

ANNUAL REPORT 2023



MINNESOTA AQUATIC INVASIVE
SPECIES RESEARCH CENTER

UNIVERSITY OF MINNESOTA
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Leech Lake 



LETTER FROM THE DIRECTOR

It wasn't that long ago that Minnesota's aquatic invasive species landscape was marked by uncertainty and seemingly unsolvable questions. There was a sense of hopelessness; it felt like the issues caused by AIS were inevitable in all corners of the state. The need for an interdisciplinary research program on the University of Minnesota campus was the path forward. This vision was realized with the creation of the Minnesota Aquatic Invasive Species Research Center (MAISRC) in 2012.



With the creation of MAISRC, the state took a chance on a new approach: that through dedicated and long-term research, solutions could be put within reach. My goal as the Director of MAISRC is to advance a rigorous academic program with field and lab research, world-class training, and outreach that is directly engaged with local communities and natural resource managers. This could not be done without the hard work and commitment from many – check out our 10-year anniversary video for a thank you! z.umn.edu/10video

Because of our collective effort, we have been able to accomplish some big wins:

- Combined field, lab, and big data approaches to **optimize control methods** for curlyleaf pondweed, Eurasian watermilfoil, and common carp.
- **First in the world to map the zebra mussel genome**, which is now being used to test high-precision control methods in the lab.
- Launched updated **online decision-support tools to guide efficient use of limited resources**.
- And so much more!

As we look towards the future of AIS research in Minnesota, it's clear that we are moving in the right direction. As knowledge gaps are filled and new tools developed, we need to prioritize the implementation of research findings. We are excited to announce that in 2024 we will be launching a new initiative focused on implementing MAISRC research to suppress common carp populations in multiple Minnesota watersheds. Stay connected to MAISRC as we collaborate with local partners to get this work done and create an effective and efficient framework for the implementation of more research-based solutions.

MAISRC is advancing scientific understanding and driving innovation to address significant, complex AIS problems proactively and creatively. With our collective vision, effort, and investment, we can solve our AIS problems and make a difference in the future health of our beloved lakes, rivers, and wetlands.

See you on the lake,

A handwritten signature in black ink, appearing to read "Nicholas Phelps".

Dr. Nicholas Phelps
Director
Minnesota Aquatic Invasive Species Research Center

ABOUT MAISRC

Aquatic invasive species are water-dwelling organisms that aren't originally from the area they currently reside. They can harm the environment, economy, and even human health. In Minnesota, some examples include zebra mussels and Eurasian watermilfoil, which pose a serious threat to our state.

