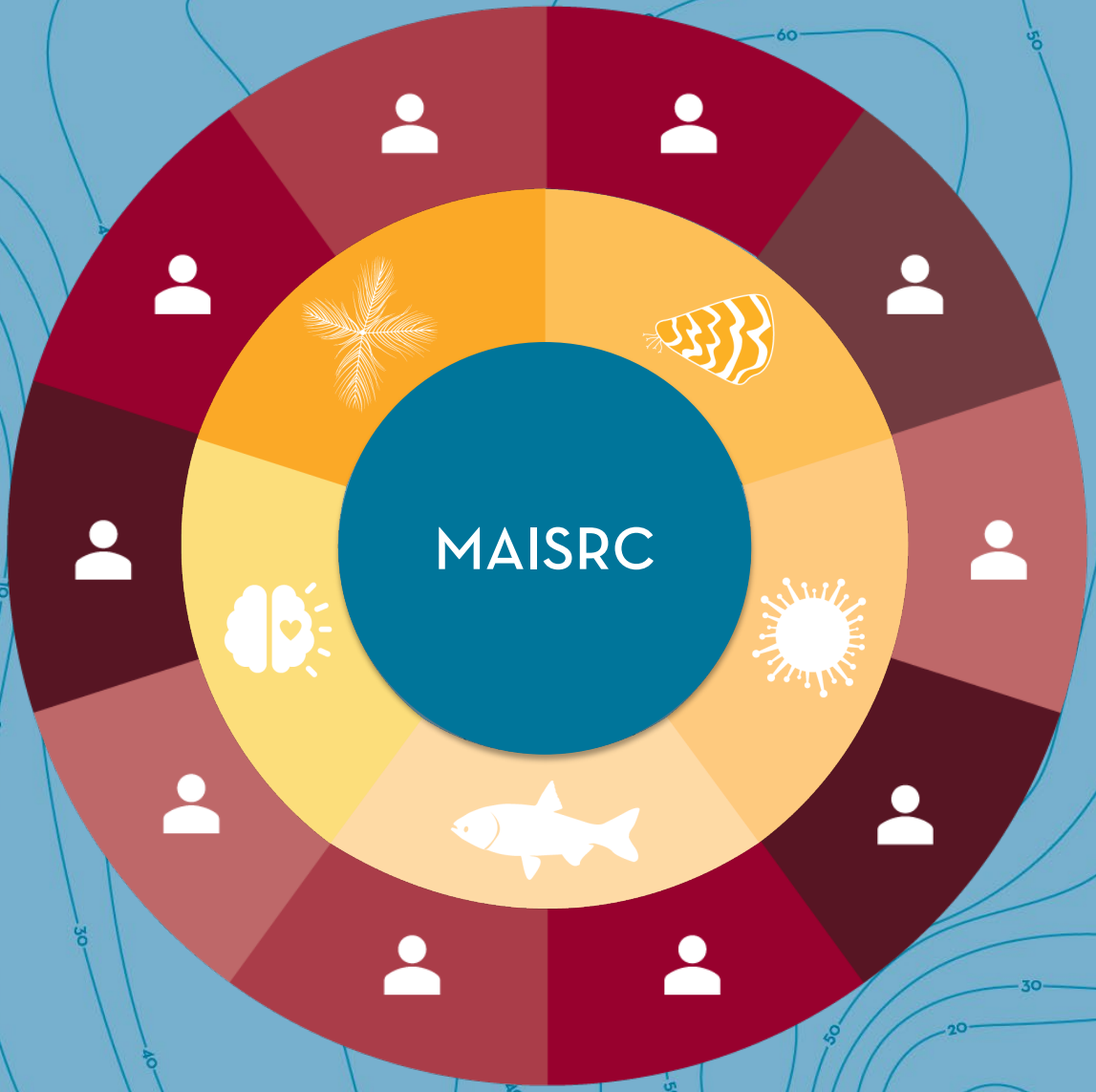
Minnesota Aquatic Invasive Species Research Center

Environment and Natural Resources Trust Fund

# Zebra mussels at Pickerel Lake

Meg Duhr, August 2022

# Minnesota Aquatic Invasive Species Research Center




- World-class researchers
- Plants
- Pathogens
- Fish
- Invertebrates
- Social science

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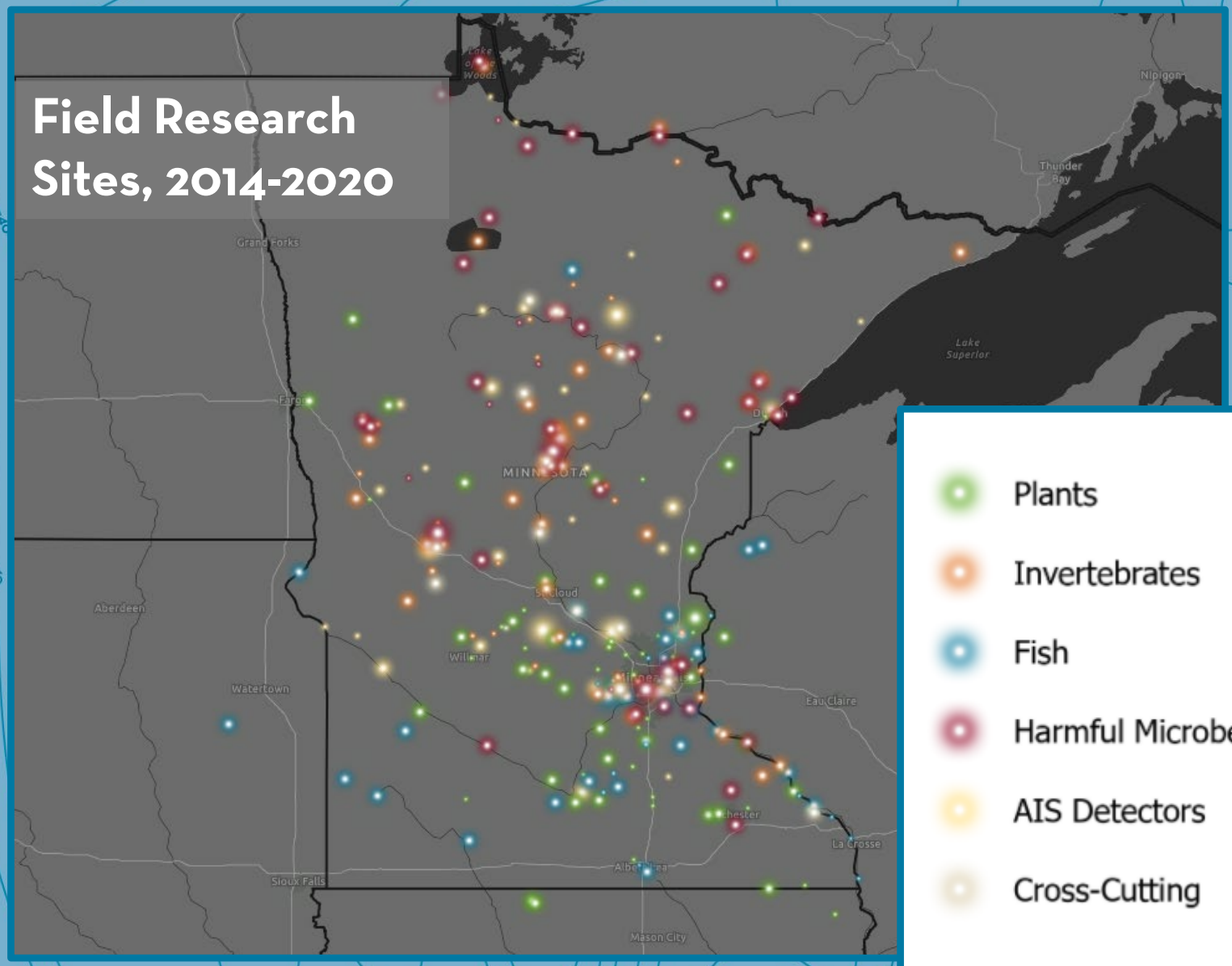
# Field Research Sites, 2014-2020



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## Life history and impacts

- Small, filter-feeding mussels
- Few to no predators
- Filter massive amounts of plankton
- Early maturation, explosive growth
- High tolerance of extreme conditions, poor water quality
- Easily spread through recreational boating pathway, movement of in-water equipment

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# Zebra mussels

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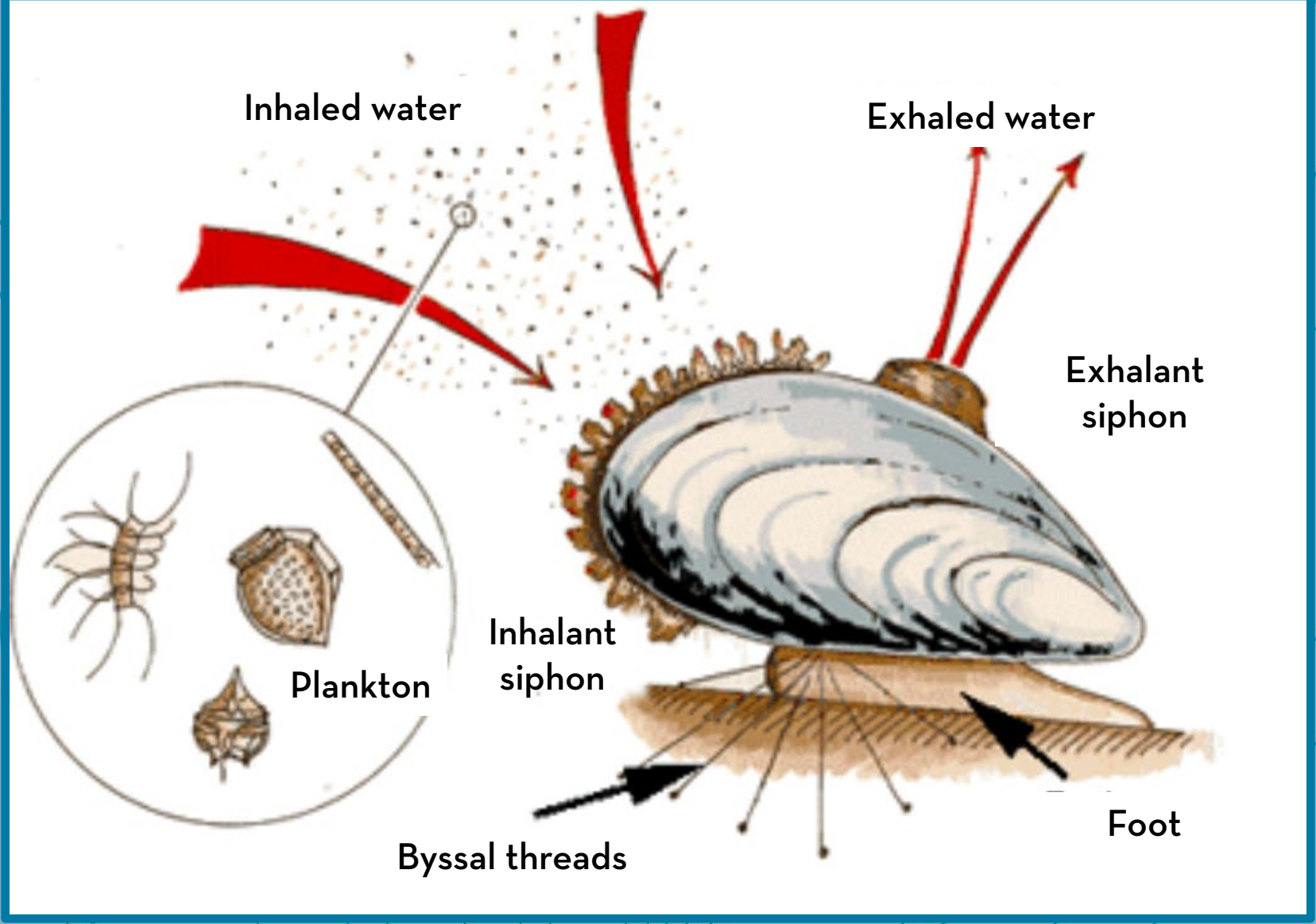
Inhaled water
Exhaled water
Exhalant siphon
Inhalant siphon
Plankton
Byssal threads
Foot

