

Final Abstract

Final Report Approved on September 30, 2026

M.L. 2023 Project Abstract

For the Period Ending June 30, 2026

Project Title: Restoring Mussels in Streams and Lakes - Continuation

Project Manager: Lindsay Ohlman

Affiliation: MN DNR - Ecological and Water Resources Division

Mailing Address: 2109 North Lakeshore Drive

City/State/Zip: Lake City, MN 55041

Phone: (651) 314-6304

E-mail: lindsay.ohlman@state.mn.us

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

Funding Source:

Fiscal Year:

Legal Citation: M.L. 2023, Chp. 60, Art. 2, Sec. 2, Subd. 08d

Appropriation Amount: \$825,000

Amount Spent: \$825,000

Amount Remaining: -

Sound bite of Project Outcomes and Results

CAMP completed propagation of Mucket, Black Sandshell, and Higgins Eye and reintroduced 10,000+ mussels into the Cannon, Cedar, and Mississippi Rivers. We completed monitoring at six established reintroduction sites and estimated survival and growth of the new populations. We chose four new sites for reintroductions and began propagating Elktoe.

Summary of Project and Outcomes

CAMP propagated 258,906 Mucket, Black Sandshell, Snuffbox, Spectaclecase, and Elktoe mussels. We accomplished this by collecting 45 gravid female mussels, extracting glochidia, inoculating 633 host fishes, and rearing juveniles in our lab for their first 1 – 2 years (Table 1). We currently have 3,318 mussels remaining in the lab and secondary culture from this effort (2024 & 2025 cohorts) and we continued to rear 8,980 sub-adults (2017, 2021, 2022 cohorts) for reintroductions during M.L. 2025 (Table 2). We tagged and released 10,679 Mucket, Black Sandshell, Higgins Eye, and Snuffbox among 10 reintroduction sites (four new) within the Cannon, Cedar, and Mississippi River watersheds (Table 3; Figure 1). We recaptured 944 tagged mussels during annual monitoring in the Cedar and Cannon River watersheds; this included seven Monkeyface previously translocated from Iowa in 2023. We quantified annual survival and growth of Mucket (Cannon River) and Black Sandshell (Cedar River) that were released in 2020 and monitored annually 2021 – 2023. Estimated

survival of Mucket ranged 42 – 100% and mussels are growing ~18 mm per year in shell length. Black Sandshell survival ranged 53 – 86% and are growing ~26 mm per year. Both species have been reproductive at each site annually (Figure 2) and we will begin surveys to find recruited offspring during M.L. 2025. Low recaptures of Monkeyface suggest propagation with reintroduction may be a better approach for this species. Environmental parameters measured during surveys showed water quality was generally within thresholds of what mussels need to thrive, with only one site having high ammonia coupled with low dissolved oxygen measured during monitoring (Figure 3). CAMP completed the Field Guide to the Freshwater Mussels of Minnesota and launched the Clam Counter Minnesota ID app. Visuals can be found in Supplemental Attachments: Final Abstract August 2026 - Figures.

Project Results Use and Dissemination

CAMP was featured in a video by the Science Museum of Minnesota which highlighted the impact of ENRTF dollars. We gave presentations and interviews to the scientific community, public, and media including the Freshwater Mussel Conservation Society, West Metro Chapter of Minnesota Master Naturalists, Lake City Lions Club, Viking River Cruise, Austin Daily Herald, KIMT-TV, and KAAL-TV (see Supplemental Attachments). We set up displays at the Minnesota State Fair and Metro Area Children's Water Festival. We published several newsletters, social media posts, passed out thousands of posters, demonstrated the Clam Counter app, and provided several lab tours.



Environment and Natural Resources Trust Fund

M.L. 2023 Approved Final Report

General Information

Date: October 5, 2026

ID Number: 2023-060

Staff Lead: Tiffany Schaufler

Project Title: Restoring Mussels in Streams and Lakes - Continuation

Project Budget: \$825,000

Project Manager Information

Name: Lindsay Ohlman

Organization: MN DNR - Ecological and Water Resources Division

Office Telephone: (651) 314-6304

Email: lindsay.ohlman@state.mn.us

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

Project Reporting

Final Report Approved: September 30, 2026

Reporting Status: Project Completed

Date of Last Action: September 30, 2026

Project Completion: June 30, 2026

Legal Information

Legal Citation: M.L. 2023, Chp. 60, Art. 2, Sec. 2, Subd. 08d

Appropriation Language: \$825,000 the first year is from the trust fund to the commissioner of natural resources to propagate, rear, and restore native freshwater mussel assemblages and the ecosystem services they provide in the Mississippi, Cedar, and Cannon Rivers; to evaluate reintroduction success; and to inform the public on mussels and mussel conservation.

Appropriation End Date: June 30, 2026

Narrative

Project Summary: Restoring native mussel assemblages can improve water quality and ecological health of rivers. Mussels 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 have 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. Multiple age classes, requiring multiple years of effort are needed to increase genetic diversity and long-term success.

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: \$200,000

Activity Description:

Mussels that have been reintroduced in the Cedar and Cannon River watersheds will be monitored annually. There are three geographically separate sites within each watershed, and monitoring will consist of measuring physical and chemical parameters (water depth and temperature, dissolved oxygen, pH, conductivity, ammonia) at three points per site. Flow will be measured at one point per site. Additionally, each site will be surveyed using passive integrated transponder (PIT) equipment to recapture tagged mussels to collect shell length and assess gravidity. Data on the number of mussels captured, as well as size data, will be used to model survival and growth of each species at each site. Mussels reintroduced at two sites within the Mississippi River watershed will be monitored for gravidity, and will consist of timed searches to find tagged mussels. Tagged mussels that will be recaptured (monitored) during the grant period were reintroduced in 2020-2022. Annual monitoring began in 2021 and will extend into this period because three years of recapture data is needed to calculate survival estimates.

Activity Milestones:

Description	Approximate Completion Date
Quantify environmental parameters at mussel release sites	June 30, 2025
Recapture at least 10 tagged mussels at previously-funded restoration sites annually (2-3 sites/watershed).	June 30, 2025
Document reproductive status	June 30, 2025
Quantify growth and survival for site (per river).	June 30, 2025

Activity 2: Propagate and rear mussels for reintroduction in rivers

Activity Budget: \$400,000

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.