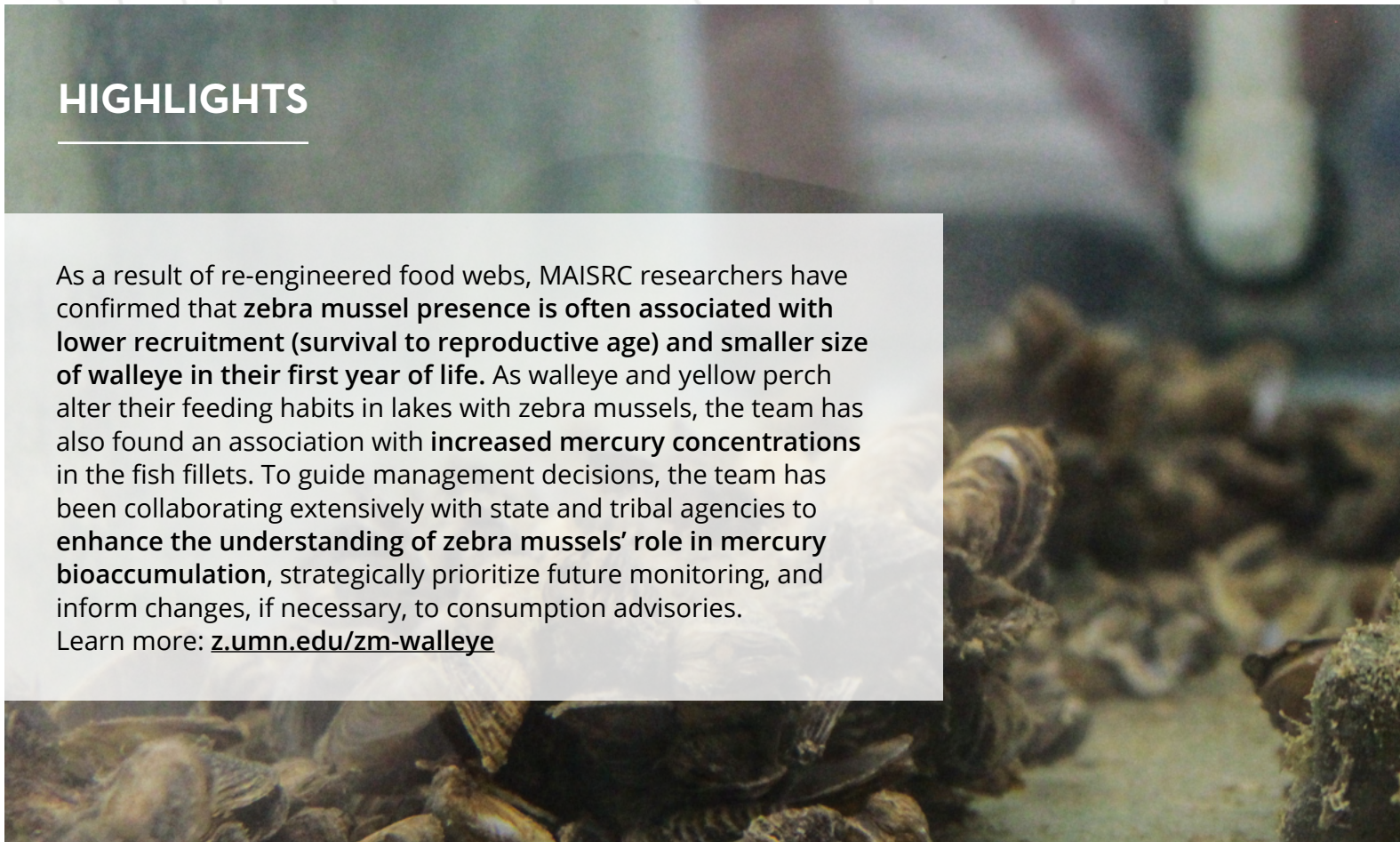
The **Minnesota Aquatic Invasive Species Research Center (MAISRC)** was established in 2012 with funding from the state legislature and the Minnesota Environment and Natural Resources Trust Fund. It is a hub for research and management strategies, bringing together experts and resources to set clear priorities for studying invasive species and conducting research. By playing this central role, MAISRC ensures research findings have a bigger impact, avoids duplication, fills in knowledge gaps, and helps turn innovative ideas into practical solutions.

