FIELD NOTES: ANNUAL REPORT 2024

MINNESOTA AQUATIC INVASIVE SPECIES RESEARCH CENTER

UNIVERSITY OF MINNESOTA

LETTER FROM THE DIRECTOR

In a world filled with countless options and opportunities, finding things we can all agree on can feel like a challenge. Two that come to my mind include 1) mid-season optimism for the Minnesota Vikings, and 2) solving our aquatic invasive species (AIS) problems. My expertise lies in forecasting the spread of zebra mussels rather than predicting football outcomes, so I'll focus on the latter. The science is clear, and we can all agree: AIS have negatively impacted our ecosystems, economies, and way of life in Minnesota. Off the dock, in the boat, county board rooms and the state capital – AIS are a priority – for every Minnesota lake, river, and wetland.

MAISRC has, and will continue to, work with partners to develop research-based solutions to Minnesota's AIS problems and inspire action by others. For the last decade we have worked to implement a strategic plan that positioned MAISRC as a world-class research institution. As we sunset our current strategic plan at the end of 2024, I am reflecting on the significant progress and the accomplishments of our research teams. I am so proud of our students, staff, project managers, and many, MANY, partners! Teamwork makes the dream work.

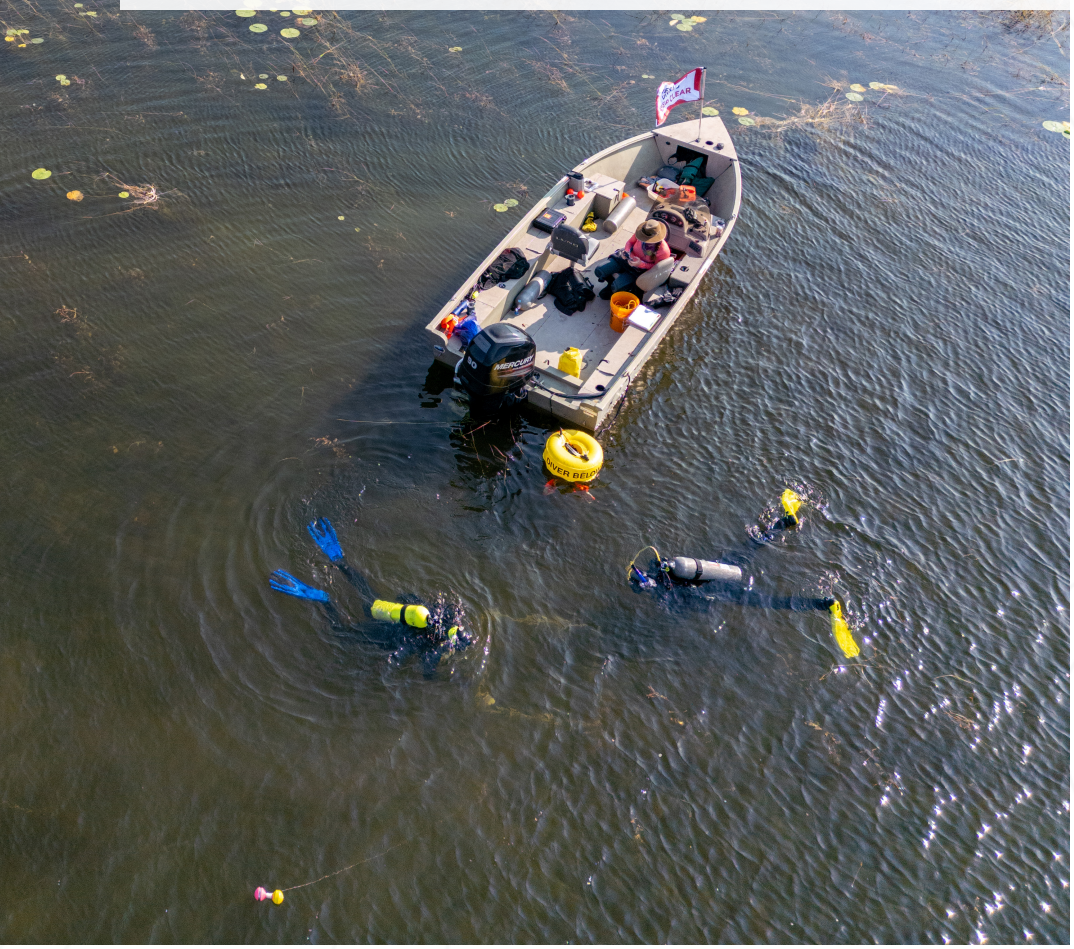
Looking forward, I am excited to report that after a year-long process, we have finalized a new 10-year strategic plan – one that shifts our focus from aspiring to create a world-class research program to sustaining one that delivers innovative, impactful solutions to tackle AIS head-on.

Our new plan has inclusively shaped our future and charts a path forward with ambitious, but achievable, goals. We have built our new strategic plan around MAISRC's core values (see inset).

