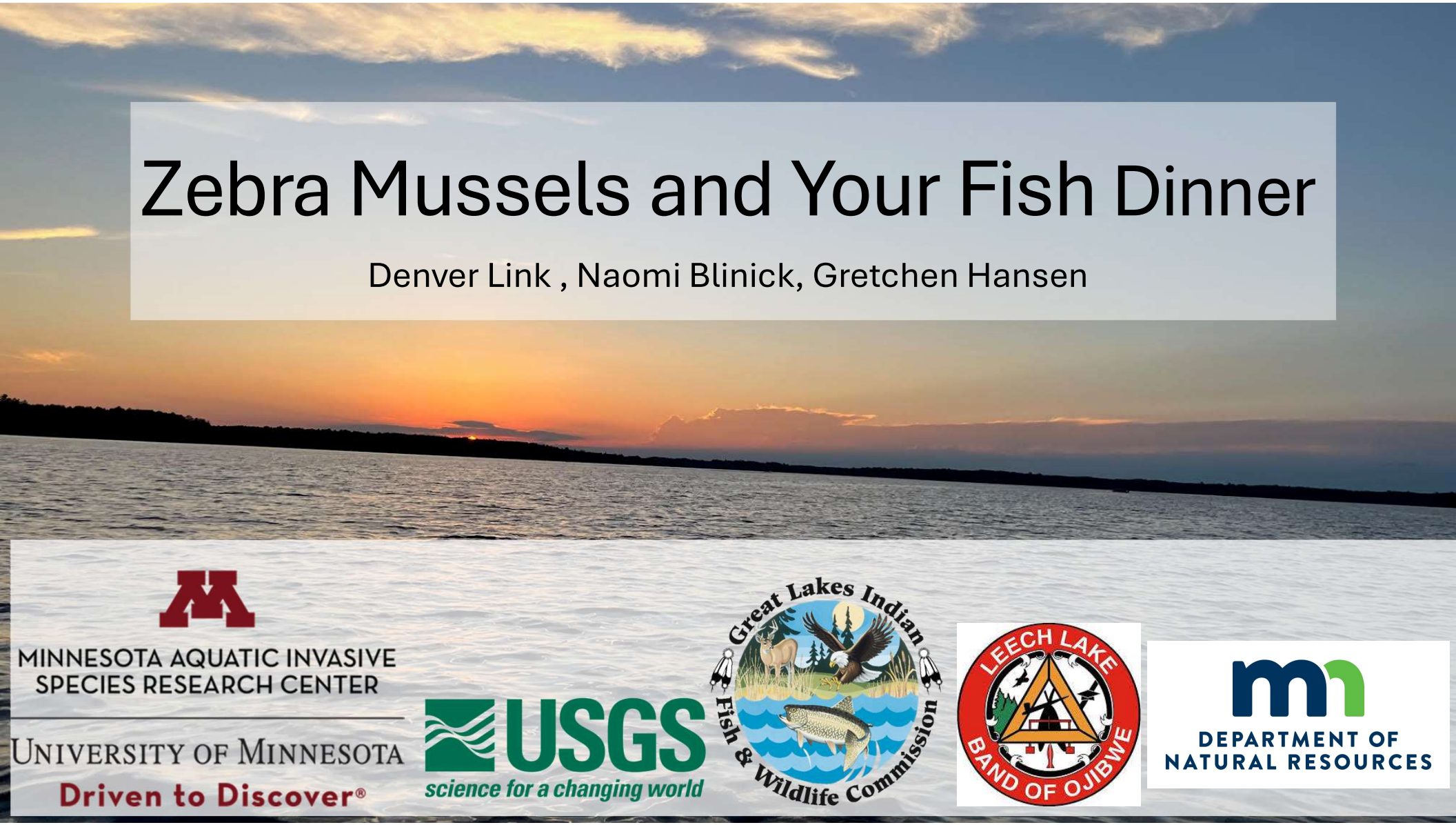


Zebra Mussels and Your Fish Dinner

Denver Link , Naomi Blinick, Gretchen Hansen

MINNESOTA AQUATIC INVASIVE SPECIES RESEARCH CENTER

UNIVERSITY OF MINNESOTA
Driven to Discover®

USGS
science for a changing world

Great Lakes Indian Fish & Wildlife Commission