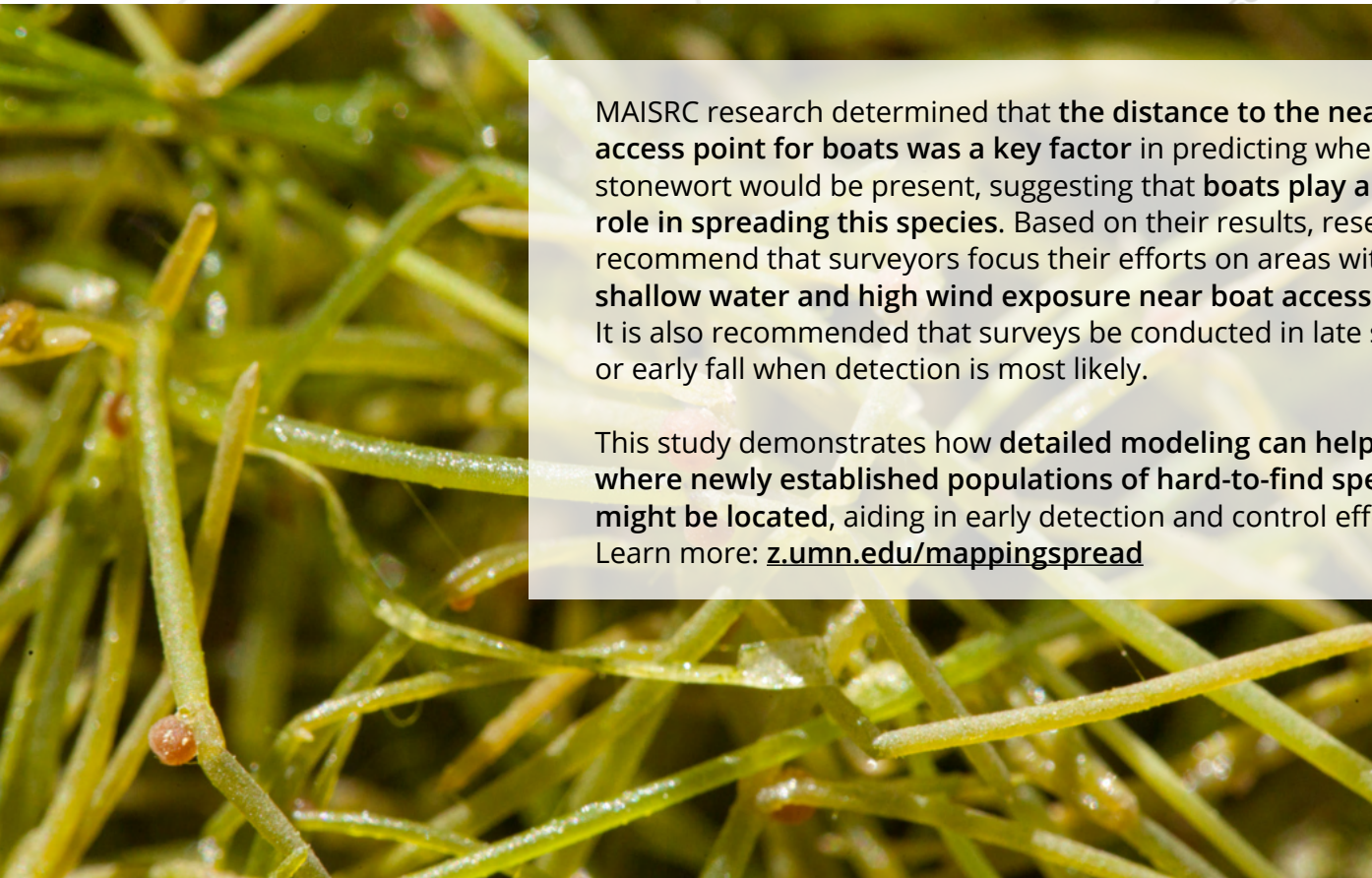
MAISRC's team includes experts in various fields like microbiology, engineering, ecology, and genetics. Their diverse knowledge creates an environment for groundbreaking research. The main goal is to find research-based solutions to Minnesota's aquatic invasive species problems. Projects focus on:

- **Prevention** (stopping invasions before they happen)
- **Control** (managing invasive species once they're here)
- **Management** (restoring balance to ecosystems)
- **Advancing knowledge** to inspire action by others

