

# Final Abstract

Final Report Approved on December 19, 2024

## M.L. 2020 Project Abstract

For the Period Ending June 30, 2024

**Project Title:** Testing Effectiveness of Aquatic Invasive Species Removal Methods

**Project Manager:** Valerie Brady

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**Funding Source:**

**Fiscal Year:**

**Legal Citation:** M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 06f

**Appropriation Amount:** \$110,000

**Amount Spent:** \$110,000

**Amount Remaining:** -

### Sound bite of Project Outcomes and Results

Dirty boat interiors can spread invasive species. The single most-effective tool to clean boat interiors was a vacuum while hand-picking debris. Clean livewells with a water-rinse or towel-wipeout followed by blowing compressed air down the drain tubing. Decoys and waders can be effectively cleaned with a water-rinse or vacuum.

### Overall Project Outcome and Results

Cleaning boats after recreating in lakes is important because boats can transfer aquatic invasive species (AIS) between waterbodies. Fully drying boats is the recommended method to prevent AIS spread but is not always possible before launching into a different waterbody. Self-service tools may be provided at launches to encourage boat cleaning. The tools vary and may include waterless tools (e.g., vacuum, cloth wipe, compressed air) as well as low-pressure water rinses. Most studies have focused on boat exteriors and trailers, not boat interiors. We tested the effectiveness of 4 cleaning methods on the interior of a boat fouled to simulate a) typical angling boat and livewell use, and b) waterfowler use including duck decoys and waders. For each simulation, we repeatedly fouled the same boat with an exact count of dead and surrogate AIS to test: 1) hand removal; 2) waterless tools; 3) low-pressure water rinse; and 4) a combination of all methods. We conducted 10 replicates for each cleaning test for each simulation. The effectiveness of the methods

depended on the type of AIS (e.g., spiny water fleas versus plant matter), and on the type of boat fouling. All methods in combination or the vacuum alone removed the highest proportion of AIS from both the waterfowler and angling boats. Using additional tools (e.g., wipe, vacuum, or low-pressure rinse) increased the removal of AIS from livewells over hand removal alone. In particular, compressed air removed materials stuck in the livewell drain tubing. Hand removal was the least effective method for cleaning duck decoys and waders. These results provide guidance to state agencies, managers, and cleaning station manufacturers on the best cleaning tools to provide at boat launches to more thoroughly clean boats and gear.

### **Project Results Use and Dissemination**

We presented our results to the Minnesota DNR Aquatic Invasive Species Program and Minnesota Lakes and Rivers Advocates online. We gave in-person results presentations at the following conferences: North America Invasive Species Management Association, Minnesota Water Resources Conference, North American Lake Management Society, and the Upper Midwest Invasive Species Conference. Our CD3 collaborators emailed our recommendations to 7740 people; 5% (387) clicked on the link. A manuscript is being submitted to the Lake and Reservoir Management Journal (updated draft attached).



## Environment and Natural Resources Trust Fund

M.L. 2020 Approved Final Report

### General Information

**Date:** December 19, 2024

**ID Number:** 2020-063

**Staff Lead:** Mike Campana

**Project Title:** Testing Effectiveness of Aquatic Invasive Species Removal Methods

**Project Budget:** \$110,000

### Project Manager Information

**Name:** Valerie Brady

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### Project Reporting

**Final Report Approved:** December 19, 2024

**Reporting Status:** Project Completed

**Date of Last Action:** December 19, 2024

**Project Completion:** June 30, 2024

### Legal Information

**Legal Citation:** M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 06f

**Appropriation Language:** \$110,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota for the Natural Resources Research Institute in Duluth to test how well boat-cleaning methods work, to provide the Department of Natural Resources with a risk assessment, and to provide recommendations for improving boat-launch cleaning stations to prevent the spread of aquatic invasive species.

**Appropriation End Date:** June 30, 2024

## Narrative

**Project Summary:** The best way to prevent aquatic invasive species spread is to stop the transfer of water and living material between lakes. We will test how well boat cleaning methods work.

