Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2016 Work Plan

Date of Report: May 29, 2016

Date of Next Status Update Report: December 01, 2016

Date of Work Plan Approval: June 7, 2016

Project Completion Date: June 30, 2019

Does this submission include an amendment request? __

PROJECT TITLE: RESTORING NATIVE MUSSELS FOR CLEANER STREAMS AND LAKES

Project Manager: Mike Davis

Organization: MNDNR

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Location: Statewide

Total ENRTF Project Budget:	**ENRTF Appropriation:**	**$600,000**
	Amount Spent:	**$0**
	Balance:	**$600,000**

Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 04c

Appropriation Language:

Appropriation Language: $600,000 the second year is from the trust fund to the commissioner of natural resources in cooperation with the Minnesota Zoological Garden for a statewide mussel program to rear, restore, and re-establish native mussel species in streams and rivers. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

I. PROJECT TITLE: RESTORING NATIVE MUSSELS FOR CLEANER STREAMS AND LAKES

II. PROJECT STATEMENT:

1. Minnesota's native mussels are a critically important component of aquatic ecosystems, but have been lost or diminished in many Minnesota water bodies. Harvest for pearls and buttons, pollution, dams and destabilized waterways has caused mussel populations to decline dramatically in North America including Minnesota where 80% of our species have been affected (see graphics). Improvements from Clean Water Act implementation and watershed and stream restoration work are creating opportunities to reverse this trend. However, the complex life cycle of native mussels' (see graphic) prevents some populations from recovering naturally. This leaves an ecological gap in our stream restoration efforts that will limit ecosystem recovery. Reestablishing the water cleansing, and nutrient processing capacity that mussel populations provide will improve water quality and restore the biotic communities that mussels support and that fish and wildlife depend on while helping delist species in trouble.

2. Goals for this project are:

A. Restore historic mussel species aggregations in select streams to improve stream health through restoration of their unique provisioning of ecosystem services
    a. Reintroduce up to six species of mussels historically present in the Cedar River between Austin, MN and the Iowa border.
    b. Reintroduce up to three species of mussels historically present in the Cannon River system of SE Minnesota.
    c. Reintroduce up to six species historically present in the Mississippi River to Upper Pool 2 in St. Paul.

B. Reestablish mussel populations that contribute to delisting state endangered and threatened species
    a. Four state threatened mussel species (mucket, elktoe, monkeyface and fluted shell) will be reintroduced to the Cedar River between the Iowa border and Austin, MN. Females for propagation will be obtained from the Cedar River in Iowa in cooperation with the IA DNR.
    b. Juveniles of one state threatened mussel species, mucket, now limited to the Cannon River between Lake Byllesby and Northfield, MN will be produced and raised for reintroduction to two other reaches of the Cannon River system; one that is now missing entirely, elktoe, will be obtained from the nearby Zumbro River drainage and juveniles produced and raised for reintroduction. Expanding the range of these species contributes towards eventual delisting.
    c. Propagation and reintroduction of three federally endangered mussel species (Higgins' eye, snuffbox, and winged mapleleaf) and one state threatened species (mucket) will continue in the Mississippi River between the Ford Dam and the Mississippi/Minnesota River confluence. Additional species may be added to this effort.

C. Engage and inform the public about the importance of aquatic ecosystems and the unique role that mussels play in benefiting people by rearing juvenile mussels in full view of MN Zoo visitors.
    a. A cooperatively developed interpretive display will be placed inside the building next to the bridge over the Zoo's lake where passersby can see young mussels being grown for reintroductions and learn about the important ecological role they play in freshwater.

b. The MN Zoo website will be further developed to feature mussel reintroduction work and the importance of mussels to freshwater ecosystems.