HIGHLIGHTS

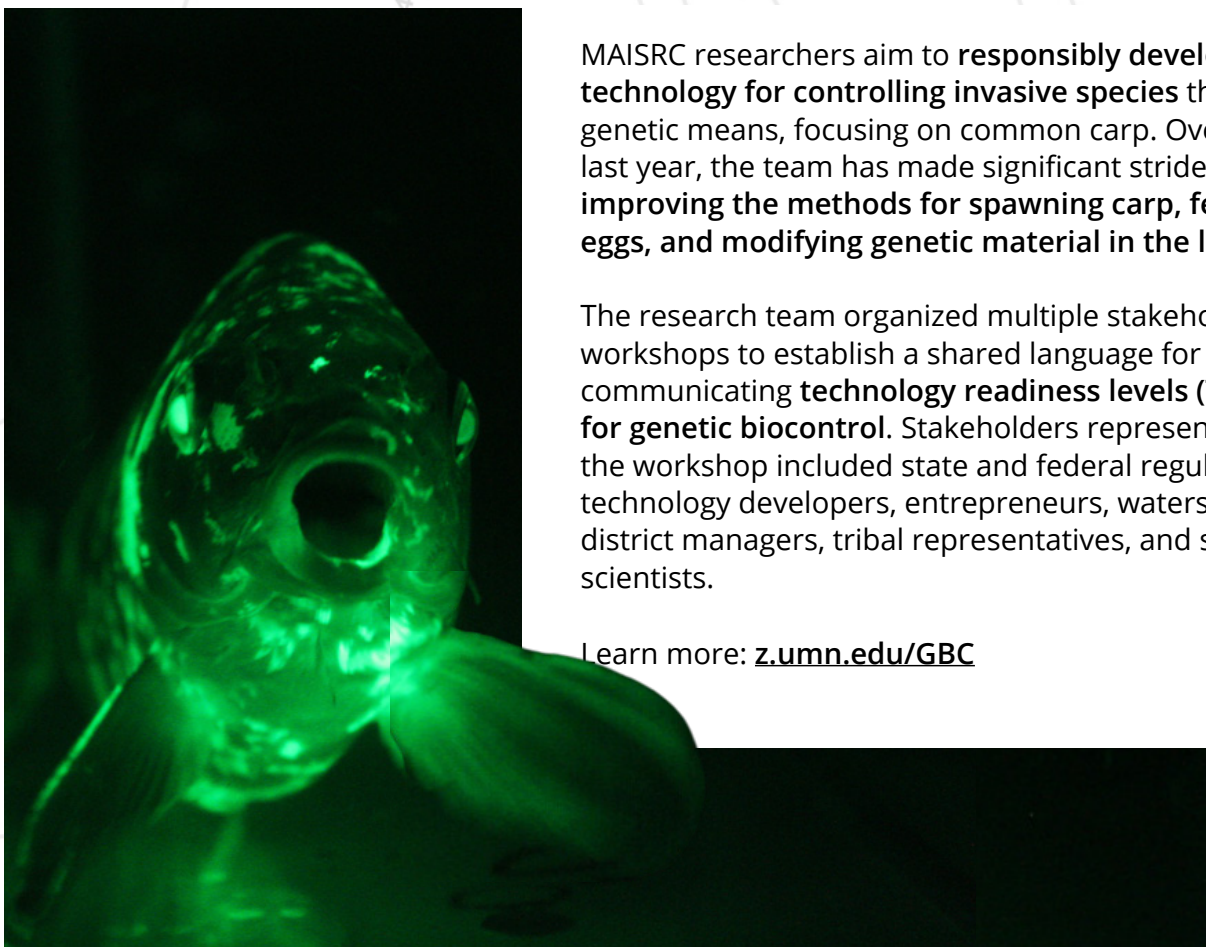
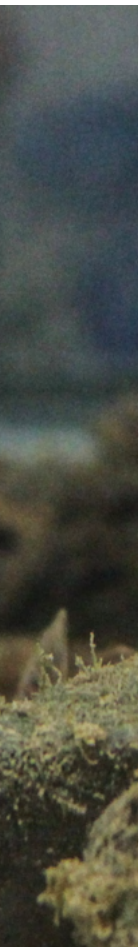
As a result of re-engineered food webs, MAISRC researchers have confirmed that **zebra mussel presence is often associated with lower recruitment (survival to reproductive age) and smaller size of walleye in their first year of life**. As walleye and yellow perch alter their feeding habits in lakes with zebra mussels, the team has also found an association with **increased mercury concentrations** in the fish fillets. To guide management decisions, the team has been collaborating extensively with state and tribal agencies to **enhance the understanding of zebra mussels' role in mercury bioaccumulation**, strategically prioritize future monitoring, and inform changes, if necessary, to consumption advisories. Learn more: z.umn.edu/zm-walleye





MAISRC research determined that **the distance to the nearest access point for boats was a key factor** in predicting where starry stonewort would be present, suggesting that **boats play a major role in spreading this species**. Based on their results, researchers recommend that surveyors focus their efforts on areas with **shallow water and high wind exposure near boat access points**. It is also recommended that surveys be conducted in late summer or early fall when detection is most likely.