Cover photo: Otter Lake, Anoka County
Photo by Naomi Blinick

CORE VALUES

- MAISRC is uniquely positioned to advance knowledge and develop research-based AIS solutions.
- Education and training are essential to grow capacity for AIS response.
- Public awareness and engagement support innovative research programs and implementation of AIS solutions.
- An intellectually vibrant and diverse research community fosters innovation, collaboration, and productivity.
- Impactful, solutions-oriented research requires stable funding, well supported teams, and advanced infrastructure.



Our new strategic plan is founded on partnership and collaboration. MAISRC has never done our work alone and we will need your continued engagement to keep it going. As I reflect on the last year, and the decade before that, I am inspired by SO MANY of you and the advice, time, advocacy, funding, and other resources you have provided MAISRC. As always, thank you for your support!

MAISRC will continue to advance scientific understanding and drive innovation to address our complex AIS problems strategically and creatively. I am confident that we are moving in the right direction, and I am excited about our future. 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,

Nick Phelps, PhD
Director, Professor

Steamboat Bay, Leech Lake, Cass County
Photo by Naomi Blinick

ABOUT THE MINNESOTA AQUATIC INVASIVE SPECIES RESEARCH CENTER

Develop research-based solutions that can reduce the impacts of aquatic invasive species in Minnesota by preventing spread, controlling populations, and managing ecosystems; and to advance knowledge to inspire action by others.

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. MAISRC is a national hub for research and management strategies, bringing together experts and resources to set clear priorities for studying aquatic 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 including microbiology, engineering, ecology, and genetics - creating a collaborative environment for groundbreaking research. The goal is to find research-based solutions to Minnesota's aquatic invasive species problems. Research 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

Learn more about MAISRC's history with this 10 year anniversary video. (z.umn.edu/10video)

Funding for MAISRC is provided by the Minnesota Environment and Natural Resources Trust Fund (ENRTF) as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR); the State of Minnesota, and private donations.

Potamogeton illinoensis (Illinois Pondweed)
Otter Lake, Anoka County
Photo by Naomi Blinick

INVERTEBRATES

Evaluating the source and status of invasive signal crayfish in Minnesota

In October 2023, the Minnesota Department of Natural Resources confirmed the presence of signal crayfish in Lake Winona, near Alexandria, MN. This marked the first recorded instance of signal crayfish in Minnesota waters. The goal of the project is to use mitochondrial DNA (mtDNA) to trace the geographic origin of the signal crayfish and assess their population status in Lake Winona and nearby lakes.

MAISRC researchers successfully sequenced mtDNA from signal crayfish specimens collected in Lake Winona. The results revealed a common invasive lineage of signal crayfish previously found in non-native populations in other places in the world, indicating that the Lake Winona population likely originated from the Pacific Northwest. These findings provide valuable insight into the invasion's origins and are essential for developing and refining methods to detect signal crayfish through environmental DNA (eDNA) testing.

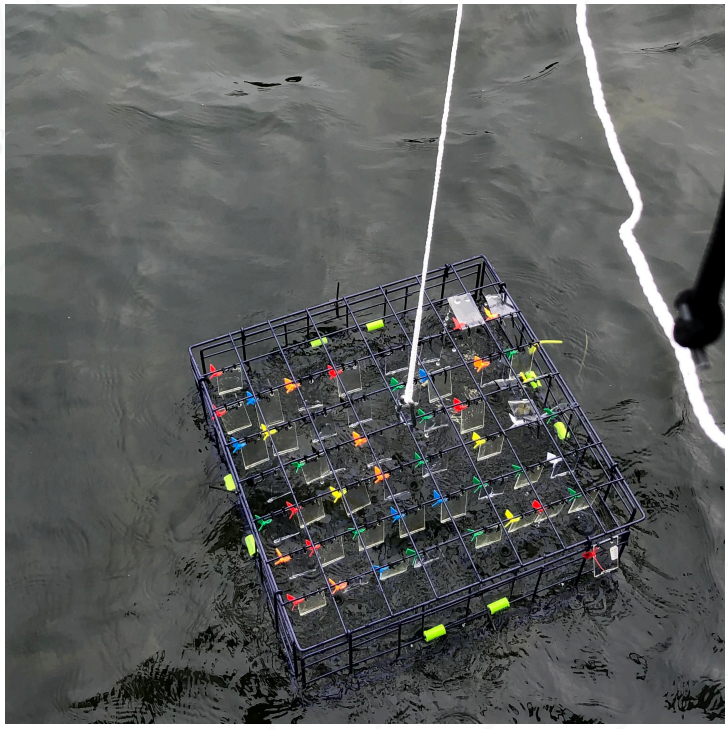
MAISRC researchers have some encouraging news: early trapping efforts have not found any signal crayfish in the area where they were caught last fall. This could mean that only a small number are present or that they may not be there anymore. Researchers are planning additional trapping to continue searching for them if they are still in the area. To involve the community and increase the sensitivity of detection, eDNA kits are being used to help local residents learn about and participate in the research.