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

Boat launch inspections and cleaning campaigns focus largely on the exteriors of boats and trailers with only minimal attention paid to boat interiors and other gear. But even small amounts of water moved between lakes may transfer spiny water fleas (SWF) or zebra mussel larvae. Similarly, mud, debris and water inside the boat could transport seeds, SWF eggs, small snails or bits of invasive vegetation. When we power-washed 5 boats used in wetland research, we captured 4,498 total organisms and plant parts, including more than 24 invertebrate species such as invasive zebra mussels and faucet snails. Faucet snails can carry a parasite that has caused waterfowl die-offs in MN; they are tiny, easily transported, reproduce abundantly, and can survive many days out of water. Anglers (1.4 million MN licenses in 2018) and other boating enthusiasts typically get water, zooplankton, and bits of plant material in their boats. Duck hunters and others going to more shallow, wetland areas may get their boats much dirtier and transport different AIS. Here, we will address the question: How well do various boat cleaning methods work at removing AIS for different user groups, anglers and duck hunters?

**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.**

In an ideal world, all boats moved between lakes would be completely squeaky-clean and dry. Unfortunately, this is not happening. While drying kills all aquatic invasives, it can take 5+ days to get boats completely dry in cool, humid weather. Not surprisingly, many people do not wait and instead try to clean their boats. How well do these cleanings work? Most boat launches either have no tools at all (e.g., only hand removal is possible) or have a self-service cleaning station with waterless tools (e.g., brushes, tongs, vacuums). Previous assessments of waterless cleaning station effectiveness have focused on boat and trailer exteriors, not on contamination inside boats. The worst-case scenario is a false sense of security created by poorly-performing cleaning methods. The boat owner thinks all is clean and is unconcerned about moving to another lake, when in reality there are spiny water fleas stuck in the live well, invasive milfoil on the boat floor or faucet snails on their boots. We will test the effectiveness of the self-service (non-DNR) AIS removal methods at cleaning boat interiors against the DNR standard for cleaning, which is to use a power washer to remove AIS.

**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?**

Self-service waterless cleaning stations are being purchased with state funding and placed at many boat launches. Are these stations as effective as possible at preventing AIS spread? How can they be even more effective? Our results will help boat launch and lake managers choose the best cleaning tools for lake protection based on the AIS in their lake; help AIS personnel and agency managers customize AIS removal strategies for particular user groups and water bodies; and provide the information necessary to help cleaning station manufacturers improve their tools. (Note: minimal changes to original proposal, mostly formatting and including reviewer recommendations).

## Project Location

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

Region(s): NE

**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: Assess how well self-service AIS removal methods clean boat interiors and gear

**Activity Budget:** \$100,576

**Activity Description:**

We designed an experiment to determine the effectiveness of various removal methods at cleaning both a) recreational angler boat interiors and b) duck hunter boat interiors and gear (decoys, boots).

Specifically, we will quantify the living material (potential AIS propagules) removed by cleaning methods available at boat launches:

- 1) visual inspection and hand removal,
- 2) typical boat launch waterless cleaning station,
- 3) low-pressure water rinse from a garden hose, and
- 4) all methods listed above.

Each of these cleaning methods will be compared to the DNR cleaning standard of power washing to determine what was missed. This study design allows us to determine how many potential propagules were removed by each method and how many were missed (by comparison to what is removed by power washing). We will seek input on our study design from agency AIS personnel. Our results will not be influenced by cleaning station manufacturers. This activity can be accomplished with the original budget by slightly reducing statistical replication.

Outcome 1: Determination of removal efficiency of each cleaning method for each type of use: angling and duck hunting.

Outcome 2: Recommendations to improve the performance of boat launch cleaning stations to reduce the risk of AIS spread.

**Activity Milestones:**

Description	Approximate Completion Date
Webinar introducing study to agency AIS personnel, inspectors and managers (added at request of reviewers)	March 31, 2022
Cleaning efficiency assessment of 4 AIS removal methods for angler-type boats (minimum of 8 replicates)	February 28, 2023
Cleaning efficiency assessment of 4 AIS removal methods for duck hunting boats (minimum 8 replicates)	January 31, 2024
Statistical assessment of cleaning efficiencies for each type of boat: angling and duck hunting	March 31, 2024

### Activity 2: Information transfer to lake managers, agency AIS personnel and policy makers

**Activity Budget:** \$9,424

**Activity Description:**

Task: Inform AIS personnel, agencies (e.g., MNDNR), cleaning station manufacturers, policy makers and researchers of our findings and elicit their assistance in outreach messaging.

