Final Abstract

Final Report Approved on November 13, 2025

M.L. 2020 Project Abstract

For the Period Ending June 30, 2025

Project Title: Expanding Restoration And Promoting Awareness Of Native Mussels

Project Manager: Seth Stapleton

Affiliation: Minnesota Zoological Garden

Mailing Address: 13000 Zoo Blvd

City/State/Zip: Apple Valley, MN 55124

Phone: (952) 431-9443

E-mail: seth.stapleton@state.mn.us

Website: http://mnzoo.org/

Funding Source:

Fiscal Year:

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 03f

Appropriation Amount: $489,000

Amount Spent: $466,039

Amount Remaining: $22,961

Sound bite of Project Outcomes and Results

To promote the conservation of native mussels in Minnesota, we reared juvenile mussels for reintroduction, researched methods to improve their growth in captivity, reared walleye to support propagation efforts, and implemented the school-based Show Us Your Mussels challenge to raise awareness and encourage public action to benefit water quality.

Overall Project Outcome and Results

Native mussels fulfill integral roles in aquatic ecosystems, filtering algae, pollutants and sediment from waterways and creating habitats for fish and other aquatic wildlife. Unfortunately, many mussel populations around the country – including here in Minnesota – have been significantly depleted. To improve the conservation of mussels, we leveraged our strengths as a zoo-based conservation organization, including the high-quality water resources present on our campus, our expertise in aquatic systems, and our position as the State's largest environmental educator. With the support of the Environment and Natural Resources Trust Fund, we expanded our capacity to house native mussels. In coordination with the Minnesota Department of Natural Resources, we reared juvenile mussels representing numerous species including Black Sandshells, Higgins Eye and Muckets; more than 4,000 individuals were returned to priority watersheds such as the Cannon, Cedar, and Mississippi Rivers over the 4 years of this project. The Zoo team also

supported associated post-release field surveys led by the DNR. Our research on rearing methods further suggested that housing adult mussels alongside juveniles yields improved growth. We have integrated these findings in our rearing protocols where practical. We also designed and constructed systems to rear walleye, returning several cohorts of this important host fish to the DNR to support mussel propagation efforts.

Finally, we implemented the Show Us Your Mussels Challenge to enhance public awareness and encourage public action benefitting the conservation of aquatic resources. Student-created digital media campaigns from 25 schools reached >130,000 community members during this project. Lesson plans and on-demand videos developed to support this initiative are available for use by educators around the state.

This project has improved the conservation of our aquatic resources by rearing native mussels and their host fish, informing future culture methods, and supporting the development of the future stewards of our natural resources.

Project Results Use and Dissemination

The Zoo leveraged its position as the State's largest environmental educator, sharing information about Minnesota's native mussels and aquatic resources through various outlets, such as on-campus interpretation and programming including summer camps, our website and social media channels, email communications to member and donor households, off-site events such as the Dakota County Fair, and professional meetings. The Show Us Your Mussels Challenge also provided an excellent means to disseminate information, with student-led campaigns engaging with >130,000 community members over the course of this project (see the Attachments section for lesson plans developed in association with this initiative).

Environment and Natural Resources Trust Fund

M.L. 2020 Approved Final Report

General Information

Date: December 2, 2025

ID Number: 2020-025

Staff Lead: Mike Campana

Project Title: Expanding Restoration And Promoting Awareness Of Native Mussels

Project Budget: $489,000

Project Manager Information

Name: Seth Stapleton

Organization: Minnesota Zoological Garden

Office Telephone: (952) 431-9443

Email: seth.stapleton@state.mn.us

Web Address: http://mnzoo.org/

Project Reporting

Final Report Approved: November 13, 2025

Reporting Status: Project Completed

Date of Last Action: November 13, 2025

Project Completion: June 30, 2025

Legal Information

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 03f

Appropriation Language: $489,000 the second year is from the trust fund to the Minnesota Zoological Garden to promote mussel conservation by rearing juvenile mussels for reintroduction, researching methods to improve growth and survival in captivity, and encouraging public action to benefit water quality. This appropriation is available until June 30, 2025, by which time the project must be completed and final products delivered.

Appropriation End Date: June 30, 2025

Narrative

Project Summary: The Minnesota Zoo will improve mussel conservation by rearing juvenile mussels for reintroduction, researching methods to improve growth and survival in captivity, and encouraging public action to benefit water quality.

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

To improve the conservation of mussels and promote water quality, the Minnesota Zoo is culturing juvenile mussels produced by the DNR for reintroduction and researching husbandry methods that will best support restoration efforts. Native mussels serve as critical ecosystem engineers, creating habitat for fish and other aquatic wildlife and helping to keep Minnesota's waterways clean by filtering algae, sediment, and pollutants. Today, however, freshwater mussels are the most at-risk group of species in the nation. Minnesota is no exception, as mussel populations in many of our waterways have been significantly depleted.

The Zoo will build upon previous ENRTF investments that have enabled us to increase our capacity for rearing juvenile mussels to >10,000 individuals and supported the construction of a research facility. To date, >1,000 mussels have been returned to the DNR for reintroduction, and research findings from sediment trials have improved rearing success. Launched in 2017, the Show Us Your Mussels Challenge promotes awareness about water resources and encourages public action through student-created digital media campaigns. Students from 30 schools have reached >120,000 members of the public with messages of mussel conservation, and teachers state-wide have been engaged through lesson plans developed by the Zoo.

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 use our strengths as a zoo-based conservation organization to expand upon our mussel conservation activities, thereby improving the conservation of mussels in Minnesota. Specifically, we will leverage our unique site, expertise in aquatic systems, and high-quality water resources to continue to rear mussels provided by the DNR and USFWS for eventual reintroduction. We will further develop our on-site capacity to evaluate methods that improve growth and survivorship for new target species. Finally, we will use our educational expertise and high annual visitation – some 1.3 million visitors per year – to further promote public awareness and inspire action through an expanded Show Us Your Mussels Challenge. This proposal specifically addresses the DNR's need for additional space for rearing juvenile mussels, thus supporting long-term restoration goals.

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?

Without targeted conservation action, populations of imperiled, native mussels will be unable to recover and fulfill their key ecological roles. To improve the conservation of our aquatic resources, we will:

- Rear native mussels to support reintroduction efforts led by the DNR and better position the Zoo to complement restorations;
- Advance our understanding of mussel rearing and propagation to maximize growth and survival; and
- Promote awareness and encourage public action on behalf of healthy waterways and aquatic wildlife by expanding our digital media initiative.

