Final Abstract

Final Report Approved on January 4, 2024

M.L. 2021 Project Abstract

For the Period Ending June 30, 2023

Project Title: Restoring Mussels in Streams and Lakes - Continuation

Project Manager: Madeline Pletta

Affiliation: MN DNR - Ecological and Water Resources Division

Mailing Address: 2109 N Lakeshore Dr

City/State/Zip: Lake City, MN 55041-9028

Phone: (651) 314-6306

E-mail: madeline.pletta@state.mn.us

Website: https://www.dnr.state.mn.us/ewr/index.html

Funding Source:

Fiscal Year:

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 08b

Appropriation Amount: $619,000

Amount Spent: $619,000

Amount Remaining: -

Sound bite of Project Outcomes and Results

MDNR Center for Aquatic Mussel Programs reintroduced over 4,400 native mussels into three watersheds in southeast Minnesota, bringing our total number to over 17,000 since 2016. We completed monitoring of mussels and habitat at reintroduction sites. We disseminated information through outreach events, including facility tours, presentations, and newsletters.

Overall Project Outcome and Results

The MDNR Center for Aquatic Mussel Programs (CAMP) propagated 775,486 Mucket, Black Sandshell, Higgins Eye, Snuffbox, and Spectaclecase mussels at our laboratory in Lake City, Minnesota. We accomplished this by collecting 47 gravid female mussels, extracting glochidia, inoculating 437 host fishes, and raising juveniles in our lab for their first year of life (Table 1). We continue to rear 31,765 sub-adult mussels in preparation for release (previous cohorts age 1 – 2 years; mean shell length range 10 – 40 mm) at grow-out locations including lakes near Austin and Cannon Falls, the Saint Croix River, Minnesota Zoo, and Waterville Fish Hatchery. We reintroduced 4,445 Mucket, Black Sandshell, Higgins Eye, and Snuffbox into eight sites among the Cannon (n = 3), Cedar (n = 3), and Mississippi River (n = 2) watersheds. We recaptured 1,764 tagged mussels during three annual surveys and collected size and condition data that will be used to

evaluate success among sites. We observed gravid female Mucket and Black Sandshell in each watershed, suggesting reproduction is possible if fish hosts are available (Figure 1). We quantified environmental parameters at each site and found some potential concerns for ammonia in the Cedar and Mississippi Rivers because of values > 0.07 ppm (Figure 2). We completed physical characterization of sites on the Cedar River (Status Updates June 30 & July 3, 2023) but the Cannon River is postponed until shared survey equipment becomes available. Additionally, CAMP engaged and informed citizens and the media about our program and the importance of mussels via public and professional presentations, interviews, newsletters, tours, and our website. We also continued to work on developing a phone application to identify mussels. Visuals can be found in Optional Attachments: Final Abstract October 2023 (figures).

Project Results Use and Dissemination

The importance of our work was highlighted through multiple presentations and interviews to the public and media including the Hormel Nature Center native mussel exhibit, IJ Holton Middle School, Waterville Fish Hatchery (Mankato Free Press), PBS Prairie Sportsman ("Mike's Muckets" video), and a Viking River Cruise. We set up display booths at the Minnesota State Fair, Metro Children's Water Festival, and the DNR Roundtable meeting and passed out hundreds of posters, provided touchable shells and buttons, and showed a mussel filtration video (see previous status updates for photos). Moreover, professional presentations were given at Freshwater Mussel Conservation Society's biannual conference.

Environment and Natural Resources Trust Fund

M.L. 2021 Approved Final Report

General Information

Date: November 21, 2024

ID Number: 2021-039

Staff Lead: Mike Campana

Project Title: Restoring Mussels in Streams and Lakes - Continuation

Project Budget: $619,000

Project Manager Information

Name: Madeline Pletta

Organization: MN DNR - Ecological and Water Resources Division

Office Telephone: (651) 314-6306

Email: madeline.pletta@state.mn.us

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

Project Reporting

Final Report Approved: January 4, 2024

Reporting Status: Project Completed

Date of Last Action: January 4, 2024

Project Completion: June 30, 2023

Legal Information

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 08b

Appropriation Language: $619,000 the first year is from the trust fund to the commissioner of natural resources to restore native freshwater mussel assemblages and the ecosystem services they provide in the Mississippi, Cedar, and Cannon Rivers and to inform the public on mussels and mussel conservation.

Appropriation End Date: June 30, 2024

Narrative

Project Summary: Restoring native mussel assemblages can improve water quality and ecological health of rivers. Mussel filter water, purifying and improving water clarity by removing particles and contaminants like E. coli bacteria.

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Minnesota's native mussels are a critically important component of aquatic ecosystems, but have been lost or diminished in many Minnesota water bodies. Historical accounts speak of mussels literally paving the bottom of rivers. 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. This drastic decline of mussels over the last century has diminished the filtering capacity and other benefits mussels provide. Today, Clean Water Act implementation and advances in mussel culture and restoration offer opportunities to mitigate this trend. A single mussel can filter 10 gallons of water a day, over years to decades of its life, and a 6-mile stretch of mussel beds can filter out over 25 tons of particulates per year while filtering the entire volume of a river many times over at base flows.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

We propose to restore native mussel assemblages in the Cedar, Cannon, and Mississippi rivers by continuing to propagate, rear, release and monitor mussels in these watersheds

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

Reintroducing up to six species of mussels historically present in the Cedar River downstream of Austin, MN, up to two species historically present in the Cannon River system upstream of Northfield, MN, and up to six species historically present in the Mississippi River upstream of its confluence with the Minnesota River. 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 endangered and threatened species.