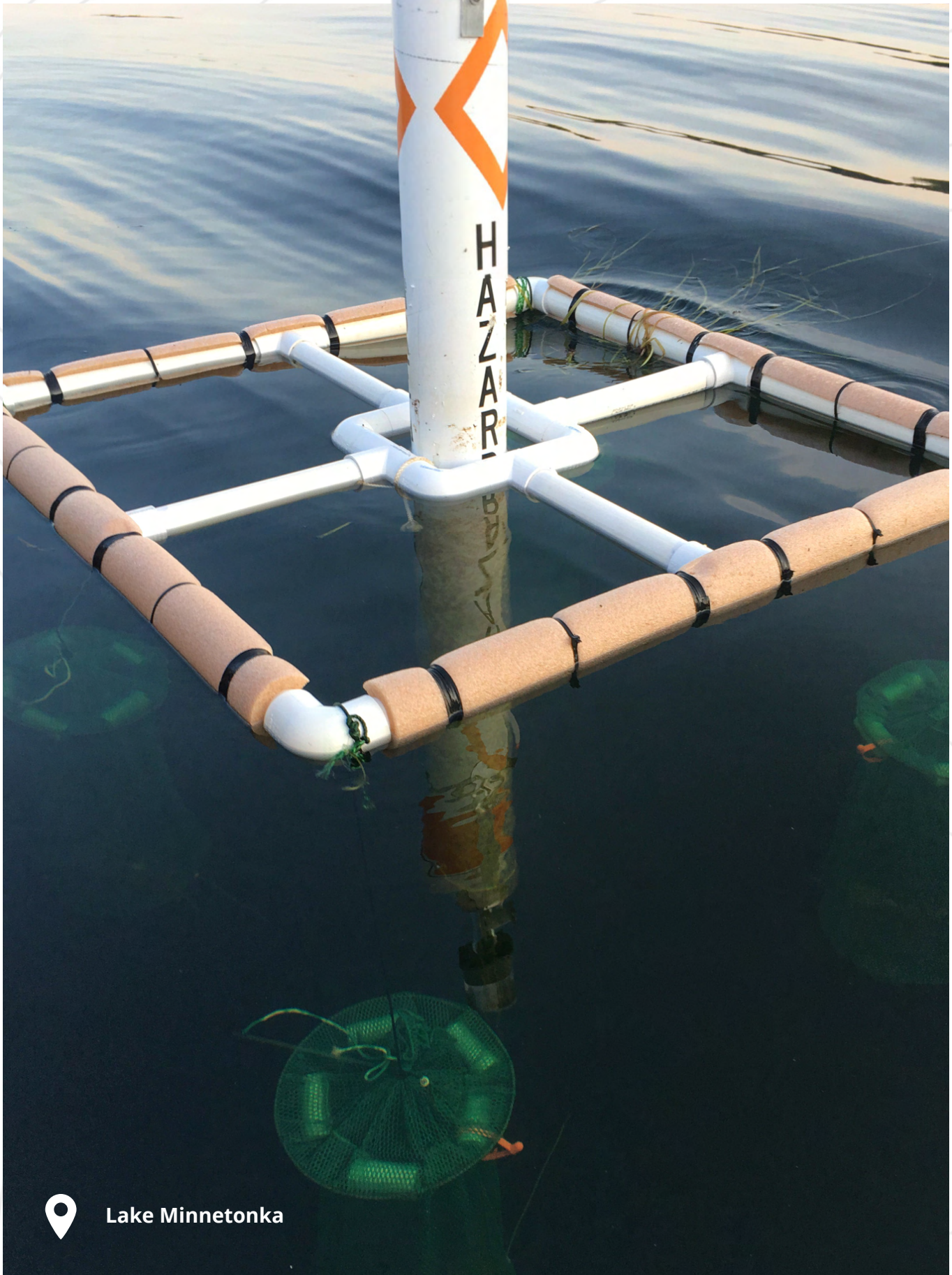
This study demonstrates how **detailed modeling can help predict where newly established populations of hard-to-find species might be located**, aiding in early detection and control efforts. Learn more: z.umn.edu/mappingspread



MAISRC researchers aim to **responsibly develop technology for controlling invasive species** through genetic means, focusing on common carp. Over the last year, the team has made significant strides in **improving the methods for spawning carp, fertilizing eggs, and modifying genetic material in the lab**.

The research team organized multiple stakeholder workshops to establish a shared language for communicating **technology readiness levels (TRL) for genetic biocontrol**. Stakeholders represented at the workshop included state and federal regulators, technology developers, entrepreneurs, watershed district managers, tribal representatives, and social scientists.

Learn more: z.umn.edu/GBC



Lake Minnetonka





INVERTEBRATES

COPPER-BASED TREATMENT TO SUPPRESS ZEBRA MUSSEL POPULATIONS

Zebra mussels have been changing our lakes and rivers for decades, in many cases, establishing dense populations that have re-engineered entire ecosystems. In this study, MAISRC researchers build on previous research to suppress zebra mussel populations while minimizing non-target impacts by treating infested areas with a low-dose copper treatment over an extended period of time.

MAISRC researchers applied a low dose of an EPA-approved copper-based product in Maxwell Bay of Lake Minnetonka. An additional bay was used as an untreated reference site that allowed researchers to compare the effectiveness and non-target impacts of the treatment. Their findings showed that **three months after the treatment, significantly fewer juvenile zebra mussels settled** in the treated bay than the untreated bay. The zooplankton abundance in the treated bay was reduced in the short-term but had recovered at one year. Zebra mussel density gradually increased in years two to three, indicating that retreatment would be necessary to prevent repopulation in subsequent years for partial lake treatment. The information will be used to **guide decision making with stakeholders for invasive mussel management** in Minnesota.