LEECH LAKE BAND OF OJIBWE

DEPARTMENT OF NATURAL RESOURCES

Primary Team

Dr. Gretchen Hansen

Denver Link

Naomi Blinick

Collaborators

DEPARTMENT OF NATURAL RESOURCES

Paul Radomski
Heidi Rantala
Michael Verhoeven

USGS science for a changing world

Sarah Janssen
Grace Armstrong
David Krabbenhoft
Tyler Wagner

LEECH LAKE BAND OF OJIBWE

Tanya Roerick
Baylor Short
Raining White
Baylor Short
Nathan Pyburn

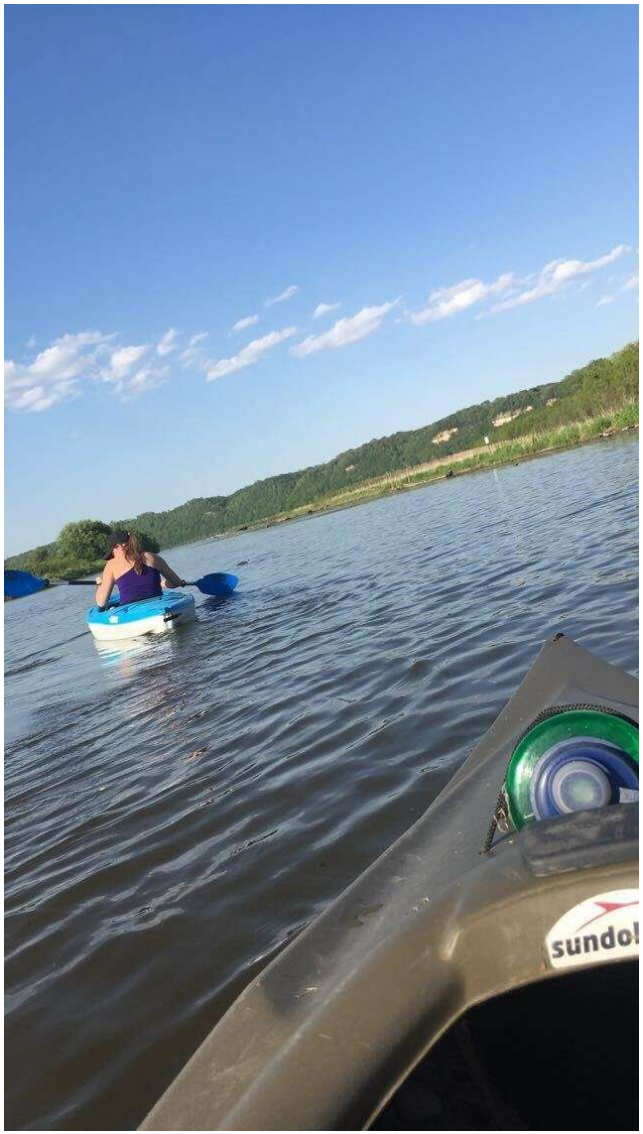
MPCA

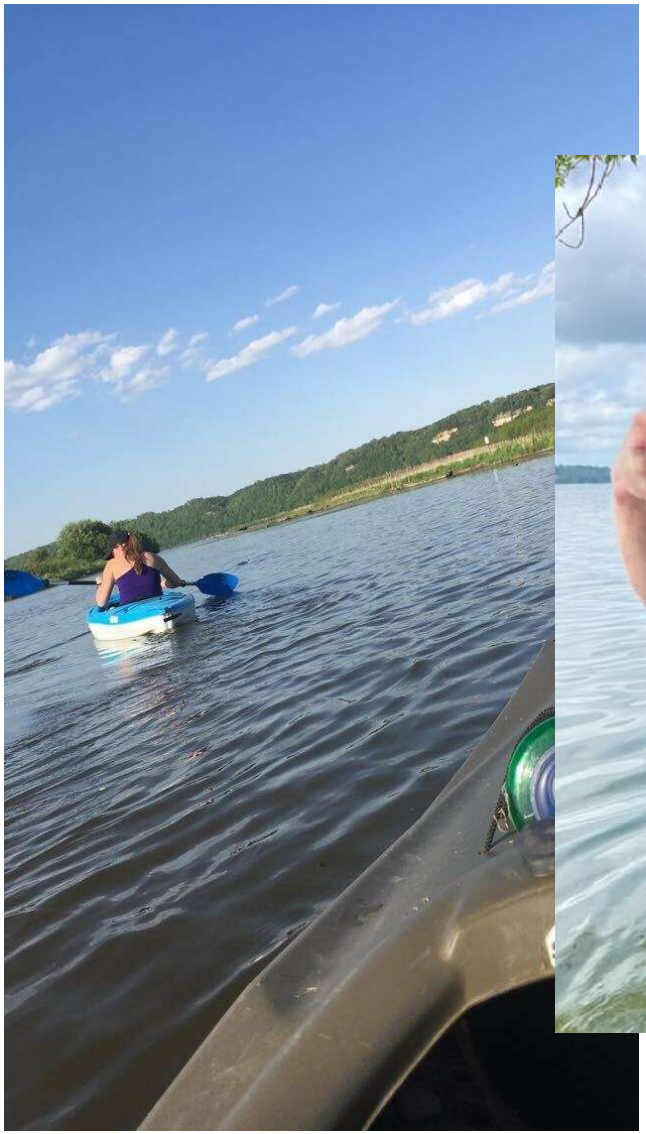
Jennifer Brentrup

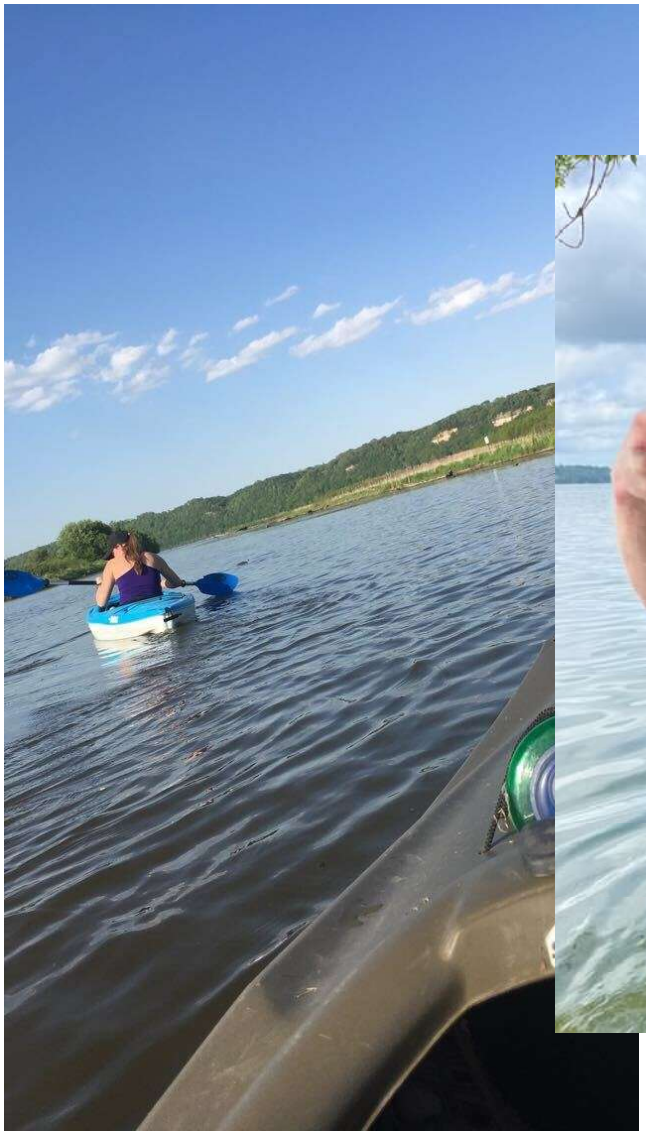
Great Lakes Indian Fish & Wildlife Commission

