



MINNESOTA AQUATIC INVASIVE
SPECIES RESEARCH CENTER

UNIVERSITY OF MINNESOTA
Driven to Discover®

Annual Report 2022



Fenske Lake, St Louis County

LETTER FROM THE DIRECTOR

Another busy Minnesota winter is behind us, where we organized, analyzed, and planned. Spring is now in full swing, and with it comes another field season for our researchers: We will wear life jackets and sunscreen. We'll pack our lunches and gear to collect samples from across the state. Some of us return to the MAISRC Containment Lab each day, methodically mapping out research scenarios. Others crunch data at the computer or around a conference room table. The work doesn't stop - each moment spent studying the aquatic invasive species (AIS) in Minnesota is a step to reducing their harmful impact on our lakes, rivers, and wetlands. Good science takes hard work and time.

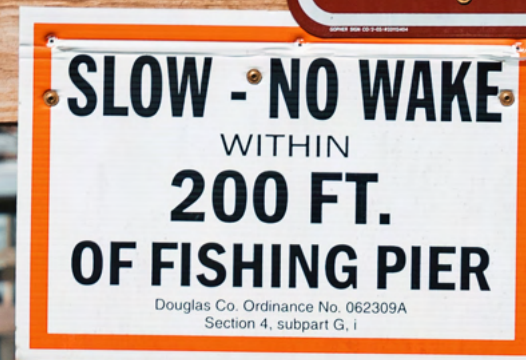
Good science also takes collaboration. We couldn't do any of this important work without the strong relationships with our partners in AIS research. Our projects range from working with Tribal Nations for the preservation of wild rice, to recruiting and training community volunteers through our AIS Detectors program. Working with our partners is one of the most rewarding parts of our job. I highly encourage you to connect with us - give feedback, share information, join us in the field, tell us about your problems, and brainstorm ideas!

Built on our research, we're developing tools and technologies that help state agencies, managers, lake associations, and community organizations in the fight against AIS. An example of this is with our online application, AIS Explorer. AIS Explorer is intended to support decision-making related to aquatic invasive species surveillance and watercraft inspection activities by modeling different invasive scenarios. Someone recently contacted us from Polk County with a question about using the AIS Explorer, and mentioned that they have the app bookmarked to help them make management decisions more effectively. MAISRC tools are reaching into all corners of the state. It may be awhile before we talk about eradicating AIS from Minnesota lakes, but when we work collaboratively using available tools built from evidence-based science, we can suppress the detrimental impacts to our ecosystems and position ourselves for future success.



A handwritten signature in black ink that reads "Nicholas Phelps".

Dr. Nicholas Phelps
Director
Minnesota Aquatic Invasive Species Research Center



Lake Victoria, Douglas County

Photo by Tony Webster
tonywebster.com

ABOUT MAISRC

At the most basic level, aquatic invasive species are water-dwelling organisms that are not native to the area they are currently in and cause, or have the potential to cause, harm to the environment, economy, or human health. Aquatic invasive species in Minnesota, such as zebra mussels and Eurasian watermilfoil, are a real and growing threat to our state's environment, economy, and way of life.

Created in 2012 with support funds from the Minnesota legislature and the Minnesota Environment and Natural Resources Trust Fund, the Minnesota Aquatic Invasive Species Research Center (MAISRC) has become the nexus of research and management—bringing together the brightest minds and institutions to create clear priorities both in species of study and lines of research. By serving this central role, MAISRC is able to amplify the impact of research findings, reduce overlap and minimize gaps, and create the pipeline that advances innovative research initiatives to real-world applications.

MAISRC's team of researchers have incredible diversity in their areas of expertise—from microbiology, engineering, freshwater ecosystems, toxicology, quantitative ecology, genetic modification, diagnostic validation, risk assessment, epidemiological modeling, and more! This broad spectrum of knowledge creates a powerful, innovative, and intellectually expansive environment for research that results in groundbreaking findings.