If MAISRC researchers can identify best practices for eliminating juvenile zebra mussels before they reach adulthood, fewer non-target species will be affected.

Learn more: z.umn.edu/coppercontrol





FISH

ACOUSTIC CONDITIONING IN COMMON CARP

Over the last year, MAISRC researchers conducted experiments in both controlled laboratory settings and real-world environments to **investigate whether common carp could learn to associate a sound cue with food** - similar to Pavlov's dog. Initial analysis showed that sound cues alone did not affect common carp behavior, but **when combined with bait (corn), sound led to more coordinated gatherings of carp** in less time than without the sound.

This suggests that **using sound and bait together could be a more efficient method for removal of common carp during active management**. This is a practical and low-cost strategy that could be immediately implemented. This finding is important for managing carp populations because it suggests that **using intermittent baiting methods could potentially be as effective, if not more so, than continuous baiting**, saving managers money on bait and labor while still achieving desired outcomes.

Learn more: z.umn.edu/carpcontrol





Pond near Rice Creek



PLANTS

BUILDING A CENTRALIZED DATABASE OF WATERMILFOIL STRAIN GEOGRAPHIC DISTRIBUTION AND HERBICIDE RESPONSE FOR USE IN MANAGEMENT DECISION MAKING

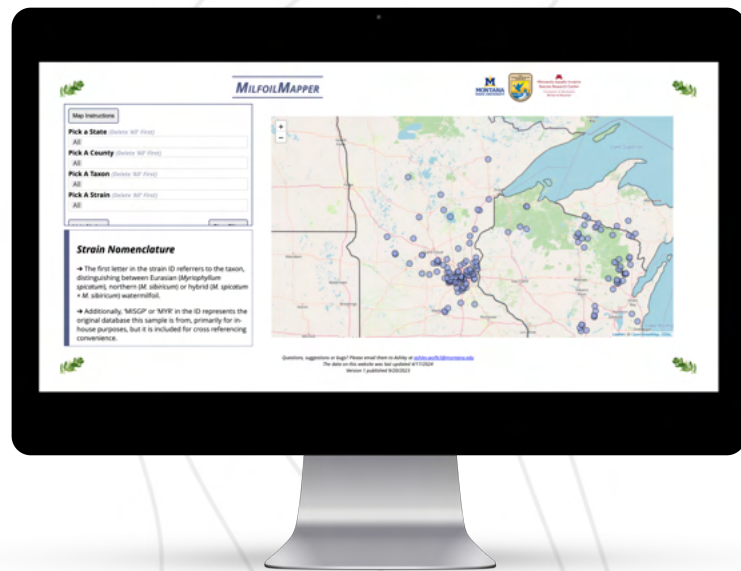
Hybrid watermilfoil, a cross between the invasive Eurasian and native northern watermilfoils, presents a unique challenge due to invasive tendencies, as well as its resistance to some herbicides. In this study, MAISRC researchers examined the herbicide response to five of the most prevalent genotypes of milfoil to determine effective control strategies.



Each genotype was exposed to a gradient of doses of three commonly used herbicides in aquatic plant management: 2,4-D, triclopyr, and florpyrauxifen-benzyl (commonly known as ProcellaCOR).

The results revealed that **all five genotypes were effectively controlled by ProcellaCOR**. However, the efficacy of other herbicides varied significantly. Triclopyr demonstrated effective control of all five genotypes at label rate dosages, but two genotypes have evidence of resistance. 2,4-D controlled three genotypes at label rates, but two genotypes, a hybrid genotype and the northern genotype, are resistant. These findings are **crucial to support managers with the most cost-effective treatment options** specific to the genotype of the lake in question. Learn more: z.umn.edu/watermilfoil

An online app built by the project team can be used to locate watermilfoil strains and herbicide tolerance in Minnesota and beyond: z.umn.edu/milfoilmap





MICROBES

CAN ENDEMIC PATHOGENS
BE USED TO CONTROL AIS?



Lake Elysian

Researchers at MAISRC investigated **Koi herpesvirus (KHV)**, a deadly virus that affects common carp and the ornamental color variant, koi, and found it to be surprisingly widespread among common carp populations in Minnesota. Genetic data of pathogen and host revealed that KHV may have been an endemic disease of common carp in their native range and introduced with the fish more than 100 years ago.