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: Rearing native mussels at the Zoo and improving husbandry practices

Activity Budget: $340,770

Activity Description:
We will use the Zoo's increased capacity for rearing juvenile mussels – we can now accommodate more than 10,000 individuals – to continue to benefit mussel restoration by growing mussels provided by the DNR and US Fish and Wildlife Service from small juveniles until they are large enough for reintroduction. To further support the DNR's activities, we will construct systems to grow newly transformed, microscopic mussels produced at their facility and to hold host fish that are needed for mussels to reproduce. We also will improve quarantine systems for new acquisitions to evaluate protocols for minimizing the potential transfer of disease and zebra mussels to uninfested waters. Using the Zoo's recently constructed research and rearing lab, we will examine factors that may improve mussel survival and growth in captivity, such as sediment size, flow rates, and supplemental feed, to improve husbandry practices and accelerate the return of mussels to native waterways. This research will build upon studies conducted during 2019 and 2020. Activities will focus on species identified by DNR and USFWS as priorities in the Cedar, Cannon, and Mississippi River watersheds.

Activity Milestones:

Description	Approximate Completion Date
Construct and optimize juvenile mussel rearing systems, host fish systems, and quarantine systems.	October 31, 2022
Rear juvenile mussels. Up to 1,000 reared to releasable size per species annually.	June 30, 2025
Complete experiments to evaluate rearing methods that maximize growth and survival. Finalize analyses and reports.	June 30, 2025

Activity 2: Expanding the Show Us Your Mussels digital media challenge and promoting public awareness

Activity Budget: $148,230

Activity Description:
The Minnesota Zoo's Show Us your Mussels Challenge will continue to serve both middle and high school students and provide teachers with multiple levels of support for implementation. Students will develop and deliver digital media campaigns — such as online videos, websites, and social media outreach — promoting mussel conservation, water quality, and personal or community action. The focus on digital media allows teachers to engage in the challenge, whether providing instruction in-person, through distance learning or flexing between the two models. We will leverage our educational expertise to engage teachers and students through in-person or virtual Zoo classes, presentations to schools, professional development for teachers, and educational resources updated to reflect current state and national standards. We will strengthen our partnership with local schools and evaluate the impact on knowledge, attitudes, and behaviors of participants and the public.

Activity Milestones:

Description	Approximate Completion Date
Mussel educational resources updated to meet new state science standards and realities including distance learning.	June 30, 2024
Recruitment of new schools to participate in the SUYM challenge (annual).	December 31, 2024
Professional development, presentations to schools and other support provided to teachers (annual).	April 30, 2025
Top schools visit Zoo to participate in on-site conservation programs or equivalent virtual experience (annual).	June 30, 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Mike Davis	Minnesota DNR	Technical expertise and guidance. Provision of juvenile mussels and coordination of release of more fully-grown sub-adult mussels. Project Manager of the DNR's ENRTF-supported mussel conservation project.	No
Bernard Sietman	Minnesota DNR	Technical expertise and guidance, particularly associated with research elements of Activity 1 and identification of priority species. Provision of juvenile mussels and coordination of release of more fully-grown sub-adult mussels.	No
Madeline Pletta	Minnesota DNR	Technical expertise and guidance. Provision of juvenile mussels and coordination of release of more fully-grown sub-adult mussels.	No
Lindsay Ohlman	Minnesota DNR	Technical expertise and guidance. Provision of juvenile mussels and coordination of release of more fully-grown sub-adult mussels.	No
Zeb Secrist	Minnesota DNR	Technical expertise and guidance. Provision of juvenile mussels and implementation of release of more fully-grown sub-adult mussels.	No
Megan Bradley	US Fish and Wildlife Service, Genoa National Fish Hatchery	Technical guidance and expertise. Provision of additional juvenile mussels and coordination of release of more fully-grown sub-adult mussels.	No
Elizabeth Glidewell	US Fish and Wildlife Service, Genoa National Fish Hatchery	Technical guidance and expertise. Provision of additional juvenile mussels and coordination of release of more fully-grown sub-adult mussels.	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.
Updates on activities and progress will be shared with collaborators via regular reports, and information about this work and the conservation of Minnesota's aquatic resources will be disseminated to the general public frequently. These communications may include presentations by Zoo staff to school groups, summer camps and other public venues and sharing information on the Minnesota Zoo's web page, social media outlets, and via correspondence with member households. In addition, select Zoo staff and volunteers will be trained in speaking with the public about mussels, the Zoo's rearing and research program, our partnerships with the DNR and other organizations, and the benefits of mussels for a healthy ecosystem and improved water quality. Results of research evaluating optimal conditions for maximizing mussel growth and survival in captivity will be submitted for publication in peer-reviewed scientific journals and presented at professional conferences.

The Minnesota Environment and Natural Resources Trust Fund (ENRTF) will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENRTF Acknowledgement Guidelines.

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 proposal is part of a larger, multi-partner effort, including the DNR and USFWS, to restore imperiled mussel

populations across Minnesota and the upper Midwest to historic levels. Given the significant filtration performed by healthy mussel communities, these restoration efforts will help achieve Minnesota's clean water goals. Public awareness about mussel conservation and actions to improve water quality will be increased by our project. We expect that the mussel rearing activities will need to continue beyond the scope of this proposal; the Zoo will continue to seek other sources of support for this initiative.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Rearing Native Mussels for Reintroduction and Expanding Water Quality Awareness	M.L. 2017, Chp. 96, Sec. 2, Subd. 04c	$591,000

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount	$ Amount Spent	$ Amount Remaining
Personnel										
Mussel Conservation Specialist, 1 person at 0.8 FTE for 4 years		Coordination and implementation of Activity 1; assistance with implementation of Activity 2.			36%	3.2	X	$293,400	-	-
Project Manager / Principal Investigator, 1 person at 0.05 FTE for 4 years		Overall coordination of project activities. Research oversight and coordination.			28%	0.2	X	$27,700	-	-
Education Project Coordinator, 1 person at 0.13 FTE for 4 years		Coordination and implementation of Activity 2			20%	0.52	X	$53,800	-	-
Intermittent mussel educator, 1 person at 0.05 FTE for 4 years		Implementation of Activity 2			12%	0.2	X	$12,100	-	-
							Sub Total	**$387,000**	**$387,000**	**-**
Contracts and Services										
TBD	Professional or Technical Service Contract	Contracts with teachers to update school materials and resources associated with mussel conservation to meet new state education standards. 5 teachers x $500 contracts x 1 summer. Competitive bid process.				0.04		$2,500	$1,000	$1,500