Activity Milestones:

Description	Approximate Completion Date
Yearly collection of host fish; 10-200 host fish per mussel species.	May 31, 2024
Yearly collection of gravid females (broodstock); 2-10 mussels per species.	September 30, 2024
Juvenile mussels (50-1,000) will be collected from each host fish per mussel species.	October 31, 2024
Rear juvenile mussels to releasable size (10-1,000 per species).	June 30, 2025

Activity 3: Reintroduce mussels into to selected restoration sites

Activity Budget: \$150,000

Activity Description:

Once mussels reach a releasable size (minimum size 1.5 cm), each mussel is marked with a unique identifier (PIT tag, Hallprint tag, colored glue dot) to provide growth and survival information upon recapture. Mussels will be released in up to six selected restoration sites per river. Site selection is determined by flow, depth, water quality, substrate, and presence of current mussel population. Additionally, Monkeyface, a state threatened species, has only been documented as empty shells in the Cedar River in Minnesota. However, a stable population remains in northern Iowa. Although Monkeyface has been at the forefront of propagation efforts, difficulties with host fish have resulted in unsuccessful cohort years. With permitting by the Iowa DNR, 50 Monkeyface will be collected, tagged with passive integrated transponders (PIT), and transported to the Cedar River in Minnesota for two consecutive years. Monkeyface will be monitored for survival and gravidity annually.

Activity Milestones:

Description	Approximate Completion Date
Place unique identifiers and measure mussel prior to release.	June 30, 2025
Select additional release sites based on prior data collection.	June 30, 2025
Reintroduce juvenile mussels to selected restoration sites (1-6 sites per river of each species).	June 30, 2025
Collect, tag, and relocate up to 50 Monkeyface annually	June 30, 2025

Activity 4: Outreach to citizens

Activity Budget: \$75,000

Activity Description:

Inform the public and media about our program and the importance of mussels. We will update and publish a digital field guide of the Freshwater Mussels of Minnesota. Species names and distribution have been revised since the original publication (Sietman 2003). The updated guide will be available for download on the DNR webpage. Also, 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.

Activity Milestones:

Description	Approximate Completion Date
Yearly staff presentations at various platforms (State Fair, Water Festival, Nature Centers)	March 31, 2025
Newsletter reaching greater than 3,000 recipients	June 30, 2025
Greater than 250 downloads of the Mussel Phone App	June 30, 2025
Update and publish Digital Field Guide	June 30, 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Tim Ruzek	Cedar Watershed District	Assist with mussel release locations in the Cedar River, and monitor East Side Lake cage location (in-kind contribution)	No
Kelly Poole	Iowa DNR, Threatened and Endangered Species Coordinator	Access to female mussels in Iowa's Cedar River (in-kind contribution).	No
Alison Holdhusen	National Park Service, Mississippi National River and Recreation Area	Assists with monitoring and collection of donor mussels (in-kind contribution).	No
Tam Smith	US Fish and Wildlife Service, Twin Cities Field Office	Permitting and planning for reintroduction of federally listed species (in-kind contribution).	No
Megan Bradley	US Fish and Wildlife Service, Genoa National Fish Hatchery	Assists with obtaining host fish and female mussels (in-kind contribution).	No
Dan Kelner	US Army Corps of Engineers	Coordinates and pays for monitoring of reintroduction sites on the Mississippi River (non-state funding source)	No
Ben Meinrich	MN Zoo	Assist with growing juvenile mussels to release size at Zoo lake. MN Zoo has their own ENRTF funding directly relating to this project.	No
Scott Gritters	IA DNR	Fisheries Biologist and Malacologist; assist with Monkeyface permitting (in-kind contribution).	No
Luke Reese	Hormel Nature Center	Director and project advocate for mussel in Austin and at HNC (in-kind contribution).	No
Andrew Scholten	MN DNR Waterville Fish Hatchery	Primary contact for secondary culture in ponds at Waterville Fish Hatchery (in-kind contribution).	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.

We will be disseminating our work project results via DNR Social Media accounts, public presentations, State Fair booth, and CAMP newsletters. Additionally, we will involve partners in areas where restoration work is occurring. The Mussel Application will include information obtained by our ENRTF grant and is publicly available via App Store. 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 fourth 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
Restoring Mussels In Streams And Lakes - Continuation	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 08b	\$619,000

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount	\$ Amount Spent	\$ Amount Remaining
Personnel										
NR Specialist Senior - 1 staff		Lead Mussel Propagation Biologist			25%	1.2	X	\$123,901	-	-
NR Specialist Intermediate - 3 staff		Mussel Propagation and Rearing Biologist, Database Manager/IT support, Dive Survey Coordinator			25%	2.32	X	\$162,462	-	-
Research Scientist - 1 staff		Lends expertise in mussel distribution, taxonomy and biology helping to improve results and design monitoring plans			25%	0.56	X	\$65,312	-	-
Intern - 2 staff		Juvenile mussel culture, fish husbandry, monitoring release sites			10%	2		\$32,800	-	-
Mussel Program Supervisor - 1 staff		Administration of the Mussel Program and overall coordination of project activities and research			25%	0.8	X	\$79,747	-	-
NR Specialist - 2 staff		Fish and mussel care, lab maintenance, monitoring release sites			25%	2.02	X	\$148,077	-	-
Technician - 2 staff		Fish and mussel care, lab maintenance, monitoring release sites			10%	2.24		\$26,734	-	-
							Sub Total	\$639,033	\$639,033	-
Contracts and Services										
							Sub Total	-	-	-
Equipment, Tools, and Supplies										
	Tools and Supplies	Temperature loggers and water quality instruments. No single piece of equipment will exceed \$5,000.	Track temperature and WQ at monitoring sites, ponds, and all other mussel culture systems.					\$2,000	\$2,000	-
	Tools and Supplies	Mussel and fish system supplies including PVC, holding tanks, water pumps, aerators and a well-water	Expand, update, and rebuild juvenile culture and fish holding systems in new facility					\$55,793	\$55,793	-

		filtration unit. No single piece of equipment will exceed \$5,000.								
	Tools and Supplies	Mussel culture supplies	Food for mussels and fish, purchase host fish					\$4,700	\$4,700	-
	Equipment	New employee gear. No single piece of equipment will exceed \$5,000.	New employee gear (masks, snorkel, wetsuit, regulator, BCD, waders, boots, dry suits) and replace broken gear					\$7,469	\$7,469	-
	Equipment	Power failure alarm components. No single piece of equipment will exceed \$5,000.	Alert us to power failures for outlets that power critical aquaculture equipment to reduce the risk of losing live animals. This equipment will work with our current system so that we have increased capacity and range needed for our new facility.					\$9,772	\$9,772	-
							Sub Total	\$79,734	\$79,734	-
Capital Equipment										
		PIT tag receiver with submersible antenna	Detect passive integrated transponder (PIT) tagged mussels at reintroduction sites	X				\$5,577	\$5,577	-
		Walk-in refrigerator with installation	Hold fertilized female mussels (brood) in a chilled environment for use in propagation	X				\$15,461	\$15,461	-
							Sub Total	\$21,038	\$21,038	-
Acquisitions and Stewardship										
							Sub Total	-	-	-
Travel In Minnesota										
	Miles/ Meals/ Lodging	Fleet charges and travel expenses for staff - Vehicle costs range from 0.32 - 0.39 cents per mile, vehicle costs in FY2021 were \$4,200; staff receive meal coverage for travel over 35 miles, all 50	Collect brooding mussels and host fish, place juveniles in growing baskets, collect juveniles for tagging and release, monitoring					\$25,000	\$25,000	-