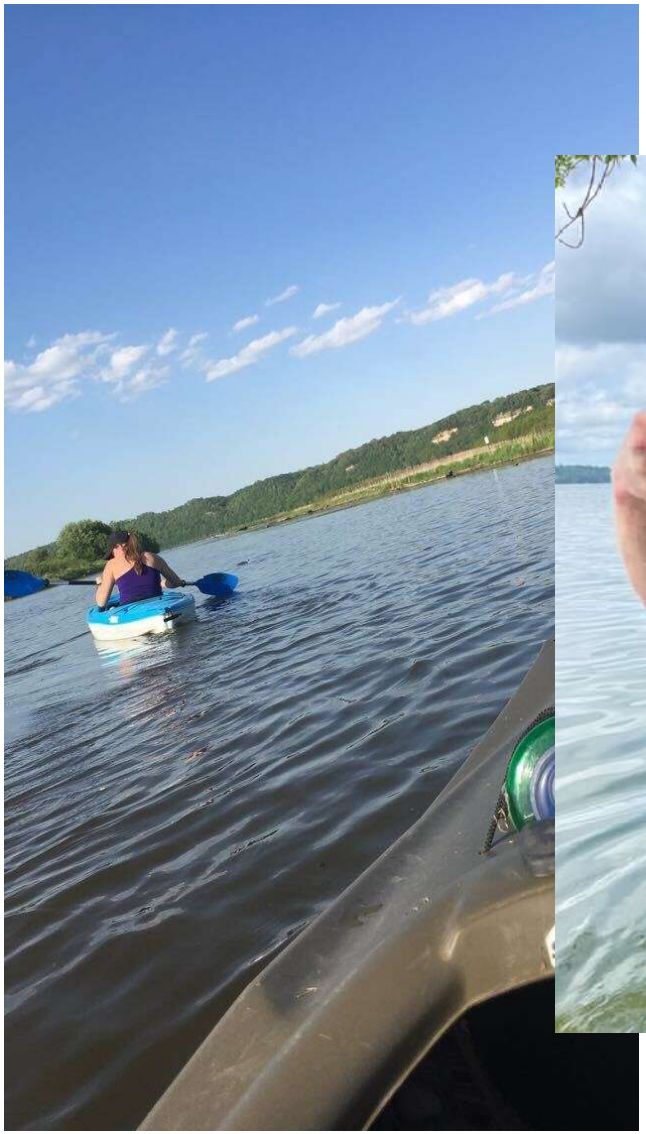
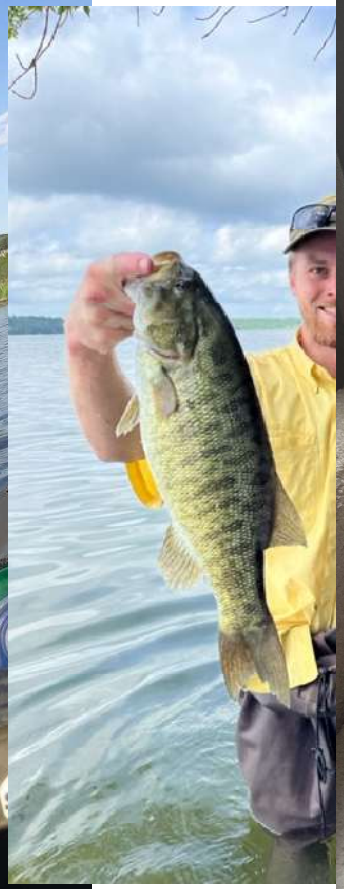
Caren Ackley
Mark Leuhring
Adam Ray

Erin Schliep


sundo



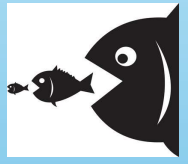


Outline

1. Mercury in fish

2. Zebra mussels



3. Zebra mussel impacts on Hg in fish

4. Preview of New Project

5. Q/A

The Minnesota Star Tribune

ENVIRONMENT

Health officials have new advice on what fish are safe to eat in Minnesota

The Minnesota Department of Health has a new warning for PFAS in the Vermillion River south of the Twin Cities, and a new method of determining whether fish in northeast Minnesota are low enough in mercury.