**Zebra mussels may exacerbate existing water quality challenges**

- Filter feeding increases water clarity→more light in water column→ deeper, denser algae and other plant growth
- Phosphorus is shunted from water column to the lake bottom in near-shore areas, supporting filamentous algae growth; shells also provide attachment substrate
- ZM selectively consume beneficial algae while rejecting toxic, blue-green algae (*Microsystis sp.*)

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Video of a feeding zebra mussel rejecting a *Microcystis* alga

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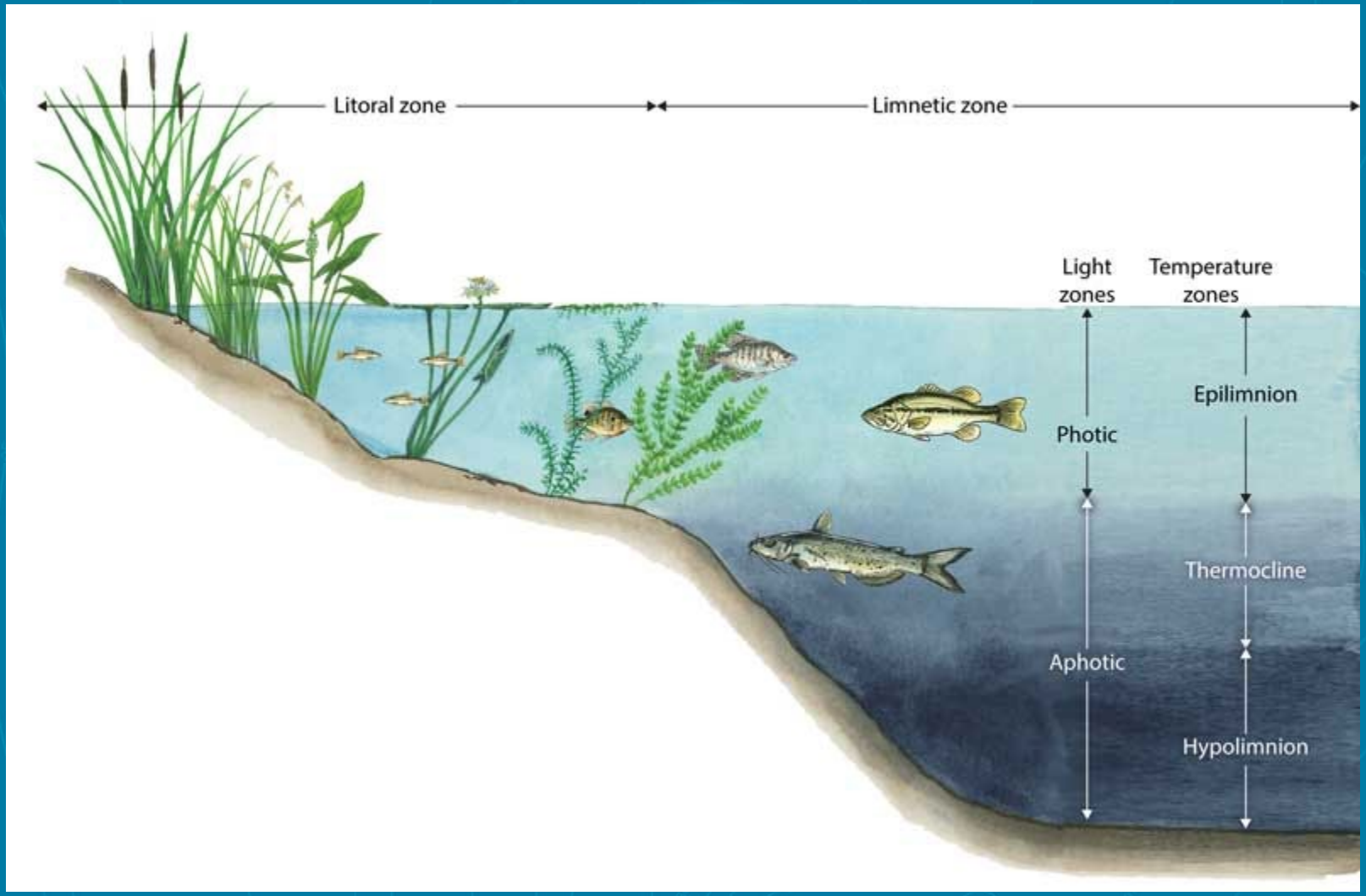
Litoral zone
Limnetic zone
Light zones
Temperature zones
Photic
Epilimnion
Thermocline
Aphotic
Hypolimnion

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## What can we do about it?

- ✓ Mitigate runoff and nutrient loading (rain gardens, natural shorelines, native plantings, and reduced fertilizer use)
- ✓ Support watershed-scale efforts to limit nutrient inputs (land trusts and sustainable farming practices)
- ✓ Keep AIS plant species in check

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# Most importantly:

## No new AIS introductions!

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# Potential impacts on recreational fishing

- Fish habitat and food availability significantly altered with ZM establishment
- More light leads to denser plant growth and changes predator prey relationships
- Water temperatures rise due to greater light in the water column, cold water species like walleye not favored

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# MAISRC Research: Sustaining walleye populations: assessing impacts of AIS

- Large lakes study (completed 2020)
- Small/medium-sized walleye lakes (results pending)

# What did we find?

(baby walleye and baby perch)

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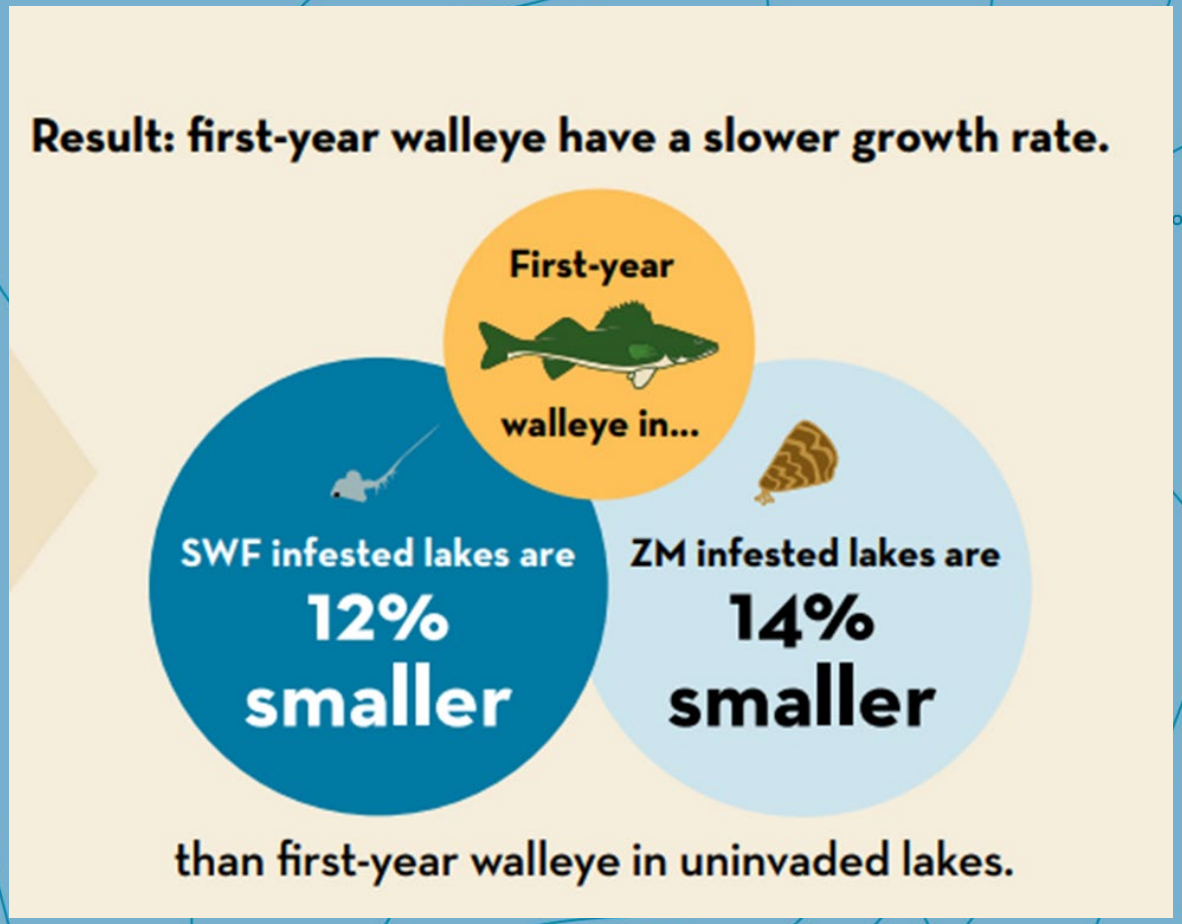


In lakes with BOTH zebra mussels AND spiny water flea, first-year walleye are 25% smaller!

# Potential impacts to swimming areas

- Sharp shells cut bare feet
- Empty shells can pile up on beaches
- Zebra mussel can establish on sand/muck bottoms by settling on native clams or on the shells of other zebra mussels

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## What can we do about it?

- ✓ Wear water shoes
- ✓ Scrape off by hand
- ✓ Hire a lake service provider that does zebra mussel clean-up
- ✓ Rake shells from beach and dispose
- ✓ Move mussel-encrusted rocks outside the swimming area

# Boats, docks, and lifts

- Will damage boat engines if allowed to settle inside
- Can foul hulls and propellers, reducing performance
- Can accumulate on docks and lifts, posing a nuisance at high densities

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## What can we do about it?

- ✓ Store boats on lifts, fully out of the water
- ✓ Hand scraping swim ladders
- ✓ Store docks on shore during the fall/winter
- ✓ Taking your boat to another lake? Hit the decon station!

## Important reminders!

- Some activities may require a permit; check with lake association leaders or local GFP staff before undertaking large efforts
- Choose a reputable company that is aware of AIS prevention best practices
- Docks, lifts, and swimming rafts should be out of the water for at least 21 days before transfer to another waterbody
- Dispose of zebra mussels at a compost site at least 300 from water

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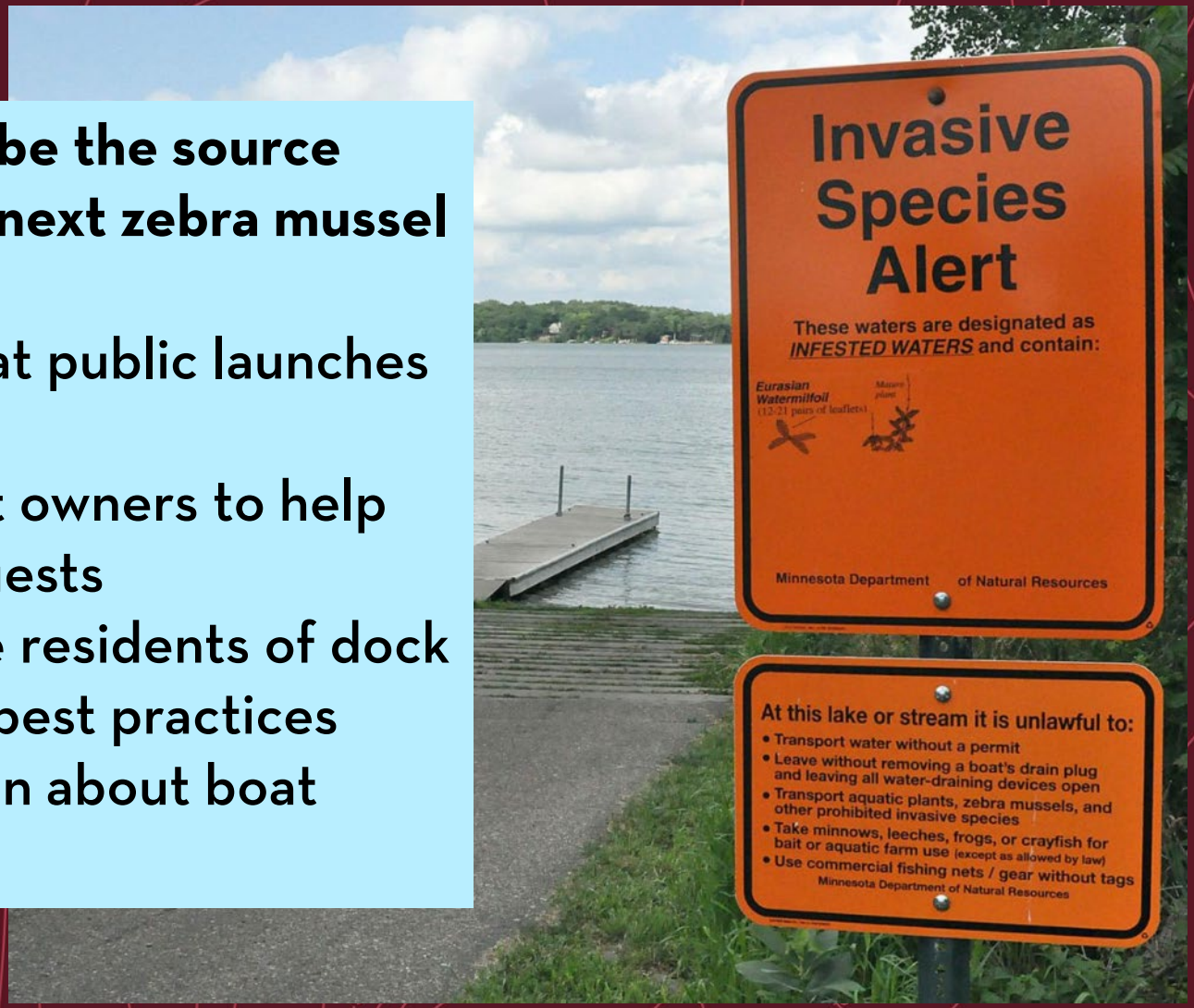
**Don't let your lake be the source population for the next zebra mussel invasion**