		trips in FY21 were greater than 35 miles.	reintroduction sites. Outreach events.							
							Sub Total	\$25,000	\$25,000	-
Travel Outside Minnesota										
	Miles/ Meals/ Lodging	Fleet charges and staff expenses, no lodging	Trips to Iowa to collect female mussels for propagation and Monkeyface for relocation to Minnesota.	X				\$467	\$467	-
							Sub Total	\$467	\$467	-
Printing and Publication										
	Publication	Digital Field Guide (update 2013 version)	update and publish a digital field guide of the Freshwater Mussels of Minnesota. Species names and distribution have been revised since the original publication (Sietman 2003). The updated guide will be available for download on the DNR webpage.					-	-	-
							Sub Total	-	-	-
Other Expenses										
		Direct and necessary expenses includes all department support services.	To support the costs related to the program administration *Direct and Necessary expenses: People Support (\$13,490), Safety Support (\$2,718), Financial Support (\$10,269), Communication Support (\$1,811), IT Support (\$30,420), and Planning Support (\$1,020) necessary to accomplish funded programs/projects.					\$59,728	\$59,728	-
							Sub Total	\$59,728	\$59,728	-

							Grand Total	\$825,000	\$825,000	-
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Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Personnel - NR Specialist Senior - 1 staff		Lead Mussel Propagation 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 - NR Specialist Intermediate - 3 staff		Mussel Propagation and Rearing Biologist, Database Manager/IT support, Dive Survey Coordinator	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 - Research Scientist - 1 staff		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 - Mussel Program Supervisor - 1 staff		Administration of the Mussel Program and overall coordination of project activities and research	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 - NR Specialist - 2 staff		Fish and mussel care, lab maintenance, monitoring release sites	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 Equipment		PIT tag receiver with submersible antenna	This equipment is specially designed to help us detect PIT tagged mussels at reintroduction sites so that we can obtain information on individuals and thus, it allows us to track success of sites. The number of reintroduction sites is expected to increase during this grant and in the future, and adding a new PIT monitoring unit will allow us to survey our sites more efficiently by having two people scanning simultaneously. It will also serve as a back up in the event of equipment failure or battery loss which has occurred in the past. Additional Explanation : We continue to monitor multiple mussel reintroduction sites annually and plan to add more sites during this grant period. We will continue to monitor them long term (3+ years each site) including during this grant and future anticipated grants.
Capital Equipment		Walk-in refrigerator with installation	Our current home-sized refrigerator has been repaired multiple times and is in a failing state. Additionally, it does not provide the space we need to house the quantity and

			number of species of mussels we use for propagation. A walk-in cooler would allow us to build aquaculture systems inside to keep mussels separated by watershed, which is important to prevent disease transfer from mussels sourced in different watersheds. A walk-in refrigerator would also provide us space to pre-chill water we use for system water changes. Separation of species/watersheds also helps prevent total loss of our stock in the event of a pump or aeration failure. The space would also be designed with the possibility of holding inoculated fish in a chilled environment which is required for certain mussel species to complete metamorphosis on fish gills. Maintaining the health of our brood mussels is the basis of successful propagation. Additional Explanation : We collect brood mussels annually and they must be kept chilled for several days to several months to prevent them from aborting before we extract larvae. We plan to continue our propagation efforts for several threatened and endangered species well into the foreseeable future.
Travel Outside Minnesota	Miles/Meals/Lodging	Fleet charges and staff expenses, no lodging	Out of state travel is required to collect female mussels needed for propagation.

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. Not guaranteed funding for this grant period.	Secured	\$35,000	\$35,000	-
			Non State Sub Total	\$35,000	\$35,000	-
			Funds Total	\$35,000	\$35,000	-

Attachments

Required Attachments

Visual Component

File: [5aa74b45-034.pdf](#)

Alternate Text for Visual Component

Top: a collection of photos from our program, starting at upper left: 6-month old Mucket mussels, brooding female displaying her mantle lure, tagging propagated Black Sandshell, reintroducing mussels, public outreach, juvenile mussel collection system, and mussels recovered during monitoring (center). Bottom: depiction of CAMP's objectives relating to the mussel lifecycle....

Supplemental Attachments

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

Title	File
Background Check Certification	fcc57f6f-04a.pdf
Table of Species Reintroductions in MN	634334f7-ca9.pdf
Status Update April 1, 2024 - Activity Visuals	ac5e5304-541.pdf
Status Update October 1, 2024 - Activity Visuals	e8b0c9b4-c8b.pdf
Status Update April 1, 2025 - Activity Visuals	5b6ded21-713.pdf
Status Update October 1, 2025 - Activity Visuals	64c1797d-d75.pdf
Status Update April 1, 2026 - Activity Visuals	bd9c229a-b0e.pdf
Final Status Update August 14, 2026 - Activity Visuals	45e2813b-12a.pdf
Field Guide to the Freshwater Mussels of Minnesota 2nd Edition	8f74effa-d0f.pdf
Field Guide to the Freshwater Mussels of Minnesota 2nd Edition	1fd61a79-fb0.pdf
Final Abstract September 2026 - Figures	82fa41da-1f4.pdf

Media Links

Title	Link
KAALTV News Coverage of Mussel Reintroduction	https://www.kaaltv.com/news/cedar-river-watershed-district-and-department-of-natural-resources-look-to-restore-vital-river-populations/?utm_source=Sailthru&utm_medium=onsite&utm_campaign=recommended&fbclid=IwY2xjawEs1dJleHRuA2FlbQlXMQABHRjqhoZauebZIVcBnQol1RD93o_MOQWt-1SullOk6yxdAlGoiwPQgVAdyw_aem_M58fXmzgwR0_Sf-Pa5UyWg
KIMT News Coverage of Mussel Reintroduction	https://www.kimt.com/video/minnesota-department-of-natural-resources-releases-mussels-into-cedar-river/video_b4d39bb2-b7f0-5502-b7e4-aeffaac497c5.html?fbclid=IwY2xjawEs1p1leHRuA2FlbQlXMQABHT6O9miLr4XDEFICojQA2YnuACulPEWUfGCLhJSxcMFFCq8x3i1TsBXphg_aem_1Fbl2yqpRp1CHmQurT7Vaw
Thank you from Governor to the DNR Mussel Lab	https://www.republicaneagle.com/opinion/viewpoint-thank-you-lake-city/article_34f14e00-1f6c-11ef-9ef4-a7ac239350aa.html
Instagram Post about Snuffbox Inoculation	https://www.instagram.com/p/C9Psv6kJ44N/?utm_source=ig_web_button_share_sheet&igsh=MzRIODBiNWFIZA==