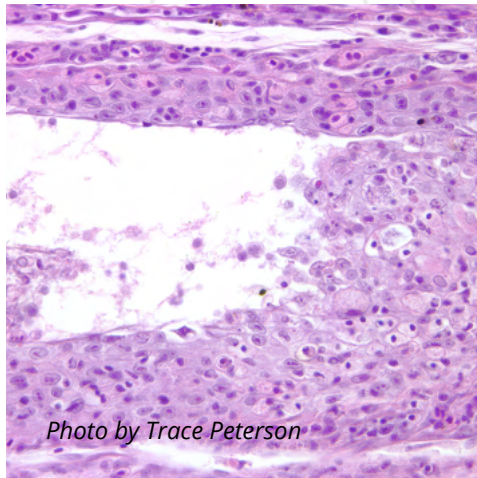


Photo by Trace Peterson



For naïve populations, the team explored KHV's potential as a **pathogenic biocontrol agent for managing common carp populations** by conducting laboratory exposure trials and studying naturally-infected wild common carp. Researchers were able to isolate KHV from a wild carp population in North America for the first time and determined that **direct social contact among fish is the primary route of transmission**, and confirmed persistence in male fish to be critical to the disease ecology.

Monitoring of KHV in Lake Elysian over multiple seasons showed that **the virus can be transmitted to naïve carp returning from spawning areas**. Importantly, the team confirmed that KHV is species-specific, **targeting only carp and not infecting other native fish, despite cohabitation**.

These pieces to the puzzle allow researchers to consider a variety of strategies to optimize management objectives. While questions remain, the results support continued investigation into KHV as part of an integrated pest management plan, **leveraging its ability to induce large mortality events in carp populations**.

Learn more about this project: z.umn.edu/native-pathogens



CROSS CUTTING

DETECTING AQUATIC INVASIVE SPECIES USING ENVIRONMENTAL DNA IN WATER SAMPLES

Researchers at MAISRC studied the **detectability of the environmental DNA (eDNA, DNA that is released or shed from an organism into the environment) of zebra mussel, common carp, spiny water flea, and rusty crayfish using small amounts of water collected and filtered by volunteers.** Insights gained from these species will enhance understanding of eDNA monitoring for other species in the future.

The research team recruited and trained **100 volunteers from around Minnesota** and provided sampling equipment, with the goal of volunteers independently collecting water samples and filtering for eDNA. Filters were mailed to the university and **analyzed in the lab for the presence of the four invasive species** with reported presence or absence within each lake. **Results were compared to eDNA sampling results conducted by University scientists** to determine the detection rate of volunteer sampling.