- ✓ Update signage at public launches and resorts
- ✓ Work with resort owners to help them educate guests
- ✓ Inform lakeshore residents of dock and lift transfer best practices
- ✓ Share information about boat decon options

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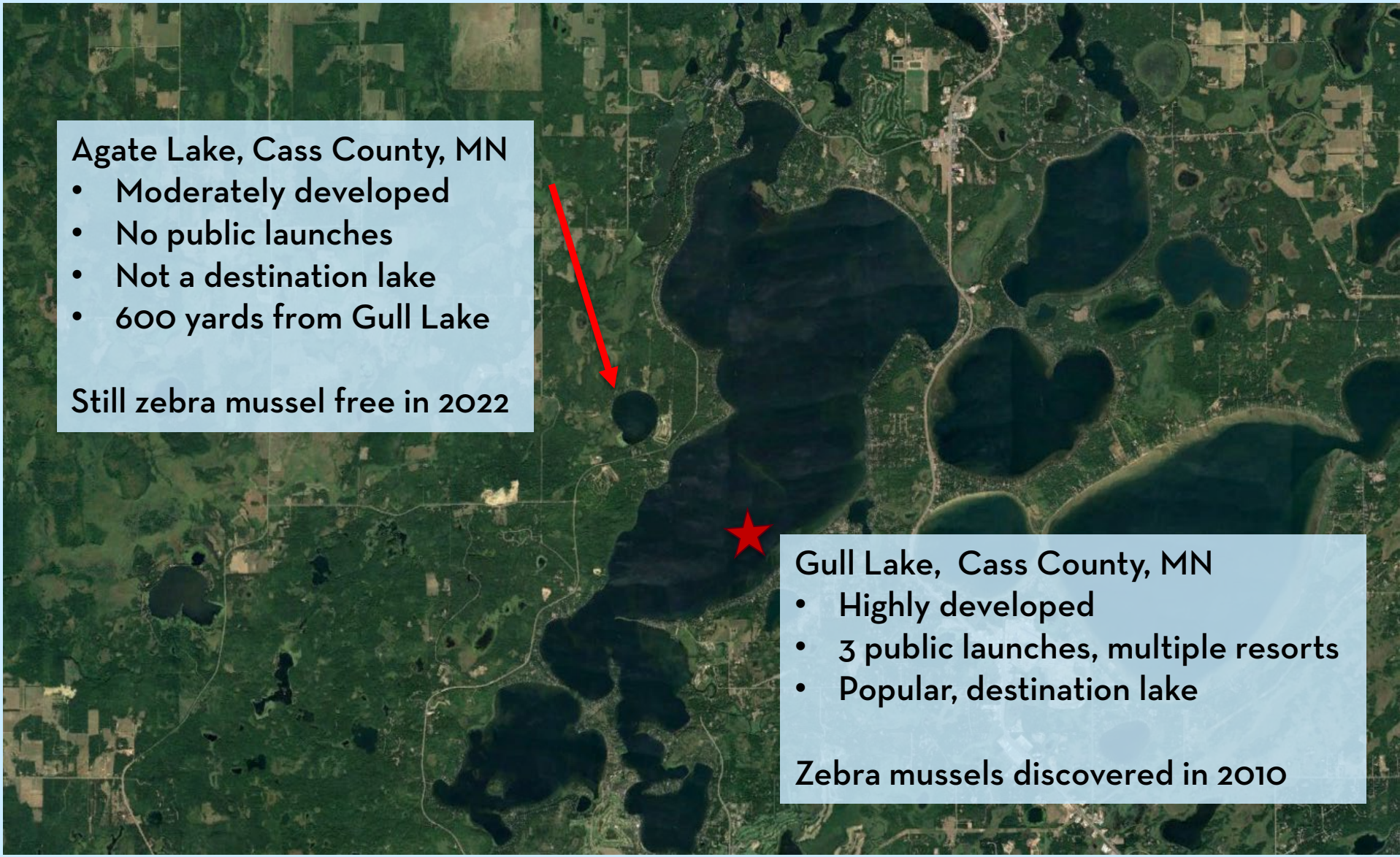
# What about waterfowl and other wildlife?

# Birds and other wildlife as a vector?




Star Tribune, 7/31/17

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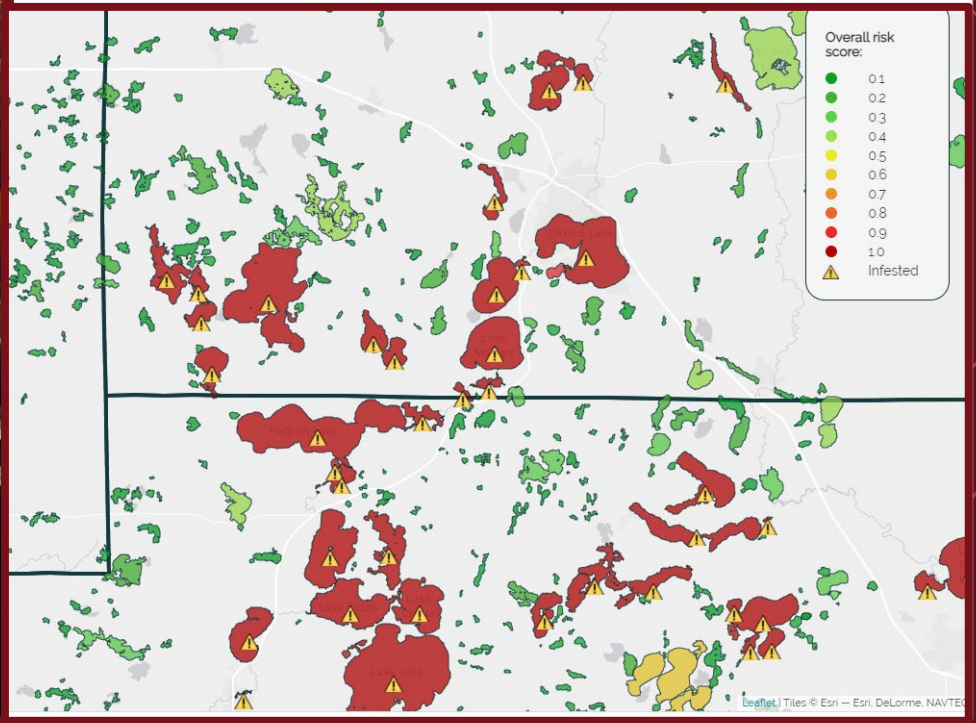
## Zebra mussel research highlights

- Used genetics to understand spread pathways
- Risk analysis on residual water in boats
- Models to predict invasion and help managers prioritize boat inspections



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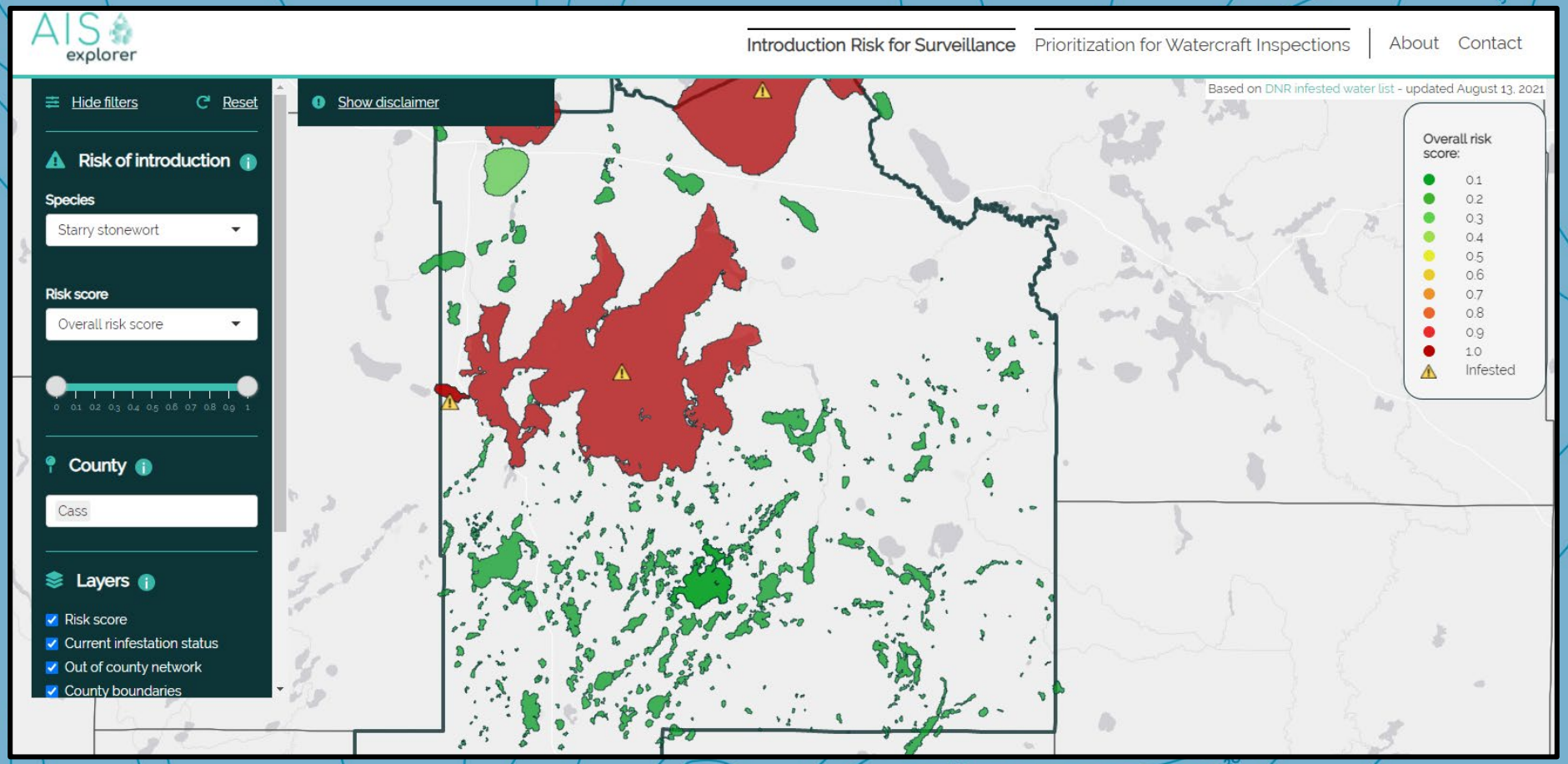