Instagram Post about the Clam Counter Minnesota digital app	https://www.instagram.com/p/DHHKgpMzRfR/?utm_source=ig_web_button_share_sheet&igsh=MzRIODBiNWFIZA==
Instagram Post about host attraction methods	https://www.instagram.com/p/DFdK9LQMvj3/?utm_source=ig_web_button_share_sheet&igsh=MzRIODBiNWFIZA==
Instagram Post about the Spectaclecase mussel	https://www.instagram.com/p/DB9yJ3tF2W/?utm_source=ig_web_button_share_sheet&igsh=MzRIODBiNWFIZA==
Facebook Post about the Clam Counter Minnesota digital app	https://www.facebook.com/MinnesotaDNR/posts/pfbid036nNdfGN8WUJH93V94HG75KU3Cv3HGcmYQETmD1sfGwVT7E8W6tyXhHSNM9i76KKbl?rdid=2rqZwh2E1LGsNYth#
Facebook Post about the Spectaclecase mussel	https://www.facebook.com/MinnesotaDNR/posts/pfbid029wJrtioh7t4n2kW7U9CLDKdwwm1rRk2m4SvPoVb2maJgaEpK7ANJCQPDhpHCA5c8l?rdid=GZTx7XT9Fvx9LfMj#
Link to download the Clam App Minnesota from Google Play Store	https://play.google.com/store/apps/details?id=com.dnr.clamcounter&pcampaignid=web_share
FutureForward.org	https://futureforward.org/search-directory/minnesota-department-of-natural-resources-center-for-aquatic-mollusk-programs/
Science Museum of Minnesota featuring CAMP	https://www.youtube.com/watch?v=1Pi850x0yNo

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

Reporting Date requested May 1, and November 1

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 understand that travel expenses are only approved if they 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?

No

Does the organization have a fiscal agent for this project?

No

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

N/A

Work Plan Amendments

Amendment ID	Request Type	Changes made on the following pages	Justification For Amendment Request (word limit 75)	Date Submitted	Approved	Date of LCCMR Action
1	Project Manager	Previous Manager: Madeline Pletta (madeline.pletta@state.mn.us) New Manager: Lindsay Ohlman (lindsay.ohlman@state.mn.us)	I am separating DNR September 12, 2023.	August 14, 2023	Yes	September 6, 2023
2	Amendment Request	• Budget • Project Collaborators - Project Manager Info • Other • Budget - Personnel • Budget - Capital, Equipment, Tools, and Supplies • Budget - Travel and Conferences • Budget - Other • Budget - Non-ENRTF Funds Contributed • Attachments	Beginning 9/23, one senior staff member left, one retired, we hired two new staff, and three existing staff changed job titles. We also secured some funds from an additional source, therefore, our total salary need has decreased. We are proposing to balance the budget by expanding, rebuilding, and repairing propagation and fish holding systems to fit our new facility. Additionally, we would like to update our brood holding system and monitoring equipment (capital expenditures).	March 8, 2024	Yes	March 28, 2024
3	Amendment Request	• Budget • Other • Budget - Professional / Technical Contracts • Budget - Capital, Equipment, Tools, and Supplies • Budget - Travel and Conferences • Budget - Other • Attachments	The developer for the Clam App has waived all maintenance fees due to delays. Moving reduced costs for certain culture supplies. DNR fleet rates increased. Additional travel to/from field sites is anticipated. Power failure alarm components cost more than anticipated. To balance the total budget we will eliminate the clam app budget, increase travel budgets, reduce budgets for water quality instruments and food, and increase the budgets for system expansion and power failure equipment.	November 20, 2024	Yes	November 21, 2024
4	Amendment Request	• Budget - Capital, Equipment, Tools, and Supplies • Budget - Travel and Conferences	Alarms, PIT equipment, and fridge install came in under budget. Field guide was handled internally; no charge. Out-of-state travel for Monkeyface collection	June 25, 2025	Yes	June 26, 2025

		Budget - Printing and Publication	was cancelled. Supplier increases in mussel food, PVC, pumps, filters, and fuel costs will cause shortage in supplies and in-state travel budgets. To balance total budget, we'll eliminate the publication budget and reduce budgets for alarms, out-of-state travel, capital expenditures; we'll increase in-state travel and supplies budgets. Supplies purchases will be completed 6-30-25.			
5	Completion Date	Previous Completion Date: 06/30/2025 New Completion Date: 12/31/2025	LCCMR staff (TS) workaround as final update was submitted as an additional update.	June 25, 2025	Yes	June 25, 2025
6	Completion Date	Previous Completion Date: 12/31/2025 New Completion Date: 06/30/2025	TS changing completion date back to 6/30/25 as the PM accidentally filled out the final status update as an additional status update.	June 26, 2025	Yes	June 26, 2025
7	Completion Date	Previous Completion Date: 06/30/2025 New Completion Date: 06/30/2026	More time is needed to complete the final report	August 6, 2025	Yes	August 6, 2025

Status Update Reporting

Final Status Update August 14, 2026

Date Submitted: September 21, 2026

Date Approved: September 22, 2026

Overall Update

The Center for Aquatic Mollusk Programs (CAMP) made great progress towards restoring native mussel assemblages in Minnesota by continuing to propagate, rear, release, and monitor mussels in the Cedar, Cannon, and Mississippi Rivers. In the Cedar River, propagation for Black Sandshell and Mucket was completed in 2024, and two additional reintroduction sites were established upstream of the Iowa border where they were presumed extirpated a decade ago. In the Cannon River, propagation for Mucket was also completed in 2024, followed by releases at two additional reintroduction sites within their historical range upstream of Northfield Dam. We also began propagating Elktote (state threatened) for this river. In the Mississippi River, there are two sites in Upper Pool 2 where propagated Snuffbox, Higgins Eye, and Mucket have been reintroduced for many years, and propagation was completed for the latter two species in 2024. Propagation for Snuffbox and Spectaclecase is ongoing with several cohorts of these species currently being reared, and they may be suitable for reintroduction into Pool 2 in coming years. For each species, CAMP raised several thousand mussels representing multiple age classes, helping ensure that newly established reintroduction sites are genetically diverse. Activity visuals can be found in Supplemental Attachments.

Activity 1

This activity was previously marked complete.

(This activity marked as complete as of this status update)

Activity 2

This activity was previously marked complete.

(This activity marked as complete as of this status update)

Activity 3

This activity was previously marked complete.