We will host a webinar with agency AIS personnel to present our findings and recommendations about which cleaning methods are most effective for removing different types of AIS from boat interiors and gear used for various recreational purposes. We will work with these personnel on outreach messages to target specific user groups that may differ in their use of boats and gear or be more likely to spread different types of AIS. Importantly, we will make recommendations to cleaning station manufacturers on upgrades or changes that may improve the removal efficiency of

these stations.

Outcome 1. Recommendations provided for a) cleaning method effectiveness at removing different types of AIS; b) the best AIS removal methods and messaging for various user groups, equipment types, and AIS; and c) improving cleaning station tools and options.

Outcome 2. Relay project results, messages and recommendations by a) giving webinars to cleaning station manufacturers, agency AIS staff, lake associations and others who work at boat launches to prevent AIS spread, and b) by preparing a manuscript for publication.

**Activity Milestones:**

Description	Approximate Completion Date
Webinar with AIS professionals for information transfer and to craft outreach messages and recommendations	April 30, 2024
Presentation at MN Aquatic Invaders Summit and similar venues, write manuscript	June 30, 2024

## Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Edgar Rudberg	CD3 Company	The CD3 Company is collaborating with us and providing in-kind match. They will provide a cleaning station and an engineer to assist us in configuring the cleaning station for optimal sample collection at no cost. They have agreed to have no influence on this study or interpretation of results.	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.**

Because dissemination of our results is critical to accomplishing our objectives of improving the success of self-service decontamination stations at preventing the spread of AIS, we included these activities as our Task 2. Those plans are repeated here.

We will host a webinar with agency AIS personnel to present our findings and recommendations about which cleaning methods are most effective for removing different types of AIS from boat interiors and gear used for various recreational purposes. We will work with these personnel on outreach messages to target specific user groups that may differ in their use of boats and gear or be more likely to spread different types of AIS. Importantly, we will make recommendations to cleaning station manufacturers on upgrades or changes that may improve the removal efficiency of these stations.

Outcome 1. Recommendations provided for a) cleaning method effectiveness at removing different types of AIS; b) the best AIS removal methods and messaging for various user groups, equipment types, and AIS; and c) improving cleaning station tools and options.

Outcome 2. Relay project results, messages and recommendations by a) presenting at the Minnesota Aquatic Invaders Summit (which is well attended by AIS researchers, managers and inspectors), b) presenting at other regional conferences, and c) a scientific publication.

All outreach materials will acknowledge ENRTF funding as per the 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 project will assess the effectiveness of 4 AIS removal methods to clean the interiors of angling and duck hunting boats. Managers across MN can use our results to determine what cleaning tools and methods will work best depending on lake usage and types of AIS present. Because this is an independent assessment of typical non-DNR cleaning stations, station manufacturers can use these results to increase the effectiveness of their cleaning stations. Long term, reduction in the transportation of water and biotic materials will slow the spread of AIS in Minnesota.

## Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
MAISRC Subproject 15: Determining Highest Risk Vectors of Spiny WaterFlea Spread	M.L. 2017, Chp. 96, Sec. 2, Subd. 06a	\$0



## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount	\$ Amount Spent	\$ Amount Remaining
<b>Personnel</b>										
Principal Investigator Valerie Brady		Overall project management and coordination; lead reporting and outreach. NRRI research staff (not teaching faculty) receive minimal salary support from UMD; they are largely paid on grant monies and their effort on this project will be paid from ENTRF.			26.7%	0.06		\$6,063	-	-
Co-investigator Josh Dumke		Day-to-day coordinator of project; leads data analysis, assists with reporting and outreach. NRRI research staff (not teaching faculty) receive minimal salary support from UMD; they are largely paid on grant monies and their effort on this project will be paid from ENTRF.			26.7%	0.36		\$29,864	-	-
Taxonomists (Robert Hell and Holly Wellard Kelly)		Lead laboratory analysis and sample processing; assist with data analysis and reporting. NRRI research staff (not teaching faculty) receive minimal salary support from UMD; they are largely paid on grant monies and their effort on this project will be paid from ENTRF.			23%	0.69		\$44,947	-	-
Technician		Assist with all aspects of project. NRRI research staff (not teaching faculty) receive minimal salary support from UMD; they are largely paid on grant monies and their effort on this project will be paid from ENTRF.			23%	2.7		\$17,575	-	-
Summer technician or student		Will assist the technician with all aspects of the field portion of the project.			8.2%	0.21		\$8,279	-	-
							<b>Sub Total</b>	<b>\$106,728</b>	<b>\$106,728</b>	<b>-</b>

<b>Contracts and Services</b>										
							<b>Sub Total</b>	-	-	-
<b>Equipment, Tools, and Supplies</b>										
	Tools and Supplies	General field supplies	Livewell proxy; duck decoys, sieving and netting material, filters for CD3 machine, capture mats to capture items washed from boats; vials and bottles for sample storage; ethanol preservative for samples					\$2,316	\$2,316	-
	Tools and Supplies	Lab supplies	Waterproof paper, pails for sample storage, waterproof pencils and markers, microforceps					\$168	\$168	-
							<b>Sub Total</b>	<b>\$2,484</b>	<b>\$2,484</b>	-
<b>Capital Expenditures</b>										
							<b>Sub Total</b>	-	-	-
<b>Acquisitions and Stewardship</b>										
							<b>Sub Total</b>	-	-	-
<b>Travel In Minnesota</b>										
	Miles/ Meals/ Lodging	Travel for fieldwork	Travel to local wetland to obtain biotic items, mud, and water for tests. 30 miles round trip at \$0.56/mile, estimated 18 trips with 2 work trucks and boats to collect material to use for tests. Tests will be performed at NRRI to help ensure consistency and standardization.					\$788	\$788	-

	Conference Registration Miles/ Meals/ Lodging	Travel to Minnesota Aquatic Invasive Species Conference to present results.	Two people, estimated 365 miles round trip, one night, with per diem and conference registration estimated at \$225 each.					-	-	-
							<b>Sub Total</b>	<b>\$788</b>	<b>\$788</b>	-
<b>Travel Outside Minnesota</b>										
							<b>Sub Total</b>	-	-	-
<b>Printing and Publication</b>										
							<b>Sub Total</b>	-	-	-
<b>Other Expenses</b>										
							<b>Sub Total</b>	-	-	-
							<b>Grand Total</b>	<b>\$110,000</b>	<b>\$110,000</b>	-

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
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## Non ENRTF Funds

Category	Specific Source	Use	Status	\$ Amount	\$ Amount Spent	\$ Amount Remaining
<b>State</b>						
			<b>State Sub Total</b>	-	-	-
<b>Non-State</b>						
In-Kind	CD3 waterless cleaning station use donated by CD3 Company along with staff time.	The CD3 company has agreed to provide us with a CD3 waterless cleaning station free of charge for this project (value \$2000) and are additionally providing the time of the CEO (40 hrs) and an engineer (40 hrs) to assist with the project (value \$10,000). See attached match letter.	Secured	\$12,000	\$5,511	\$6,489
In-Kind	UMN unrecovered indirect costs are calculated at the UMN negotiated rate for research of 55% modified total direct costs.	Indirect costs are those costs incurred for common or joint objectives that cannot be readily identified with a specific sponsored program or institutional activity. Examples include utilities, building maintenance, clerical salaries, and general supplies. ( <a href="https://research.umn.edu/units/oca/fa-costs/direct-indirect-costs">https://research.umn.edu/units/oca/fa-costs/direct-indirect-costs</a> )	Secured	\$60,500	\$60,500	-
			<b>Non State Sub Total</b>	<b>\$72,500</b>	<b>\$66,011</b>	<b>\$6,489</b>
			<b>Funds Total</b>	<b>\$72,500</b>	<b>\$66,011</b>	<b>\$6,489</b>

## Attachments

### Required Attachments

#### *Visual Component*

File: [938c1516-146.pdf](#)

#### *Alternate Text for Visual Component*

Our visual shows our study design testing 4 AIS removal methods on two types of boats (angling and duck hunting) against the DNR-preferred boat cleaning method of high pressure power washing. We will assess how many items were removed and missed by each boat cleaning method....