**AISexplorer.umn.edu**

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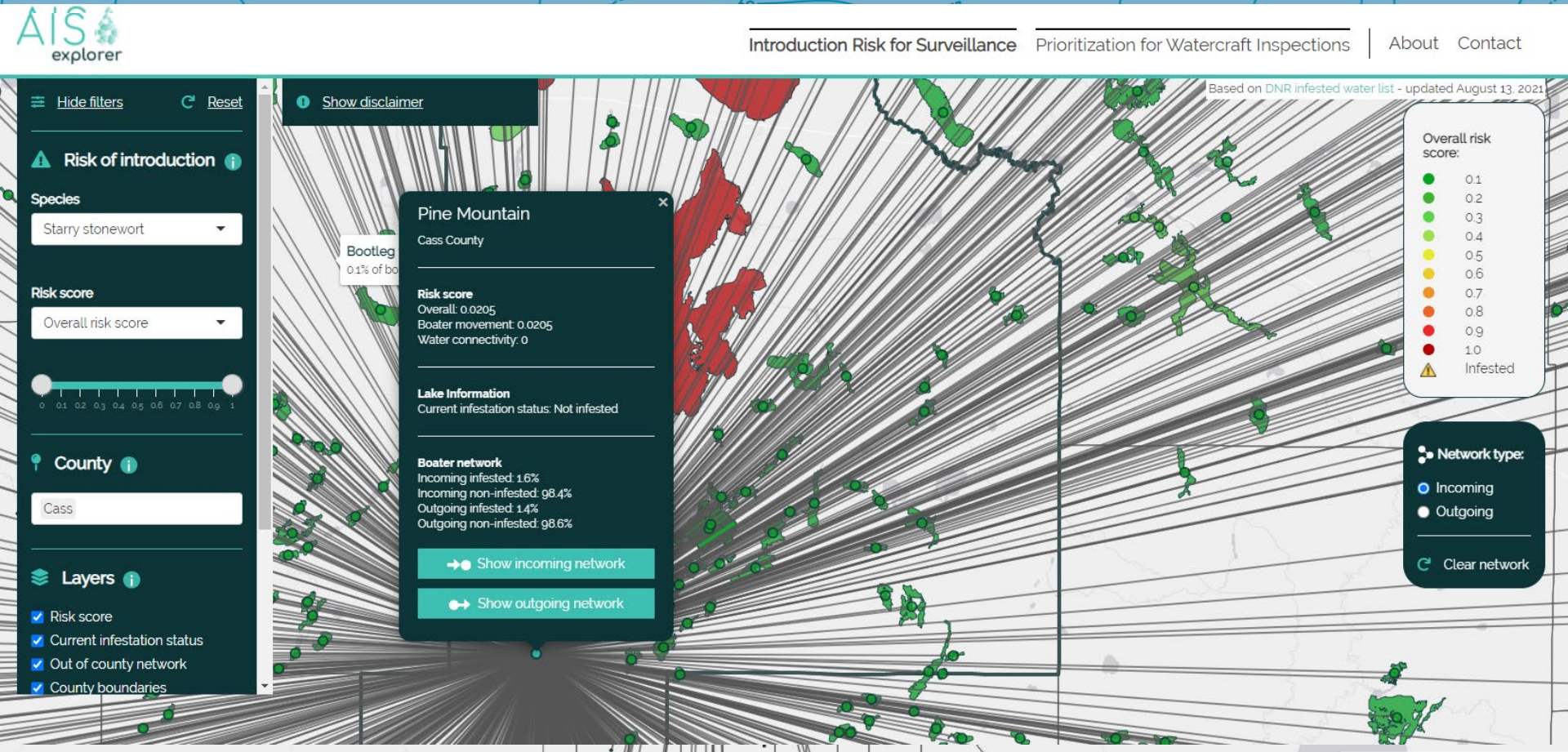


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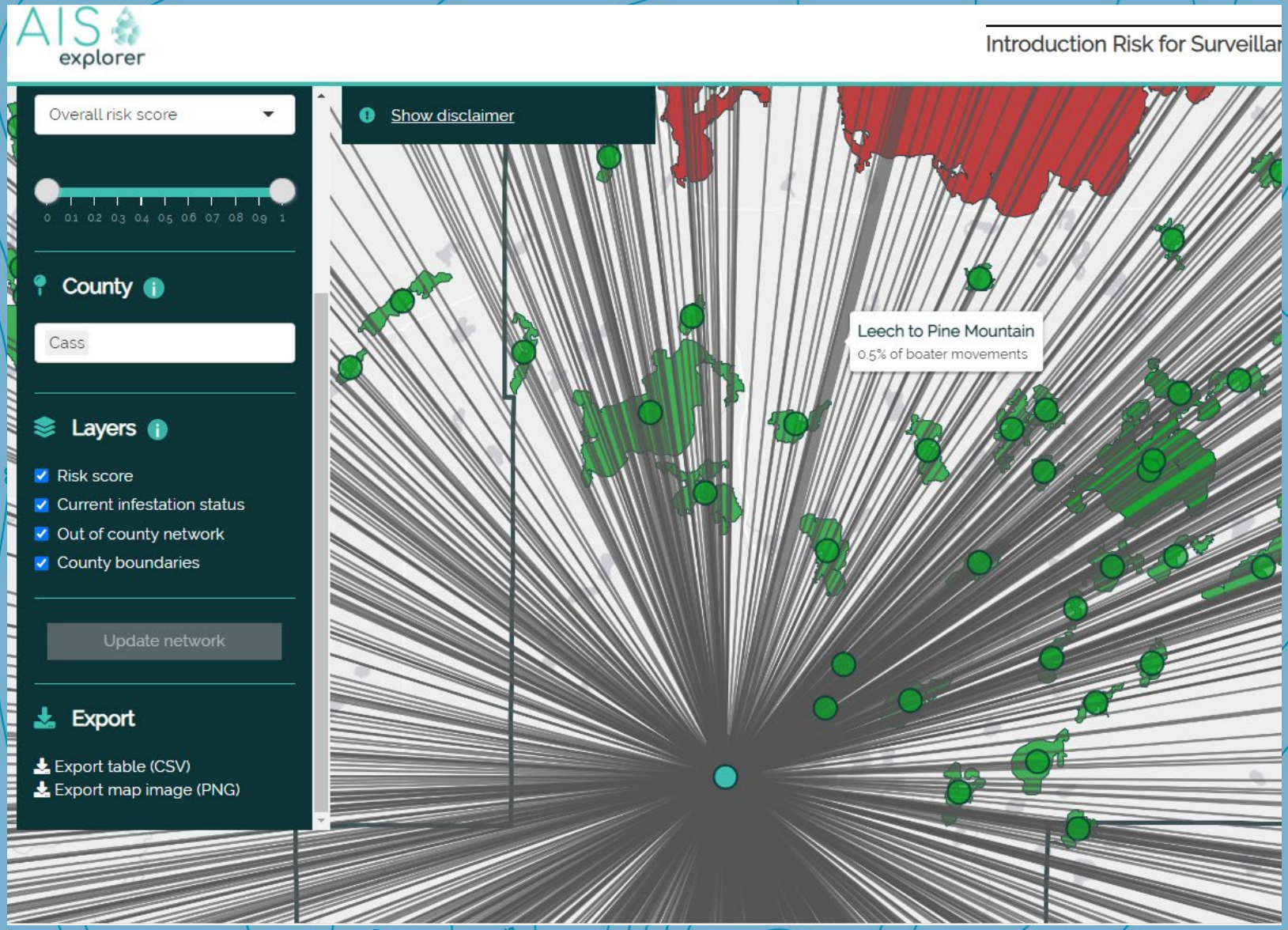


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News releases >

## Zebra mussel larvae confirmed in Rainy Lake in St. Louis County

September 1, 2021

Environment

## Invasive starry stonewort found in Leech Lake

Kirsti Marohn Brainerd, Minn. July 19, 2021 1:50 p.m.

## Zebra mussels confirmed in 5 more Minnesota lakes

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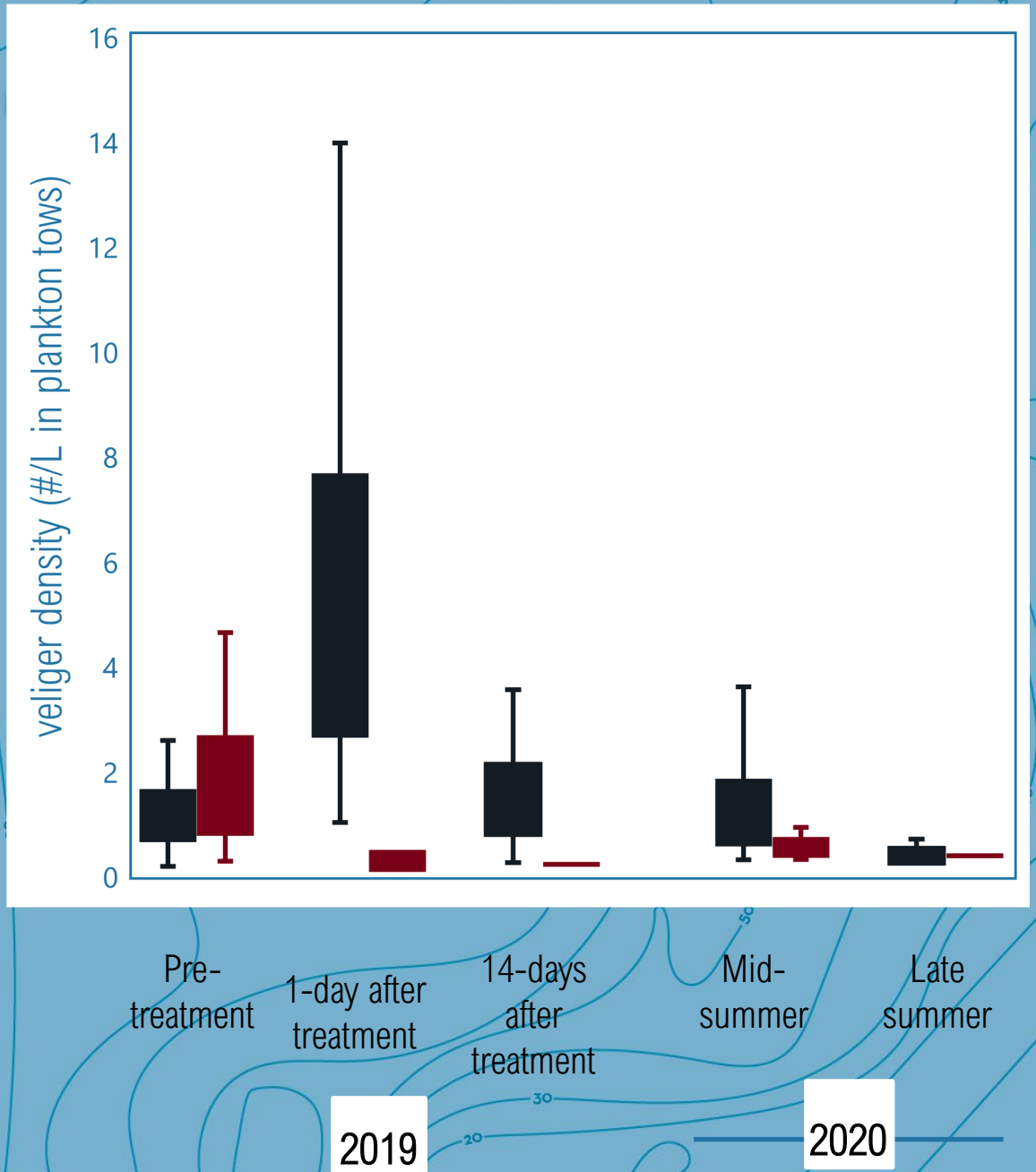
## Low-dose copper sulfate for zebra mussel control 2015-present