							Sub Total	**$2,500**	**$1,000**	**$1,500**
Equipment, Tools, and Supplies										
	Tools and Supplies	Cartridge filters, drum filter screens, other filters, UV light bulbs, replacement pump parts, fish food, supplemental mussel feed, water quality testing kits and calibration standards, and other supplies for current and new systems. Annual replacements for 4 years.	Maintenance of systems for rearing juvenile mussels and researching husbandry methods.					$18,500	$18,497	$3
	Tools and Supplies	Tags, attachment materials, substrate, and other research supplies.	Research supplies to assess rearing conditions that improve growth and maximize survival of mussels. Materials to quantify water quality.					$2,000	$1,992	$8
	Tools and Supplies	Materials for construction and optimization of newly transformed juvenile mussel systems and host fish systems; materials for expanding rearing systems in Zoo's A Lake; expansion of quarantine system. Includes pumps, chillers, tanks, pipe, mussel rearing baskets, small dock extension, and other equipment and supplies.	Develop capacity to rear newly transformed juvenile mussels and fish hosts at the Zoo. Improve and expand rearing capacity in Zoo's A Lake and quarantine capacity.					$29,680	$29,330	$350
							Sub Total	**$50,180**	**$49,819**	**$361**
Capital Expenditures										
		Water quality meter and associated sensors to measure temperature, dissolved oxygen, pH, and other key water quality metrics	Measure water quality parameters at mussel and host fish rearing locations on Zoo campus to ensure appropriate water chemistry	X				$9,800	$9,161	$639
							Sub Total	**$9,800**	**$9,161**	**$639**
Acquisitions and Stewardship										

							Sub Total	**-**	**-**	**-**
Travel In Minnesota										
	Miles/ Meals/ Lodging	Fuel / mileage, meals and lodging. Rates as permitted by the State of Minnesota. $400 / year for 4 years.	Travel to field sites in southern and central Minnesota and conduct site visits with project partners.					$1,600	$243	$1,357
	Conference Registration Miles/ Meals/ Lodging	Fuel / mileage, meals, lodging and conference registration fees associated with Activity 2. Rates as permitted by State of Minnesota regulations. $600 / year for 4 years.	Travel to conferences specifically related to the digital media challenge and / or mussel conservation to engage educators. Conferences may include TIES Education Technology Conference, MnSTA Conference on Science Education (MNCOSE), Minnesota Independent School Forum STEM Conference, and Minnesota Educator Academy Conference.					$2,400	$1,236	$1,164
							Sub Total	**$4,000**	**$1,479**	**$2,521**
Travel Outside Minnesota										
							Sub Total	**-**	**-**	**-**
Printing and Publication										
	Printing	Printing of educational resources. $30 / copy x 100 copies.	Mussel conservation resources for teachers participating in the digital media challenge (Activity 2).					$3,000	-	$3,000
	Printing	Printing of promotional materials (2,000 half pages x $0.40 / unit and 1,500 full pages x $0.80 / unit).	Materials promoting the digital media challenge (Activity 2) for distribution at select conferences.					$2,000	$856	$1,144
							Sub Total	**$5,000**	**$856**	**$4,144**

Other Expenses										
		Promotional post card mailing to educators state-wide. 6,000 post cards x $0.18 / unit for 4 years.	Recruit teachers to participate in the digital media challenge (Activity 2)					$4,320	$628	$3,692
		Busing (transportation) costs. $1,500 / school x 6 schools / year for 4 years.	Transport students from top participating schools to the Zoo to learn more about the conservation of mussels and aquatic resources.					$26,200	$16,096	$10,104
							Sub Total	**$30,520**	**$16,724**	**$13,796**
							Grand Total	**$489,000**	**$466,039**	**$22,961**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Personnel - Mussel Conservation Specialist, 1 person at 0.8 FTE for 4 years		Coordination and implementation of Activity 1; assistance with implementation of Activity 2.	**Classified :** This staff person has the necessary expertise required to successfully implement Activity 1 and assist with the implementation of Activity 2. ENRTF funding will make it possible for this individual to work on the project for the percentage of time indicated in the budget. Without this funding, they would be unable to support the project with their time. Responsibilities for classified staff will be reprioritized and reallocated as necessary to support the project.
Personnel - Project Manager / Principal Investigator, 1 person at 0.05 FTE for 4 years		Overall coordination of project activities. Research oversight and coordination.	**Classified :** This staff person has the necessary expertise required to successfully coordinate project activities and oversee research and scientific elements. ENRTF funding will make it possible for this individual to work on the project for the percentage of time reflected in the budget. Without this funding, they would be unable to support the project with their time. Responsibilities for classified staff will be reprioritized and reallocated as necessary to support the project.
Personnel - Education Project Coordinator, 1 person at 0.13 FTE for 4 years		Coordination and implementation of Activity 2	**Classified :** This staff person has the necessary expertise required to successfully coordinate and implement the education elements of the project (Activity 2). ENRTF funding will make it possible for this individual to work on the project for the percentage of time reflected in the budget. Without this funding, they would be unable to support the project with their time. Responsibilities for classified staff will be reprioritized and reallocated as necessary to support the project.
Personnel - Intermittent mussel educator, 1 person at 0.05 FTE for 4 years		Implementation of Activity 2	**Classified :** This staff person has the necessary expertise required to successfully implement the education elements of the project (Activity 2). ENRTF funding will make it possible for this individual to work on the project for the percentage of time reflected in the budget. Without this funding, they would be unable to support the project with their time. Responsibilities for classified staff will be reprioritized and reallocated as necessary to support the project.
Capital Expenditures		Water quality meter and associated sensors to measure temperature, dissolved oxygen, pH, and other key water quality metrics	We will measure water quality metrics at rearing locations on campus to ensure that they provide the appropriate water chemistry to support successful husbandry and high rates of growth and survival. **Additional Explanation :** We will continue to rear mussels and host fish in support of the DNR's recovery efforts, and this probe will be a critical tool to measure water quality metrics at these sites to ensure that they provide the appropriate water chemistry conducive to mussel rearing.