By working together with organizational partners and community members, researchers are making sure the lakes in the Alexandria area are thoroughly monitored.

Learn more: **z.umn.edu/signal-crayfish**

Lake Agnes, Douglas County
Photo by Gretchen Hansen

Signal crayfish
Photo by Jeff Benca



Development of durable, potent biologicals to mitigate the spread of sessile AIS

Biofouling is a natural phenomenon that affects submerged structures, boats, docks, and anchors, adding significant costs to Minnesota's utilities and industry and serves as a vector for the spread of zebra mussels in Minnesota waters. The current method of combating biofouling involves the use of metals or other biocides, which can be harmful to the environment. MAISRC researchers aim to address this by developing and evaluating eco-friendly, biological coatings to reduce biofouling and control the spread of zebra mussels.

This project, now entering its seventh year, is producing significant insights into strategies for preventing zebra mussel attachment. MAISRC researchers' sequencing analyses have shown that enzymatic coating formulations meaningfully alter microbial community structure on surfaces, a factor that may influence biofouling dynamics. Researchers have also characterized the UV resistance of these enzymes, affirming their durability as potential coating additives, and are collaborating with the UMN Bioresource Center to refine production methods.

Research shows that coating type affects zebra mussel attachment strength. Tests found that acrylic coatings outperform silicone ones, offering key insights for further material evaluations. Field samples from sites like Tonka Bay Marina are undergoing DNA analysis. Early rRNA sequencing results indicate that enzyme-treated surfaces reduce microbial diversity and change microbial communities, potentially deterring zebra mussels by altering surface biofilms.

Researchers are studying how factors like biofilm composition, quorum sensing, nutrient levels, and surface properties—such as hydrophobicity (water repellency) and color—affect zebra mussel attachment. Notably, zebra mussels attach about six times more strongly to silicone, a hydrophobic surface, than to acrylic, where attachment is minimal.

These findings are informing the development of optimized coatings to combat zebra mussel infestation and may soon offer practical tools to protect Minnesota's waters.

Learn more: **z.umn.edu/biofouling**

Photos courtesy of the Elias Lab

PLANTS

Starry stonewort and wild rice: assessment and response

The spread of invasive starry stonewort (SSW) in Minnesota poses significant concerns for lake ecosystems, particularly where it intersects with vulnerable species like wild rice. In Leech Lake, northern Minnesota, SSW has invaded a wild rice bed important to the Leech Lake Band of Ojibwe. Wild rice is a sacred food and relative for Indigenous communities in the upper Midwest and is valued by many Minnesotans. Due to its cultural significance and ecological sensitivity, chemical control methods are not suitable for managing AIS in wild rice habitats, making it essential to assess SSW's impacts on wild rice and explore non-chemical control strategies.

Over two field seasons, MAISRC researchers tracked SSW's spread in a bay of Leech Lake using consistent monitoring transects. They surveyed the surrounding native plant community and evaluated wild rice growth in relation to SSW abundance during harvest seasons. While data analysis is ongoing, preliminary results show that although SSW is abundant in many locations, its spread across the bay and lake has been limited in recent years.

The Leech Lake Band of Ojibwe Division of Resource Management conducted experimental removals of SSW using Diver Assisted Suction Harvesting (DASH). The site's soft sediments, ideal for wild rice, complicated DASH operations. However, these challenges led to innovative solutions that improved the tool's effectiveness in mucky conditions. This advancement is significant for future aquatic invasive plant management projects where physical removal is preferred over chemical methods.

This project fostered collaboration and knowledge transfer. Researchers trained Leech Lake Tribal College students and interns in data processing, plant identification, and fieldwork methods. Findings were shared with management, research, and academic audiences to support broader applications.

While the monitoring outcomes are still being finalized, prevention remains the most effective strategy against invasive species like SSW. This collaborative effort enhances understanding of SSW's impacts on native aquatic plants and supports local expertise in managing invasive species. Learn more: **z.umn.edu/SSW-wildrice**

Steamboat Bay, Leech Lake, Cass County
Photo by Naomi Blinick

PLANTS

Enhancing habitat and diversity in cattail-dominated shorelines

Hybrid cattails, a cross between native broadleaf cattail *(Typha latifolia)* and invasive narrowleaf cattail *(Typha angustifolia)*, rapidly spread in Minnesota wetlands, displacing native plants and wildlife in nearshore areas. Their dense growth reduces water flow, lowers water quality, and diminishes habitat suitability for fish, birds, and other animals. Controlling these cattails is essential for preserving wetland biodiversity and health.

MAISRC research has shown that removing hybrid cattails improves dissolved oxygen levels and promotes native plant regrowth, enhancing nearshore fish habitat. Current research focuses on understanding regional variations in these effects across Minnesota.

Six lakes are being monitored in this study, with uninvaded plots established at each site and additional fish sampling sites set up in Big Marine Lake. Initial cattail management efforts have been completed, and year one sampling began in June 2024. Researchers installed temperature and dissolved oxygen loggers and conducted water quality, fish, and plant sampling through September 2024.