Project Location

What is the best scale for describing where your work will take place?

Statewide

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

During the Project and In the Future

Activities and Milestones

Activity 1: Monitoring mussels released into streams

Activity Budget: $130,000

Activity Description:
Mussels released at each site in each stream will be monitored for survival, growth and eventually reproductive status annually. Additionally, environmental variables (e.g., flow, water temp, water depth, ammonia, etc.) will be monitored to determine potential reasons we see the survival and growth response. Physical attributes of two release sites on the Cannon River and two sites on the Cedar River will be characterized.

Activity Milestones:

Description	Approximate Completion Date
Physical characterization of monitoring sites on the Cedar River and Cannon River	June 30, 2023
Quantifying environmental parameters at mussel release sites	June 30, 2023
Recapture at least 10 tagged mussels at restoration sites annually (per river).	June 30, 2023

Activity 2: Outreach to citizens

Activity Budget: $39,000

Activity Description:
Inform the public and media about our program and the importance of mussels. We will staff a booth at the MN State Fair each year. Here, citizens can acquire the new ENRTF mussel ID app, see demonstrations on its use, and try it out with native mussel shells on display. Additionally, we will have posters available for handout and a collection of shells that people can see and handle. Quarterly posts to the DNR Facebook page and our CAMP newsletter will update citizens on our activities funded by the ENRTF and will feature results of our milestones for propagation, releases and monitoring. We will host an annual Open House where citizens can tour our lab; and see juvenile mussels of various sizes and the fish that host them.

Activity Milestones:

Description	Approximate Completion Date
Host open house for citizens	March 31, 2023
Yearly staff present at various platforms (State Fair, Water Festival, Nature Centers)	March 31, 2023
Newsletter reaching greater than 3,000 recipients	June 30, 2023
Greater than 250 downloads of the Mussel Phone App	June 30, 2023

Activity 3: Propagate, grow and release mussels for reintroduction in rivers

Activity Budget: $450,000

Activity Description:
Up to ten brooding female mussels of each target species will be collected by wading, snorkeling or with SCUBA. Broodstock are collected from early spring to late fall depending on the targeted species' life history. Host fish will be inoculated with larvae harvested from female mussels by combining them in an aerated water bath. Post inoculation, fish will be moved into holding tanks specifically designed for mussel propagation, placed into cages within their watershed or released at selected mussel restoration sites. Juveniles will be collected from the host fish retained at our facility for 2-12 weeks after inoculation. All juveniles collected will be counted and placed into mussel rearing systems

and monitored for growth and survival. Juvenile mussels may be reared at our Center for Aquatic Mollusk Programs (CAMP) for up to 18-months before moving them to a natural system for continued growth. Mussels will be released into selected rivers at 2-years or once they reach a releasable size.

Activity Milestones:

Description	Approximate Completion Date
Yearly collection of host fish; 10-200 host fish per mussel species.	May 31, 2022
Yearly collection of gravid females (broodstock); 2-10 mussels per species.	September 30, 2022
Juvenile mussels (50-1,000) will be collected from each host fish per mussel species.	October 31, 2022
Reintroduce juvenile mussels to selected restoration sites (1-3 sites per river of each species).	June 30, 2023
Rear juvenile mussels to releasable size (10-1,000 per species).	June 30, 2023

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Joe Walton	Dakota County Parks Natural Resources	Monitor mussel cage site location for disturbances.	No
Tim Ruzek	Cedar Watershed District	Assist with mussel release locations in the Cedar River, and monitor East Side Lake cage location.	No
Kelly Poole	Iowa DNR, Threatened and Endangered Species Coordinator	Access to female mussels in Iowa's Cedar River	No
Alison Holdhusen	National Park Service, Mississippi National River and Recreation Area	Assists with monitoring and collection of donor mussels	No
Byron Karns	National Park Service, St. Croix National Riverway	Assists with monitoring and collection of donor mussels	No
Tam Smith	US Fish and Wildlife Service, Twin Cities Field Office	Permitting and planning for reintroduction of federally listed species	No
Doug Aloisi	US Fish and Wildlife Service, Genoa National Fish Hatchery	Assists with obtaining host fish and female mussels	No
Dan Kelner	US Army Corps of Engineers	Coordinates and pays for monitoring of reintroduction sites on the Mississippi River	No
Ben Meinrich	MN Zoo	Assist with growing juvenile mussels to release size at Zoo lake.	No

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.
Mussel ID application will include information obtained via our ENRTF grant. We will be disseminating our work results via the State Fair each year, and are involving public organizations such as the Hormel Nature Center in Austin, MN, Soil and Water Conservation Districts where mussel restoration is taking place. We produce a mussel newsletter via the DNR that has hundreds of subscribers as of this year. All project communication and outreach will acknowledge ENRTF by ENRTF logo, and attribution language.