3. Female mussels will be collected from a population within the target river system where possible, or from the nearest river system when not. Mussel larvae will be non-lethally harvested and host fish inoculated. Fish will be held in the DNR's Center for Aquatic Mollusk Programs lab, held in cages in the river, or released into the area of the stream targeted for reintroduction. In the lab, transformed juvenile mussels (see graphic) will be collected and placed into rearing systems where filtered river water augmented with commercial food will feed them until they have grown to 2-3 mm (see graphic). Juveniles not retained in the lab will be transferred to the MN Zoo where they will be grown using the zoo's lake water until they are 30-50 mm in length (see graphic), then released into the river segment targeted for restoration. Fish placed in cages will be removed after mussel transformation is complete and any resulting juveniles allowed to grow within the cage to protect them from predation and to facilitate collection later. Inoculated fish will be released and presumably scatter the transformed juvenile mussels along a continuum of the stream that is traversed by the fish. Annual monitoring of released mussels and searching for those resulting from fish releases will allow us to document growth and survival and to determine when mussels have been successfully restored.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of December 1, 2016

Project Status as of May1, 2017

Project Status as of December 1, 2017

Project Status as of May 1, 2018

Project Status as of December 1, 2018

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1:
Description: Juvenile mussel propagation

Up to ten female mussels of each subject species holding larvae will be collected by wading, snorkel or SCUBA. This activity will occur from early spring to late fall depending on the targeted species life history that we are working with. Larvae will be harvested from each female and placed into containers holding the proper host fish species and allowed time for attachment to the hosts to complete. Fish are then placed into tanks set aside for each species from each river in an artificial aquatic habitat system, placed in cages in a river or released at targeted mussel restoration sites. For the next 2-12 weeks juvenile mussels held in our lab will be collected from the artificial aquatic habitat system by flushing them out of each fish tank and onto a fine mesh screen.

Summary Budget Information for Activity 1:	**ENRTF Budget:**	**$ 191,649**
	Amount Spent:	**$ 0**
	Balance:	**$ 191,649**

Outcome	Completion Date
1. 2-10 gravid females of each species will be collected each year from each river to assure adequate genetic variation of propagules.	April – October each year depending on mussel species
2. 10-200 of host fish will be inoculated with each mussel species from each river and from 100-5,000 larvae attached to each.	Usually within 30 days of collection unless being held overwinter in chilled water
3. 50-1,000 juveniles will be collected from each host fish of each mussel species and transferred to growing chambers.	6-12 weeks post inoculation unless fish are held overwinter in chilled water

Activity Status as of December 1, 2016

Activity Status as of May 1, 2017

Activity Status as of December 1, 2017

Activity Status as of May 1, 2018

Activity Status as of December 1, 2018

Final Report Summary:

Activity 2: Rearing juvenile mussels

Budget: $269,355
Amount Spent: 0

Transformed juvenile mussels will be collected from fish holding tanks and placed into containers with filtered river water augmented with commercial foods flowing past them to provide food and oxygen. Survival and growth will be monitored. When 2-3 mm in length (one growing season) surviving juveniles will be either placed into cages submerged in a river or lake or moved to the MN Zoo and grown in public view in the Zoo's lake or indoor display for another 2-4 growing seasons.

Summary Budget Information for Activity 2:

ENRTF Budget: $ 269,355
Amount Spent: $ 0
Balance: $ 269,355

Outcome	Completion Date
1. 10-1,000 juvenile mussels of each species will survive to be 2-3 mm in length	Varies by species 100-400 days
2. 50-1,000 juvenile mussels of each species will be transferred to MN Zoo annually	30 days from transfer

3. 45-900 mussels of each species raised at the zoo will be released into rivers annually after 2016.	July 1, 2018

Activity Status as of December 1, 2016

Activity Status as of May 1, 2017

Activity Status as of December 1, 2017

Activity Status as of May 1, 2018

Activity Status as of December 1, 2018

Final Report Summary:

Activity 3: Releasing and monitoring juvenile mussels.
Juvenile mussels 30-40 mm or larger will be gathered at the MN Zoo or from growing cages, counted, measured for length, and released at reintroduction sites in rivers. These mussels will be permanently marked to identify them as captive raised individuals and monitored annually to determine survival and growth.