Preliminary data analyses are underway, providing insights into how hybrid cattails impact lakes differently. This detailed understanding will guide tailored management strategies to maintain healthy, diverse wetlands and high-quality fish habitats.

Learn more: **z.umn.edu/cattails**

Top: Big Marine Lake, Washington County
Bottom: Lake Belle Taine, Hubbard County
Photos by Amy Schrank

Beyond the sign: Influencing recreational boaters required behaviors

Can more engaging signs and messages influence the intentions of boating anglers to adopt behaviors that prevent the spread of aquatic invasive species?

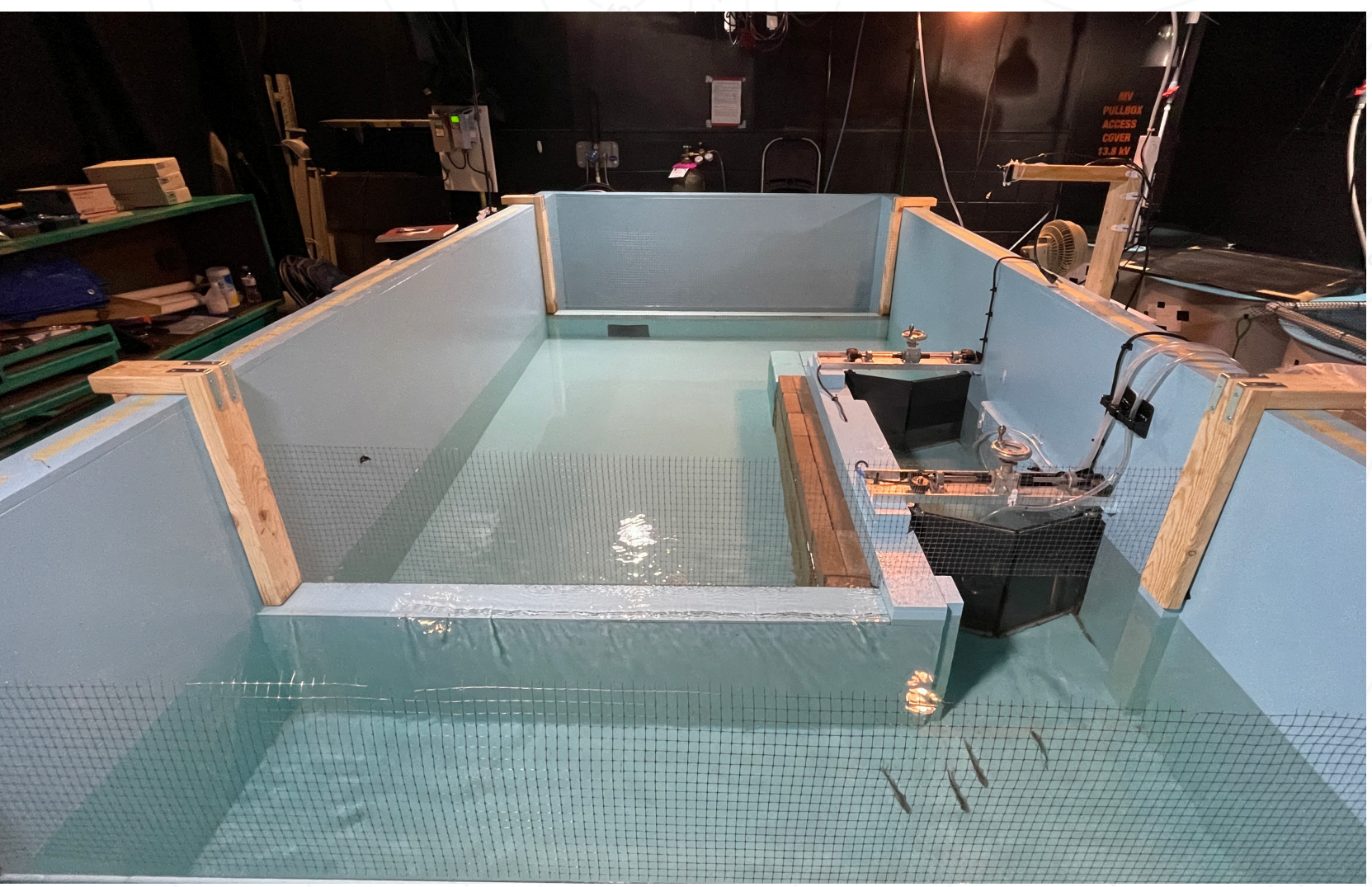
Despite existing laws requiring the cleaning of watercraft, trailers, and gear to prevent the spread of AIS, compliance remains inconsistent. Observations at four Minnesota boat landings provided baseline data on anglers' preventive behaviors and highlighted areas for improvement. Follow-up interviews with anglers at risk of violating AIS laws further informed the development of targeted messaging.