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?

This will be our third grant from the ENRTF and part of a long-term effort to reestablish mussels in these streams. As we seek funding from other sources to expand our work to other rivers and lakes it is crucial to be able to retain our staff and facility that makes this work possible.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Restoring Native Mussels in Streams and Lakes	M.L. 2016, Chp. 186, Sec. 2, Subd. 04c	$600,000
Restoring Native Mussels in Streams and Lakes	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03b	$500,000

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount	$ Amount Spent	$ Amount Remaining
Personnel										
Madeline Hayden, NR Spec Sr		Lead Mussel Propagation Biologist			24%	2		$169,000	-	-
Mike Davis, Natural Resources Program Consultant		Project management, provides institutional knowledge and context			8%	0.24		$28,000	-	-
NR Spec		Fish husbandry, lab management/maintenance, monitoring release sites			62%	0.6		$48,000	-	-
Zeb Secrist, NR Spec		Database manager, IT support, dive survey expert			31%	0.24	X	$19,500	-	-
Lindsay Ohlman, NR Spec Int		Mussel Propagation and rearing biologist			33%	2	X	$175,000	-	-
Bernard Sietman, Research Scientist		Lends expertise in mussel distribution, taxonomy and biology helping to improve results and design monitoring plans			24%	0.24	X	$27,000	-	-
Kathryn Holcomb		Mussel Program Supervisor			50%	0.1	X	$10,000	-	-
							Sub Total	**$476,500**	**$476,500**	**-**
Contracts and Services										
							Sub Total	**-**	**-**	**-**
Equipment, Tools, and Supplies										
	Tools and Supplies	Temperature Loggers and Water Quality instruments	Track temperature and WQ at monitoring sites, ponds, and all other mussel culture systems					$1,500	$1,500	-

	Tools and Supplies	PVC parts and pumps for juvenile culture systems	Expand current juvenile capture and culture systems					$10,121	$10,121	-
	Equipment	mussel rearing baskets and aeration equipment	For containing and supporting juvenile mussels growing in ponds or rivers. Aeration for continuous water movement within the ponds.					$3,500	$3,500	-
	Tools and Supplies	Lab supplies	Food for mussels and fish, purchase host fish, mussel tagging supplies					$22,883	$22,883	-
							Sub Total	**$38,004**	**$38,004**	**-**
Capital Expenditures										
		Outboard motor for 20 ft dive boat (150hp E-Tech)	Existing motor is 12 years old, to ensure reliability replacing with new is needed	X				$13,850	$13,850	-
		Ventless Dishwasher and water softening system, soiled dish table w/ sink, clean dish table w/o sink, accessories	Create a defined dishwashing space for all laboratory ware, mussel aquaria, and miscellaneous dirty dishware. Area would include loading area for dirty aquaria (soiled dish table with pre-rinse sink and spray nozzle, ~6ft total length), ventless commercial dishwasher, and drying area (clean dish table, ~6ft total length)..	X				$38,344	$38,344	-
							Sub Total	**$52,194**	**$52,194**	**-**
Acquisitions and Stewardship										
							Sub Total	**-**	**-**	**-**
Travel In Minnesota										

	Miles/ Meals/ Lodging	Fleet charges and expenses for staff	Collect brooding mussels and host fish, place juveniles in growing baskets, Collect juveniles for tagging and release, Monitoring reintroduction sites					$10,000	$10,000	-
							Sub Total	**$10,000**	**$10,000**	**-**
Travel Outside Minnesota										
	Miles/ Meals/ Lodging	Fleet charges and staff expenses, no lodging	Trips to Iowa to collect female mussels needed for propagation					$4,000	$4,000	-
							Sub Total	**$4,000**	**$4,000**	**-**
Printing and Publication										
							Sub Total	**-**	**-**	**-**
Other Expenses										
		*Direct and necessary expenses: People Support ($13,122); Safety Support ($2,437); Financial Support ($9,305) ; Communication Support ($1,324); IT Support ($26,452); and Planning Support ($1,149) necessary to accomplish funded programs/projects.	*Direct and necessary expenses includes all department support services.					$38,302	$38,302	-
							Sub Total	**$38,302**	**$38,302**	**-**
							Grand Total	**$619,000**	**$619,000**	**-**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Personnel - Zeb Secrist, NR Spec		Database manager, IT support, dive survey expert	**Classified :** This position does 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 these positions is essential for implementing this project.
Personnel - Lindsay Ohlman, NR Spec Int		Mussel Propagation and rearing biologist	**Classified :** This position does 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 these positions is essential for implementing this project.
Personnel - Bernard Sietman, Research Scientist		Lends expertise in mussel distribution, taxonomy and biology helping to improve results and design monitoring plans	**Classified :** This position does 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 these positions is essential for implementing this project.
Personnel - Kathryn Holcomb		Mussel Program Supervisor	**Classified :** This position does 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 these positions is essential for implementing this project.
Capital Expenditures		Outboard motor for 20 ft dive boat (150hp E-Tech)	Updated Quote/PO less than original price. Final price $13850 **Additional Explanation :** Monitoring mussels is a key element to our programs success, and the only way to monitor on the Mississippi River is via a dive boat. Our current motor is 12 years old, therefore, a new motor would ensure the continuous monitoring of restoration sites for greater than 10 years.
Capital Expenditures		Ventless Dishwasher and water softening system, soiled dish table w/ sink, clean dish table w/o sink, accessories	In February 2023, the MN DNR signed a new lease agreement to relocate our facility into an adjacent building. The facility located at 2111 N Lakeshore Drive, will allow our program to increase research and propagation efforts via increased laboratory space. This provides a unique opportunity to obtain new equipment to improve workflow and safety. The Center for Aquatic Mollusk Programs is seeking to purchase a Hobart ventless dishwashing unit that includes tablespace for soiled and drying dishware. Since 2016, our facility has been growing its propagation efforts to restore native freshwater mussels, now producing greater than 500,000 juveniles per year. Juvenile mussels (size 250 microns) are placed into hundreds of aquaria which require routine cleaning to monitor survival and growth. Daily, we are cleaning several aquaria as well as additional labware associated with rearing mussels (i.e., beakers, food containers, etc.). Our current cleaning method includes soaking the aquaria in a 100-gallon tub of diluted acid, then bending