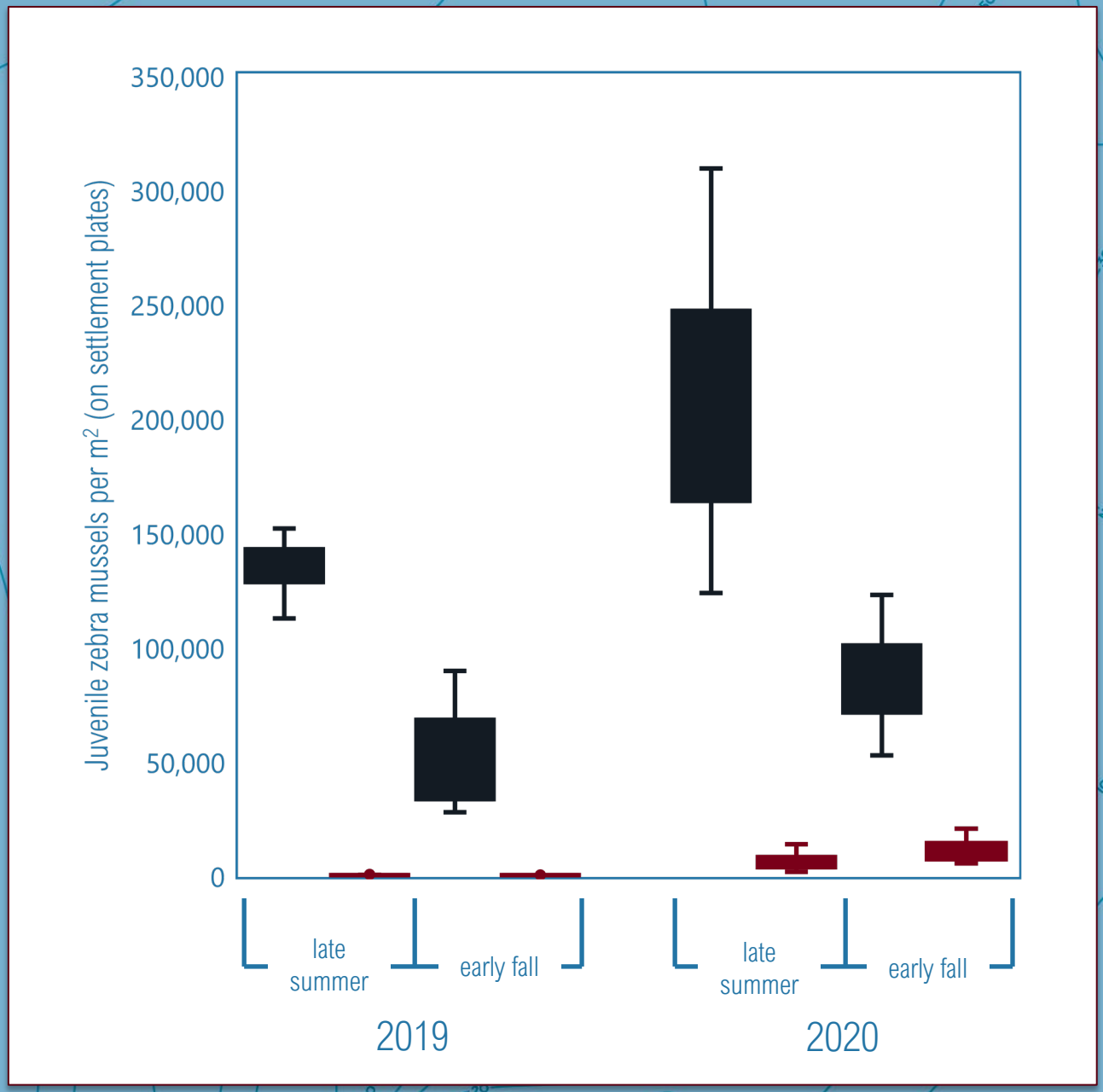
- Lab testing to optimize water temperature and exposure time to kill young mussels
- Small scale open water trials to test concept in real lake conditions in 2017
- Large scale (160 acre) trial in Lake Minnetonka in 2019

# Copper sulfate treatment reduced veliger density




Dahlberg and Waller 2021

# Copper sulfate treatment reduced zebra mussel settlement




Dahlberg and Waller 2021

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## Continuing work: Assessing and refining copper-based treatment approaches


- Additional post-treatment monitoring at 2019 Lake Minnetonka site
- Characterize biotic and abiotic features, and conduct lake-side toxicity trials on zebra mussels and non-target species at new lake

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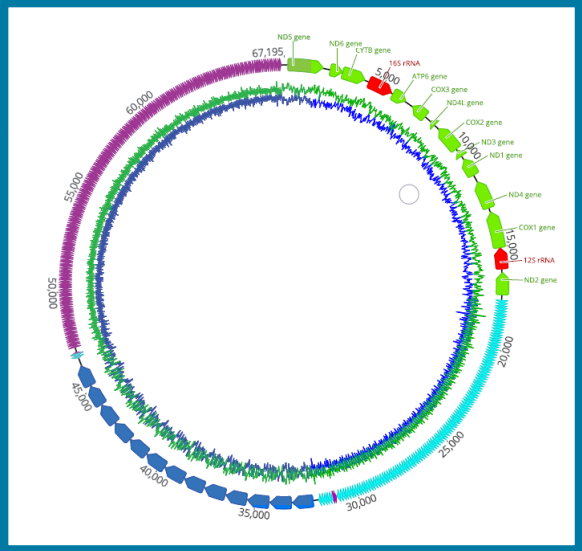
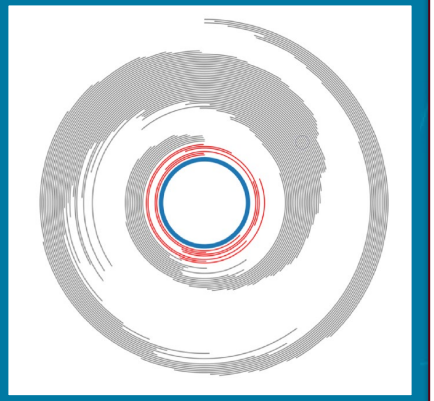
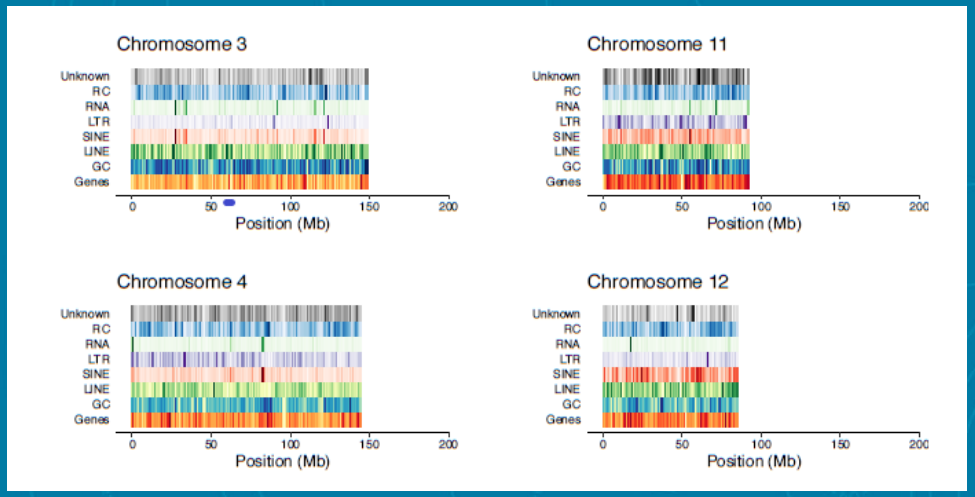


## Zebra mussel genome mapping

- Complete map of zebra mussel genome
- New insights into the genes responsible for shell formation, attachment, and other key vulnerabilities
- All data open-sourced for the entire research community

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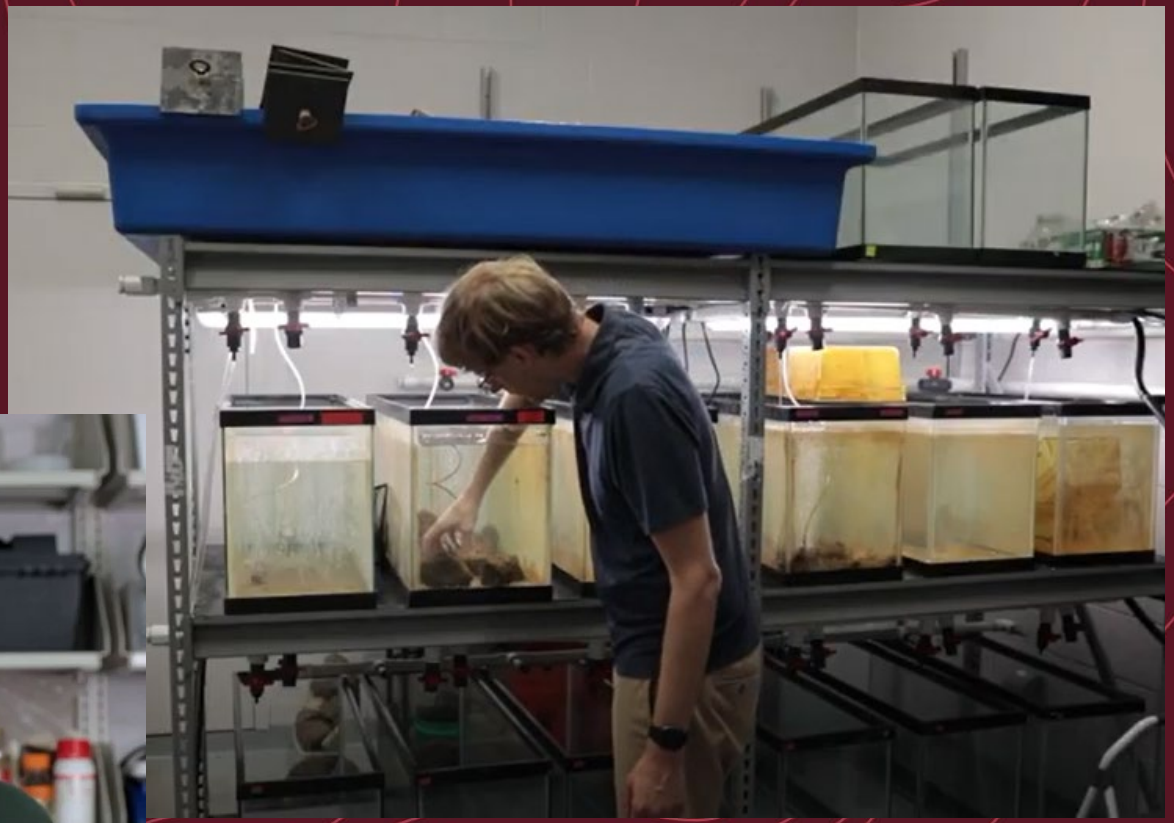
# Raising zebra mussels in the lab