Summary Budget Information for Activity 3:

ENRTF Budget: $ 94,483
Amount Spent: $ 0
Balance: $ 94,483

Outcome	Completion Date
1. 40 to 750 released mussels of each species will survive initial release at each release site	Annual fall monitoring
2. 35 to 700 individuals of each mussel species released at each site in each river will be alive and growing one year after release.	July 1 2018

Activity Status as of December 1, 2016

Activity Status as of May 1, 2017

Activity Status as of December 1, 2017

Activity Status as of May 1, 2018

Activity Status as of December 1, 2018

Final Report Summary:

V. DISSEMINATION:
Description:
Project progress will be disseminated via annual or semiannual MNDNR news releases and at least one full article in the MN Conservation Volunteer. An updated "Mussels of Minnesota" poster showing the present

status of all mussel species on the front with QR codes linking smart phones to more information on the MN DNR website such as life history descriptions and current efforts funded by this grant. Posters will be provided free of charge to the public. Annual updates of our progress will be presented as either PowerPoint or poster presentations at annual mussel conservation meetings, workshops and symposia. An updated MNDNR webpage will feature this proposal and present progress reports annually.

Status as of: May 1, 2017

Status as of: May 1, 2018

Status as of: July 1, 2019

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Personnel:		
	$524,710	Project manager, .75 FTE yr 1, 2 - $144,348; Malacologist, .75 FTE yr1, 2 - $116,500; Aquarist/Malacologist, .75 FTE yr 1, 2 – $77,502; Database Manager/Malacologist, .75 FTE yr1, 2 - $79,869; Mussel Culture Biologist, 1 FTE yr 1, 2 - $106,491.
Equipment/Tools/Supplies:	$10,339	SCUBA air refills and dive gear maintenance, purchasing host fish for propagation work, fish food, filters.
Printing:	$8,170	Updating and reprinting Mussels of MN poster
Travel Expenses in MN:	$7,000	Travel to collect gravid female mussels, transporting juveniles to MN Zoo, hauling river water for mussel food, travel to mussel release sites to monitor mussels.
Other: Out of State Travel	$3,000	To Iowa and Wisconsin to collect donor females that are not available in MN
DNR Direct & Necessary		
		People support – $11,640
		Safety support - $2,744
		Financial support - $7,745
		Communication support - $1,236
		IT support - $22,352
		Planning support - $829
		Procurement support - $235
Total Direct and Necessary cost	$46,781	
TOTAL ENRTF BUDGET:	**$600,000**	

Explanation of Use of Classified Staff: Two .75 FTE classified staff positions will be supported, these positions do not have a permanent dedicated funding base and so the MN DNR cannot backfill the ENRTF portion of their salaries. Classified staff manage this program but they may not be retained to work on mussels without the support of this ENTRF grant. Retaining both of these positions is essential for implementing this project.

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

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 4.0

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

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
State Wildlife Grant, cash, $40,000/year	$80,000	$0	Facility operations, rent ($40,000/year)
US Army Corps of Engineers IPAs, cash reimbursement	$70,000	$0	Staff Time - monitoring data analysis, reports
State			
Mussel Mitigation, cash	$20,000	$0	Staff time and expenses
TOTAL OTHER FUNDS:	**$170,000**	**$0**	

VII. PROJECT STRATEGY:

A. Project Partners: Dan Kelner, U. S. Army Corps of Engineers, funding and planning partner in support of monitoring reintroduction sites of federally listed mussel species; U. S. Fish and Wildlife Service, Tamara Smith, planning and permitting support and Nathan Eckert Genoa National Fish Hatchery, host fish supply and some juvenile mussels; National Park Service, Byron Karns and Alison Holdhusen, planning and staff support for monitoring in the St. Croix and Mississippi Rivers; Iowa DNR, Kelly Poole, Jen Kirth and Scot Gritters, permitting and logistical support for acquiring donor female mussels; MN Dept of Transportation, Jason Alcot, mitigation funds per project requirements; MN Zoo, Tara Harris, Alan Maguire, Ben Minerich, and Matt McLaughlin, providing facility and staff time for mussel rearing and public information.

B. Project Impact and Long-term Strategy: Native mussel restoration in Minnesota is a long term strategy to rebuild our aquatic ecosystem infrastructure and a natural progression of efforts that build on prior public investments that have made this feasible. Successful restoration can take a decade or more of effort. Indications of success can be demonstrated within 3-6 years of ENRTF expenditures. Demonstrating success is intended to lead to permanent non ENRTF funding of this work.

