

M.L. 2021 Minnesota Aquatic Invasive Species Research Center Subproject Abstract

For the Period Ending December 31, 2024

SUBPROJECT TITLE: MAISRC Subproject 22.3: Assessing and refining copper-based treatment to suppress zebra mussel populations

SUBPROJECT MANAGER: Dr. Diane Waller

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<https://www.usgs.gov/centers/umesc/science/aquatic-ecosystem-health>

FUNDING SOURCE: Environment and Natural Resources Trust Fund (ENRTF)

LEGAL CITATION: M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 06e

SUBPROJECT BUDGET AMOUNT: \$159,505

AMOUNT SPENT: \$159,405

AMOUNT REMAINING: \$100

Sound bite of Project Outcomes and Results

The project is the second phase of a multi-year effort to evaluate low-dose copper treatments for suppressing zebra mussel populations while minimizing nontarget effects. This research culminated in a Structured-Decision Making process with resource managers and stakeholders to develop knowledge-based management alternatives for zebra mussels in Minnesota lakes.

Overall Subproject Outcome and Results

Since their arrival in the 1980s, zebra mussels have spread from Duluth Harbor to over 300 lakes in Minnesota, including 14 new infestations in 2024 (MNDNR 2024). The ecological and economic damage caused by zebra mussels has been well-documented across the state. Eradicating zebra mussels after they have become established in a lake is challenging due to the lack of selective control tools and application techniques. Our research investigated an alternative management approach to eradication and population suppression by targeting the sensitive larval stage (i.e., veliger) of the mussel. Copper-based pesticides are the most widely used tool for open water treatments of zebra mussels; however, copper is toxic to many aquatic organisms, especially when applied at the maximum allowable concentration (1 milligram per liter; EPA REG. NO. 64962-1). We applied a low-dose copper treatment of 47 parts per billion, 4.7% of the maximum allowed, at peak veliger density in July 2022 and measured zebra mussel settlement and native community responses from August 2022 through October 2023. The 2022 treatment reduced juvenile mussel settlement by over 90%; although native zooplankton were also reduced, their populations rebounded within 30 days. One year later, juvenile zebra mussel settlement and native community abundance were similar to pretreatment levels. The results show that control actions may have to be repeated depending on the desired level of mussel suppression. Decisions on how to manage zebra mussel infestations are challenging, especially when stakeholder interests are diverse and management goals differ. This project culminated in a Structured-Decision Making (SDM) workshop with resource managers and local stakeholders to help guide future management actions for zebra mussels in Minnesota lakes. Our SDM was initially modeled as a decision-making process for an individual lake. As it is applied, the lessons learned can be used to adapt and guide decisions on zebra mussel management in multiple Minnesota lakes.

Reference: [Infested Waters List | Minnesota DNR](#)

Subproject Results Use and Dissemination

The results of the low-dose treatment in Maxwell Bay will be disseminated in a peer-reviewed journal. A first draft of the manuscript is in preparation and expected to be completed by July 31, 2025.

The decision model developed from the Structured Decision-Making process will be provided in a format that can be used by resource managers, to be determined (e.g., Shiny App, journal publication).

The results of the seasonal study of adult zebra mussels will be disseminated in a peer-reviewed journal. Final data analysis is underway, and a first draft is scheduled to be completed by July 1, 2025.

Two manuscripts were written on the results of the first low-dose copper treatment (phase 1 of the low-dose copper research). The manuscripts completed USGS review and have been submitted to *Ecotoxicology* as a two-part series. One paper covers the treatment and effects on zebra mussels (i.e., the target organism) and the second paper covers the affects to other communities in the lake (i.e., non-target organisms).

Peer-Reviewed Publications

- Dahlberg, A.D., Waller, D.L., Hammond, D., Lund, K., and Phelps, N.B.D., 2023, Open water dreissenid mussel control projects: lessons learned from a retrospective analysis: *Scientific Reports*, 13(10410), <https://doi.org/10.1038/s41598-023-36522-5>
- Dahlberg, A.D., Waller, D.L., Severson, T.J., Barbour, M.T., Meuleman, M., Wise, J.K., Bajcz, A. W., Jankowski, M. Phelps, N.B.B. Using bioavailability modeling to refine copper treatments for zebra mussel control with better understanding risks to non-target species. *Prepared for resubmission*.
- Barbour, M. T., Dahlberg, A., Luoma, J., Severson, T. J., Wise, J. K., Bennie, B., Hammond, D., Waller, D. L. Assessing a low-dose copper treatment for dreissenid mussels: effects on zebra mussel (*Dreissena polymorpha*) population. *Submitted to journal*.
- Dahlberg, A., Barbour, M. T., Luoma, J., Severson, T. J., Wise, J. K., Meuleman, M., Bennie, B., Hammond, D., Phelps, N.B.D., Waller, D. L. Assessing low-dose copper treatment for dreissenid mussels: effects on nontarget organisms. *Submitted to journal*.

Presentations/Videos

- 2023 MAISRC Research & Management Showcase: Low Dose Copper to Reduce Zebra Mussel Recruitment
<https://z.umn.edu/2023ShowcaseCopper>
- Assessing and refining copper treatments to zebra mussel populations. MAISRC Showcase, Diane Waller (Presenter), Matt Barbour, Matt Meulemans, Todd Severson, Jeremy Wise, Angelique Dahlberg, Nicholas Phelps. September 25, 2024. About 40 people in-person.
- Structured Decision-Making progress update to Minnesota Department of Natural Resources. Virtual meeting. Mike Colvin (Presenter). December 17, 2024.
- Great Lakes Panel on Aquatic Nuisance Species, 15 November 2023. Hybrid presentation.
- “USGS Update on Aquatic Nuisance Species Research” presented by Diane Waller. Included highlights of the present study on low dose copper and seasonal copper sensitivity in zebra mussels.
- Invasive Mussel Collaborative Meeting, 15 December 2023. Hybrid presentation, “Invasive Mussel Research” presented by Diane Waller. Included highlights of the present study on low dose copper and seasonal copper sensitivity in zebra mussels.

- Conducted a virtual meeting with Bureau of Reclamation and Army Corps of Engineers staff to initiate a collaborative study on low dose copper treatment in hydropower facilities. Data from the current MAISRC project are informing the treatment levels for investigation.
- Conducted virtual meetings with resource managers in Colorado, North Carolina, Kentucky, and New York state and provided information on copper toxicity and treatments.
- National Invasive Species Awareness Week, February 26, 2024. Virtual presentation, “Invasive dreissenid mussels alter aquatic communities.” Presented by Diane Waller. Webinar sponsored by NAISMA.
- Minnesota Department of Natural Resources Research Update meeting. February 27, 2024. Virtual presentation and discussion, “Effects of low-dose copper on zebra mussel recruitment and introduction to structured-decision making for invasive species.” Presented by Matthew Barbour and Diane Waller.
- Invasive Mussel Collaborative Webinar Series, May 29, 2024. Virtual presentation, “Unraveling the nuances of dreissenid mussel control tool efficacy,” Presented by Matthew Barbour. Webinar sponsored by the IMC.
- USGS-USACOE Invasive Species Research Collaboration Discovery Session, Jun 17, 2024. Virtual presentation, “Invasive mussel control research for hydropower facilities and open water habitats.” Presented by Diane Waller.

Select Media Coverage

- [PBS Prairie Sportsman: Little Critter Copper Control](#). *Video*.
- [Invasive Dupes, Part 4: Two Tiny Mussels, One Big Difference | Chicago News | WTTW](#)