			over this tub to scrub and rinse. This method is a health risk, ergonomically incorrect, and amounts to greater than 30 minutes per day scrubbing. A commercial dishwasher would eliminate the need to soak the aquaria in acid and would also reduce cleaning time, water usage, and prevent back strain. The dishwasher we are proposing is ENERGY STAR rated, using only 0.67 gallons per rack rinse (maximum consumption 24.12 gallons per hour) and utilizes drain water energy recovery (DWER). Washing cycle times range 1 – 6 minutes, decreasing our overall washing efforts. Additionally, we have estimated the time-cost analysis and determined the machine would pay for itself within a few years of purchase. Amendment Justification/Explanation Extended: During this grant period, we had originally planned to purchase a dock ($12,318) and aeration system ($14,893) to be used at Waterville Fish Hatchery to expand mussel propagation. In April 2022, DNR Leadership proposed funding that would move our facility to a neighboring building that better suited our expansion needs: including office space, laboratory space, electrical capacity, and potential to construct our own water source. In February 2023, the lease agreement was signed. Due to this unforeseen move, and the potential for the construction of an on-site water source the dock and aeration system at Waterville Fish Hatchery is no longer a priority purchase. Rather, this move provides us with an opportunity to obtain new equipment to increase workflow in the laboratory. Additional supplies were adjusted to increase the budget for purchasing the dishwasher: heated shirt -$2,000; laser engraving unit -$7,000; lab supplies -$617; new dive boat motor cost adjustment -$2,516. These supplies are items we determined to be less important in comparison to the purchase of a commercial dishwasher and dish tables. **Additional Explanation :** The dishwasher and tablespace equipment will be used daily throughout its lifespan to clean mussel aquaria and labware. The quantity of items to clean is expected to increase as our program continues to grow its research and propagation efforts, thereby, increasing our use of this equipment over time.

Non ENRTF Funds

Category	Specific Source	Use	Status	$ Amount	$ Amount Spent	$ Amount Remaining
State						
			State Sub Total	**-**	**-**	**-**
Non-State						
Cash	USACE funds periodic monitoring at Mississippi River reintroduction sites	Supports staff salary, expenses and equipment cost to conduct monitoring.	Pending	$10,000	-	$10,000
			Non State Sub Total	**$10,000**	**-**	**$10,000**
			Funds Total	**$10,000**	**-**	**$10,000**

Attachments

Required Attachments

Visual Component

File: da95f91a-6bc.pdf

Alternate Text for Visual Component

Left to right: MNDNR biologists releasing mussels into the Cedar River near Austin, MN. Juvenile mussels with identifying tags glued to their shells. Mussel life history graphic showing relationship with host fish. A bag of tagged mussels ready for release. Graphic showing the percent of mussels that are threatened and endangered compared to other animal groups in North America....

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
background check	421ae407-037.pdf
Status Update June 1, 2022 (figures)	8e5ce2e1-7fd.pdf
Status Update December 1, 2022 (figures)	adde13b3-007.pdf
Status Update June 1, 2023 (figures)	3d2fa1ef-169.pdf
Status Update June 30, 2023 (figures)	1718340a-46c.pdf
Final Abstract October 2023 (figures)	c2560c52-98c.pdf