### Supplemental Attachments

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

Title	File
Match letter by CD3 Company	<a href="#">1c14b308-00c.pdf</a>
Background check file - Brady	<a href="#">53c926bd-3ea.pdf</a>
Removing invasive species from boat interiors: What works best?	<a href="#">7454dd34-2c0.pdf</a>
Cleaning test boat using CD3 station	<a href="#">a9de2297-b6f.jpe</a>
Cleaning test boat using CD3 station, 2	<a href="#">1b75f4d3-a4a.jpe</a>
Fouling duck decoys	<a href="#">f1b1cf5d-7db.jpe</a>
Test boat fouled with wetland mud & plant materials	<a href="#">2d0413e8-202.jpe</a>
Updated: Removing invasive species from boat interiors: What works best?	<a href="#">1e476924-30d.pdf</a>

### Difference between Proposal and Work Plan

#### *Describe changes from Proposal to Work Plan Stage*

We have extended the timeline of this project an extra year (with no change in tasks, objectives, or budget) because of the delay in being able to start this project and because of the complications of Covid-19 on our lab and research work. This extension will give us the time to ensure that we can complete the project as planned (desired end date 6/30/2024). So yes, the end date matches our desired end date.

Because of the reduction in our budget (and the time delay in funding, which has led to cost increases), we can only promise 8 replicates per boat type instead of the 10 replicates we had originally envisioned. This has been noted in Activity 1.

We will take the boats to the wetland to use to obtain biotic material for fouling the boats for the test, but to ensure standardization, we will do the tests in the NRRI parking lot. We will carefully mix up a slurry of biotic materials collected from the wetland and use part of that slurry to foul the boat each time for each replicate. This will ensure much better standardization than trying to foul the boats out in the wetland, and will result in better data for statistical analysis.

## 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?**

N/A

**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 UMN Policy on travel 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?**

Yes, Sponsored Projects Administration

## 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	<ul style="list-style-type: none"> <li>• Budget</li> <li>• Budget - Personnel</li> <li>• Budget - Capital, Equipment, Tools, and Supplies</li> <li>• Budget - Travel and Conferences</li> <li>• Budget - Non-ENRTF Funds Contributed</li> </ul>	PI needed assistance measuring the vacuum pressure and air compressor pressure on the boat cleaning station that we are testing and to compare those measurements to a shop vac and the NRRI building compressed air pressure. We will have to use a shop vac and the building compressed air as a substitute for the cleaning station for some tests, and so we need to know how these systems compare.	March 21, 2023	Yes	March 30, 2023
2	Amendment Request	<ul style="list-style-type: none"> <li>• Budget</li> <li>• Activities and Milestones</li> <li>• Budget - Personnel</li> <li>• Budget - Capital, Equipment, Tools, and Supplies</li> <li>• Budget - Travel and Conferences</li> </ul>	Requesting move of unspent money in supplies and conference travel to salaries. We did not have data to present at the planned conference and are instead doing webinars with AIS staff to provide outreach on our results (no travel costs). And we did not need all the anticipated supply money, but are spending more time on sample processing than expected.	April 6, 2024	Yes	April 8, 2024
3	Amendment Request	<ul style="list-style-type: none"> <li>• Other</li> <li>• Budget - Personnel</li> <li>• Budget - Capital, Equipment, Tools, and Supplies</li> <li>• Budget - Travel and Conferences</li> <li>• Attachments</li> </ul>	Requesting move of a small amount of money from personnel and supplies to cover local travel costs incurred during the project work. Travel was back and forth to a wetland to obtain fouling materials for our AIS cleaning tests.	August 14, 2024	Yes	November 26, 2024