Non ENRTF Funds

Category	Specific Source	Use	Status	$ Amount	$ Amount Spent	$ Amount Remaining
State						
Cash	Minnesota Zoo's General Operating Budget	Administrative costs, utilities, and other expenses associated with implementation of activities, estimated at 15% of the total grant	Secured	$73,350	$69,906	$3,444
Cash	Minnesota Zoo's appropriation from State of Minnesota's Clean Water, Land and Legacy amendment or General Operating Budget	Supplemental funds for additional unforeseen project expenses including equipment and supplies, estimated at $2,500 / year for 4 years	Pending	$10,000	-	$10,000
			State Sub Total	**$83,350**	**$69,906**	**$13,444**
Non-State						
Cash	Minnesota Zoo Foundation	Supplemental funds for additional, unforeseen project expenses including equipment and supplies, estimated at $2,500 / year for 4 years	Pending	$10,000	$10,000	-
			Non State Sub Total	**$10,000**	**$10,000**	**-**
			Funds Total	**$93,350**	**$79,906**	**$13,444**

Attachments

Required Attachments

Visual Component

File: 4ad5bf80-b0a.pdf

Alternate Text for Visual Component

We will grow mussels produced by the DNR to a releasable size. We will conduct research to improve husbandry and engage the public via student-created digital campaigns....

Supplemental Attachments

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

Title	File
Background Check Certification	1e10b5cf-8b3.pdf
Show Us Your Mussels - Postcard for marketing the SUYM Challenge	9dc5c1ad-5ad.pdf
Show Us Your Mussels - Flyer for marketing the SUYM Challenge	df55d8e6-bd2.pdf
Show Us Your Mussels - Factsheet for marketing the SUYM Challenge	cd0a9cc4-8d7.pdf
Lesson Plan - Introduction to native freshwater mussels	e6b526d2-a90.pdf
Lesson Plan - Native and Invasive Mussels	190c906a-d92.pdf
2025 SUYM Challenge Awards Presentation	0b52c484-5b1.pdf
Show Us Your Mussels - Participating Schools	ab06209d-76c.pdf
FMCS Presentation - Mussel nurseries	c19b94c4-df1.pdf
Example of particle analyses from Minnesota Zoo waterbodies for rearing mussels	3d2dec53-349.pdf
Figures - Rearing Juvenile Mussels with Adult Mussels	7ba21f99-c39.pdf

Media Links

Title	Link
Show Us Your Mussels Challenge	https://mnzoo.org/mussels-challenge-2/

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

The Minnesota Zoo experienced significant reductions in capacity as a result of the pandemic, but the activities outlined in the workplan are very consistent with the originally submitted proposal. Modest changes to the scope of work include adding the construction of systems to rear newly transformed, juvenile mussels and updating the Show Us Your Mussels Challenge to reflect new distance learning realities. Similarly, the updated budget is consistent with the original submission. Revisions include: personnel costs to reflect updated salary projections and changes in capacity (the Zoo no longer has an Evaluation and Research Specialist); Equipment and Supplies to accommodate the inclusion of systems for rearing newly transformed mussels and inflation; travel associated with the Show Us Your Mussels (SUYM) Challenge; the Professional / Technical Services Contracts in relation to the SUYM Challenge; and the Online Promotion of the SUYM Challenge(Other), as online promotion is no longer possible.

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?

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	Date of LCCMR Action
1	Amendment Request	• Other • Budget - Capital, Equipment, Tools, and Supplies • Budget - Other	The Zoo's water quality probe, a critical tool to monitor key husbandry metrics, recently broke and is no longer functional. Additionally, costs associated with bussing students to the Zoo for the Show Us Your Mussel challenge are significantly lower than anticipated, partially because we were not consistently invoiced by participating school districts. As such, we propose to reallocate a portion of bus funding to facilitate the purchase a new water quality meter and necessary sensors.	April 24, 2025	Yes	May 1, 2025

Status Update Reporting

Final Status Update August 14, 2025

Date Submitted: November 12, 2025

Date Approved: November 13, 2025

Overall Update
The Minnesota Zoo has successfully advanced our mussel conservation objectives through focused rearing, research, and public engagement efforts. With ENRTF support, we have continued to expand on-site capacity and evaluated husbandry methods for native mussels, helping to safeguard Minnesota's most imperiled aquatic wildlife group. Building on prior investments, the Zoo cultured ~4,500 juvenile mussels for release in partnership with the DNR during the last 4 years. The last of these mussels will be ready for reintroduction during late 2025 and 2026, supporting critical restoration goals. Research on rearing conditions has led to measurable improvements in growth and survivorship, thereby enhancing future propagation efforts.

The Zoo's Show Us Your Mussels Challenge has grown significantly. Since the onset of this project, student-created digital media campaigns from 25 schools have reached >130,000 community members, raised public awareness and promoted conservation actions statewide. Educators incorporated mussel conservation into classrooms using Zoo-developed lesson plans and on-demand videos, and participants reported an increased awareness about mussel ecology and actions they can take to support mussel conservation.

With ~1.4 million annual visitors and a strong online presence, the Zoo remains uniquely positioned to continue inspiring broad support for mussel conservation and water quality protection.

Activity 1
The Minnesota Zoo made significant progress in advancing mussel conservation through expanded research and rearing system development. With the capacity to house >10,000 juvenile mussels, we are actively rearing ~8,500 individuals provided by the Minnesota DNR to support restoration in priority watersheds, including the Cedar, Cannon, and Mississippi Rivers. In 2022, ~2,000 mussels were released representing 3 species (Black Sandshell, Higgins Eye, and Muckets). No mussels were released in 2023 or 2024 due to lapsed production during the pandemic, but in 2025, ~2,500 mussels were released to 3 watersheds, again including Black Sandshell, Higgins Eye, and Muckets.

We achieved key infrastructure milestones, including optimization of systems for rearing juvenile mussels, housing host fish necessary for mussel reproduction, and improving quarantine systems to enhance biosecurity and provide increased support for the DNR's restoration goals.

In the Zoo's research and rearing lab, experiments evaluating factors such as supplemental feeding and rearing juvenile mussels in the presence of adults were completed. Results suggest that in the presence of high food density, rearing young mussels with adults yields significantly improved growth. With fluctuating food availability in our primary rearing lake, we can use this culture method to improve annual growth.
(This activity marked as complete as of this status update)

Activity 2
The 2024-2025 Show Us Your Mussels Challenge (SUYM) concluded with seven schools (~650 students) awarded the opportunity to visit the MN Zoo and participate in a 30-minute mussel exploration session with Zoo staff. In post-SUYM surveys, nearly all students reported a better understanding why native mussels are important to the environment, ~75% are taking action to improve water quality, and ~75% believe their projects influenced public behavior to improve

water quality and native mussels. Teachers cited the curriculum and site visits from Zoo staff as the two most beneficial activities provided for the SUYM program, and all educator survey respondents indicated that they would recommend the program to peers.