Media Links

Title	Link
Prairie Sportsman: Mike's Muckets	https://video.pbsnc.org/video/mikes-muckets-uifify/
2021 Cedar River Watershed District annual report: Mussel movement (page 5)	https://issuu.com/mowerswcd/docs/2021_crwd_annual_report
Cedar River's mussels getting stronger	https://www.austindailyherald.com/2022/09/cedar-rivers-mussels-getting-stronger/
Endangered mussels reproducing in Minnesota's Cedar River	https://www.startribune.com/endangered-mussels-reproducing-in-minnesotas-cedar-river-for-first-time-in-decades/600201501/
Mussel, fish surveys around Austin document the health of the Cedar River Watershed	https://www.postbulletin.com/sports/northland-outdoors/mussel-fish-surveys-around-austin-document-the-health-of-the-cedar-river-watershed
Flexing mussels: mussels exhibit opens at nature center	https://www.austindailyherald.com/2022/10/flexing-mussels-mussels-exhibit-opens-at-nature-center/
Cedar River's mussels getting stronger	https://cedarmn.medium.com/cedar-rivers-mussels-getting-stronger-35aa69be7537
Good signs from Austin as Minnesota works to restore native mussels	https://www.lccmr.mn.gov/misc/2023-02-01_outdoor_news_minnesota_roundtablers_learn_about_mussels.pdf
DNR Webinar	https://www.youtube.com/watch?v=KP4rElE9zak
Freshwater Mussel Filtration Timelapse	https://www.youtube.com/watch?v=s_CaNfFtHhg
MPCA Webinar	https://www.youtube.com/watch?v=ioKTdNXaprk
2022 CRWD annual report	https://issuu.com/mowerswcd/docs/2022_crwd_annual_report?fr=xKAE9_zU1NQ
The Knowledge Bank Of Mussel Man Mike Davis	https://www.youtube.com/watch?v=wnMIlXpXV2g&t=1s

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

We reduced employee FTEs, added some costs/expenses in order to arrive at the approved budget total of $619,000. Activities were not altered in nature but reduced in scope. changed completion date to 2024 and attached background check document

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

Yes

Do you agree travel expenses must follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I understand the Commissioner's Plan applies.

Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

No

Work Plan Amendments

Amendment ID	Request Type	Changes made on the following pages	Explanation & justification for Amendment Request (word limit 75)	Date Submitted	Approved	Accepted Pending Legislative/LCCMR Action	Date of LCCMR Action
1	Amendment Request	• Budget - Personnel • Budget - Capital, Equipment, Tools, and Supplies	New hires; Program supervisor (4/22) and NR Spec (7/22). Salary amounts were changed to reflect these additions. Due to increased need for salary, equipment costs were reduced to balance budget.	June 3, 2022	Yes	N/A	June 23, 2022
2	Amendment Request	• Budget - Capital, Equipment, Tools, and Supplies • Attachments	The dishwasher and tablespace equipment are needed to improve workflow and safety. We hand wash several hundred containers; therefore it would improve our efficiency and reduce water usage. February-2023, DNR Leadership signed a lease agreement at a neighboring building that better suited our needs. Due to this unforeseen move, the dock and aeration system is no longer needed. Additional supplies were adjusted to increase dishwasher budget; items were postponed or purchased with other funding sources.	February 10, 2023	Yes	N/A	February 10, 2023
3	Project Manager	Previous Manager: Mike Davis (mike.davis@state.mn.us) New Manager: Madeline Pletta (madeline.pletta@state.mn.us)	I will retire before the project is completed	April 13, 2023	Yes	N/A	April 13, 2023
4	Completion Date	Previous Completion Date: 06/30/2024 New Completion Date: 06/30/2023		May 19, 2023	Yes	Yes	May 19, 2023

5	Amendment Request	• Budget • Project Collaborators - Project Manager Info • Narrative • Budget - Printing and Publication • Budget - Capital, Equipment, Tools, and Supplies • Budget - Travel and Conferences • Budget - Other • Attachments	• The Clam Counter was delayed in development due to a medical emergency. Therefore, there is no balance due for the mussel phone app during this project period. The mussel phone app budget moved into Tools and Supplies - lab supplies to purchase mussel tagging supplies.	August 14, 2023	Yes	N/A	September 7, 2023

Status Update Reporting

Final Status Update July 3, 2023

Date Submitted: August 14, 2023

Date Approved: September 7, 2023

Overall Update

In preparation of work for our future grant, we collected 30 adult Monkeyface mussels from the Cedar River in Iowa in June and relocated them to the Cedar River near Austin, Minnesota. Our goal was to collect a mix of males and females, during a time in which females were hopefully fertilized and may release mature glochidia in the new location. We tagged mussels with passive integrated transponder (PIT) tags and released them in the same reintroduction site as our Black Sandshell and Mucket. We plan to assess their survival this fall during our normal monitoring. Activity visuals can be found in Optional Attachments: Status Update June 30, 2023 (figures).