Our core mission is to develop research-based solutions for Minnesota's aquatic invasive species problems. Our projects focus on:

- **Prevention**—not allowing an invasive species to enter a new area
- **Control**—containing or reducing an invasive species once it is introduced
- **Management**—restoring the balance to ecosystems during and after an invasion
- **Advancing knowledge** on aquatic invasive species to inspire action by others.

Developing species-specific methods of RNA interference (RNAi) using genetic weak points in the zebra mussel genome, first steps towards the application of targeted genetic biocontrol strategies.

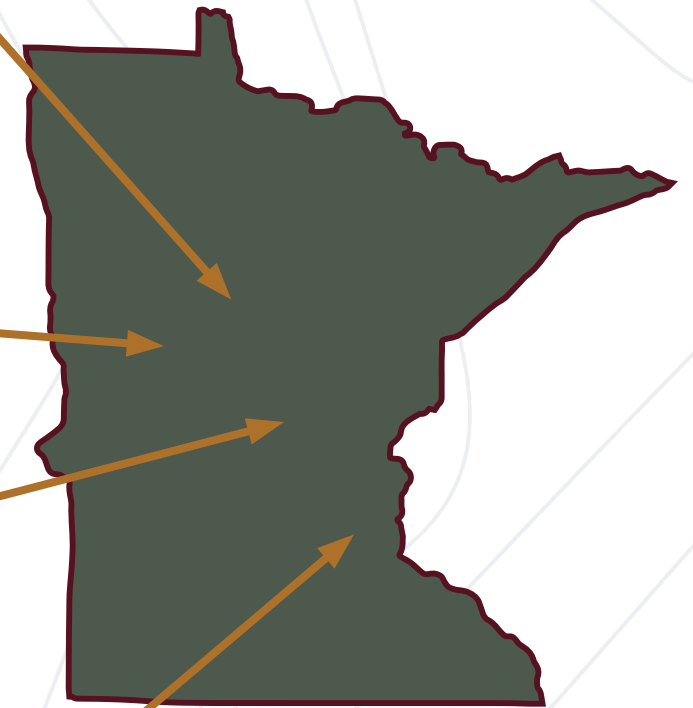
Mobilized 70+ volunteers and partners to survey and map invasive Phragmites across Minnesota. Identified 470+ populations and developed a management plan. We continue to support local level efforts to this day.

Developed a model that allows scientists to simulate invasion dynamics within lakes and across a network, and compare the influence of different management strategies under idealized circumstances.

Effective suppression: Low dose copper reduced the zebra mussel population density in a lake below levels where they cause ecological impacts for about two years.

WORKING IN MINNESOTA

MAISRC built a solid foundation of research and continues to launch exciting new projects every year. From spiny water fleas in the Northeast to common carp in the Southwest, and everything in between, MAISRC is well-positioned to leverage past successes and inform real-world solutions for aquatic invasive species throughout Minnesota. View some of our accomplishments on these pages. You can also explore an interactive online map of our work across Minnesota at: z.umn.edu/MAISRCmap





PROJECT: AIS IMPACTS ON WALLEYE POPULATIONS AND MERCURY CONCENTRATIONS

Invasive zebra mussels profoundly affect lake ecosystems, but their impacts on walleye are not well understood. For this project, the research team evaluated how walleye recruitment to their first fall season was affected by zebra mussels in Minnesota lakes. Statistical models were applied to walleye data collected by the Minnesota Department of Natural Resources to assess changes in walleye, finding a 41% decrease in walleye recruitment in zebra mussel infested lakes.

The research team evaluated how zebra mussels influence food webs supporting walleye and yellow perch, and how food web changes influence mercury concentrations in fish tissue. Mercury in fish tissue was, on average, 66% higher for adult walleye and 91% higher for adult yellow perch in lakes containing zebra mussels compared to those in uninvaded lakes. On average, mercury concentrations in 16-inch walleye from lakes containing zebra mussels were 0.28 ppm, above the 0.2 ppm threshold triggering human consumption advisories by the Minnesota Department of Health.