During this project, middle and high school students' digital media campaigns reached >130,000 community members. Projects included online videos, websites, and social media outreach promoting mussel conservation, water quality, and public action. Over 1,800 students with winning campaigns visited the Minnesota Zoo and were provided further mussel conservation experiences with Zoo staff.

To support teachers, 9 on-demand professional development videos were created that accompanied the SUYM Challenge. Mussel educational resources were updated to include virtual options and to ensure alignment with Next Generation Science Standards and current science standards.
(This activity marked as complete as of this status update)

Dissemination
The Zoo leveraged its position as the State's largest environmental educator, sharing information about Minnesota's native mussels and the conservation of aquatic resources through various outlets, including on-campus interpretation and programming, our website and social media channels, and email communications to member and donor households. The Show Us Your Mussels Challenge also provided an excellent mechanism to disseminate information, with student-led campaigns engaging with >130,000 community members over the course of this project. We also anticipate preparing a manuscript for publication in the scientific literature, summarizing key findings on rearing juvenile and adult mussels together.

Additional recent outreach about mussels occurred during meetings at the annual Freshwater Mollusk Conservation Society Meeting held in Ann Arbor, Michigan (funded by the MInnesota Zoo's general operating budget); ongoing steering committee meetings for the Association for Zoos and Aquariums Saving Animals From Extinction Freshwater Mussel workgroup; an internship exchange with the Shakopee Mdewakanton Sioux Community to share our mussel work; and numerous summer camp presentations this summer for middle and high school students. Educational opportunities for on-site visitors also have continued via our interactive displays and interpretation at our Minnesota fish exhibit and at our rearing cabin on the Zoo's Main Lake.

Status Update Reporting

Status Update April 1, 2025

Date Submitted: April 24, 2025

Date Approved: May 1, 2025

Overall Update
With the support of the Environment and Natural Resources Trust Fund, the Minnesota Zoo has continued to promote native mussel conservation in Minnesota. We are rearing newly transformed and older juvenile mussels in association with recovery initiatives coordinated by the Department of Natural Resources. These mussels ultimately will be released into target watersheds in the State to bolster depleted populations. Research conducted at the Zoo suggests that rearing juvenile mussels alongside adults yields improved growth. As such, we will adopt this method where possible to improve growth of head-started mussels in our care. Finally, the Show Us Your Mussels campaign is completing a successful 2024-2025 academic year, engaging local students in mussel ecology and conservation, with student-created projects sharing the importance of Minnesota's aquatic resources and reaching >68,000 people.

Activity 1
We continued to rear newly transformed mussels previously provided by the DNR during the fall and winter. Following some attrition, these individuals now number ~750 and have attained an average size of ~3 mm.

We also have advanced our work investigating the potential benefits of rearing smaller mussels alongside adults. Initial analyses suggest that juvenile Plain pocketbook mussels reared with adult Mucket mussels grew larger than individuals that were housed alone. As such, we anticipate placing adults with juveniles in rearing baskets for future head-starting efforts.

We have continued to partner with a researcher from the Field Museum of Natural History to assess how morphology and growth are impacted by stream conditions. Analyses suggest that rearing mussels in sandy substrates and at lower densities near the surface of the water results in higher growth. Specifically, mussels reared at the surface experienced lower pH readings as well as higher temperatures and dissolved oxygen levels. Continued analyses later this spring will attempt to tease apart the relationships between these variables and growth rates.

Finally, the Zoo's mussel biologist joined a course on mussel biology hosted by the US Fish and Wildlife Service.

Activity 2
We are wrapping up a successful Show Us Your Mussels campaign for the 2024-2025 academic year. Two new schools registered this year, bringing our total number of participating high schools and middle schools to 13. The student-created digital campaigns yielded a community reach of >68,000 people, with top media platforms leveraged including Instagram, TikTok and YouTube. As a result of this project, 97% of student participants reported a better understanding of the importance of freshwater mussels and actions that are necessary to improve their conservation and improve water quality. Additionally, 75% of participants reported that their campaigns positively influenced community behaviors towards mussels, and one individual even noted that a friend registered to check water vessels for invasive species. The top five schools and three smaller schools with the most votes and community reach are being awarded a full supported field trip to the Minnesota Zoo this spring, with a personalized program and an opportunity to visit our Mussel Conservation Cabin.

Dissemination
The Show Us Your Mussels Challenge has provided a great conduit for community outreach again this season. We attended two teacher conferences to present on the Show Us Your Mussels (SUYM) challenge, resulting in new schools

registering for the program. To prepare students for the SUYM challenge, Zoo educators shared information about freshwater mussels during in-person and virtual presentations. The Zoo's mussel biologist also presented our work to high school students at Avail Academy in Fridley, to Minnesota Zoo volunteers, and on two television spots promoting the Zoo's upcoming Wildlife Conservation Benefit.

Status Update Reporting

Status Update October 1, 2024

Date Submitted: October 1, 2024

Date Approved: November 22, 2024

Overall Update

The Minnesota Zoo continues to advance the conservation of native mussels and Minnesota's aquatic resources with the support of the Environment and Natural Resources Trust Fund. We received newly transformed mussels from the DNR earlier this summer; these individuals are growing well, with release anticipated in 2027. We also are rearing older juvenile mussels for eventual release into select Minnesota waterways, in support of ongoing recovery efforts. Studies conducted at the Zoo this summer will inform new propagation strategies to improve head-start mussel growth rates and development. Specific questions include quantifying potential benefits associated with 1) rearing adult mussels alongside juveniles in husbandry systems and 2) positioning rearing baskets in waters flowing at different rates and at variable depths. The Show Us Your Mussels campaign continues to engage students and their communities in learning about these animals and the aquatic resources important to mussel and human populations alike.

Activity 1

The DNR provided newly transformed mussels in mid-summer; more than 11,000 individuals representing 3 species are currently being grown in specially designed rearing systems. Current average size of these newly transformed mussels is ~2.5 mm.

We also are rearing juvenile mussels in systems with and without adult mussels to investigate if smaller Plain pocketbook and Higgins eye mussels exhibit better growth rates when reared alongside adult mussels. We will analyze growth data this winter to determine if this strategy will benefit head-start growth. In partnership with a researcher from the Field Museum of Natural History, we are investigating if stream conditions impact morphology and growth of Giant floater mussels by replicating stream conditions with a subset of animals in our primary rearing lake.