# Status Update Reporting

## Final Status Update August 14, 2024

**Date Submitted:** August 14, 2024

**Date Approved:** November 26, 2024

### Overall Update

We tested the most effective cleaning methods and tools typically available at boat launches to clean the interiors of boats as they might be fouled by anglers or waterfowlers. These tests generated 592 samples. We found that the vacuum was very effective for removing material from inside boats that could spread aquatic invasive species. Hand picking of large debris was also effective, but removal efficacy decreased as material size decreased (e.g., zooplankton, seeds). Detailed signage about effective tool use may aid boaters in their cleaning and we have provided detailed recommendations to our collaborators at the CD3 company for dissemination and during our presentations. We have already presented our results to three different audiences and have plans for at least two more presentations, with the potential for two additional presentations depending on funding. Our collaborators at the CD3 Company have sent our preliminary recommendations out to their entire nationwide email list. We also have a draft manuscript nearly ready for submission to a national journal focused on lake management with members very invested in preventing the spread of aquatic invasive species.

### Activity 1

We tested the most effective cleaning methods and tools typically available at boat launches to clean the interiors of boats as they might be fouled by anglers or waterfowlers. Each test for each tool or method consisted of 10 replicates. In addition, we tested tool/method ability to clean boots, waders and duck decoys to more realistically assess a waterfowler setup. These tests generated 592 samples, which were carefully sorted and counted to assess material removal efficiency of each tool and method. We found that the vacuum was very effective for removing material from inside boats that could spread aquatic invasive species. Hand picking of large debris was also effective, but removal efficacy decreased as material size decreased (e.g., for spiny water flea, plant seeds, etc.) A low-pressure water rinse could cause material to become lodged in crevices or under the boat floor and so should be used after hand picking and vacuuming when attempting to remove all materials. If a water rinse is used, we recommend the vacuum be used after that to remove any remaining water. Hand picking and water rinses worked best for waders and decoys. Detailed signage about effective tool use may aid boaters.

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

### Activity 2

Because the fall invasive species conferences are outside the time-frame of this project, we have sought other methods of disseminating our results. Preliminary results were presented in poster format to about 75 attendees of the 14th Annual St. Louis River Summit at the University of Wisconsin, Superior (WI), March 6, 2024. In addition, we gave two hour-long webinars to about 30 attendees each for the Minnesota DNR aquatic invasive species program staff (May 21, 2024) and members of the Minnesota Lakes and Rivers Advocates (June 4, 2024). In addition, we have two other guaranteed presentations lined up: Minnesota Water Resources Conference (Oct. 15, 2024), St. Paul, Minnesota, and the Upper Midwest Invasive Species Conference (Nov. 12, 2024), Duluth, Minnesota. We have two other national conference opportunities to present this research out-of-state if we can secure funding (see Dissemination). Finally, we have a draft manuscript nearly ready for submission to the Lake and Reservoir Management Journal. Our collaborators at the CD3 Company have been sharing our recommendations to their contacts throughout the nation.

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

### Dissemination

We began the project with a webinar for Minnesota AIS state agency personnel. Once results were available, we began

presenting at conferences and via webinars:

- 14th Annual St. Louis River Summit, Superior, Wisconsin, March 6, 2024. Poster session. Approximately 75 poster views.
- Minnesota DNR Aquatic Invasive Species Program, May 21, 2024, presentation via webinar. 30 MNDNR staff in attendance.
- Minnesota Lakes and Rivers Advocates, June 4, 2024, presentation via webinar. 30 attendees, general public and lake associations.
- Our CD3 collaborators emailed our recommendations to 7740 people; 5% (387) clicked on the link.

Planned future dissemination events:

- Water Science station, Minnesota State Fair, June 27-28, 2024. One to two 3-hr sessions manning the booth to discuss NRRI water research, including this project.
- (potential, if we find funding) North America Invasive Species Management Association national conference, Missoula, Montana, Sept. 1, 2024.
- Minnesota Water Resources Conference, St. Paul, Minnesota, Oct. 15, 2024. Presentation.
- (potential, if we find funding) North American Lake Management Society national conference, Lake Tahoe, Nevada, November 6, 2024. Presentation.
- Upper Midwest Invasive Species Conference, Duluth, Minnesota, Nov. 12, 2024. Presentation.