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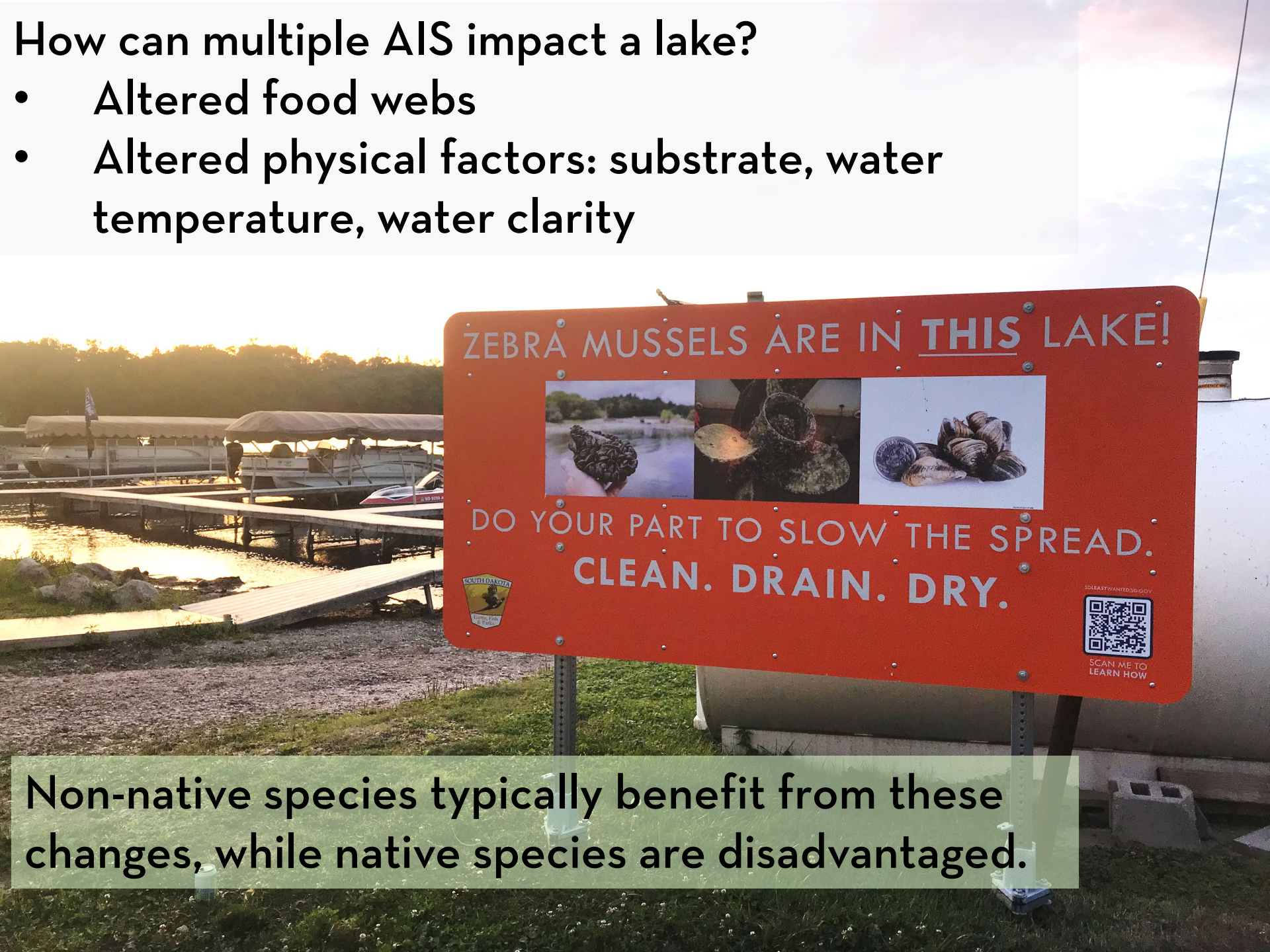
# New project: RNA-interference screens for zebra mussel biocontrol target genes

- Design, produce, and test double stranded RNA producing bacterial strains for in-water delivery
- Establish tests and carry out RNA interference screens for genes affecting feeding, survival, reproduction, shell growth, and byssal thread attachment

How can multiple AIS impact a lake?

- Altered food webs
- Altered physical factors: substrate, water temperature, water clarity




Non-native species typically benefit from these changes, while native species are disadvantaged.

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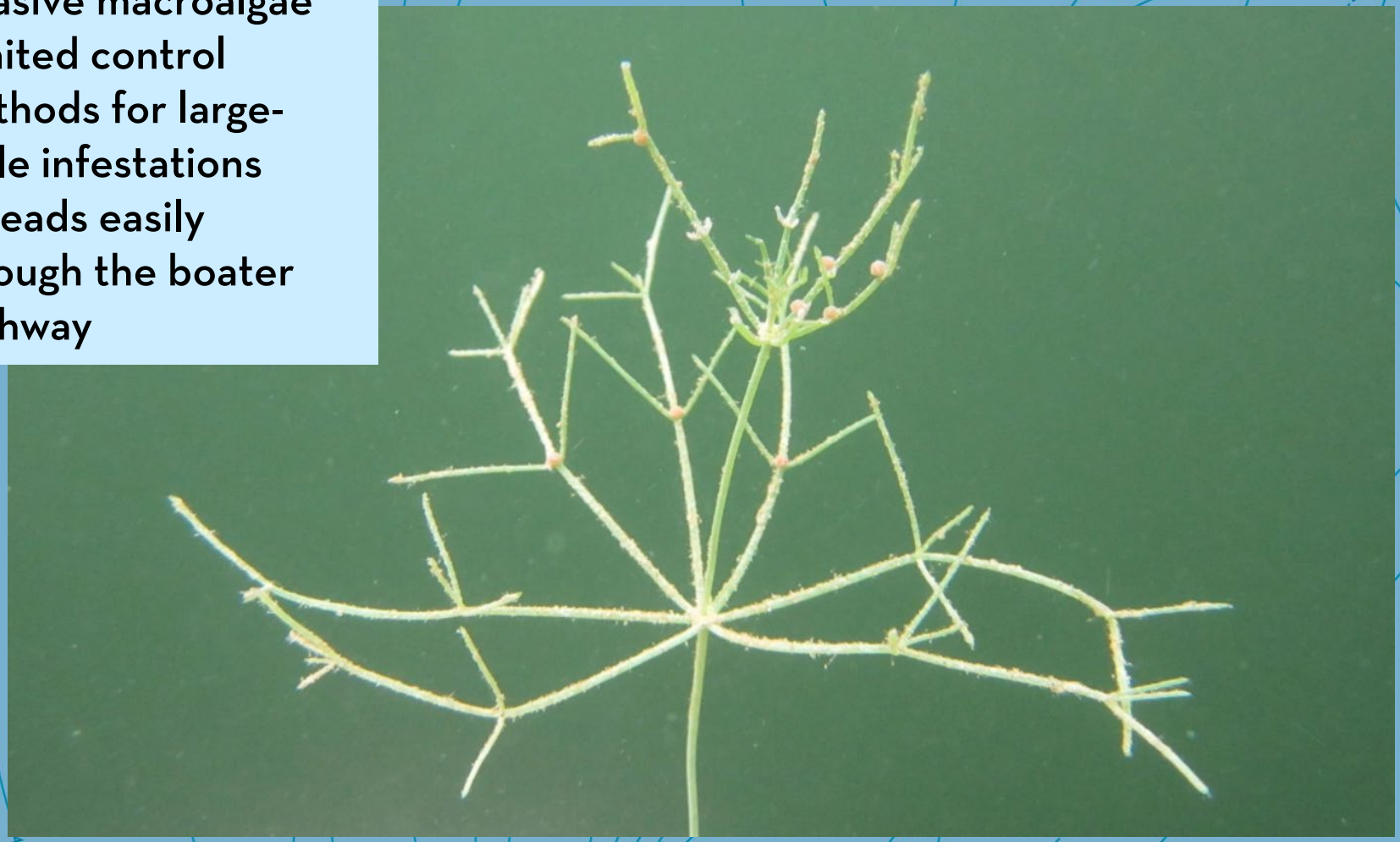
# Starry stonewort

- Invasive macroalgae
- Limited control methods for large-scale infestations
- Spreads easily through the boater pathway



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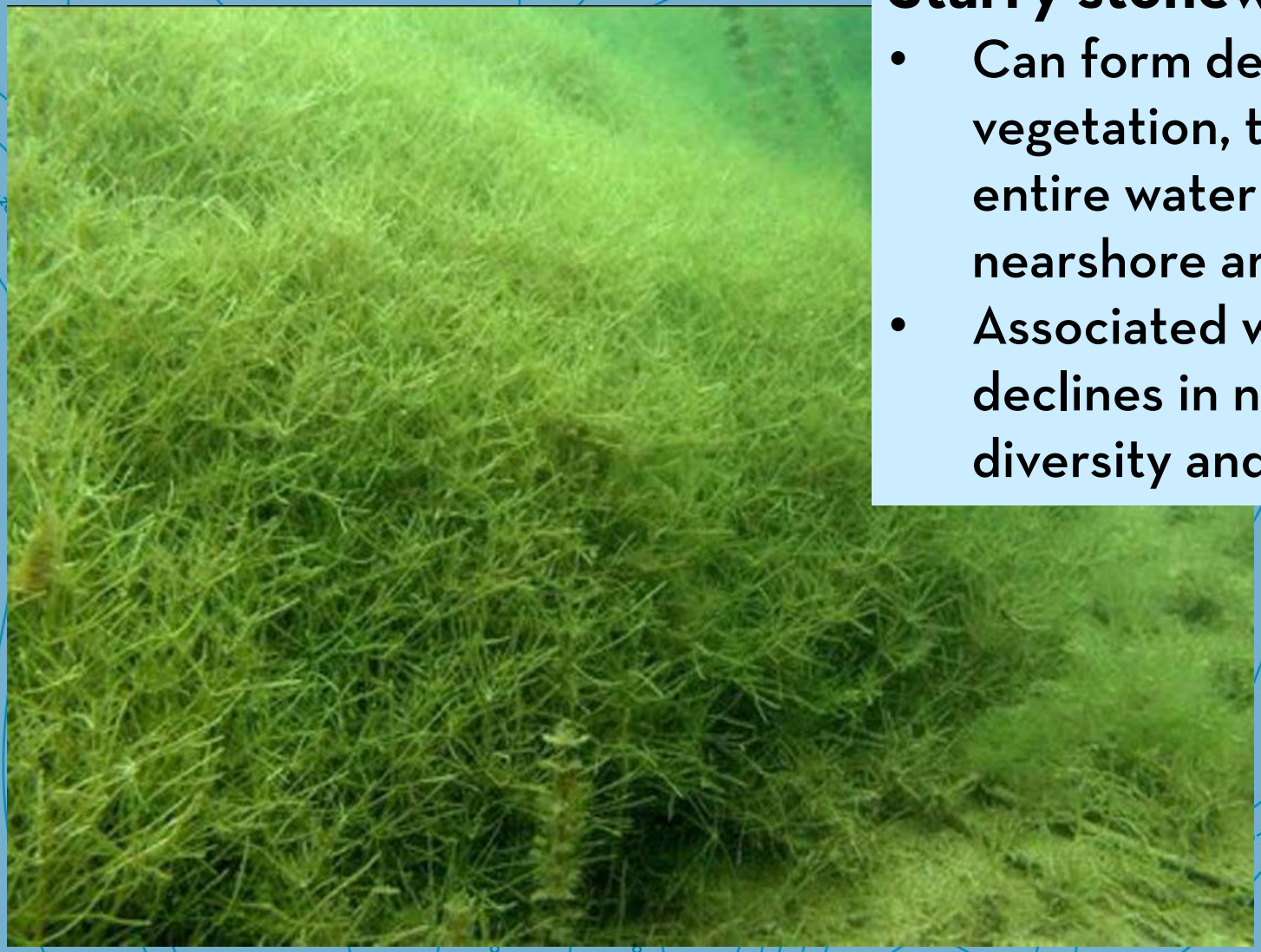

## Starry stonewort

- Can form dense walls of vegetation, taking up the entire water column in nearshore areas
- Associated with dramatic declines in native plant diversity and abundance

White, star-shaped bulbils (below) are starry stonewort asexual reproductive structures. It can also reproduce through fragments

Starry stonewort Photo by Paul Skawinski

# Zebra mussels join starry stonewort as unwanted species in central Minnesota's Lake Koronis

postbulletin.com • 11d

PAYNESVILLE — Add zebra mussels to the list of aquatic invasive species in Lake Koronis. The Minnesota Department of Natural Resources has confirmed a ...

