats. Additional detailed field surveys will be used to understand the current relationship between mussel diversity/community dynamics and bed conditions. This information will be used to constrain laboratory experiments in Activity 2. Our methodology and resampling plan will be disseminated to DNR as a model to apply to other MN watersheds to detect changes in native mussel populations due to changes in environmental conditions.

Summary Budget Information for Activity 1:

ENRTF Budget: \$ 164,773
Amount Spent: \$ 0
Balance: \$ 164,773

Activity Completion Date: December 31, 2018

Outcome	Completion Date	Budget
1. Spatial Data Collection (water quality, flow rate, land use, etc. from DNR, PCA, USGS)	April 30, 2015	\$ 16,746
2. Resampling to document environmental conditions and mussel populations in MRB and St. Croix.	September 30, 2017	\$ 123,580
3. Report detailing the changes in mussel populations and environmental variables in each watershed. Results will be presented in Activity 3.	December 31, 2017	\$ 24,447

Activity Status as of July 1, 2015:

Activity Status as of January 1, 2016:

Activity Status as of July 1, 2016:

Activity Status as of January 1, 2017:

Activity Status as of July 1, 2017:

Activity Status as of January 1, 2018:

Final Report Summary:

ACTIVITY 2: Quantifying Mussel Response to Changes in Environmental Conditions

Description: To quantify native mussel responses to a 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 Outdoor StreamLab and flumes at St. Anthony Falls Laboratory at the University of Minnesota. The Outdoor StreamLab is a unique outdoor experimental stream channel located across the Mississippi River from downtown Minneapolis. This experimental stream allows for direct manipulation of environmental conditions in a field-scale channel while collecting laboratory quality measurements. Laboratory experiments will focus on mussel response to suspended sediment (water quality) and bed instability (increased flows or siltation). To gather background information on mussel response to altered environmental conditions, growth rates and physiological stress (e.g., tissue glycogen, enzymatic biomarkers) will be measured for two species at the MRB and St. Croix field sites.

Summary Budget Information for Activity 2:

ENRTF Budget: \$ 161,680
Amount Spent: \$ 0
Balance: \$ 161,680

Activity Completion Date: December 31, 2018

Outcome	Completion Date	Budget
1. Physiological response of mussels in the MRB and St. Croix (as a report and Activity 3)	October 2015	\$ 30,000
2. Physiological response of mussels to suspended sediment (as a report and Activity 3)	March 2016	\$ 65,840
3. Physical reaction of mussels to bed stability (as a report and Activity 3)	April 2017	\$ 65,840

Activity Status as of July 1, 2015:

Activity Status as of January 1, 2016:

Activity Status as of July 1, 2016:

Activity Status as of January 1, 2017:

Activity Status as of July 1, 2017:

Activity Status as of January 1, 2018:

Final Report Summary:

ACTIVITY 3: Engaging the MN Public in Native Mussel Conservation

Description: Through the collaboration with the River Life program at the University of Minnesota, we seek to engage the public in water quality issues, broadly, and freshwater mussel conservation, specifically. River Life is a program of the Institute for Advanced Study at the University of Minnesota that works to build communities of knowledge and practice that develop new understandings of systems of people, land, and water. They work through student programs (training the next generation), develop collaborative cross-disciplinary research agendas (science to humanities) and develop digital (social media) and face-to-face programs. Efforts will be monitored with metrics designed to measure reach, engagement, and conversations.

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 ENTRF funded Urban Wilderness Canoe Adventure to have the results and significance of our research reach the audiences that have already been developed.

Researchers and students will present the results from our project to Minnesota public through an extension of the DNR’s popular Historical DNR Building at the State Fair. We will help develop interpretation for the indoor fish aquaria, present project results, as well as provide general information about mussels and the importance of water and habitat quality, to DNR building visitors.

Summary Budget Information for Activity 3:

ENRTF Budget: \$ 23,547
Amount Spent: \$ 0
Balance: \$ 23,547

Activity Completion Date: December 31, 2018

Outcome	Completion Date	Budget
1. Reach 20,000+ people per day at the MN State Fair Historical DNR Building with a native mussel display led by student researchers	September 2017	\$ 7,849
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	\$ 7,849
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	\$ 7,849

Activity Status as of July 1, 2015:

Activity Status as of January 1, 2016:

Activity Status as of July 1, 2016:

Activity Status as of January 1, 2017:

Activity Status as of July 1, 2017:

Activity Status as of January 1, 2018:

Final Report Summary:

V. DISSEMINATION:

Description: We will present the results from our project through a number of deliverables. Scientific results from Activities 1 and 2 will be submitted for publication in peer-reviewed journals as well as presented in local (e.g., St. Croix River Research Rendezvous) and national (e.g., Society of Freshwater Science, Freshwater Mollusk Conservation Society) meetings of natural resource professionals. We will also meet with biologists in charge of Minnesota mussel conservation efforts (i.e., Mike Davis and Bernard Sietman, DNR) to discuss our results and offer ideas to improve mussel community resampling methodology to detect changes in native mussel populations due to changes in environmental conditions. We are also excited to present the results from our project to Minnesota public through a range of public engagement strategies including an extension of the DNR's popular Historical DNR Building at the State Fair (Activity 3). Project results and general information about mussels and the importance of water and habitat quality will be shared by researchers and students through public presentations, and social media (Activity 3). A comprehensive report of results and analyses from this project will be submitted to the LCCMR by December 31, 2017.