Researchers tested AIS prevention messaging in various formats, including written definitions, augmented reality (AR) presentations, and prevention messaging with photos and text, during the 2024 Northwest Sportshow. While AR formats were engaging, logistical challenges made them unsuitable for widespread use at public access points at this time. Instead, updated signs encouraging longer cleaning and draining times were tested at boat launches. However, most anglers merely glanced at these signs, indicating potential sign fatigue.

The findings reveal that while public intentions to prevent AIS spread are high, actual behaviors often fall short, particularly in the absence of watercraft inspectors. Creative messaging must be paired with practical, attention-grabbing solutions to close this gap. This research offers valuable insights into improving AIS prevention strategies and optimizing outreach efforts to protect Minnesota's waterways effectively.

Learn more: **z.umn.edu/beyondthesign**

Photos courtesy of Megan Weber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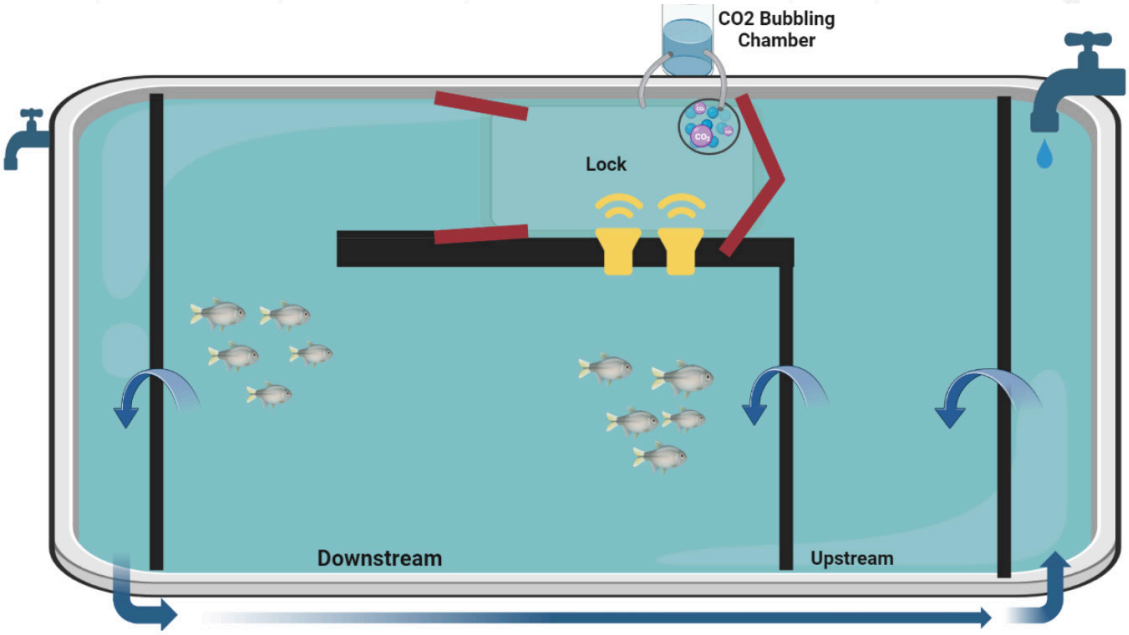


FISH

Evaluating CO2/sound bigheaded carp deterrents in model lock/dam

The project's goals are to enhance and develop new barriers using carbon dioxide to deter the range 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 deployed to prevent upstream carp migration.

This research project relied on a custom-built tank designed and constructed by the Applied Research and Engineering team at the St. Anthony Falls Laboratory (SAFL). SAFL created a tank that included features like lock and miter gates, a spillway, and systems to manage water flow. After building the tank, SAFL transported it to the MAISRC containment lab and completed the installation. This collaboration shows how partnerships can bring specialized skills together to make important research discoveries possible.

MAISRC researchers have completed initial experiments demonstrating that a combined carbon dioxide and sound-based deterrent can be 100% effective in preventing the upstream movement of invasive bigheaded carp in a model lock and dam setting.

New trials are underway to test the deterrent's effectiveness on highly motivated carp, which are rewarded with food if they bypass the barrier. Initial observations indicate that the carp exhibit strong rheotaxis, or movement in response to water flow.

To further explore this behavior, researchers have initiated additional experiments to assess whether adjusting water currents near the lock can redirect the carp away from the lock entrance.

To date, all experiments have taken place during daylight hours, but researchers now have the ability to study the deterrent's effectiveness under low-light or nighttime conditions. This capability is particularly relevant since Mississippi River locks operate continuously, and understanding any potential changes in deterrent response at night could help improve control strategies.

Learn more: **z.umn.edu/CO2-deterrent**

Top: Lock and Dam #5, photo by August Schwerdfeger
Bottom: Scale model lock and dam, MAISRC Containment Lab, photo by Michael Frett

Diagram by Michael Frett

MICROBES

Practical field-based tools for detecting high priority microbes

MAISRC researchers are developing faster, field-based methods to detect harmful microbes in natural environments. Current detection techniques are slow, require extensive lab work, and depend on specialized equipment. To address this, the team is creating a tool that identifies DNA and RNA of harmful microbes directly from water samples using Loop-mediated Isothermal Amplification (LAMP).