By Chloe Johnson
The Minnesota Star Tribune

APRIL 2, 2026 AT 12:00PM

The Minnesota Star Tribune

ENVIRONMENT

Health officials have new advice on what fish are saf

The Minnesota Depa
Vermillion River sou
whether fish in nort

By Chloe Johnson
The Minnesota Star Tribune

APRIL 2, 2026 AT 12:00PM

MPRnews
Stay Curious. Stay Connected.

Newsletters

Menu | Programs & Podcasts | Schedule | Ways to Give | Search | Sign in

Trouble by the water: Minnesota's lakes under threat

Dan Kraker · On Farm Lake, east of Ely, Minn. · August 5, 2025 4:00 AM · **UPDATED:** AUGUST 13, 2025 1:10 PM

Across northern Minnesota's pristine lake country, mercury contamination is growing

The Minnesota Star Tribune

ENVIRONMENT

Health officials have new advice on what fish are saf

The Minnesota Depa
Vermillion River sou
whether fish in nort

By Chloe Johnson
The Minnesota Star Tribune

APRIL 2, 2026 AT 12:00PM

MPRnews
Stay Curious. Stay Connected.

Newsletters

Menu | Programs & Podcasts | Schedule | Ways to Give | Search | Sign in

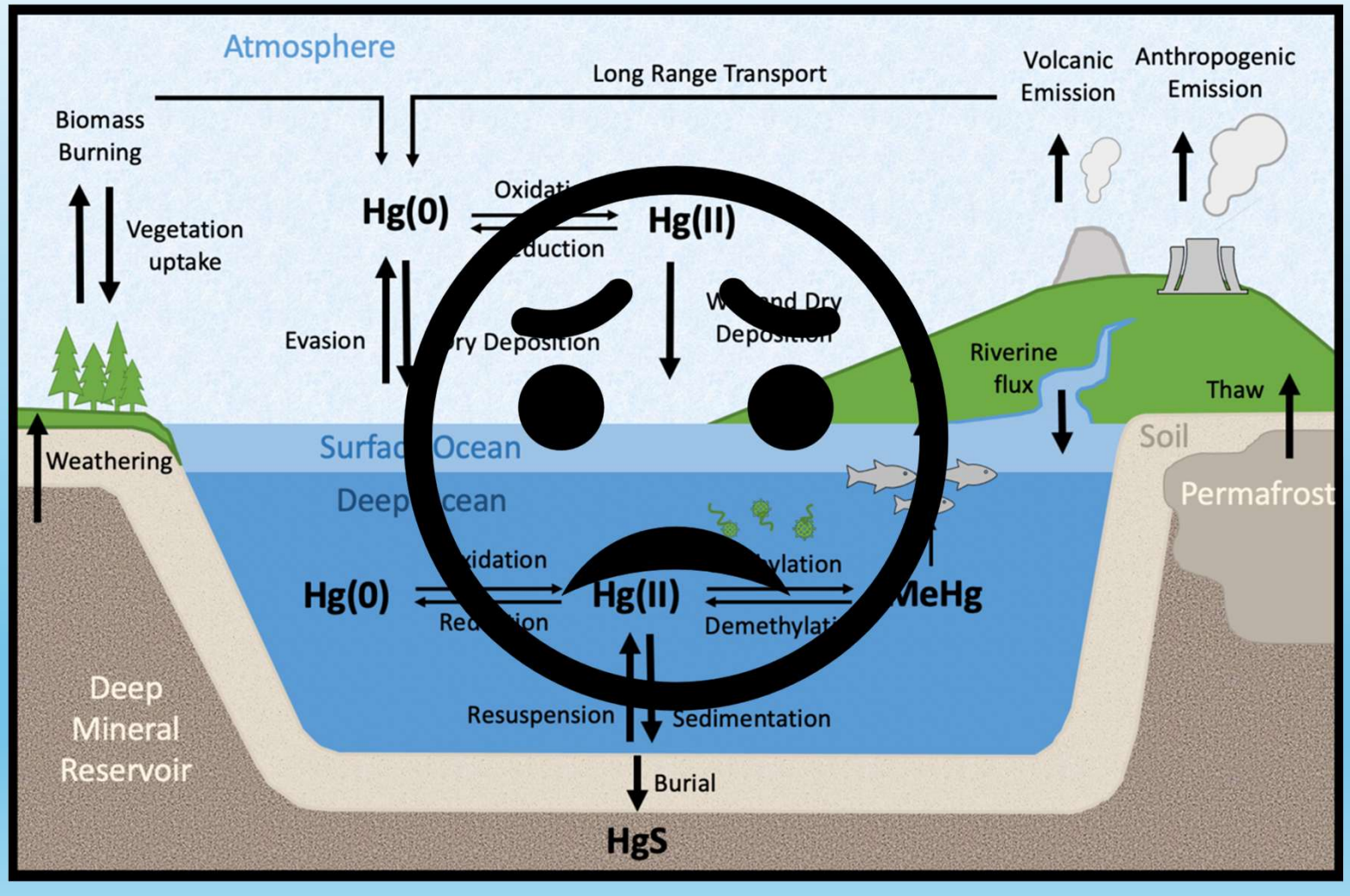
MN invasive zebra mussels linked to higher mercury levels in fish