Activity 1

Physical characterization of the three Cedar River reintroduction sites showed bankfull width and depth increase from upstream (site 1: width = 80; depth = 3.8) to downstream (site 3: width = 150; depth = 5.1); see Table 1. However, the river becomes more entrenched as it flows from site 1 to site 3, due to having a narrower width of flood-prone area at site 3. Sites 1 and 2 can be characterized as shallow, sinuous, and predominantly gravel (~60%) and cobble (~20%). The most downstream point is the deepest and straightest (i.e., less sinuous) and has a higher ratio of cobble (~35%) to gravel (~41%). The Cannon River monitoring sites will be completed this summer when shared survey equipment becomes available. Water quality parameters measured during monitoring are summarized in Table 2. We recaptured a total of 928 live mussels and 19 dead (shells) during monitoring years 2021 (n = 451) and 2022 (n = 496) at our reintroduction sites. The third and final round of monitoring mussels will occur in fall 2023, therefore, updates pertaining to recaptures or quantifying environmental variables will be continued in next grant period (M.L. 2023).
(This activity marked as complete as of this status update)

Activity 2

In June, CAMP staff presented to over 225 individuals in the community of Austin. Restoring Minnesota's Mussels was included in the Senior Special (65+), Nature Play (Pre K – 3rd grade), and Project E3 (5/6th grade) to highlight their importance and the impact of our project in the Cedar Watershed. At each event, staff provided Mussels of Minnesota posters (M.L. 2019) and the opportunity to examine and touch mussel shells, pearl buttons, button blanks, and natural occurring pearls. Moreover, the Mankato Free Press released an article showcasing the cooperative partner with the MN DNR Fisheries division. The Clam Counter was delayed in development; therefore, this milestone was not able to be achieved. However, staff received a beta version of the Clam Counter – MN DNR. This application will be publicly available in the coming weeks. Lastly, a small open house was held at CAMP in 2022. At this time the DNR commissioner and several staff were in attendance. Another open house will be held to celebrate moving to the new facility in 2024 (ML. 2023).
(This activity marked as complete as of this status update)

Activity 3

We transferred 15,621 Mucket, Higgins Eye, and Black Sandshell (age 309 - 349 days) to grow-out locations at Eastside Lake, Waterville Fish Hatchery, and the Minnesota Zoo during June. We also transferred 817 Spectaclecase (~10 mm) propagated in 2021 to the Saint Croix River for grow-out. Spectaclecase propagated in 2022 will stay in the lab one more year and be transferred in 2024. Mean survival in the lab was 16% but varied greatly among species (Mucket = 14%; Higgins Eye = 27%; Black Sandshell = 6%, and Spectaclecase < 1%). The average growth rate was 0.025 mm/d and was highest for Higgins Eye (0.036 mm/d) and lowest for Spectaclecase (0.011 mm/d). Newly metamorphosed mussels transferred to the Minnesota Zoo in early 2022 were assessed spring 2023 and only Higgins Eye and Mucket survived,

averaging less than 1%. The mean growth rate was 0.012 mm/d, and these mussels will stay at the zoo for another year before reintroduction. The second and third round of mussel reintroductions into the Cedar, Cannon, and Mississippi Rivers will occur in early August.
(This activity marked as complete as of this status update)

Dissemination
The importance of freshwater mussels continues to spread via media outlets, previous webinars, newsletters, in-person presentations, and in-classroom learning. Webinars available on YouTube have over 3.4k view combined, and our newsletter has an opening rate of nearly 30% and over 5,200 subscribers.

Status Update Reporting

Status Update June 1, 2023

Date Submitted: August 14, 2023

Date Approved: September 7, 2023

Overall Update

Early this spring, leadership signed a lease agreement that has moved our facility into a neighboring building. At this time, we designed a new building semantic and subsequent electrical mapping to ensure systems are adequately powered. Moreover, construction of suitable plumbing is scheduled to commence in early June. Due to this, propagation efforts for 2023 will begin in the fall.

Staff monitored the growth and survival of 2022 juvenile mussels throughout the winter. Higgins Eye, Black Sandshell, and Mucket maintained growth rates that ranged from 0.02-0.04 mm/d. Growth rates for Higgins Eye were above average when compared to previous years data. Overall, ~22,000 mussels remain in our facility and will be placed into secondary culture locations as soon as possible.

Once again, we have had limited success with Snuffbox culture, but with an increased survival of Spectaclecase in the pulsed flow system, we plan to replicate the effort with the seemingly more difficult Snuffbox mussels in 2024. Activity visuals can be found in Optional Attachments: Status Update June 1, 2023 (figures).

Activity 1

No status update for the reporting period.

Activity 2

Freshwater mussels were the highlight display at the Minnesota DNR's Annual Roundtable. This event gathers stakeholders and conservation leaders throughout Minnesota, and this project took centerstage. Traveling with Russel the Mussel, Hormel Nature Center's giant replica mussel, our table highlighted the propagation success within the DNR and this project. This platform provided a launching pad for subsequent presentations for the Minnesota Outdoor Skills and Stewardship and the Minnesota Pollution Control Agency webinar series, as well as in-person at the Hormel Nature Center. Additionally, staff presented to the Division of Fish and Wildlife at the DNR Fish Academy. Moreover, staff hosted a facility tour and presentation for the Upper Mississippi River Conservation Committee annual meeting. Lastly, the beta-version of Clam Counter was delivered to staff members for final review.