(This activity marked as complete as of this status update)

Activity 4

CAMP completed the Field Guide to the Freshwater Mussels of Minnesota 2nd Edition. The guide is 158 pages of colorful new mussel photos, updated species names, and detailed distribution maps (Figure 1). The digital guide is available upon request while our Creative Services Unit develops the link for a downloadable PDF on the DNR website. The new guide is another tool in our toolbox that we use to connect Minnesotans to the world of freshwater mussels. Previously, CAMP completed the Clam Counter Minnesota app in 2025, which was featured in one of our many newsletters, demonstrated during the State Fair, and presented at technical meetings. The app has over 600 individual downloads and is now gaining momentum after developers fixed technical issues following the launch. These tools, coupled with outreach events, are helping mussel conservation gain awareness. CAMP sent out seven newsletters throughout this grant and the recipient list has grown to more than 6,800 people across the country.

(This activity marked as complete as of this status update)

Dissemination

CAMP developed many products during this grant, including annual reports, seven newsletters, seven Instagram and Facebook posts, the Clam Counter Minnesota app, the field guide, and of course, hundreds of thousands of mussels! In all our written and digital products and presentations, we ensured the ENRTF logo was prominent; in the field guide, the logo is displayed on the inside cover. In the Clam Counter Minnesota app, the logo is found on the "About" page.

Additionally, CAMP provided 11 lab tours, gave seven presentations, participated in the State Fair and two Metro Area Children's Water Festival events, and four career fairs. Cumulatively, we interacted with hundreds of citizens of all ages, and at every opportunity, we explained our work was made possible through the ENRTF and LCCMR.

Status Update Reporting

Status Update April 1, 2026

Date Submitted: March 26, 2026

Date Approved: March 31, 2026

Overall Update

The Center for Aquatic Mollusk Programs (CAMP) completed growth modeling for the mark-recapture study of propagated Black Sandshell and Mucket mussels reintroduced in 2020 at six sites in southeast Minnesota. Three annual surveys provided a snapshot of life-after-release for 747 individuals recaptured at least once. Both species appear to be performing well in the wild, but modeled growth was generally higher for Black Sandshell in the Cedar River sites compared to Mucket in the Cannon River watershed (Cannon & Straight Rivers) sites. Annual modeled survival (reported in the October 1, 2024 status update) exceeded 80% in two Cedar sites, compared to one site in the Cannon. Potential drivers of these differences will be explored during the next grant period, when we will model possible effects of cohorts, habitat variables, length-at-release, and species. CAMP is also making progress on publishing the Digital Field Guide, with completion expected in May 2026. Activity visuals can be found in Supplemental Attachments.

Activity 1

We completed growth analysis of recapture data from 2021 – 2023 annual surveys at our six reintroduction sites. We used shell length and known-age data from recaptured PIT and Hallprint tagged mussels to create growth curves for each site using the von Bertalanffy Growth Model. We created candidate models for the Cedar River (3 sites) and Cannon River watershed (3 sites) where “site” was a factor used to predict the coefficients L_{∞} (asymptotic average length in millimeters), K (growth rate coefficient), and t_0 (age when average length equals zero). We statistically compared candidate models, and for both watersheds, the top (most parsimonious) models predicted a common K (Cedar=0.51, all sites; Cannon=0.36, all sites) but variable L_{∞} (Cedar: Site 1=132, Site 2=124, Site 3=122; Cannon: Site 1=115, Site 2=107, Site 3=98). Black Sandshell in the Cedar River sites are characterized by very fast growth (~26 mm/yr) and predicted to reach their max length in about 3.5 years (Figures 1 & 2). Mucket in the Cannon River watershed sites are growing moderately fast (~18 mm/yr) and may reach their max length in about 4.5 years (Figures 1 & 3).

(This activity marked as complete as of this status update)

Activity 2

This activity was previously marked complete.

(This activity marked as complete as of this status update)

Activity 3

This activity was previously marked complete.

(This activity marked as complete as of this status update)

Activity 4

CAMP is making progress on publishing the Digital Field Guide. In January 2026, we submitted our work to the Creative Services Unit who is overseeing production. We should receive feedback from them by the end of March 2026. We will then have about a month to send them any last-minute changes before the final version becomes available to the public.

Dissemination

We presented survival and growth results of our mark-recapture study to the Mussel Coordination Team during our meeting in March 2026 (Figure 4). The meeting was attended by more than 50 stakeholders from state and federal agencies, universities, zoos, and non-governmental organizations.

Status Update Reporting

Status Update October 1, 2025

Date Submitted: September 30, 2025

Date Approved: November 18, 2025

Overall Update

We reinstated propagation efforts for the endangered Spectaclecase (*Cumberlandia monodonta*); a mussel we have not propagated since 2022. Work for this species and their host fish, Goldeye, is expected to continue for the next several years. Holding Goldeye in the lab is challenging and requires specialized tanks and aeration, so this spring, we built a new 800-gallon recirculating system to house them. The annual monitoring of our original reintroduction sites in the Cedar River (n = 3) and Cannon River watershed (n = 3) is complete for PIT-tagged mussels that were released in 2020. Activity visuals and additional links can be found in Supplemental Attachments.

Activity 1

Recapture data is being analyzed to estimate growth rates of Black Sandshell (*Ligumia recta*) and Mucket (*Actinonaias ligamentina*) that were released in 2020 in the Cedar River and Cannon River watershed.

Activity 2

Previously collected Elktote (*Alasmodonta marginata*) brood released glochidia prematurely, so we will try again with this species in the fall. In May and June, we collected Goldeye from the Red River and 26 adult Spectaclecase mussels from the Saint Croix River; we used three females to inoculate 10 Goldeye. We also collected two gravid Snuffbox (*Epioblasma triquetra*) from the Saint Croix River and inoculated 125 Logperch. Inoculated fish were held in recirculating aquaria while larvae developed on their gills. More than 152,000 juvenile Spectaclecase and 8,800 Snuffbox were collected from tanks and placed into culture systems (Figure 1). We began two 12-week experiments to test these species' survival and growth among substrate types, which included worm castings and composted cow manure. The experiment was conducted in our newly built hybrid pulsed flow system (Figure 2). In June, we moved 1-yr. old Black Sandshell, Mucket, and Snuffbox from the lab to grow-out locations where they will spend the next 1-2 years before release. We placed 782 mussels in totes at Eastside Lake near Austin, 1,296 in baskets at Waterville State Fish Hatchery ponds, and 138 in totes in the Saint Croix River near Lakeland (Figure 3).

(This activity marked as complete as of this status update)

Activity 3

This activity was previously marked complete.

(This activity marked as complete as of this status update)

Activity 4

We published a newsletter in May about our program's survey work across the state, which is necessary for understanding which species we should propagate (Figure 4). The newsletter reached 6,947 recipients and was also posted to the DNR's Facebook and Instagram pages. Work on the digital Field Guide continues, and our Creative Services department has reviewed our proposed changes and provided a production schedule requiring several rounds of editing. The finished product is expected to be available on our website by mid-November. The Clam Counter app is gaining popularity, with more than 100 new downloads and several mussel sightings submitted by users.