The Zoo's mussel biologist assisted the DNR with recovery surveys this summer, collecting data on growth rates and site fidelity at previous release locations and helping tag head-started mussels for reintroduction.

The well at the Zoo's primary mussel-rearing lake has been in continuous operation since July. So far, lake levels have returned to 1.5 feet below our minimum target depth; we remain on-track to reach our goal of 6 feet next summer.

Activity 2

The 2023-2024 school year ended with 11 participating middle and high schools reaching a record of 110,00 community members through their digital campaigns. The 5 top reaching schools and one smaller school, who effectively contributed to the overall community reach, were awarded a field trip to the Minnesota Zoo with a personalized program at our Mussel Conservation Cabin.

The 2024-2025 Show Us Your Mussel Challenge registration has begun, and 6 schools are already registered. We continue to support and increase educators' knowledge and understanding of freshwater mussels with many resources including classroom visits by our staff and the on-line videos and curriculum offered on our website.

Dissemination

Community outreach was supported mostly by interaction through the Show Us Your Mussels challenge. We presented about the Show Us Your Mussels (SUYM) challenge at one annual teacher conference in early fall and will be sharing SUYM at the Minnesota Science Teacher's Conference later this year, where marketing materials will be distributed to

solicit additional participation. Advertisement of the program is listed in the Reach for the Stars publication by Synergy & Leadership Exchange and the Minnesota Academic League (www.synergyexchange.org/reach-for-the-stars), on the Minnesota Zoo's Education page (https://mnzoo.org/mussels-challenge-2/) and on the MNEdu Facebook page, which has >1,000 followers. Our mussel biologist and other Conservation team members shared information about the conservation of mussels and Minnesota's aquatic resources at more than a dozen camps at the Zoo this summer and presented to two classes at the School of Environmental Studies.

Status Update Reporting

Status Update April 1, 2024

Date Submitted: April 1, 2024

Date Approved: May 28, 2024

Overall Update
Successful rearing of walleye in 2023 contributed to the release of thousands of juvenile mussels directly to watersheds in southern Minnesota. We also solidified our associated husbandry methods, successfully rearing ~100 walleye in a new cohort this winter. We continued research on rearing diverse assemblages of mussels, with findings suggesting that rearing juvenile mussels with adult Mucket mussels improves juvenile growth. Revisions to husbandry protocols should yield larger individuals for release that are less vulnerable to predation and have a greater probability of survival following reintroduction. The Show Us Your Mussels challenge continues to engage students and their communities in learning about these animals, our aquatic resources, and the connections to ecological and human health.

Activity 1
By late summer and early fall, we maintained 40 walleye from the cohort that were initially obtained in fall, 2022 and subsequently reared at the Zoo. Twenty individuals that were ~7-10 inches in length by fall, 2023 were returned to the DNR, inoculated with larval mussels, and released to the Cannon River to distribute transformed mussels. The remaining walleye were delivered to the DNR's CAMP facility for late-season infestations there. About 100 new walleye acquired in October, 2023 were quarantined and have been reared in preparation for use as fish hosts this May.

Results from the second year of growth experiments suggest that the presence of adult Mucket mussels reared with year-old mussels head-started at the Zoo yields improved growth for the juveniles. These results support husbandry improvements to increase juvenile mussel growth rates; we may explore how this rearing strategy can benefit more juvenile mussel species.

The well was installed and run for 2 weeks before winter conditions required it to be shut down for the season. We submitted a request for an appropriation to allow for a higher water pumping allowance per day, with a goal of having several additional feet of depth within the next 4 years.

Activity 2
The 2023 – 2024 school year is wrapping up a successful year with the Show Us Your Mussels challenge. Five new schools participated in the program this year, bringing the total participating high and middle schools to 14. Student-created digital campaigns reached >63,800 people in their communities. The top media platforms utilized were YouTube, Instagram and TikTok. As a result of these projects, more than 78% of participants reported a better understanding of the importance of freshwater mussels and what actions the public can take to conserve their populations and improve water quality. The top 5 schools receiving the most votes and achieving the greatest community reach, as well as a smaller school, were awarded a fully funded field trip to the Minnesota Zoo to be completed this spring. Their visits will include a personalized program at our Mussel Conservation Cabin.

Dissemination
We supported community outreach primarily via interaction through the Show Us Your Mussels challenge. In the fall, we hosted a teacher professional development program to strengthen familiarity with freshwater mussels. To prepare students, the Conservation and Education teams presented content about mussel conservation to the students.

Staff from the Riverbend Nature Center in Faribault visited the Zoo and toured our conservation facilities, including an introduction to our mussel head-starting activities. We are now planning a mussel conservation talk to occur in Faribault

this fall.

We also supported an informational career interview by a group of high school students; hosted a mussel sorting event for students from the School for Environmental Studies to help learn about and organize a newly acquired collection of shells; and continued to share information about the conservation of Minnesota's aquatic resources via regular newsletters to Zoo members and through our social media channels.

Status Update Reporting

Status Update October 1, 2023

Date Submitted: October 1, 2023

Date Approved: November 22, 2023

Overall Update
The Minnesota Zoo continued our mussel conservation activities in support of the native mussel recovery efforts led by the Department of Natural Resources. The host fish rearing system that was completed last fall has yielded its first cohort of walleye, which are being used for mussel reproduction. Because the DNR is moving facilities this year, no new mussels were produced in the lab, but the walleye reared at the Zoo are helping to return juvenile mussels directly to recovery sites this fall. The Zoo is still rearing ~4,000 mussels in our facility and lakes, including ~1,500 individuals scheduled for release in 2024 and >2,000 mussels that have been integrated into research projects managed by the Zoo and outside partners. The Show Us Your Mussels (SUYM) digital media challenge continues to benefit water resource conservation messaging in the state, with the previous academic year's student-led projects reaching nearly 50,000 community members. The Zoo's Education team is currently promoting the upcoming school year's SUYM challenge.

Activity 1
Twenty of the walleye cohort that has been reared at the Zoo were transported to southern Minnesota for a stream-side inoculation of Mucket mussel larvae. These walleye will shed young mussels along the Cedar River to bolster depleted populations. Two more releases of inoculated fish are planned this fall to further distribute young mussels in Minnesota watersheds.

We completed the second year of study for two research projects. Measurements of study specimens will inform how different environments impact the morphology of mussels and how rearing conditions that include diverse assemblages affect survival and growth. Results will inform best practices for husbandry.

Zoo staff joined the DNR in completing dives to survey for head-started mussels that were released previously; tagging and measuring mussels; and releasing mussels along the Cedar and Cannon Rivers several times this summer.