Finally, we have a manuscript nearly ready for submission to the Lake and Reservoir Management Journal (draft attached).

# Status Update Reporting

## Status Update April 1, 2024

**Date Submitted:** April 5, 2024

**Date Approved:** April 8, 2024

### Overall Update

We have completed testing of cleaning tools and methods for both angler-type and waterfowler-type fouled boats for AIS removal to prevent AIS spread. Because we tested 4-5 methods for each boat type with 10 replicates per test and saved all power wash rinses as well, this generated about 700 samples. We have processed all the samples and are now doing data entry and QC. We provided preliminary results of our angling boat cleaning at the St. Louis River Summit in Superior, WI, in March 2024. We anticipate that data analysis will be completed by the end of April. Outreach will occur in May and June so that we will complete the project by June 30, 2024.

### Activity 1

Data collection and sample processing are complete for this activity. We have collected all the samples for assessing cleaning station tools for both an angler-type boat and a waterfowler-type boat, complete with waders and duck decoys. We tested 4-5 tools or combinations of tools/cleaning methods for each boat type, with 10 replicates run for each test. This generated approximately 700 samples because we also saved the power wash samples to see what was missed after each replicate test.

We are currently working on data entry and quality-checking the data before we run statistical analyses of our results to determine removal efficiencies. Our next step will be to use the removal efficiencies to provide recommendations for making cleaning stations even more effective.

### Activity 2

We provided preliminary results of our angler boat cleaning tests as a poster at the 14th Annual St. Louis River Summit in Superior, Wisconsin in March 2024. Wellard Kelly H, Brady V, Hell R, Pierce K, Jeffrey P, Pederson B, Dumke, J. It only takes one! How to get AIS out of your boat. Poster presentation at St. Louis River Estuary Summit, Superior, Wisconsin, March 2024. Because the Upper Midwest Invasive Species Conference does not occur until fall 2024, after the project end date, we will meet our outreach goals by giving webinars to state agency AIS staff, lake associations, and others who work to reduce the spread of AIS. We have already lined up webinars with MNDNR AIS staff and the Minnesota Lakes and Rivers Advocates group for May and June, 2024.

### Dissemination

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# Status Update Reporting

## Status Update October 1, 2023

**Date Submitted:** September 27, 2023

**Date Approved:** November 20, 2023

### Overall Update

Getting a CD3 station delivered to and placed safely at NRRI proved fairly difficult last year. After going to that trouble, we discovered that we could not use most of the station tools because they could not be properly cleaned or samples captured for our tests. Thus, with the help of CD3 engineers, we purchased a shop vacuum that mimics the suction pressure and hose size of the CD3 vacuum; and we outfitted NRRI building air to mimic the pressure and spray of the air from the CD3 station (we even purchased the exact same nozzle as is on the CD3 station). NRRI and CD3 engineers helped us measure both suction pressure and air blower strength on all units involved to be able to match things very accurately. This has allowed us to mimic a CD3 station while at the same time capturing each replicate sample without contamination or loss. We and the CD3 engineers did not realize at the time of proposal writing that it would prove so difficult to retrofit a CD3 station for the experimental needs of this project to ensure that there is no loss or bias.

### Activity 1

We have completed the trials for the angling boat test (milestone 2) and are over half done with the trials for the duck boat with gear tests (anticipated completion by end of Oct). Instead of using mud from a natural wetland to foul the duck boat, we created our own fouling slurry with clean dirt from a landscaping company and additions of counted vegetation pieces, tracking colored ribbon, and dead snails. This gives us much better control so that statistics are more likely to be able to detect differences among the cleaning methods. We also found that the amount of mud slurry we had proposed to foul the boat with seemed quite excessive and we reduced that to 0.5 L with the volume of subsamples for characterization now at 100 mL. Finally, we are still fouling the waders, boots, and decoys in a natural wetland, but are cleaning these items in a tub so that we are sure we are capturing all material from them so that none is lost in boat crevices, again for better control so that we reduce variability for better statistical tests. We now know why we're among the first to attempt such an experiment.