Zebra mussel-induced changes have important implications for walleye in Minnesota lakes. Lower walleye recruitment in invaded lakes may influence abundance at later life stages, which could influence harvest and stocking plans. Walleye were able to persist on nearshore food resources following zebra mussel invasions, but mercury concentrations were higher in these fish with important implications for human consumption. Given the significance of the impacts of zebra mussels documented in our study, preventing zebra mussel invasions and developing strategies to reduce population density are critical.

Visit this project online: z.umn.edu/AIS-walleye



THE NUMBERS

- **41%** decrease in walleye recruitment in zebra mussel infested lakes
- **Mercury in fish tissue was 66%** higher in adult walleye in lakes containing zebra mussels compared to those in uninvaded lakes



PROJECT: EXAMINING MOTIVATIONS FOR ILLEGAL BAITFISH RELEASE

The intentional release of live baitfish into Minnesota waters has a high likelihood of spreading aquatic invasive species (AIS), including fish pathogens, which may be accidentally introduced when otherwise innocuous native species are released. This project looked at the influence that anglers' attitudes, norms, and perceptions had on their bait disposal choices. The results improve management strategies for reducing the illegal release of live baitfish in Minnesota.

The researchers found that 28% of surveyed anglers at least "slightly agree" that they expected to release their leftover live baitfish in the future, confirming previous research and indicating that **baitfish release is an ongoing concern**. Researchers also found that people who knew Minnesota's bait disposal regulations were more likely to dispose of bait properly, suggesting that improving awareness of the rules could reduce baitfish release. Anglers who reported releasing live baitfish often believed that release would provide food for wild fish and promote strong baitfish populations.

Overall research results support communication campaigns to increase awareness of MN rules around proper bait disposal via social networks. Anglers are interested in being good resource stewards, so harnessing this tendency could go a long way in protecting Minnesota fisheries from harmful fish pathogens introduced by illegal baitfish release practices.

Visit this project online: z.umn.edu/baitfish

THE NUMBERS

- 70% of anglers indicated that being able to use live baitfish was at least moderately important to them
- Approximately 1/4 of anglers admit to releasing their live baitfish, including about 10% of anglers who knew it was against the law



PROJECT: ENHANCING HABITAT AND DIVERSITY IN CATTAIL-DOMINATED SHORELINES

Managing cattail and restoring lake shorelines have important implications for fisheries and recreation in Minnesota lakes. Left unchecked, hybrid cattails can profoundly affect nearshore lake ecosystems by outcompeting the native plant community, altering critical habitat for fishes, waterfowl, invertebrates and mammals.

For this project, the research team evaluated the effectiveness of mechanical harvesting as a management tool for hybrid cattail in Minnesota lakes. Data on fish and plants were collected before and after cattail removal to determine impact of this management strategy. While data analysis is ongoing, mechanical harvesting of hybrid cattail in nearshore lake zones is showing promise as a novel management method for inland lake ecosystems, though results appear mixed from lake to lake. Preliminary analyses show a significant decline in hybrid cattail across treatment areas one year following treatment. Data suggest a change in plant species composition within treated plots, reflecting an improved floristic quality nearing that of uninvaded sites. Additionally, the research team observed increased catches of small-bodied fishes between treated plots and changes in species composition, including greater abundances of minnows (important forage for game fishes).

Visit this project online: z.umn.edu/cattails



Big Marine Lake Photo by MAISRC



PROJECT: PUBLIC VALUES OF AQUATIC INVASIVE SPECIES MANAGEMENT

This project collected data on aquatic invasive species management and costs, public perceptions, values, knowledge, and willingness to pay for aquatic invasive species management via several surveys of different types spanning 2019 to 2021.

Minnesotans hold great value for aquatic invasive species management, both to lakes they visit and to waterbodies in the state as a whole, and are willing to pay significantly for it. Minnesotans are concerned about AIS and are generally supportive of AIS management actions and policies.