(This activity marked as complete as of this status update)

Dissemination

We presented on the Clam Counter app and results from our 2024 Snuffbox experiment at the Freshwater Mollusk Conservation Society Conference in May (Figure 5). We also continue to get the word out about mussels, and one way we do this is through internships and volunteers. Recently, CAMP was listed in the directory of FutureForward.org which

connects students to educators and employers in Minnesota. Several Master Naturalist chapters have heard about our lab, and in June, we provided a tour for a group of ten.

Additional Status Update Reporting

Additional Status Update August 14, 2025

Date Submitted: September 30, 2025

Date Approved: November 18, 2025

Overall Update

Per LCCMR staff guidance, this additional status update is not needed per guidance from LCCMR staff provided on August 5, 2025.

Activity 1

Per LCCMR staff guidance, this additional status update is not needed per guidance from LCCMR staff provided on August 5, 2025.

Activity 2

Per LCCMR staff guidance, this additional status update is not needed per guidance from LCCMR staff provided on August 5, 2025.

Activity 3

This activity was previously marked complete.

(This activity marked as complete as of this status update)

Activity 4

Per LCCMR staff guidance, this additional status update is not needed per guidance from LCCMR staff provided on August 5, 2025.

Dissemination

Per LCCMR staff guidance, this additional status update is not needed per guidance from LCCMR staff provided on August 5, 2025.

Additional Status Update Reporting

Additional Status Update August 14, 2025

Date Submitted: June 25, 2025

Date Approved: June 26, 2025

Overall Update

Per LCCMR staff guidance, this additional status update is not needed per guidance from LCCMR staff provided on June 25, 2025.

Activity 1

Per LCCMR staff guidance, this additional status update is not needed per guidance from LCCMR staff provided on June 25, 2025.

Activity 2

Per LCCMR staff guidance, this additional status update is not needed per guidance from LCCMR staff provided on June 25, 2025.

Activity 3

A translocation was scheduled to occur mid-June 2025 to move Monkeyface mussels from Iowa to Minnesota in the Cedar River. Unfortunately, rainfall is causing sustained high flows and unsafe wading conditions for that part of the river, and therefore this activity was cancelled.

(This activity marked as complete as of this status update)

Activity 4

Per LCCMR staff guidance, this additional status update is not needed per guidance from LCCMR staff provided on June 25, 2025.

Dissemination

Per LCCMR staff guidance, this additional status update is not needed per guidance from LCCMR staff provided on June 25, 2025.

Status Update Reporting

Status Update April 1, 2025

Date Submitted: June 25, 2025

Date Approved: June 26, 2025

Overall Update

The Center for Aquatic Mollusk Programs (CAMP) is happy to report the completion of the Clam Counter Minnesota app! This was a multi-year, multi-grant project to develop a digital tool to help mussel enthusiasts learn about Minnesota's 51 native species. The app features a built-in dichotomous key that guides users through a series of questions to help identify mussels they find. Users can report sightings and ask questions, which are sent directly to our staff. This is a fun and educational tool for users to track discoveries over time. The app is publicly available to download from Google Play or the Apple App store. Our restoration efforts with Black Sandshell and Mucket are nearing completion, and we will begin propagating Elktote (state threatened) for the Cannon watershed. We also plan to propagate endangered Spectaclecase and Snuffbox mussels again, which will be reintroduced into the Mississippi in coming years. These species have unique culture requirements, so we have been rebuilding and retrofitting culture systems in our lab to prepare. Our new systems were also fitted with flow alarms that will prevent loss in case of pump failures. Activity visuals (tables and figures) and additional links can be found in Supplemental Attachments.

Activity 1

We were notified by the Division of Parks and Trails (MN DNR) that a public water access development project on the Cedar River is planned near our reintroduction Site 3. Construction was scheduled to begin before the end of 2024; therefore, we conducted a mussel relocation in September to prevent their disturbance at the impact zone which overlapped a portion of our site (Figure 1). Of the 2,163 mussels that have been released there, we recaptured 51 live Black Sandshell and Mucket in the downstream 1/3 portion of the site and moved them slightly upstream and mid-channel. The dimensions of the original site boundary were 10 meters wide by 30 meters long. The new site boundary is 20 meters wide by 15 meters long, which preserves the original square footage of the river bottom where mussels were scattered. We do not expect this relocation to negatively affect population responses, but future monitoring will provide insight. We continue analyses of data for recaptured PIT-tagged mussels released in 2020 at sites in the Cedar and Cannon River watersheds. Apparent survival was estimated for each site, and growth is currently being modelled. Among-site comparisons for each watershed will be completed thereafter.

Activity 2

We collected host fishes including 142 Logperch and 23 suckers to prepare for Snuffbox and Elktote inoculations. We collected five gravid Elktote from the South Fork Zumbro River near Rochester that are being held in a temporary refrigeration system while we construct our new walk-in brood cooler (Figure 2). We continue to rear over 3,000 juvenile mussels (2024 cohorts) in the lab overwinter (Figure 3). Survival varied among species and watersheds and was highest for Black Sandshell (7%) and lowest for Mucket (1%; Cedar watershed). The generally lower survival this year compared to previous years (2022 range 4-20%; 2021 range 7-69%) was likely caused by prolonged toxic ammonia levels in our Mississippi River source water during flooding. However, growth rates surpassed previous years for all mussels which was a benefit of increasing our ambient air temperature by ~2 °C (Figure 4). Snuffbox metrics continue to exceed our expectations this year with both high survival and growth stemming from two new substrates we experimentally tested. Results suggest composted cow manure and sediment collected from the St. Croix River contributed to significantly higher survival at 12-weeks ($F_{2,9} = 9.13$, $P = 0.015$) than the control (locally collected mud; Figure 5).

Activity 3

No additional reintroductions have occurred since the status update in October 2024. Since the beginning of the grant, we have reintroduced 10,629 tagged, sub-adult Higgins Eye, Black Sandshell, Mucket, and Snuffbox mussels. In the Cedar

River, we released 3,277 mussels across five sites near Austin, MN. In the Cannon River watershed (Cannon and Straight Rivers), we released 1,560 mussels across three sites near Dundas, Fairbault, and Medford. In the Mississippi River, we released 5,792 mussels across two sites near St. Paul. Additionally, a translocation is scheduled to occur mid-June 2025 to move Monkeyface mussels from Iowa to Minnesota in the Cedar River if conditions are safe.

(This activity marked as complete as of this status update)

Activity 4

We provided a presentation about mussels to 15 West Metro-area Master Naturalists in November, of which, seven of the naturalists recently toured our lab. We also set up a booth at the Cannon Falls Career Fair in February and interacted with over 75 high school students, encouraging them to apply for internships with CAMP in the future. We sent out two newsletters that highlighted work we completed in 2024, as well as our recently completed Clam Counter Minnesota app (Figure 6). The newsletters reached more than 6,800 recipients, which is a five percent increase in subscribers compared to October 2024. We worked diligently with app developers to complete and publish this unique digital tool, which is now available on the two largest app store platforms worldwide. The new release already has dozens of downloads, and we are receiving mussel sighting submissions from users in Minnesota and beyond (Figure 7). We are also making progress on our field guide and have completed much of the content update including new photos of each species, new distribution maps, and revising descriptions. We continue to work with our agency's internal design team on formatting the guide into a digital PDF (Figure 8).