Environmental managers identified three high-priority microbes for this project: viral hemorrhagic septicemia virus (VHSV), largemouth bass virus (LMBV), and *Didymosphenia geminata* (Didymo). This project focuses on creating and testing detection tools for these microbes to enhance monitoring efforts.

MAISRC researchers have successfully optimized LAMP assays for LMBV and VHSV, enabling simplified field testing for these viruses. Challenges with Didymo genome sequencing have delayed assay development, but alternative approaches are being tested. In 2024, water samples from 15 Minnesota lakes and 10 Lake Superior tributaries were collected to test for LMBV and Didymo eDNA using the new assays. Laboratory trials for VHSV samples are ongoing.

Validating LAMP assays and conducting field testing has gained attention from fish health experts across the region. The MAISRC team plans to transfer these protocols to stakeholders by Spring 2025.

Learn more: **z.umn.edu/field-microbes**

Top: South Center Lake, Chisago County
Bottom: MAISRC Containment Lab
Photos by MAISRC

Developing streamlined detection assays for invasive fish pathogens

As with many AIS challenges, multiple tools are needed in detection efforts. In addition to detecting microbes in water using LAMP assays, MAISRC researchers are developing methods for detecting microbes in fish tissue. This project improves the efficiency of the State's surveillance program.

MAISRC researchers focused on six key pathogens, including viral hemorrhagic septicemia virus, largemouth bass virus, and parasitic and bacterial threats, developing advanced tools to detect them efficiently.

The team optimized and validated multiplex quantitative PCR (qPCR) assays, allowing simultaneous detection of multiple pathogens. This work includes:

Hatchery Pathogen Detection:
A qPCR assay for three bacterial pathogens *(Yersinia ruckeri, Aeromonas salmonicida,* and *Renibacterium salmoninarum)* has been adopted for state fish hatchery monitoring, replacing slower and more expensive methods. This advancement saves time and resources while enhancing fish health surveillance.

Invasive Microbe Tracking:
Another assay detects heterosporis, largemouth bass virus, and viral hemorrhagic septicemia virus. It supports annual monitoring programs, providing crucial data on pathogen spread. Field validation for the heterosporis test is ongoing, with over 1,200 fish samples collected from 150 Minnesota waters.

Salmonid Pathogen Screening:
A third assay targets parasitic pathogens threatening trout and salmon. It enables faster, routine detection of species spreading in the Great Lakes region, with ongoing work to confirm potential detections in Lake Superior.

These tools are being incorporated into MN DNR protocols to enhance fish disease management and help safeguard Minnesota's aquatic ecosystems.

Learn more: **z.umn.edu/pathogen-assays**

Photo by MAISRC


GARLAB

LAB TO LAKES INITIATIVE

The Lab to Lakes Initiative is a significant step forward in protecting Minnesota's lakes and ensuring their ecological health for future generations.

In 2023, MAISRC, in collaboration with numerous state and local partners, organized a workshop to identify barriers and opportunities for implementing common carp management strategies. The workshop emphasized the urgent need for action and provided essential guidance for translating research into practical management practices.

The Lab to Lakes Initiative applies research-based strategies to control common carp, one of Minnesota's most damaging invasive species, in Lake Fremont and the Chisago Chain of Lakes. Over four years, MAISRC and its partners aim to restore lake health by reducing carp populations. Efforts are already underway in both lake systems. In Lake Fremont, Sherburne Soil and Water Conservation District has contracted Carp Solutions to execute management strategies, while the Chisago Lake Improvement District has partnered with WSB for similar efforts in the Chisago Chain of Lakes. Initial steps include tracking carp movements by tagging them with PIT tags (similar to pet microchips) and radio tags. These tags provide movement data, which will guide further management activities in the coming seasons.

Simultaneously, researchers are studying the ecological impacts of carp management. Dr. Solomon David is leading a project to examine native fish responses, collaborating closely with the Chisago team, while Dr. Jake Walsh is researching changes in aquatic plant and zooplankton communities. This combined approach of collaborative research and applied management will evaluate the effectiveness of the strategies and offer insights for restoring other lakes facing similar challenges.

Learn more: **labtolakes.org**

GarLab team with a common carp, Chisago Chain of Lakes, Chisago County
Photo by Solomon David/GarLab

Lake Fremont, Sherburne County
Photos by MAISRC

OUTREACH & COLLABORATION

MAISRC held its annual AIS Research and Management Showcase on Wednesday, September 25, 2024, at the St. Paul Student Center. The event brought together researchers, resource managers, and community members for a day of learning, networking, and innovation in AIS prevention and management.

Highlights included presentations on cutting-edge topics such as genetic biocontrol methods, mapping zebra mussels using multibeam sonar, and strategies for controlling starry stonewort near wild rice beds. Attendees participated in lab tours showcasing the latest breakthroughs such as RNA interference technologies and invasive species deterrents.