Visit this project online: z.umn.edu/public-values

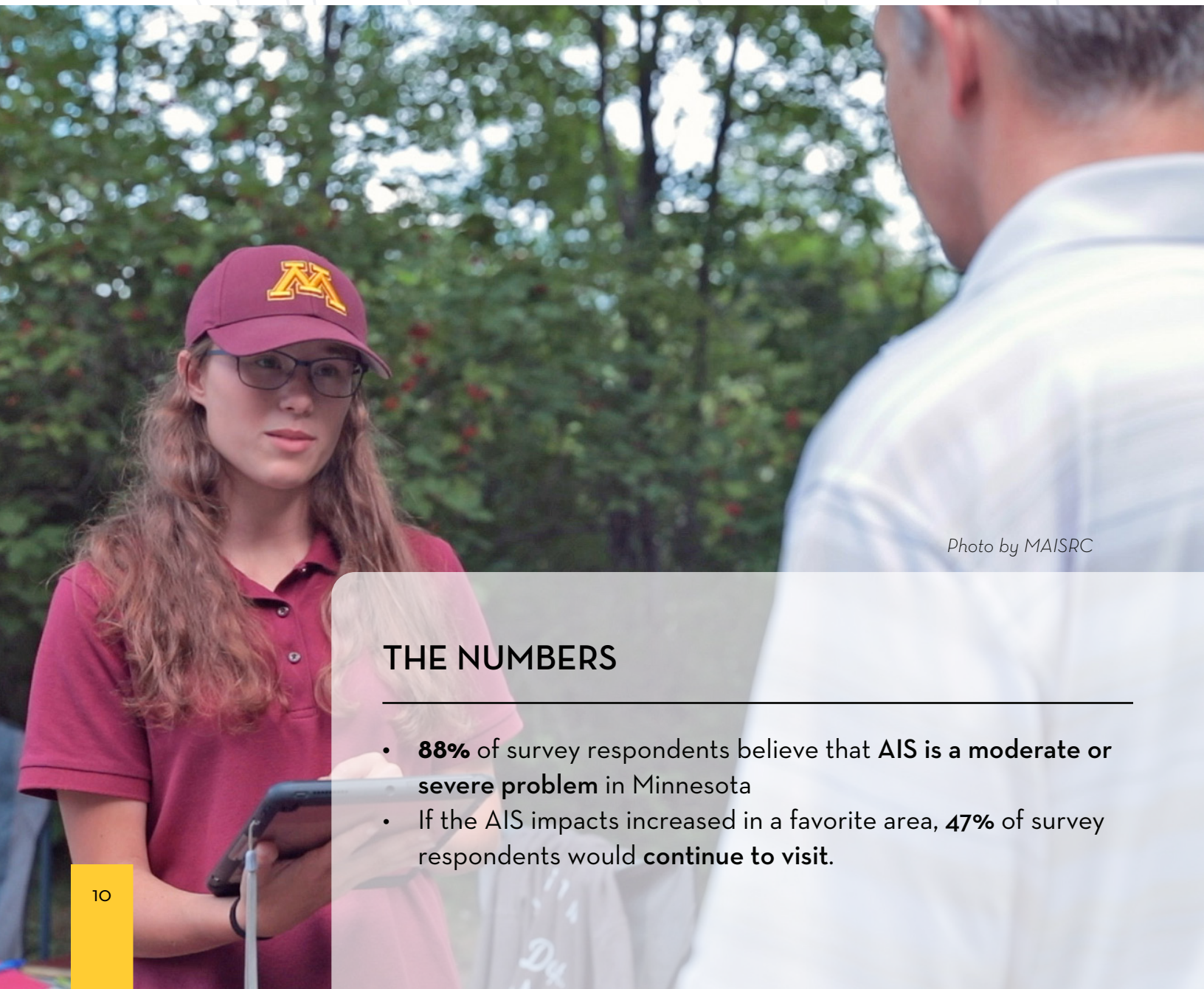


Photo by MAISRC

THE NUMBERS

- **88%** of survey respondents believe that AIS is a moderate or severe problem in Minnesota
- If the AIS impacts increased in a favorite area, **47%** of survey respondents would continue to visit.