Status as of July 1, 2015:

Status as of January 1, 2016:

Status as of July 1, 2016:

Status as of January 1, 2017:

Status as of July 1, 2017:

Status as of January 1, 2018:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	\$ Amount	Explanation
Personnel:	\$148,865	1 project manager at 25% FTE for 3 yrs; 1 research advisor at 3.8% FTE 1 yr; 1 instrumentation specialist at 2% FTE for 3 yrs; 1 technician at 1.7% time for 3 yrs; 1 post-doctoral researcher at 10.5% time for 3 yrs; 3 undergraduate research assistants at 8.3% FTE for 2 yrs and 23.3% FTE for 1 yr; River Life coordinator at 2% for 3 yrs; 1 info tech professional at 6% for 3 yrs
Professional/Technical/Service Contracts:	\$177,051	contract with Macalester College for field data collection, research collaboration, and public engagement: Personnel (70% of contract): 2 co-PIs at 8% FTE for 2 yrs; 1 research associate at 21% FTE for 3 yrs; 3 students at 20% FTE for 2 yrs; Travel Expenses in MN (11% of contract): travel to field sites including mileage, lodging and meals (MRB, St. Croix), misc. travel for equipment repair, etc., mileage, lodging, registration fees, meals for student presentations; Equipment/Tools/Supplies (5% of contract): field equipment maintenance, new equipment replacement; Other : laboratory assays (14% of contract to USGS Upper Midwest Environmental Sciences – T. Newton’s Laboratory); outreach costs (1% of contract)
Equipment/Tools/Supplies:	\$16,309	Sediment laboratory supplies; OSL supplies, equipment, and maintenance; materials for film/video and handouts
Printing:	\$1000	handout and outreach material printing
Travel Expenses in MN:	\$1,975	mileage, lodging, meals
Other:	\$4,800	laboratory fees for mussel assays (USGS Upper Midwest Environmental Sciences Center – T. Newton’s Laboratory was the only laboratory identified capable of analyzing glycogen levels in mussel tissue)
TOTAL ENRTF BUDGET:	\$350,000	

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than \$5,000: N/A

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 2.65

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 2.15

B. Other Funds:

Source of Funds	\$ Amount Proposed	\$ Amount Spent	Use of Other Funds
Non-state			
N/A	\$	\$	
State			
N/A	\$	\$	
TOTAL OTHER FUNDS:	\$	\$	

VII. PROJECT STRATEGY:

A. Project Partners:

Project Partners Not Receiving Funds:

- MN DNR: Providing mussel data and serving an advisory role

Project Partners Receiving Funds

- Macalester College: \$177,051 to conduct field data collection, research collaboration, and outreach activities

B. Project Impact and Long-term Strategy:

We are advocating cleaner and healthier Minnesota waters by understanding environmental conditions necessary to conserve and promote a diverse and sustainable native mussel population. This project will impact 1) the greater scientific community through peer-reviewed publications and presentations at scientific conferences (state, regional, and national); 2) water resources and wildlife professionals working towards freshwater mussel conservation through the dissemination of results and resampling plan, and 3) the general public through public engagement strategies designed to illustrate ecosystem services provided by freshwater mussels and the linkages between mussels and clean water. In addition, this project will educate and train the next generation of water resource professionals by incorporating undergraduate student researchers in field, laboratory, and engagement activities. Quantifying the complex interactions between mussels and their habitat will assist in: 1) maintaining ecosystem services provided by mussel, 2) using long-term mussel monitoring as a biological indicator for changes in water quality, 3) evaluating the suitability of potential mussel reintroduction sites, and 4) defining specific mussel habitat criteria for restoration planning. This research 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.

C. Spending History:

Funding Source	M.L. 1998 or FY99	M.L. 1999 or FY00	M.L. 2007 or FY08
ENRTF appropriation, 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. Hornbach (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

VIII. ACQUISITION/RESTORATION LIST: n/a

IX. VISUAL ELEMENT or MAP(S): See attached visual element.

X. ACQUISITION/RESTORATION REQUIREMENTS WORKSHEET: n/a

XI. RESEARCH ADDENDUM: See attached research addendum.

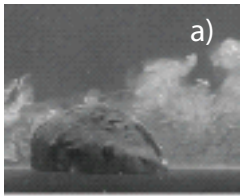
XII. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted no later than January 1, 2015, July 1, 2015, January 1, 2016, July 1, 2016, January 1, 2017, July 1, 2017, and January 1, 2018. A final report and associated products will be submitted between June 30 and August 15, 2018.