With drought conditions deepening this year, water levels in area lakes, including our mussel rearing lake, have declined significantly. The Zoo is contracting with a company to drill a well, which will augment water levels of our primary mussel rearing lake. This new infrastructure will benefit our current efforts and safeguard future mussel rearing efforts by providing a buffer against potential drought conditions.

Activity 2
Student-led initiatives created as part of the Show Us Your Mussels (SUYM) Challenge during the 2022 – 2023 academic year reached ~48,860 community members. A total of 15 middle and high schools participated in the Challenge last year, communicating about the conservation of Minnesota's aquatic resources via unique digital media campaigns. The 6 schools with the greatest reach, as well as 2 smaller schools who effectively contributed to overall community reach, were awarded a field trip to the Zoo. This trip included a personalized program at the Zoo's Mussel Conservation Cabin.

We currently are promoting the SUYM Challenge for the 2023-2024 school year. We are distributing marketing materials at teacher conferences and workshops, and we added a direct digital mailing to our list-serv with 2,000 educators. The Challenge is again advertised in the Reach for the Stars publication, on our website, and on the Minnesota Zoo for Educators Facebook page.

We also are publicizing an in-person professional development session for all educators, regardless of their participation in the Challenge this year. This professional development session will introduce the Challenge and provide associated resources for educators. Online videos and curriculum are offered on the Zoo's website.

Dissemination

We continued to disseminate information about mussel conservation and the State's aquatic resources this spring and summer:

The Zoo Conservation and Education teams shared messages to highlight the importance of mussels, as well as the threats that they face, and provided updates on research being conducted at the Minnesota Zoo to summer campers and guests.

Ben Minerich, the Zoo's Mussel Conservation Specialist, presented at several professional meetings over the past several months including the Regional Aquatics Workshop (RAW), where his talk was voted as one of 5 presentations to receive "The Best of RAW" award; the Freshwater Mollusk Conservation Society; and the Association of Zoos and Aquariums annual conference.

Status Update Reporting

Status Update April 1, 2023

Date Submitted: April 1, 2023

Date Approved: April 27, 2023

Overall Update
During the fall and winter, the Minnesota Zoo continued supporting the DNR-led native mussel reintroduction and recovery efforts by rearing mussels and their fish hosts, analyzing data quantifying the growth of mussels in our care, and implementing the Show Us Your Mussels (SUYM) challenge. We completed construction of rearing systems for juvenile mussels and host fish, an Activity 1 milestone, and expanded the Zoo's aeration system in our primary rearing lake to increase overwintering capacity for head-starting juvenile mussels. We recruited new schools to participate in the SUYM challenge; this year, engagement activities related to the SUYM campaign reached nearly 49,000 community members. We continue to leverage diverse outlets to share information about this project and the conservation of Minnesota's water resources.

Activity 1
We finalized the construction of the fish rearing tank and received >250 walleye from the DNR during the fall. Fish were quarantined and subsequently trained to eat prepared diets to improve efficiencies in husbandry. They will be returned to the DNR this summer to support propagation efforts.

Aeration expansion on the Zoo's A Lake opened ~400 square feet for head-starting mussels in the lake over winter.

Seven fat mucket mussels that outgrew their holding tank at the Minneapolis Water Works, which has been using mussels to monitor the quality of incoming water used as a drinking source, were donated to the Zoo for exhibit. We maintain an informational graphic about the work these mussels do to prevent the intake of contaminated water to the facility.

Analysis from last summer's experiment suggests that juvenile mussels raised with adults in the Zoo's A Lake grew more rapidly than juvenile mussels reared alone. These findings will be shared at the Freshwater Mussel Conservation Society Symposium and the Regional Aquatics Workshop this spring. Future husbandry plans will include the use of adult mussels in rearing systems.

We plan to meet with the DNR in April to discuss propagation goals and opportunities for future collaboration.

Activity 2
The Minnesota Zoo promoted the Show Us Your Mussel Challenge to past participants and recruited new schools via the creation of updated marketing pieces and attendance at teacher conferences and workshops, such as Minnesota Science Teacher annual conference last fall. These recruitment efforts yielded 15 participant schools this academic year, 6 of which were new to the SUYM challenge. The student-led initiatives reached >48,000 community members, communicating about the conservation of native mussels and Minnesota's aquatic resources. The most common messaging themes addressed the importance of freshwater mussels to our aquatic ecosystems and encouraged people to take action on their behalf, such as cleaning up after pets, minimizing use of salt and fertilizers, and cleaning watercraft to reduce the spread of invasive species. As a result of this project, ~75% of students responded that they have a better understanding of why native mussels are important to the environment, and >60% are taking action to improve water quality.

Dissemination

In addition to the outreach achieved by the Show Us Your Mussels challenge, which reached nearly 49,000 community members through social media platforms such as Instagram, TikTok and websites, we continued to leverage a variety of tools to share information about this project:

Ben Minerich, the Zoo's Mussel conservation Specialist, presented to high school students about mussel ecology and ongoing, collaborative conservation efforts.

The Zoo shared posts by the Minneapolis Water Works to commemorate the "retirement" of their mussels to the Zoo, communicating the important role these mussels serve by monitoring incoming drinking water and how mussels in the wild improve water quality by filtering out sediment, algae, and toxins.

The Zoo shared information about the conservation of Minnesota's water resources via internal newsletters and external communications such as the Conservation Communications e-newsletter.

Status Update Reporting

Status Update October 1, 2022

Date Submitted: October 9, 2022

Date Approved: October 24, 2022

Overall Update
Mussel rearing activities at the Minnesota Zoo continue to support the reintroduction goals of the Minnesota Department of Natural Resources (DNR). We returned gravid adult female mussels and walleye fish hosts to the DNR for propagation efforts, and ~1,750 juveniles representing 3 different mussel species were released in the Mississippi and Cedar rivers. We continued to expand our capacity at the Zoo by constructing a new fish holding system and increasing space for housing mussels in our primary rearing lake. We identified updates needed to align the teaching curriculum associated with the Show Us Your Mussels (SUYM) challenge with new state of Minnesota science standards, and we are recruiting schools to participate in this year's SUYM activities. We continued to share information about our work and the conservation of aquatic resources through a variety of outlets.

Activity 1
During the spring, we assisted the DNR with collection of gravid female mussels from the St. Croix River. We also returned gravid mussels and walleye (fish hosts) held at the Zoo overwinter to support propagation. The DNR delivered newly-transformed mussels to the Zoo throughout the summer. Individuals have reached 1-3 mm in length, an increase of 20-60 times their original length. We currently are growing ~2,000 Muckets, 100 Spectaclecase, and 4 Winged Mapleleaf for release in 2024; the latter two species have never been successfully reared at any facility.