Activity 3

We continued to rear four of five species propagated in 2022 in our lab overwinter and survival ranged 0 – 25% among species. No Snuffbox survived more than 133 days, which is typical for this species. Survival among watersheds was also variable and Cedar River mussels experienced the most mortality that started early and continued past the transition period from pedal to filter feeding. Most species' growth rates were consistent throughout the winter months, and we did not see the normal cessation. We believe this was due to better control of ambient air temperature, which we maintained at 72 °F. Spectaclecase that were raised in the pulsed flow system had the highest survival rate we have documented for this species (38%), however none survived in buckets or recirculating systems. Growth rates were also high (0.02 mm/d) while in the pulsed flow but decreased about 50% after we transitioned them to a recirculating system. We have since redesigned our pulsed flow to accommodate older, larger mussels so that future cohorts can be maintained in the system for up to two years.

Dissemination

The DNR's Annual Roundtable provided our largest in-person platform to meet with various stakeholders to discuss the

importance of freshwater mussels and our restoration project throughout Minnesota. We made a timelapse video for this event to showcase the filtration power of adult native mussels. Additionally, multiple presentations were given to biologist and other environmental agencies to aid in their understanding of the program and our projects.

Status Update Reporting

Status Update December 1, 2022

Date Submitted: December 1, 2022

Date Approved: December 20, 2022

Overall Update

The Center for Aquatic Mollusk Programs (CAMP) has received several LCCMR grants over the years that have enabled us to research, propagate, and reintroduce imperiled freshwater mussels in Minnesota. We have been working towards increasing survival and growth rates of all mussels raised at CAMP, but especially Spectaclecase and Snuffbox, which tend to do poorly. Experimentation with substrate and aquaculture systems has been beneficial, and this year, we have seen a 90% increase in the growth rate for Spectaclecase, as well as higher survival than previous years. We plan to use these techniques for Snuffbox and other species in the future. Additionally, placing juvenile mussels into secondary culture systems prior to reintroduction has proven to be a critical steppingstone for all species. Mussels that spend a year or more in natural water sources exhibit growth rates of two to three times higher than what we see in the lab. Reintroducing larger, sub-adult mussels is a great effort, but it sets up these populations for success because they are more resilient to water quality, flow, and predation concerns. Activity visuals can be found in Optional Attachments: Status Update December 1, 2022 (figures).

Activity 1

We completed a second year of monitoring reintroduction sites during August 2022. Detections and recaptures increased from 2021 and included many new individuals not previously recaptured. We detected 174 of 300 PIT-tagged mussels in the Cedar River watershed and physically recaptured 159. We detected 174 of 299 PIT-tagged in the Cannon River watershed and recaptured 99. Hallprint and Bee-tagged mussels were often found nearby, so in total, we collected data on 468 individuals. We observed gravid females at four out of six reintroduction sites on these rivers. Additionally, we monitored the Mississippi River site near Hidden Falls Regional Park during July 2022, but flow was not optimal for diving with handheld PIT equipment and the entire study area could not be surveyed, thus, only two mussels were detected and neither were recaptured. Timed searches will be conducted for this site in the future. Environmental parameters were also measured during these surveys, including water temperature and depth, dissolved oxygen, conductivity, pH, and un-ionized ammonia. We did not observe any concerns with water quality this year. Physical characterization of the Cannon River sites will be completed during spring 2023 to collect baseline geomorphic data including channel sinuosity and particle size distribution.

Activity 2

The MN DNR proudly supported our partner, the Hormel Nature Center, on a new exhibit highlighting freshwater mussels and their unique history in Austin, Minnesota. Staff provided technical assistance for the hand-painted mural, collected and identified shells for display, and critiqued an animated cartoon for scientific accuracy. The exhibit opened to the public in October 2022. Staff also participated alongside Project WET at the MN State Fair Water Day, as well as Children's Water Festival. Staff developed a mussel-name guessing game and live mussels were along for touch and feel. Additionally, multiple tours of our facility were given throughout the summer. Groups included Clean Water Legacy partners, DNR Parks and Trails, USFWS regional management team, Amery High School biology class, and several individuals from the general public. Moreover, the mussel app, Clam Counter, will be released before January 1, 2023. And our newsletter reached greater than 5,200 subscribers.

Activity 3

We transferred over 38,000 juvenile mussels of four species (2021 cohorts; size range 3 – 12 mm) from our lab to secondary culture locations during summer 2022. Mussels were placed in submerged baskets and totes, or flow-through buckets at the Minnesota Zoo, Waterville State Fish Hatchery, and Eastside Lake in Austin. Brood mussels were returned

to collection locations and new gravid females were utilized for the 2022 propagation season. We extracted glochidia from 31 donor females, inoculated 126 Walleye, 77 Logperch, and 12 Goldeye and produced over 572,000 juvenile Snuffbox, Spectaclecase, Higgins Eye, Mucket, and Black Sandshell. Several thousand newly metamorphosed of each species were transferred to the Minnesota Zoo and Genoa National Fish Hatchery, while the remaining were placed in static, recirculating, and pulsed flow culture systems in our lab to be reared overwinter. We conducted a free-release of 118 Walleye inoculated with Mucket glochidia at one of our reintroduction sites on the Cedar River in October. We marked and tagged over 4,400 Mucket, Higgins Eye, and Black Sandshell (2019 cohorts; size range 19 – 97 mm) and reintroduced them into their respective watersheds during July and September. These mussels will be monitored next fall for survival, growth,

Dissemination

Our successful restoration efforts through propagation and reintroduction, made possible through our LCCMR grants, have increased awareness of the importance of freshwater mussels statewide. These efforts were highlighted in multiple articles published by the Star Tribune and Post Bulletin, as well as smaller news outlets. Additionally, these efforts have aided in securing funding for a new facility location. The future mussel facility is an existing building located 200 yards behind CAMP. This building will be retrofitted to allow for expansion of the program relating to our restoration efforts and staffing needs.