Environment and Natural Resources Trust Fund											
M.L. 2014 Project Budget											
Project Title: Conserving Minnesota's Native Freshwater Mussels											
Legal Citation: M.L. 2014, Chp. 226, Sec. 2, Subd. 05k											
Project Manager: Jessica Kozarek											
Organization: University of Minnesota.											
M.L. 2014 ENRTF Appropriation: \$350,000											
Project Length and Completion Date: 4 Years, June 30, 2018											
Date of Report: 1/15/14											

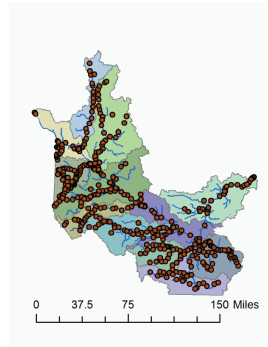
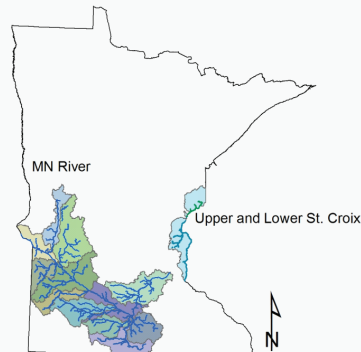
ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	Activity 3 Budget	Amount Spent	Activity 3 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	Strategic Resampling of Survey Sites: Quantifying Environmental Conditions		Quantifying Mussel Response to Changes in Environmental Conditions			Engaging the MN Public in Native Mussel Conservation					
Personnel (Wages and Benefits)	\$16,747	\$0	\$16,747	\$113,005	\$0	\$113,005	\$19,114	\$0	\$19,114	\$148,866	\$148,866
Research Associate, Jessica Kozarek: \$61,942 (33.6% benefits); 25% FTE for 3 yrs											
Professor, Miki Hondzo: \$8,651 (33.6% benefits); 3.8% FTE for 1 yr											
Instrumentation Specialist: \$13,400 (33.6% benefits); 8% FTE for 3 yrs											
Technician: \$4,228 (36.8% benefits); 1.7% FTE for 3 yrs											
Post-doc, Amy Hansen: \$16,747 (20.4% benefits); 10.5% FTE for 3 yrs											
Undergraduate research assistants: \$24,784 (7.4% benefits); 25% FTE for 2 yrs; 70% FTE for 1 yr											
River Life Coordinator, Patrick Nunnally: \$5,661 (33.6% benefits); 2% FTE for 3 yrs											
Info Tech Professional, Joanne Richardson: \$13,453 (36.8% benefits); 6% FTE for 3 yrs											
Professional/Technical/Service Contracts											
Macalester College: field data collection, research collaboration, and public engagement: Personnel (70% of contract): 2 co-PIs at 8% FTE for 2 yrs; 1 research associate at 21% FTE for 3 yrs; 3 students at 20% FTE for 2 yrs; Travel Expenses in MN (11% of contract): travel to field sites including mileage, lodging and meals (MRB, St. Croix), misc. travel for equipment repair, etc., mileage, lodging, registration fees, meals for student presentations; Equipment/Tools/Supplies (5% of contract): field equipment maintenance, new equipment replacement; Other: laboratory assays (14% of contract to USGS Upper Midwest Environmental Sciences – T. Newton's Laboratory); outreach costs (1% of contract)	\$146,051	\$0	\$146,051	\$30,000	\$0	\$30,000	\$1,000	\$0	\$1,000	\$177,051	\$177,051
Equipment/Tools/Supplies											
suspended sediment supplies				\$3,875	\$0	\$3,875				\$3,875	\$3,875
gape sensor supplies (magnets, proximity sensors)				\$5,000	\$0	\$5,000				\$5,000	\$5,000
OSL (sediment feeder maintenance, data acquisition)				\$5,000	\$0	\$5,000	\$2,433	\$0	\$2,433	\$7,433	\$7,433
Printing							\$1,000	\$0	\$1,000	\$1,000	\$1,000
handout and outreach material printing											
Travel expenses in Minnesota											
mileage, lodging, meals	\$1,975	\$0	\$1,975							\$1,975	\$1,975
Other											
laboratory fees for mussel assays (USGS Upper Midwest Environmental Sciences Center – T. Newton's Laboratory was the only laboratory identified capable of analyzing glycogen levels in mussel tissue)				\$4,800	\$0	\$4,800				\$4,800	\$4,800
COLUMN TOTAL	\$164,773	\$0	\$164,773	\$161,680	\$0	\$161,680	\$23,547	\$0	\$23,547	\$350,000	\$350,000



Large aggregations 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



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). Dots mark locations where mussel populations have been surveyed by the MN



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.

Student researchers will be involved in all stages of the project and will learn to communicate with the public through social media and in person with place-based groups to enable a future where Minnesotans understand the role of freshwater mussels in