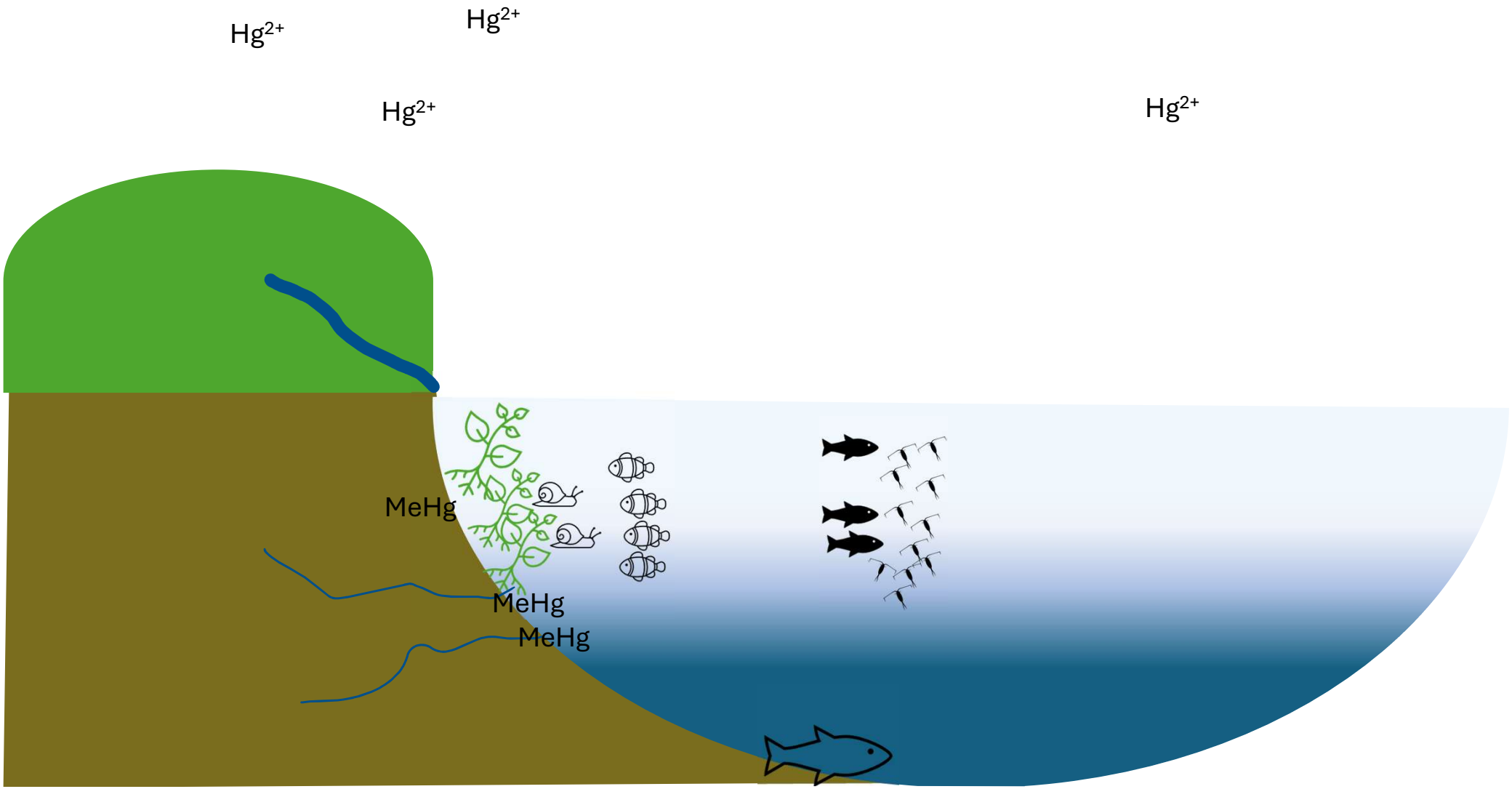
By Kilat Fitzgerald | Published November 20, 2024 5:08pm CST | Wild Nature | FOX 9 |