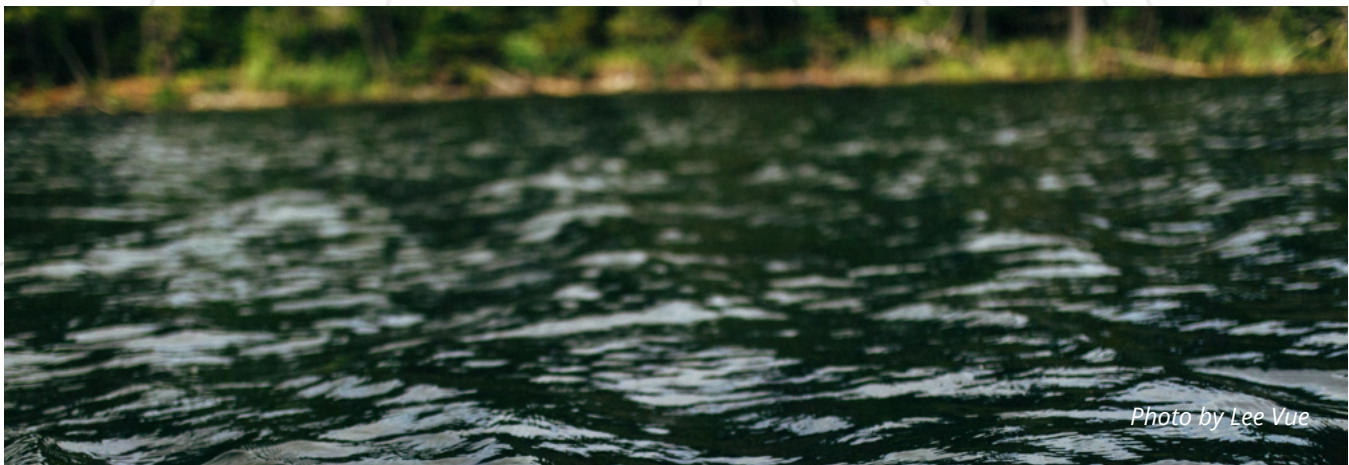


Photo by Lee Vue

The eDNA of the target species were detected at most lakes where they were known to be present, with variable accuracy rates across species. Volunteer monitors were successful in completing the sampling with prepared kits and standardized protocols, with a **level of accuracy comparable to that of University scientists**. Based on the results of this research, researchers and managers are assessing the feasibility of a **larger scale monitoring program** designed to use volunteers to collect the eDNA samples. Learn more: z.umn.edu/edna-project



OUTREACH

In March, MAISRC organized a **workshop uniting seasoned water resource managers, commercial fishers, and experts to discuss common carp**. The goal was to offer a thorough grasp of carp impacts and effective management approaches. Participants engaged in breakout sessions covering vital themes like **permitting, funding, and research**. This collaborative exchange not only enhanced individual understanding but also **laid the groundwork for joint efforts in tackling common carp challenges in aquatic ecosystems**.

COMMUNITY ENGAGEMENT

At the annual **Starry Trek event**, 187 volunteers surveyed 258 public accesses on 215 water bodies throughout Minnesota. No new infestations of starry stonewort were discovered, although participants identified **10 previously unreported instances of invasive mystery snails**.

The **Zebra Mussel Safari pilot program** continued in 2023, aiming to equip lakeshore residents with the tools and training necessary to **monitor zebra mussel infestations in their lakes**. The program will provide MAISRC with a large-scale dataset for examining **zebra mussel population dynamics over time and space**. Seven lakes participated in the 2023 season, with a total of **54 lakeshore residents contributing data**, primarily using a photography-based tool for collecting mussel settlement data.



Spiny Surveillance, a recent MAISRC volunteer AIS surveillance program aimed at the early detection of spiny water fleas, transitioned out of its pilot phase and into a soft launch. Eleven people participated in Spiny Surveillance, collectively conducting **70 trips across 29 unique lakes**. No new detections of spiny water fleas were reported. A map displaying the efforts and results of Spiny Surveillance can be accessed at z.umn.edu/SSmap



The **AIS Detectors program** continued the AIS Management 101 online course. This course covers aspects of AIS management such as monitoring, treatment options, long-term planning, and regulations. The course typically engages lakeshore residents, lake association members, AIS professionals, resource managers, and other interested members of the public. **In 2023, 35 participants successfully completed the online course.**


The **AIS Detectors Core Course** was offered in two formats last year: fully online, consisting of self-paced online learning and video conference workshops, or hybrid, combining self-paced online learning with an in-person workshop.

Across one fully virtual and three hybrid offerings, **49 new AIS Detectors received training and certification**. Since its inception, AIS Detectors have contributed **26,414 hours of volunteer service in Minnesota**, valued at nearly \$910,500.

“The program is extremely well-organized and supported, and it does an excellent job of preparing and educating its volunteers. It’s easy to stay engaged and active in AIS prevention projects, and participation keeps you informed on the latest AIS news and activities. The program values its volunteers and many other learning opportunities come along with being an AIS Detector.” - Participant

Dive into our community engagement:
z.umn.edu/aisdetector



 McNamara Alumni Center



10TH ANNIVERSARY EVENT

MAISRC hosted a 10th-anniversary celebration on Thursday, December 7, 2023, at the McNamara Alumni Center in Minneapolis, MN.

Attendees heard remarks from special guests such as **CFANS Dean Brian Buhr** and former **Minnesota Commissioner of Natural Resources Tom Landwehr**. A 20 foot banner displayed major accomplishments of the past decade. View the digital version: z.umn.edu/AIShistory

Interactive research exhibits, including **live fish and plant displays**, provided a hands-on experience that brought the importance of MAISRC's mission to life.

The celebration extended beyond dinner as guests had the opportunity to engage in meaningful conversations with researchers, faculty, and other attendees. Exchanging of ideas further strengthens the collaborative spirit that defines MAISRC. Thank you to everyone who joined us for this remarkable evening. **Your support and commitment are integral to the continued success of our mission!**





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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

The University's mission, carried out on multiple campuses and throughout the state, is threefold: research and discovery, teaching and learning, and outreach and public service. The University of Minnesota is an equal opportunity educator and employer.

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