Status Update Reporting

Status Update June 1, 2022

Date Submitted: June 1, 2022

Date Approved: June 23, 2022

Overall Update

The Center for Aquatic Mollusk Programs (CAMP) has made significant advancements regarding culture of juvenile freshwater mussels, post-reintroduction monitoring, and public outreach. Continued grants over the years have allowed us to improved survival and growth rates for most species propagated in the lab and secondary culture, including the endangered Higgins Eye mussel. We also partner with other facilities and institutions to study species whose culture requirements remain enigmatic. Subsequently, we have reintroduced more than 9,800 sub-adult mussels of four species into the Cannon, Straight, Cedar, and Mississippi Rivers. Reintroduced mussels from three rivers were recaptured last year, kicking off the first of three monitoring events that will help us learn how mussels are responding to various habitats. We have increased engagement of the public by providing tours of our lab, social media posts, and participating in a television documentary. Activity visuals can be found in Optional Attachments: Status Update June 1, 2022 (figures).

Activity 1

We completed the first year of monitoring reintroduction sites during August 2021. We detected 168 of 300 PIT-tagged mussels in the Cedar River watershed and physically recaptured 119. We detected 198 of 299 tagged in the Cannon River watershed and recaptured 81. Hallprint and Bee-tagged mussels were often found nearby, so in total, we collected data on 460 individuals. Shell measurements indicated most mussels had doubled or tripled in length within a year. Environmental parameters were also measured during these surveys, including water temperature and depth, dissolved oxygen, conductivity, pH, and ammonia. Preliminary data suggest the shallowest sites may be prone to warmer temperatures and higher ammonia levels. We plan to monitor the Mississippi River site near Hidden Falls Regional Park during summer 2022. Physical characterization of the Cedar River sites was completed in November 2021 and provided us with baseline data on parameters such as bankfull width and depth, entrenchment ratio, and channel sinuosity. Pebble counts were conducted at riffle cross sections and substrate grab samples were taken within the mussel bed to assess particle size distribution. Three reintroduction sites on the Cannon River are scheduled to be surveyed during fall 2022.

Activity 2

Program outreach is key for Minnesotans to understand why we are working to reintroduce native mussels into our waterways. We teamed up with Friends of the Hormel Nature Center (HNC) and Austin 4H to complete a mussel suitability study in Dobbins Creek. Students placed enclosures containing two species of mussels into multiple locations, and monitored monthly for growth and survival. Additionally, HNC is currently in the design-stage of a native mussel exhibit at their facility. Moreover, our staff participated in Project E3 - Engineering and Environmental Sciences for Everyone in Hayfield and Austin, MN. Students were able to engage with staff, learn about the importance of native mussels, touch shells, and the Austin students were able to visit a release site on the Cedar River. The mussel table at the State Fair received a fair amount of traffic. Here staff were able to hand out posters and talk about native and invasive mussels. Lastly, our staff paddled alongside MN Zoo EdVentures Canoe Trip on the Cannon River to discuss its recovering mussel population.

Activity 3

Twenty-six gravid female mussels were collected during the previous grant period and held in a chilled recirculating system or temperate buckets prior to larvae extraction and inoculation. Similarly, 182 host fishes were acquired several months prior by seining, electrofishing, or hatchery transfer and held in recirculating tanks. Host fish inoculations

occurred May through July and produced 274,824 juvenile Snuffbox, Spectaclecase, Higgins Eye, Mucket, and Black Sandshell. Half of the juveniles were transferred to partner agencies and secondary culture systems shortly after metamorphosis, and outcomes will be determined this spring. The other half were reared at CAMP using static, recirculating, and pulsed flow systems. Overall, survival was 41% and ranged 0 – 69% among species. The majority of mussels have reached an average size of 4 – 10 mm and will be transitioned to secondary culture in the coming months where they will quickly grow to a releasable size. A reintroduction of 10 Mucket occurred in the Cannon River watershed in April 2022 during an outreach event. These mussels were cultured in 2019, overwintered at CAMP, and placed in secondary culture July 2020 at 10 mm in length. They were tagged and released in the Straight River at an average of 47mm.

Dissemination

CAMPs efforts to restore native mussels was a feature on the Prairie Sportsman (Season 13 Episode 12). The episode outlined the programs history and highlighted a reintroduction effort into the Cannon River system. Additionally, our newsletter continues to be received by several thousand subscribers. And the Clam Counter mobile application is in development, app developers are in the design phase. Moreover, the DNR social media account used a mussel lure on April Fools to educate followers on the unique lifecycle of mussels. Staff also provided tours to local high school groups and the 2022 Gathering Partners Conference for friends of Minnesota's Natural Resources.