Photo by August Schwerdfeger

Lower St. Anthony Falls Lock & Dam
Mississippi River, Hennepin County

PROJECT: INCREASING EFFECTIVENESS OF BIGHEADED CARP DETERRENTS BY CARBON DIOXIDE INTEGRATION

This project is examining using carbon dioxide (CO₂) to deter the upstream expansion of invasive bigheaded carp. These fish continue to migrate northward and present a danger to Minnesota's aquatic habitat. The locks and dams on the Mississippi river present strategic bottlenecks where non physical deterrents can be used to prevent upstream carp migration. Acoustic deterrents (sound frequencies) have shown promise but are not completely effective.

Two different strategies are used simultaneously to increase the effectiveness of acoustic deterrents by augmenting them with carbon dioxide. Bigheaded carp display strong aversion to the gas and, if successful, the combination of sound and CO₂ will increase the effectiveness of acoustic deterrents. Researchers are currently testing this theory using a model scale lock and dam structure in the MAISRC Containment Lab.

Visit this project online: z.umn.edu/CO2-deterrent

THE NUMBERS

- **87** total outreach events
- **3,000+** people served

OUTREACH HIGHLIGHT:
SPINY WATER FLEA SURVEILLANCE

MAISRC launched a new program to help volunteers and local managers conduct spiny water flea surveillance and early detection surveys. MAISRC provides local managers and volunteers with a simple protocol, including timing and equipment guidelines aimed at optimizing spiny water flea detection in the field. Working with participants to coordinate the effort and ensure that they have the information and materials they need to participate, MAISRC works with managers to help prioritize lakes to survey using existing MAISRC research. A user-friendly process for reporting positive and negative findings will be shared with participants. You can join the MAISRC team by visiting this page: z.umn.edu/SWFsignup

Photo by Naomi Blinick

Thomas Lake, St Louis County



Through the **AIS Detectors Core Course**, over 400 participants have learned how to accurately identify aquatic invasive species present in Minnesota. Additionally, the annual **Starry Trek** event attracts over 200 participants each year and attendees have discovered four new starry stonewort populations. In 2020, a Starry Trek participant found a thriving population of invasive freshwater golden clams in Sherburne County. The early detection of the species enabled MAISRC to launch a rapid response project to monitor the population.

Community members are a powerful resource for researchers. From students and families to lakeshore association members, **anyone can contribute time and resources** to ongoing MAISRC projects. Examples include sorting data, helping to mail surveys, or coordinating personal boats for research work.

By providing participants with accurate AIS identification and management information, we are empowering them to shape the future of Minnesota's lakes. As of the 2022 field season, **AIS Detectors have logged over 22,000 volunteer hours**, a value estimated at \$750,000.

You can join the AIS Detectors! Visit the website for more information: maisrc.umn.edu/ais-detectors



Photo by MAISRC

400+

CERTIFIED
AIS DETECTORS

maisrc.umn.edu/ais-detectors

25

RESEARCH FELLOWS

maisrc.umn.edu/fellows

30

ACTIVE PROJECTS

maisrc.umn.edu/research

20

GRADUATE RESEARCH
FELLOWS

maisrc.umn.edu/graduate-fellows

As lake shore property owners who fish and recreate on our many lakes, we appreciate and want to help your fine organization in the battle against aquatic invasive species. We feel protection of our natural waters is one of the best gifts we can continue to provide for future generations.
- MAISRC donor

The partnership potential with MAISRC pilot programs, research projects, and AIS Detectors is a wonderful opportunity for citizens like me. I really enjoy being engaged in activities that help to protect and preserve our healthy lakes!
- Sharon Natzel
Volunteer Scientist



We have a home on a lake, and I'm an AIS Detector because I know the importance of protecting our lakes. My wife and I also take water clarity readings for the MPCA and water samples as part of the WAPOA water testing plus aquatic plant surveys at public landings and plankton net dragging for zebra mussel veligers. I have attended the fall showcase a number of times and find the research you are doing interesting and valuable.
- MAISRC donor



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Contributions to MAISRC support innovative research, high quality education opportunities, and the advancement of solutions for AIS management. To make a donation: 612-624-3333 | z.umn.edu/MAISRCgift

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