Dissemination

Our new lab continues to gain positive attention, and we have provided eight tours for over 40 people during the winter. The visitors came from a variety of agencies and non-profits, including Friends of Minnesota Scientific and Natural Areas, Prairie Island Indian Community, Master Naturalists, and Zoologists. We also hosted many Lake City area residents and other colleagues from the DNR. Much of our publicity comes from word-of-mouth at local events, but our Instagram and Facebook posts allow us to reach a broader audience. Our three most recent stories were about the Spectaclecase, host attraction methods, and the Clam Counter app, and have a combined total of over 900 likes (Figure 9). We also presented at the Mussel Coordination Team meeting in March to discuss our propagation and monitoring achievements with other mussel scientists around the region.

Status Update Reporting

Status Update October 1, 2024

Date Submitted: October 22, 2024

Date Approved: November 21, 2024

Overall Update

We had a successful propagation season in our new lab, producing over 95,000 juvenile mussels of three species as part of our on-going conservation efforts for the Cedar, Cannon, and Mississippi Rivers. We conducted an experiment testing substrate-type for the endangered Snuffbox, and for the first time since 2019, juveniles have survived longer than three months and are thriving. We conducted habitat reconnaissance surveys to look for new reintroduction sites for Mucket and Black Sandshell. Preliminary analyses of mark-recapture data collected during 2021 – 2023 annual PIT-tag monitoring provided estimated survival rates of existing sites, and those with > 80% were used as models to choose two new sites in the Cedar River. Reintroductions were documented by Austin-area news stations, which highlighted the importance of our work and benefits to community members. All original sites continue to serve mussels well, and this fall, we found gravid females for the third consecutive year. Overall, we released 7,297 mussels (2021 cohorts) of three species among three watersheds. This winter, we will further analyze our recapture data to estimate mussel growth rates and compare species and watersheds. Activity visuals (tables and figures) and additional links can be found in Supplemental Attachments.

Activity 1

We recaptured 90 of 599 PIT-tagged mussels in the Cedar River (Sites 1–3), including seven Monkeyface at Site 2. We recaptured 87 of 593 tagged in the Cannon (Sites 1 – 2) and Straight Rivers (Site 3). Hallprint and Bee-tagged mussels were also found, so our total number of recaptures was 431. We documented gravid mussels of each species at all sites (Figure 1). We measured high un-ionized ammonia (> 0.07 ppm) again at Cedar Site 2, but it is unclear if this is truly a chronic issue for this site, or if it may be correlated to spikes from recent rain and runoff from agricultural fields. We used PIT-tag monitoring data from 2020 released mussels to estimate recapture rates and apparent survival for each of six sites. We used Cormack-Jolly-Seber models and compared them with Akaike's Information Criteria (Tables 1 – 2). Recaptures rates (range 43 – 100%) were time dependent for all sites except Straight Site 3. Conversely, survival (range 42 – 100%) was constant for all sites except Cedar Site 1 and Straight Site 3. We conducted a 20-minute timed search for our Mississippi River site (n=2) and recaptured one dead tagged mussel.

Activity 2

Walleye held at the MN Zoo were transported to our lab in April. We collected eight gravid Snuffbox from the Saint Croix River in May, extracted glochidia, and inoculated 101 Logperch which produced 14,523 juveniles (Figure 2). We extracted glochidia from gravid Mucket (n=5) and Black Sandshell (n=5) collected from the Cedar River in Iowa and inoculated 54 Walleye, producing 30,402 Mucket and 18,176 Black Sandshell. We inoculated 20 Walleye with glochidia from Mucket (n = 5; Cannon River), producing 32,717 juveniles. Juveniles were placed into three types of culture systems (Bucket, Sprinkler, Pulse Flow) with sediment, filtered Mississippi River water, and aeration. Mussels were fed commercial algae and assessed every 3-4 weeks. Survival among species (range 2-19%) was highest for Black Sandshell (Figure 3). Growth rates among species (range 0.012 – 0.022 mm/d) was highest for Snuffbox which is a 200% increase from previous years (Figure 4). Preliminary results from our Snuffbox experiment in the Pulse Flow system suggests substrate-type plays a key role in their health. We continue to rear >20,000 mussels (2021-2024 cohorts) in our lab and grow-out systems, including 1,240 Spectaclecase (shell length ~13 mm; Figure 5).

Activity 3

We surveyed potential reintroduction sites for Mucket and Black Sandshell and chose two new sites that provided safe access, public visibility and community engagement potential, presence of native mussels, safe water quality values, and

canopy cover. These sites are located between existing sites but several river miles away, which will aid in population expansion and genetic mixing. Additionally, substrate composition and water depths are similar to our existing sites that had the highest survival estimates. We tagged, measured, and released 2,788 mussels (both species; shell length range 17 – 88 mm) among two new, and one existing site in the Cedar River (Figure 6). We did not find any new, geographically separated sites in the Cannon River watershed out of the five we surveyed; therefore, we released directly upstream or downstream of two existing sites (1,305 Mucket only; shell length range 35 – 77 mm). We also tagged and released 3,203 Mucket, Black Sandshell, and Higgins Eye mussels (shell length range 28 – 77 mm) into the Mississippi River at two existing sites (Figure 7). We returned brood to Iowa but flooding prevented surveys for Monkeyface, thus an additional trip is needed next spring to collect this species for relocation.

Activity 4

We continue to grow freshwater mussel awareness by engaging in community events, providing facility tours, and publishing newsletter and social media posts (Figure 8). In April, we participated in the Waterville Fish Hatchery Open House to highlight our partnership with them and the relationship that mussels have with fish. We also presented at the DNR's Water Day event at the State Fair in August, where staff engaged with over 250 members of the public from across the state. In September, we interacted with 120+ Metro-area fourth graders for the annual Children's Water Festival. For every event, we handed out mussel posters, ID books, and our recently developed coloring pages and word searches. Additionally, we sent out a newsletter about the history of shell-buttons, which reached 6,514 subscribers and was opened by over 1,800; this story was cross-posted on the DNR's Facebook page. We continue to navigate challenges related to the development of the Clam App, but we are hopeful we will get final approval from our IT department to launch the app in November. Progress also continues for the Digital Field Guide including a recent meeting with the DNR's Creative Services who will help us update the guide.