This project is a natural progression from 1999 when a LCMR grant began mussel surveys of the state's rivers. Surveys continued with other funds resulting in data from over 3,200 sites covering all 81 major watersheds in the state. This information is used to identify streams with potential for reintroduction. Our research has established host fish relationships needed to propagate most of Minnesota's mussel species. This proposal builds on these investments.

Reestablishing the water cleansing, and nutrient processing capacity that mussel populations provide will restore the biotic communities that mussels support and that fish and wildlife depend on while helping delist species in trouble. Expertise in accomplishing mussel restoration began in 2000 with the USFWS Jeopardy Decision for *Lampsilis higginsii* (Higgin's eye pearly mussel). This decision held that the US Army Corps of Engineers was responsible for the jeopardy by virtue of operating the navigation system on the

Mississippi River that transported zebra mussels from the Illinois River upstream as far as St Paul, MN. The first propagated Higgin's eye were produced by the MNDNR in Lake Pepin in 2001, funding from the Corps expanded that effort and over the next 10 years over 40,000 propagated Higgins' eye were released at sites in the Mississippi River by a team of state and federal biologists and facilities. This project expands those efforts to other species and other river systems. As we develop additional expertise and capacity we hope to reintroduce mussels as water quality and aquatic food web engineers throughout Minnesota, eventually delisting rare species as well.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	$ Amount
US Army Corps of Engineers, propagation, release, monitoring of Higginsii and winged mapleleaf mussels	2010-2015	$30,000
State Wildlife Grant, surveys, host research, propagation and release of state and federally listed mussel species.	2010-2015	$150,000
MNDNR mussel mitigation fund, propagation, rent.	2012-2015	$100,000

VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS: N/A

IX. VISUAL COMPONENT or MAP(S):

X. RESEARCH ADDENDUM: N/A

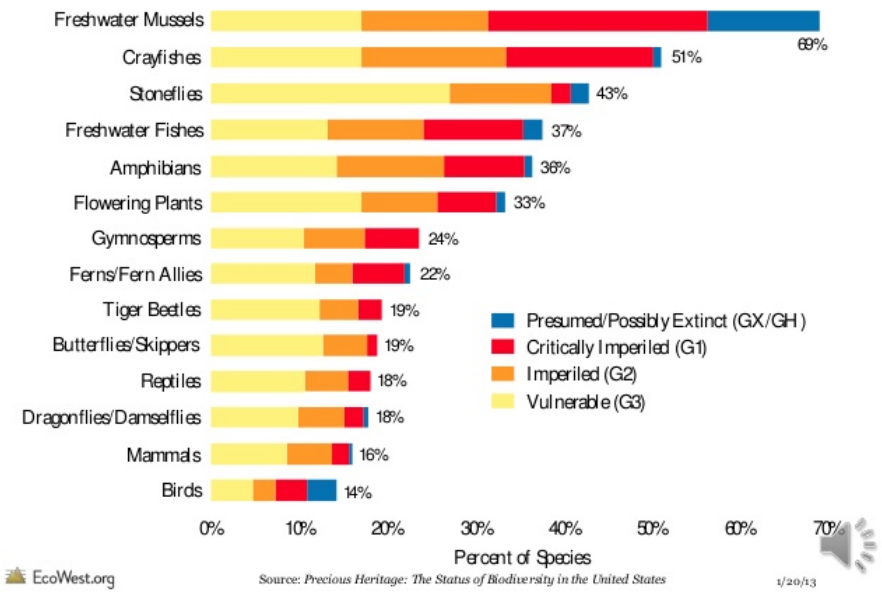
XI. REPORTING REQUIREMENTS:
Periodic work plan status update reports will be submitted no later than December 1, 2016, May 1, 2017, December 1, 2017, May 1, 2018, and December 1, 2018. A final report and associated products will be submitted between June 30 and August 15, 2019.