We returned mussels that have been reared at the Zoo to the DNR for release to local watersheds. About 250 Black sandshell mussels were transported to the Cedar River in September, and ~1,000 Mucket and ~500 Higgins eye were released to the Mississippi River in July.

We have equipment in place for our new host fish aquatic system. We will hang ultraviolet sterilizers and complete plumbing in advance of the acquisition of ~200 walleye fingerlings later this month.

We are expanding the winter aeration in A Lake. Piping will be placed by November, allowing us to keep a larger ice-free area and thus maintain additional baskets to overwinter mussels.

Activity 2
In June, we contracted with two educators to start the process of updating the Show Us Your Mussel curriculum to better align with the revised Minnesota State Science Standards. Editing and formatting of this curriculum is currently underway.

Recruitment has begun for the 2022-2023 school year's Show Us Your Mussels (SUYM) challenge. To date, nine schools have signed up to participate; registration remains open for three more months. Registered schools have received access to professional development videos and lesson plans about native freshwater mussels to prepare their students. We are continuing to offer workshops associated with the Show Us Your Mussels (SUYM) challenge virtually this school year.

We are promoting the SUYM challenge through targeted postcard mailings to 2,000 educators statewide and via our website and the Minnesota Zoo for Educators Facebook page. We presented information about the challenge at the 2022 STEM Educators Conference and anticipate that we will present and exhibit at the Minnesota Science Teachers

Association conference later this fall. New this year, the SUYM challenge is listed in the Reach for the Stars publication (www.synergyexchange.org/reach-for-the-stars), which is published as a free public service by Synergy & Leadership Exchange and the Minnesota Academic League.

Dissemination

We continued to share information about mussel conservation and Minnesota's aquatic resources through a variety of outlets:

Ben Minerich, the Minnesota Zoo's Mussel Conservation Specialist, presented about the importance of and threats to freshwater mussels at Zoo camps this summer.

We produced a short video about our rearing program for a new training module developed by the Conservation Planning Specialist Group, highlighting how our program supports recovery goals and efforts led by partners including the DNR and USFWS. This approach may serve as a model for other zoos and local conservation organizations.

Local print media, including the Star Tribune, Pioneer Press, and Austin Daily Herald, covered the release of mussels in the Cedar River in September, to which the Zoo contributed Black sandshell mussels.

We shared information about the release of Mucket and Higgins eye mussels to the Mississippi River this summer via the Zoo's quarterly Conservation Connection newsletter and provided programmatic updates on mussel conservation activities at the Zoo's regular all staff meetings.

In August, we highlighted freshwater mussels and distributed information about the Show Us Your Mussels challenge at Wild Nights at the Minnesota Zoo and the Dakota County Fair.

Status Update Reporting

Status Update April 1, 2022

Date Submitted: April 29, 2022

Date Approved: May 2, 2022

Overall Update
During the first phase of this project, the Minnesota Zoo increased the impact of our mussel rearing efforts by partnering with the Minnesota Department of Natural Resources in several ways. We have begun housing a portion of the DNR's newly transformed mussels for early life stage rearing, and we are holding adult gravid mussels over winter to provide spring brood stock. We also are rearing walleye fingerlings that will serve as host fish for larval mussels during springtime. The Minnesota Zoo also celebrated a more complete return of the Show Us Your Mussels (SUYM) challenge. This year, in lieu of in-person teacher training, we provided virtual training through a series of videos teachers could view on their own schedules. This broadened our reach and provided an unrestricted resource for the Show Us Your Mussel Challenge. By the end of December 2021, 14 schools had registered to participate; the student-led campaigns reached >350,00 people this winter and spring.

Activity 1
We successfully reared ~7,500 mussels through their most precarious life stage (grown from 0.5 microns to ~3mm), but unfortunately, an unexpected event in late winter caused a large mortality. We adjusted protocols to reduce the likelihood of such events in the future.

We housed gravid female adult mussels delivered by the DNR during fall in cold lake water so that they could overwinter with their larvae and produce young at the DNR facility during 2022. This eliminated the need to collect individuals of those species from the wild in the spring. We also received walleye fingerlings and reared them to a size of ~ 6-7 inches for use as host fish. We are constructing a new system for rearing walleye, and potentially other host fish, in the future.

Preliminary analyses of our research evaluating the growth of head-start Mucket mussels reared alone or with adults suggest that juveniles exhibited significantly higher growth rates in the presence of adults. This spring, we will replicate this experiment while tracking gut microbiome content to determine if the presence of adult mussels results in changes in the diet of newly introduced juveniles.

We are rearing ~1,800 additional mussels for release this spring.

Activity 2
In the Show Us Your Mussels (SUYM) challenge, Minnesota middle and high school students create original digital media campaigns informing the public about the impact of water quality on native mussels. The schools that receive the most votes, combined with greatest reach, receive free field trips to the Minnesota Zoo, including an interactive session with staff. Teacher support includes free professional development and access to lesson plans specifically designed around native mussels and water quality. Due to the pandemic, the 2021-2022 school year workshops were offered virtually via eight informative videos. This allowed educators to participate in training as possible and to customize the ones that were of interest to them.

Fourteen schools registered for the SUYM Challenge during the academic year. Participating schools received weekly emails, resources, materials, rubrics, graphics, and if desired, virtual visits. The student-led social media campaigns went live for voting in February.

In March, we closed voting and tallied results. Combined, the schools received >4,700 votes and reached >350,000 community members. The top schools, based on the combination of number of votes received and greatest reach, included Brooklyn Middle STEAM School, Apollo High School, Cretin-Derham Hall, Choice Technical Academy, and Humboldt High School.

Dissemination

Despite the ongoing challenges and restrictions associated with the pandemic, the Minnesota Zoo shared information about this project via several outlets.

We provided updates to staff and volunteers via monthly All Staff meetings and shared happenings with external audiences via the quarterly Conservation Connection newsletter, distributed electronically to member and donor households, and through our social media channels.

We presented information about the conservation of mussels and Minnesota's aquatic resources to ~170 students at the School of Environmental Studies, which held its own SUYM challenge (separate from the primary event this winter).

We posted announcements about the SUYM Challenge nearly weekly on the Minnesota Zoo Educator Facebook page and on our SUYM page of the Minnesota Zoo website.