### Activity 2

This activity has not yet started.

### Dissemination

This activity has not yet started.

# Status Update Reporting

## Status Update April 1, 2023

**Date Submitted:** March 21, 2023

**Date Approved:** March 30, 2023

### Overall Update

We had the loan of a CD3 station belonging to the City of Duluth from late September through early November, 2022. The CD3 station was returned to the City of Duluth the first week of November, with the move paid for by our collaborators, the CD3 company. During this time we completed 2 of the 4 surrogate AIS removal trials for the angling boat scenario. Work was halted by weather too cold to allow continued work outside. All samples for the replicates have been counted and the data entered into a spreadsheet.

### Activity 1

We used our aquatic vegetation substitutes (Tansy, grass), the aquatic plant Elodea, preserved dead spiny water fleas, and colored ribbon bits to complete 2 of the 4 removal trials for the angling boat scenario. Each replicate in each trial used a different ribbon color to allow us to determine whether or not test particles were all coming out in the replicate for which they were seeded into the boat, or in a later replicate. This will help us account for any confounding effects of bits of test material showing up in later replicates than the one for which they were used. Material from all replicates has been counted and is ready for analysis once we complete the remaining removal trials. We had to stop before completing all 4 trials last fall because the temperature dropped and we could no longer do the work outside.

### Activity 2

This activity has not yet started

### Dissemination

This activity has not yet started.

# Status Update Reporting

## Status Update October 1, 2022

**Date Submitted:** October 17, 2022

**Date Approved:** October 19, 2022

### Overall Update

We were able to have a CD3 waterless boat cleaning station moved to NRRI for this research project on Sept. 22, 2022. We are borrowing a cleaning station from the City of Duluth after the height of the boating season. The CD3 company paid for and coordinated the station move. For the past week we have been trialing and refining our methods to ensure that we produce good data that will pass peer review.

### Activity 1

We completed milestone 1 on June 7, 2022, presenting our project to the MNDNR AIS group. Cleaning station delivery to NRRI has allowed us to trial our methods. We discovered that the aquatic vegetation (milfoil, valisnaria) we hoped to use as a surrogate for actual aquatic invasive vegetation does not hold up well in the tests. Because the tests are based on counting the vegetation bits recovered after a known amount is added to the boat interior, it is critical that the vegetation hold together during the test. Trials with various types of vegetation showed that leaves of the terrestrial invasive, tansy, hold up well and tansy lasts well into the fall. This is the milfoil substitute, along with a sturdier aquatic plant, Elodea. For valisnaria, we are substituting grass blades (very similar size and shape) and green plastic ribbon cut to size and shape. We will use 20 pieces of each type in each rep (80 pieces total per rep). We have also noticed that spiny water flea tend to get lost in the boat and may not come out easily with pressure washing (or are obliterated by pressure washing). We added different color ribbon bits as tracking.

### Activity 2

This activity has not yet started.

### Dissemination

This activity has not yet started with the exception of a presentation giving a project overview and a few discussions with various AIS personnel about the project plan because we have no results yet. The presentation of the project plan was to the MNDNR Invasive Species staff meeting on June 7, 2022. They have provided feedback on tools they are interested in having us test (want us to add a cloth wipe to the station tools test).

# Status Update Reporting

## Status Update April 1, 2022

**Date Submitted:** April 26, 2022

**Date Approved:** May 16, 2022

### Overall Update

We are just getting started on this project. Most work will not be done until Fall 2022. To date we have just been working with the CD3 Company to ensure that we will have access to a CD3 waterless cleaning station and the tools and supplies we need to be ready for our fall experimental work.

### Activity 1

This spring we will present our study design to AIS managers. Additionally we have been working with our partners at the CD3 Company to arrange the loan of a CD3 waterless cleaning station and make it useable for this project, which means ensuring that we can accurately get samples out of the station. To that end we have been researching wet/dry shop and barrel vacuums with smooth-interior hoses and have had fine mesh sampling nets made. The CD3 company is paying for the vacuums and nets as part of their match contribution to the project. The actual tests will be done in the fall of 2022.

### Activity 2

Not yet started.

### Dissemination

Not yet started.