Read more on postbulletin.com

#ZEBRA MUSSEL #MUSSELS #MINNESOTA #STEARNS COUNTY #GREATER MINNESOTA

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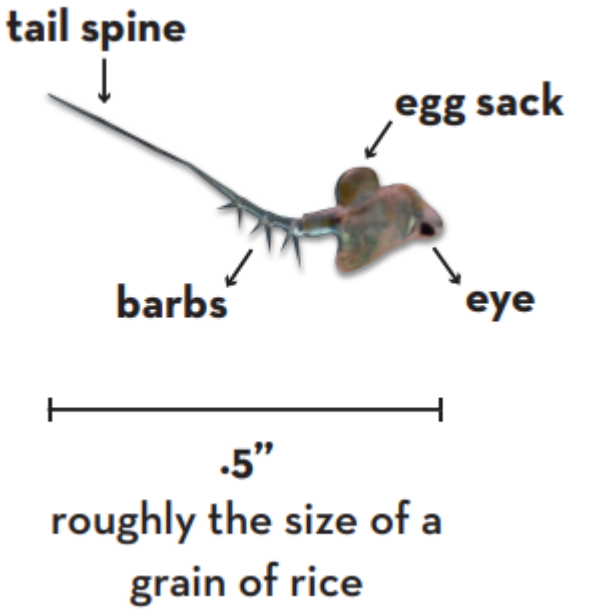




## Spiny water flea life history and impacts

- Predatory zooplankton
- Few predators of spiny water fleas
- Inedible to many young native fish
- Eat significant amounts of native zooplankton
- Early maturation and explosive growth
- Highly adaptable reproductive strategy

**No control methods currently available or in the research phase**

This image conveys ‘approximate’ range in weights, using a range of common mammal weights as a relative scale.

The large mammals below show how this size difference would play out among more familiar species.

*Copepoda*

*Bosmina*

*Daphnia*

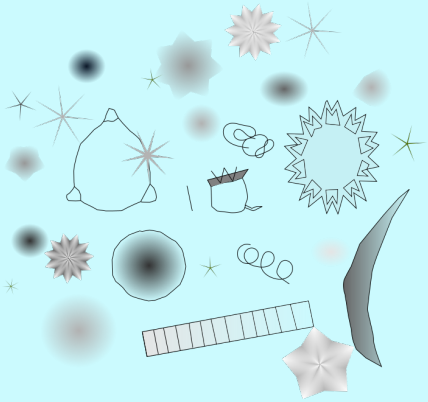
*Leptodora*

Spiny water flea

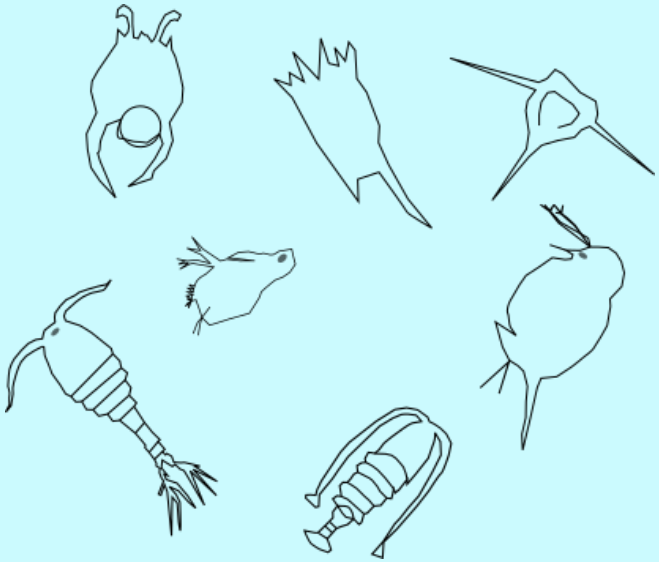
0.3 micrograms → 300 micrograms

< half a pound → 440 pounds

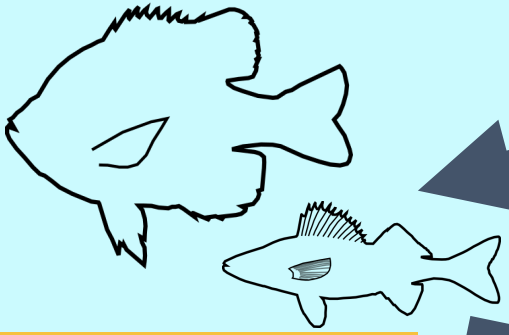
# Uninvaded Lake



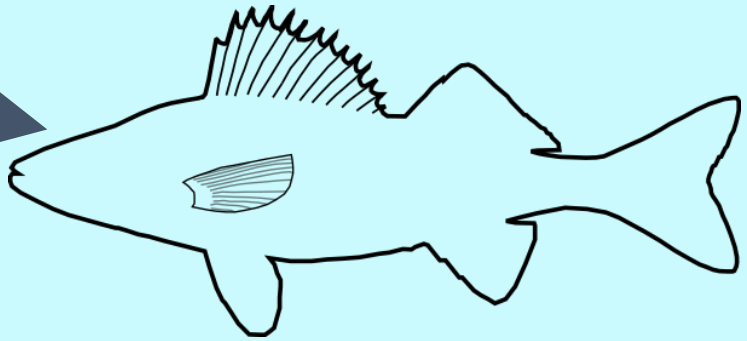
Phytoplankton



Zooplankton



Zooplanktivorous fish



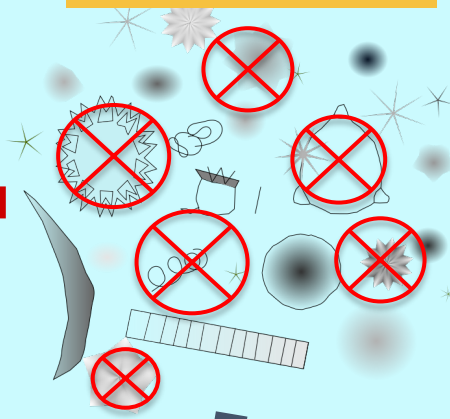
Walleye and other piscivorous fish

Food web images by: Holly Kundel

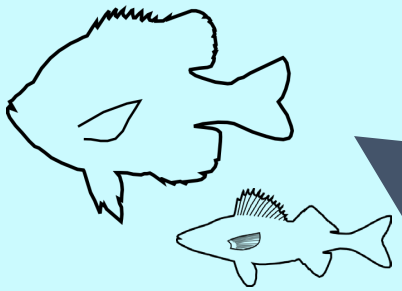
# Zebra mussel invaded lake

Zebra Mussels

Phytoplankton



Lakebed, nearshore



Zooplanktivorous fish

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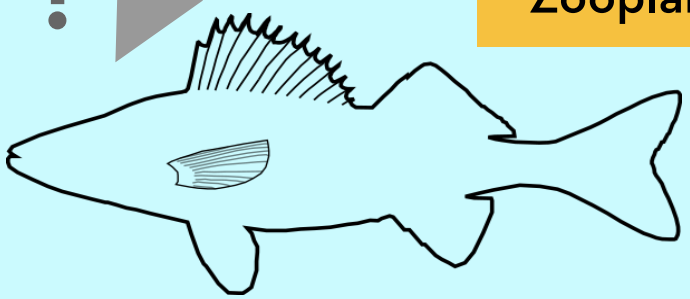
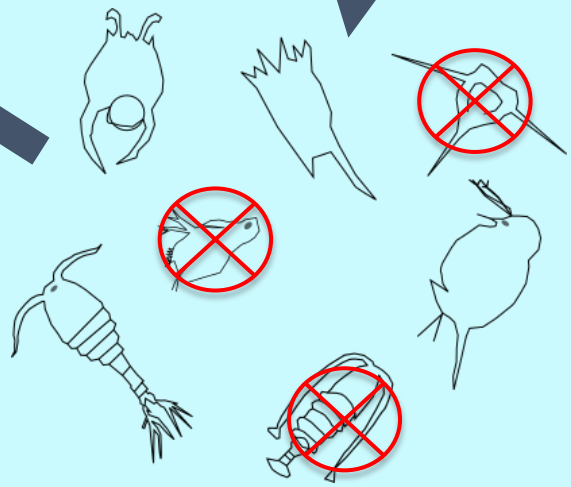


Walleye and other piscivorous fish

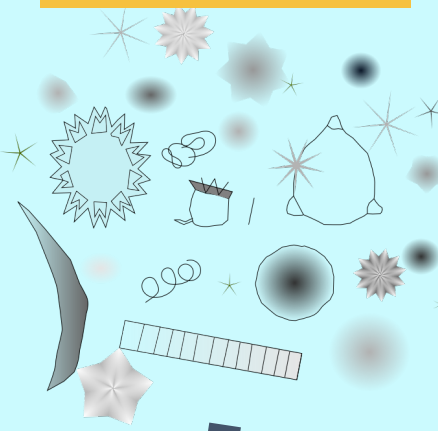


Zooplankton

Food web images by: Holly Kundel

# Spiny waterflea invaded lake

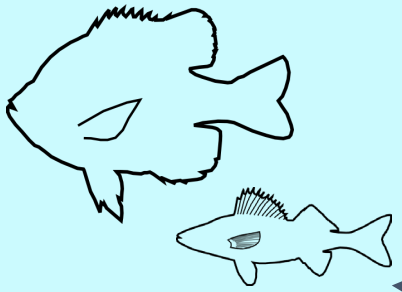
Phytoplankton



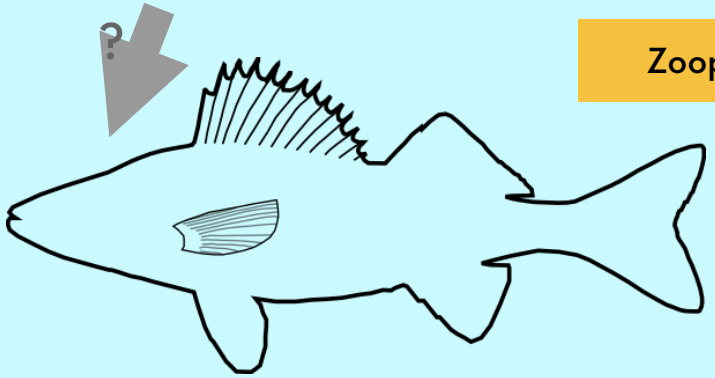
Spiny water fleas

Benthos

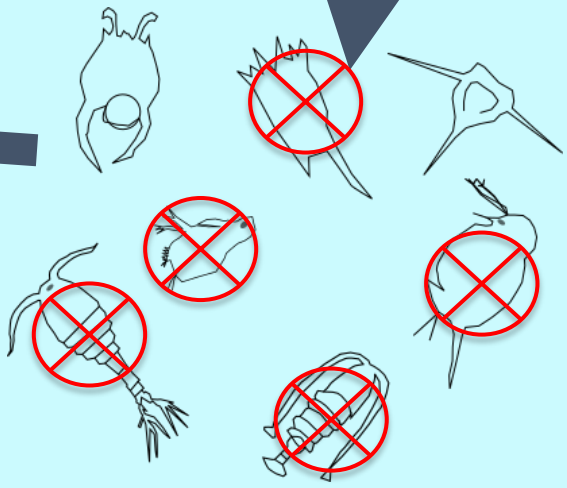
Plants and animals found on the bottom, or in the bottom sediments of lakes.



Zooplanktivorous Fish



Walleye and other Piscivorous Fish

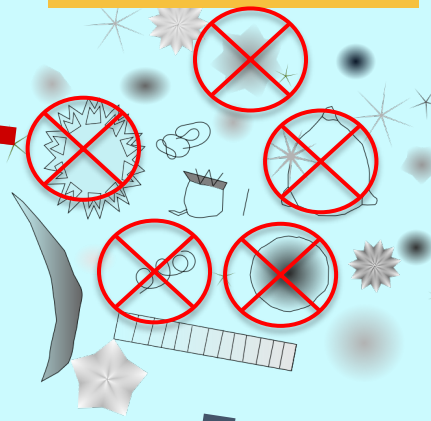


Zooplankton

Food web images by: Holly Kundel

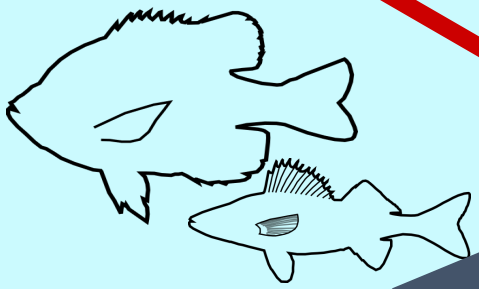
# Spiny water flea + zebra mussel invaded lake

Phytoplankton

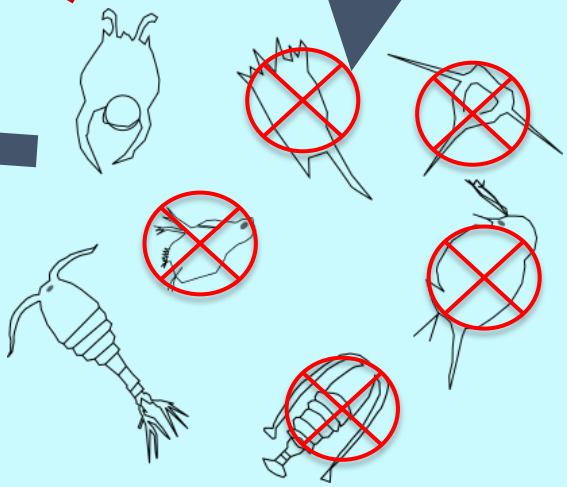


Benthos

Plants and animals found on the bottom, or in the bottom sediments of lakes.