Environment and Natural Resources Trust Fund
M.L. 2016 Project Budget

Project Title: Restoring Native Mussels in Streams and Lakes
Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 04c
Project Manager: Mike Davis
Organization: MNDNR.
M.L. 2016 ENRTF Appropriation: $600,000
Project Length and Completion Date: 3 years - June 30, 2019
Date of Report: May 29, 2016

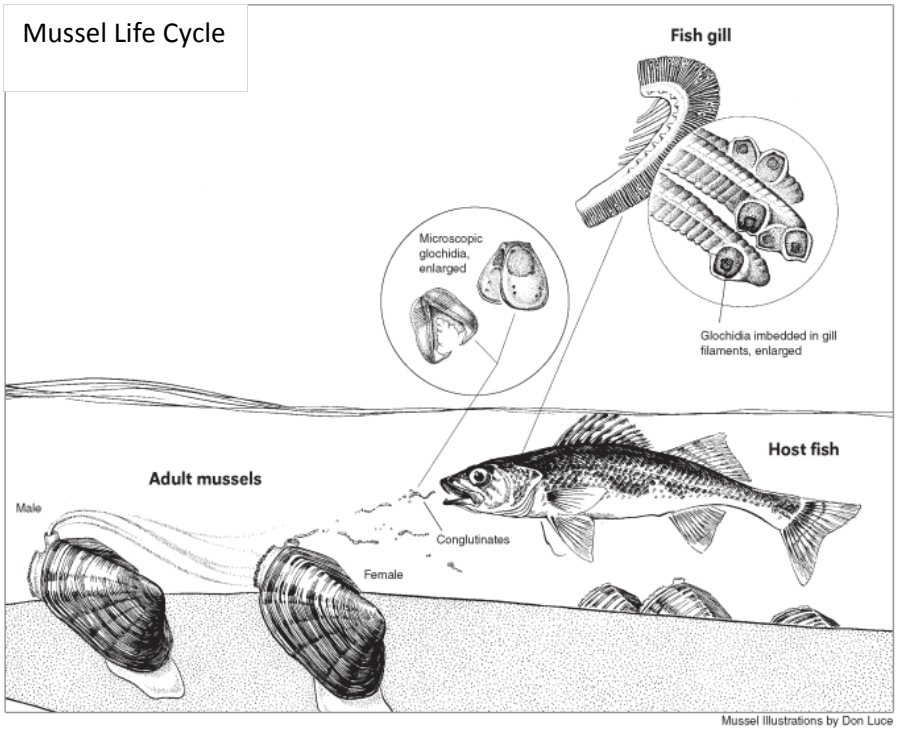
ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	Activity 3 Budget	Amount Spent	Activity 3 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	**Juvenile mussel production**			**Rearing juvenile mussels**			**Releasing and monitoring mussels**				
Personnel (Wages and Benefits)	$190,880	$0	$190,880	$272,355	$0	$272,355	$80,706	$0	$80,706	$543,941	
Mussel Culture Biologist: $125,722(72% salary,28% benefits), 1 FTE for 2 years											
Aquarist/survey diver (Shelby Marr): $77,502 (72% salary, 28% benefits), .75 FTE for 2 years											
Malacologist (Bernard Sietman): $116,500 (72% salary, 28% benefits), .75 FTE for 2 years											
Lab, database and survey diver (Zeb Secrist): $79,869 (72% salary, 28% benefits), .75 FTE for 2 years											
Project Manager/malacologist (Mike Davis): $144,348 (72% salary, 28% benefits), .75 FTE for 2 years											
Equipment/Tools/Supplies											
Purchase of host fish, food for fish,mussel food, filtration, air fills, etc											
Printing							$8,170			$8,170	
Remake and printing of mussel poster											
Travel expenses in Minnesota							$1,108			$1,108	
Travel is to collect female mussels for propagation and returning them and for travel to release sites for release and monitoring.											
Travel expenses outside Minnesota											
Some species of donor female mussels are only availabe in Wisconsin or Iowa, travel outside MN is to collect these and then to return them later.											
Subtotal	$190,880			$272,355			$89,984			$553,219	
MNDNR Direct and Necessary											
People support - $11,640											
Safety support - $2,744											
Financial support - $7,745											
Communication support - $1,236											
IT support - $22,352											
Planning support - $829											
Procurement support - $235											
Total Direct and Necessary cost	**$46,781**									**$46,781**	
COLUMN TOTAL	**$237,661**			**$272,355**			**$89,984**			**$600,000**	**$600,000**

Share of U.S. species at risk by plant/animal group



EcoWest.org Source: *Precious Heritage: The Status of Biodiversity in the United States* 1/20/13

Mussel Life Cycle



Mussel Illustrations by Don Luce