Dissemination

Moving to our new lab has created a lot of interest and excitement from the public and has optimized our ability to get the word out about mussels because we have dedicated spaces to host large gatherings. We have provided multiple tours for all types of public and professional groups as well as families. In April, several students from Zumbrota High School visited our lab. In May, we were highlighted during the Minnesota Fishing Opener where the Governor, Lt. Gov, DNR Commissioner, and others including media toured our facility. Additionally, we provided a lab-tour for 15+ members of the Pepin Community Education (Figure 9). We have also increased native mussel awareness while out in the field, such as working with a private landowner to release mussels at a new site on the Cedar River. The event was documented with interviews and footage by two news stations in Austin, and the stories highlight a new phase in the conservation of Mucket and Black Sandshell, specifically, geographic and genetic expansion. Our social media presence is growing as well thanks to posts on our Instagram page including a recent story showcasing our work with Snuffbox.

Status Update Reporting

Status Update April 1, 2024

Date Submitted: March 8, 2024

Date Approved: March 28, 2024

Overall Update

We have been annually surveying reintroduction sites for Black Sandshell, Mucket, Higgins Eye, and Snuffbox released into three watersheds since 2019. This fall, we completed the third year of monitoring PIT-tagged mussels in the Cedar and Cannon Rivers and recorded the highest number of detections and recaptures so far. Additionally, we observed several females of each species were gravid at each site, which suggests propagated populations are persisting, reproducing, and healthy. Unfortunately, one reintroduction site on the Mississippi River may not be faring as well. In August, we conducted timed searches at each of two sites where three species have been released, and observed substantial deposits of new, fine sand due to spring flooding. We did not find any live mussels at Site 2, and believe this population was either buried or displaced downstream of the study area. This loss showcases the importance of predicting how habitats may change over time when we are going through the site selection process. In the future, we may want to consider hydraulic variables such as water velocity and slope to better understand a habitat's resilience to extreme events. Activity visuals can be found in Optional Attachments: Status Update April 1, 2024.

Activity 1

We detected 410 of 599 PIT-tagged mussels in the Cedar River and physically recaptured 282. We detected 353 of 593 tagged in the Cannon River watershed and recaptured 180. We identified potential water quality concerns for two sites, including Site 1 in the Cannon where we measured high un-ionized ammonia (> 0.07 ppm), and Site 2 in the Cedar that had high ammonia coupled with low dissolved oxygen (< 5 mg/L). These issues may have been stressful for mussels, especially since they occurred during a period of low flow and warm temperatures. This spring, we will begin analysis of our recapture and habitat data to estimate mussel survival and growth and assess impacts of water quality. Results will help us determine new reintroduction sites for this fall, but we will continue to monitor current sites for 2019 cohorts to bolster the dataset and refine our understanding of habitat selection. We recaptured 27 (1 shell) Monkeyface mussels of the 30 that we translocated from Iowa into Cedar Site 2 during summer 2022. A 10-minute timed search of Site 1 in the Mississippi yielded the recapture of one Higgins Eye. All live individuals at each site appeared to be healthy and growing.

Activity 2

We continued to rear 1,100 age-1 Spectaclecase in the lab over winter, and survival (31%) and growth rates (0.016 mm/d) remained higher than average for this species. We acquired ~200 hatchery-reared walleye in October which are being held at the MN Zoo until they will be transferred to our facility this spring. We also collected 105 Logperch from the Mississippi River in September and held them in our lab. We collected 11 gravid Mucket from the Cedar and Cannon Rivers, as well as seven gravid Black Sandshell in the Cedar River and held them in a chilled recirculating system to prevent them from aborting glochidia. We plan to collect gravid Snuffbox this spring, and inoculations will commence shortly thereafter for these three species. We were alerted to high pH levels in the Waterville Hatchery Pond in October, and determined it was in the best interest of mussel health to move them to a nearby pond. We continued to rear over 50,000 (2021 & 2022 cohorts) mussels overwinter among our Waterville, Eastside Lake, Hudson, and MN Zoo grow-out locations.

Activity 3

We checked 2019 propagated mussels held at grow-out locations and determined 3,333 mussels were large enough for reintroduction. During their 3-year grow-out period, survival (22 – 87%), growth rates (0.022 – 0.057 mm/d), and shell length (19 – 99 mm) varied among species and locations. The highest survival occurred at Hudson for Mucket and highest growth rate at Eastside Lake for Black Sandshell. Unfortunately, two culture totes containing 1,022 Black

Sandshell at Eastside Lake were vandalized and no mussels were recovered. We tagged all mussels with a unique identifier (Hallprint tag) on the exterior of their shells, measured, and released them in the Cedar (n = 489), Cannon (n = 255), and Mississippi Rivers (n = 2589). In the Cedar and Cannon, mussels were scattered directly upstream or downstream of each of our current three study sites so as not to influence the ongoing PIT monitoring study. In the Mississippi, we augmented Site 1, but chose a new location (Site 3) to replace the population at Site 2 that was presumably lost during flooding. We also released 41 Walleye inoculated with Mucket glochidia into the Cedar (n = 21) and Cannon (n = 20) Rivers near existing sites to potentially support genetic variability.

Activity 4

We continue to work with the developer and our IT department to put finishing touches on the Clam App, including icon design, landing-page information, and addressing accessibility and data privacy concerns. We expect the app to be launched within the next few weeks. We were unable to present at the State Fair last year due to finishing up field work, however, we did attend the annual Children's Water Festival held at the fairgrounds in September. This was our fourth year engaging with hundreds of 4th graders from schools around the metro, and we provided information on mussel life-history, activities and games, and an opportunity to pick up shells, buttons, and live mussels. Students and teachers alike were delighted to take home an ENRTF-funded poster of Minnesota species. We published newsletters in August (5,960 recipients; 2,461 opens) and December (6,372 recipients; 2,875 opens) and posted on Facebook about topics including our move to a new facility and staffing changes. We also began planning for the release of a digital Field Guide on our website, which will require revising species names, descriptions, distribution maps, and photos.

Dissemination

We had an atypical year in 2023 resulting from moving to a new facility, and we could not conduct propagation because fish holding systems were deconstructed. Despite the absence of new mussels, we had a successful field season and increased outreach to the public and other professionals. Most recently, we set up a booth at the FutureForward Career, College, and Job Fair held at the Cannon Falls High School to connect with jobseekers and emphasize our unique work with mussels made possible through this grant. We also began posting updates to the MN DNR Instagram page to reach a more diverse audience beyond those that utilize Facebook or sign up for our newsletter. Last fall, we coordinated with Viking Travel for the second year in a row to provide an enrichment lecture on mussels for passengers aboard the Mississippi Cruise Ship. We also provided an under-construction lab tour for students in the School of Environmental Studies (Univ. of MN) as part of the "Show Us Your Mussels" MN Zoo challenge. Additionally, we will be attending the Mussel Coordination Team Conference in late March to present results related to LCCMR funded activities, including a tutorial for the MN DNR Clam App.