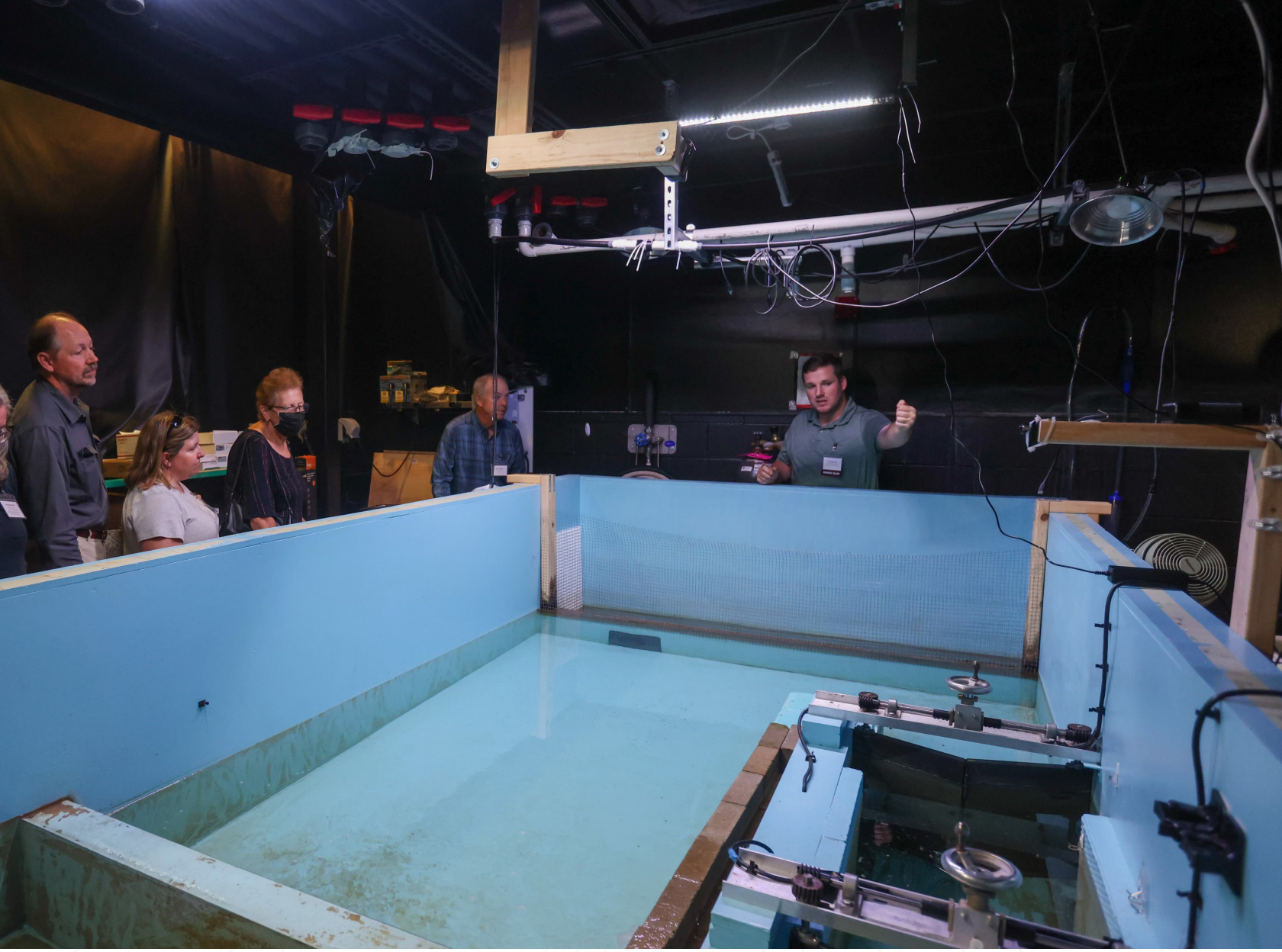
Interactive demonstrations—like distinguishing invasive *Phragmites* and automating zebra mussel counts—offered hands-on opportunities to engage with research in action.

The day also featured lively discussions over lunch, where participants connected directly with researchers, and a social happy hour with live demonstrations that capped off the event. The showcase reinforced MAISRC's commitment to actionable science, equipping stakeholders with the tools and knowledge to tackle AIS challenges across Minnesota's waters.

Thank you to all who attended and supported this important event.

Learn more: **z.umn.edu/showcase2024**

Photo of Solomon David presenting at the Showcase by Rebecca Slater



This year, MAISRC was also busy collaborating on a variety of community events across Minnesota to share research progress and updates. At the Governor's Fishing Opener in Lake City, MAISRC teamed up with Bluff View Elementary and St. John's Lutheran students for hands-on AIS activities. The students had fun showing off their creativity by writing songs and stories about AIS, including titles like "Zany Zebras" and "Rusty Rapscallions."