Zooplanktivorous Fish



Zooplankton

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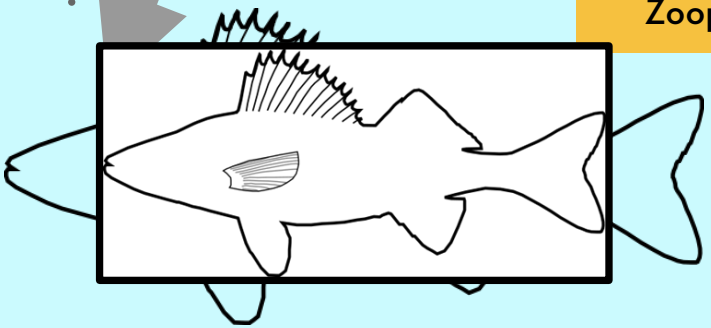

Walleye and other Piscivorous Fish

Food web images by: Holly Kundel

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# How can you support AIS detection and prevention efforts?

- AIS Detectors Program
- Starry Trek
- Stop Spiny
- Spiny water flea surveillance

Minnesota Aquatic Invasive Species Research Center

## AIS Detectors Program

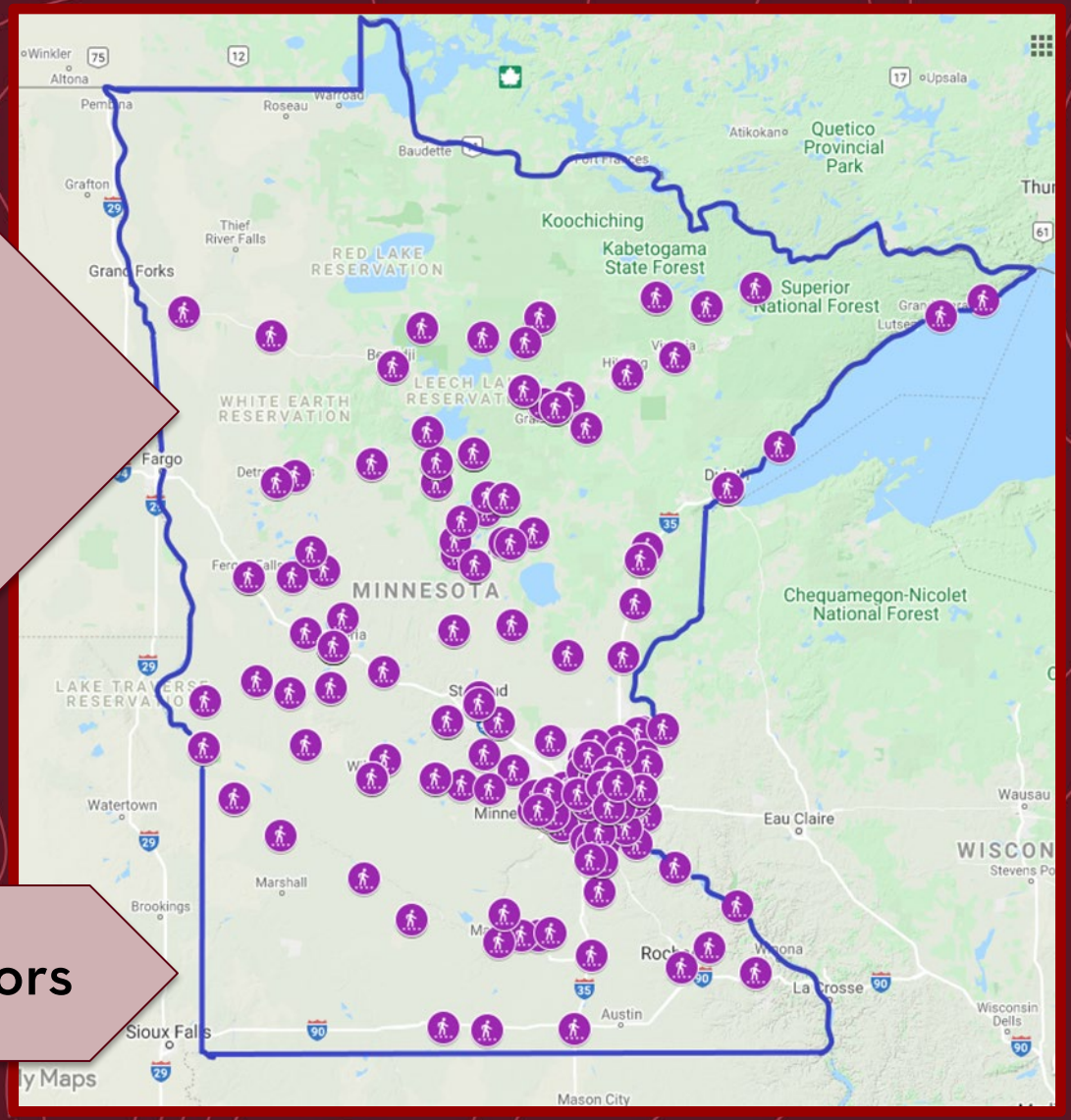
- Citizen science program for AIS early detection
- Trained through UMN experts to learn AIS and native lookalikes
- Learn best practices for reporting and verifying observations

maisrc.umn.edu/ais-detectors

MINNESOTA AQUATIC INVASIVE SPECIES RESEARCH CENTER

- **350 Detectors certified since 2017!**

South Dakota neighbors ALWAYS welcome!




maisrc.umn.edu/ais-detectors

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## Starry Trek Citizen Science Event

- Started in 2017
- 200+ participants
- 200-205 at-risk lakes surveyed annually on a one-day event
- 5 new infestations discovered, initiating rapid response and containment

# Minnesota Aquatic Invasive Species Research Center

## Find out more about all these programs at: MAISRC.umn.edu

Learn more and sign up

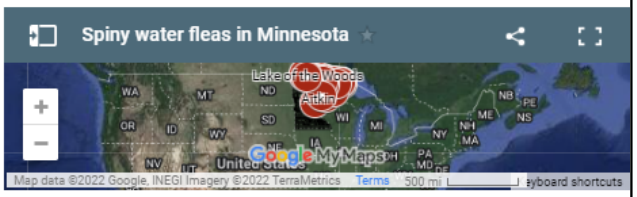
Submit survey data


Learn more about spiny water fleas

Explore the latest research

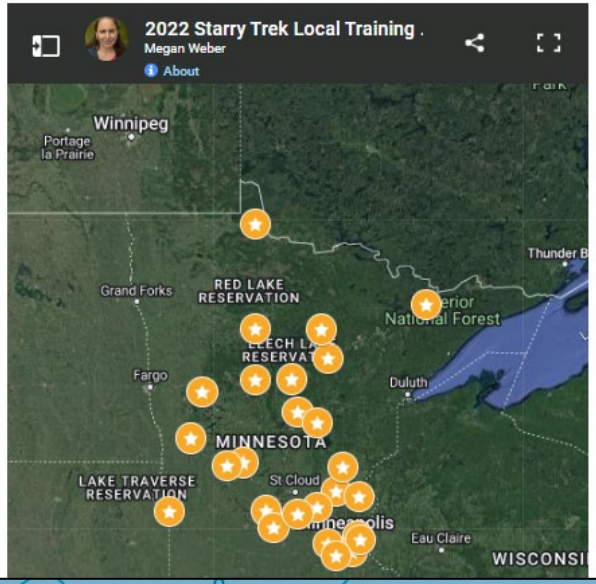
Stop Spiny campaign resources

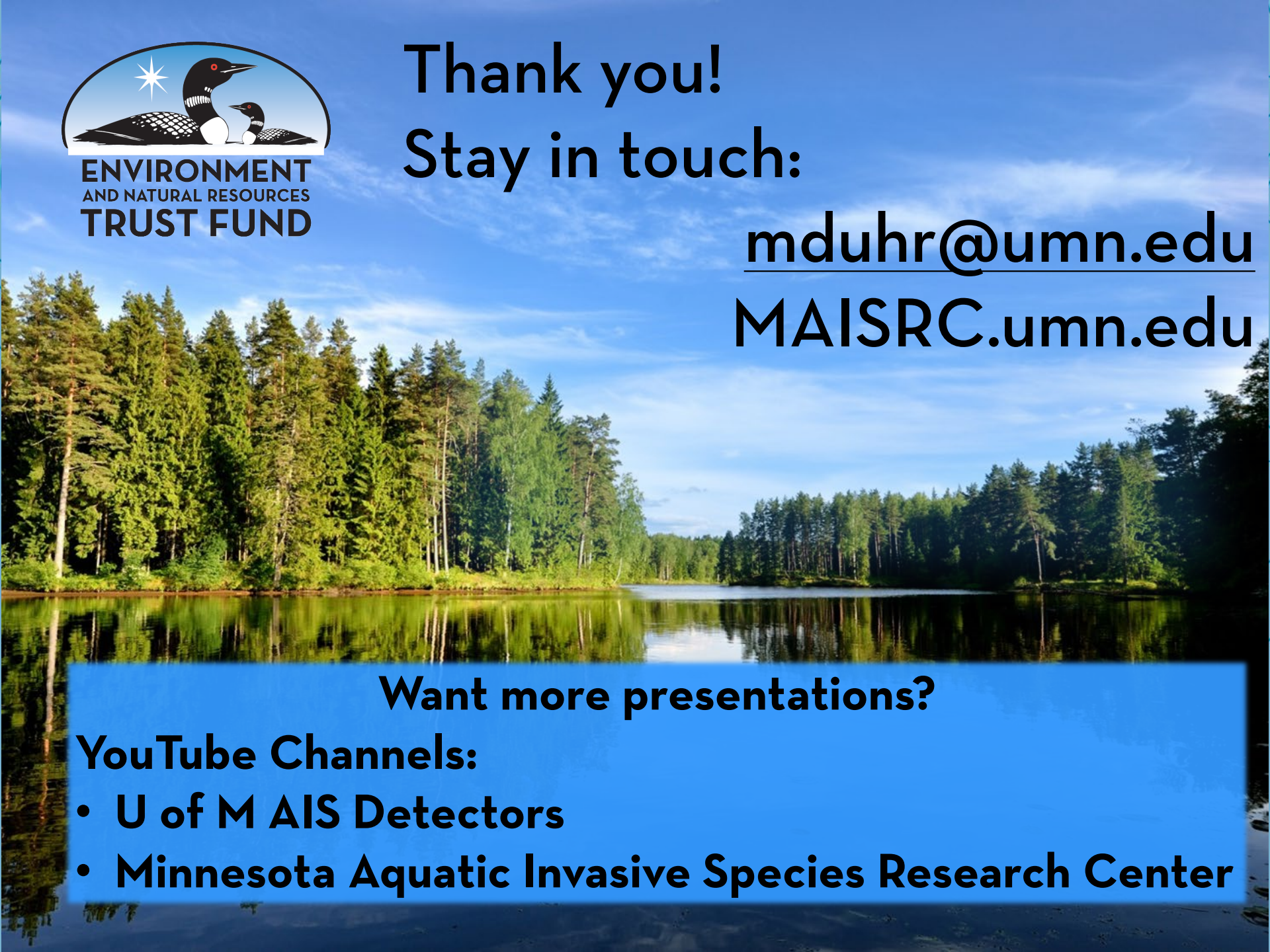
Volunteer surveillance monitoring for spiny water fleas




**REGISTER FOR STARRY TREK 2022**

Starry Trek Locations, 2022






# Thank you!

## Stay in touch:

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