Research Outreach Specialist Madeline Hayden traveled around the state to meet with lake associations and community groups enhancing understanding of AIS and their impacts.

In 2024, over 300 people toured the MAISRC Containment Lab on the University of Minnesota's St. Paul campus to get a firsthand look at the ongoing AIS research.

OUTREACH AND SCIENCE COMMUNICATION IS A CORE PART OF MAISRC'S WORK, AND PLAY A VITAL ROLE IN ADVANCING THE UNDERSTANDING OF AIS AND OUR PROGRESS TOWARD REAL-WORLD SOLUTIONS.

To request a tour of our containment lab, visit **z.umn.edu/MCLtour**. To request a speaker or for other outreach opportunities, visit **maisrc.umn.edu/outreach**

MAISRC Containment Lab, St Paul
Photo by MAISRC

AIS DETECTORS PROGRAM

The AIS Detectors Program is jointly supported by MAISRC and University of Minnesota Extension, with initial funding from the Environment and Natural Resources Trust Fund and ongoing support from the state of Minnesota. The Program aims to help protect Minnesota's life at the lake by empowering community members through its volunteer programs, events, workshops, and other educational offerings.

The **AIS Detectors Core Course** is an introductory program covering aquatic invasive species science, identification, surveillance, and reporting. Participants engage in a dynamic mix of online learning and live workshops tailored for both professionals and community members. Those in the community track become Certified AIS Detectors, joining a network of volunteers dedicated to preventing the spread of AIS through outreach, monitoring, and response efforts across Minnesota.

In 2024, the program welcomed 17 new professionals and 60 new community members to the AIS Detectors community. To date, volunteers have contributed an impressive 25,259 hours of service in Minnesota, valued at $917,154.29, showcasing their vital role in protecting the state's aquatic ecosystems.

AIS Management 101 is an award-winning online course that provides a comprehensive overview of AIS management, covering topics like monitoring, chemical and non-chemical management options, regulations, and long-term planning. In 2024, 41 participants completed the course, with 100% reporting they shared their newfound knowledge with others and 77% planning to use what they learned next year. Feedback highlights the course's balanced approach to depth and accessibility, earning praise as an excellent introduction to AIS management.

The **Aquatic Plant Identification Workshop**, hosted annually in collaboration with the Minnesota Department of Natural Resources (MN DNR), offers hands-on training with live plant specimens collected statewide. In 2024, participants learned how to identify 82 species and, upon passing an identification test, gained recognition on MN DNR's list of approved aquatic plant surveyors. This often sold-out workshop fosters critical skills for managing aquatic plants in Minnesota's lakes and wetlands, serving both beginners and experts.

These programs exemplify the AIS Detectors' commitment to advancing education and capacity for AIS prevention and management. Learn more: **z.umn.edu/aisdetector**

AIS DETECTORS

UNIVERSITY OF MINNESOTA

Driven to Discover®

Photos by MAISRC

Starry Trek

Starry Trek is an annual, one-day event where the public meets at training sites across Minnesota to learn how to identify starry stonewort (SSW) and other aquatic invasive species (AIS). After the training, participants head out to local water access points to look for signs of these AIS. Starry stonewort is an invasive algae that was first found in Lake Koronis in 2015 and has continued to slowly spread to other water bodies in Minnesota. This event is an opportunity for people to team up with hundreds of fellow Minnesotans to better understand SSW distribution in Minnesota.

This year, 194 participants from across Minnesota contributed to the largest survey effort since the program began in 2017. Volunteers searched 297 public accesses on 252 water bodies, setting a new record for coverage.

No new starry stonewort infestations were detected this year. However, other AIS discoveries were made including: Freshwater golden clam, Yellow iris, Curly-leaf pondweed, and banded mystery snails. You can join in the quest next year! Check out **starrytrek.org** for more details.

"LEARNING ABOUT AIS, HELPING TO PROTECT OUR LAKES AND RIVERS, AND INTERACTING WITH WONDERFUL PEOPLE ARE JUST SOME OF THE REWARDS FROM JOINING THE AIS DETECTOR PROGRAM!"

- AIS DETECTOR

Zebra Mussel Safari

MAISRC often hears from lake residents asking why zebra mussel populations fluctuate in number, density, and distribution over time. One way to explore these shifts is by monitoring how many zebra mussels settle each year using sampling devices placed evenly along the lakeshore.

MAISRC has partnered with over 150 lake association members from 15 Minnesota lakes to monitor zebra mussels. This effort is collecting data to inform models that predict where mussels thrive, how they spread, and which lakes are most at risk.

Lessons learned from earlier phases have improved participation, data collection, and clarity, supporting better management strategies and showcasing the value of community-driven scientific research.

Learn more: **z.umn.edu/zmsafari**

Photos by MAISRC

Potamogeton illinoensis (Illinois Pondweed)
Otter Lake, Anoka County
Photo by Naomi Blinick

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Contributions to MAISRC support innovative research, high quality education opportunities, and the advancement of solutions for AIS management.
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