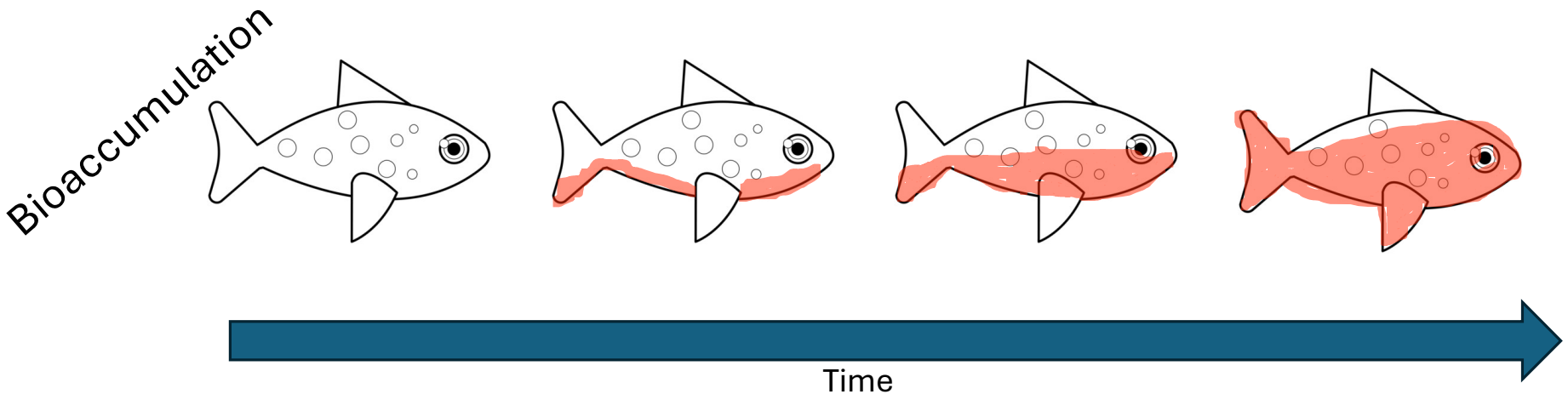
Why do we care Hg?

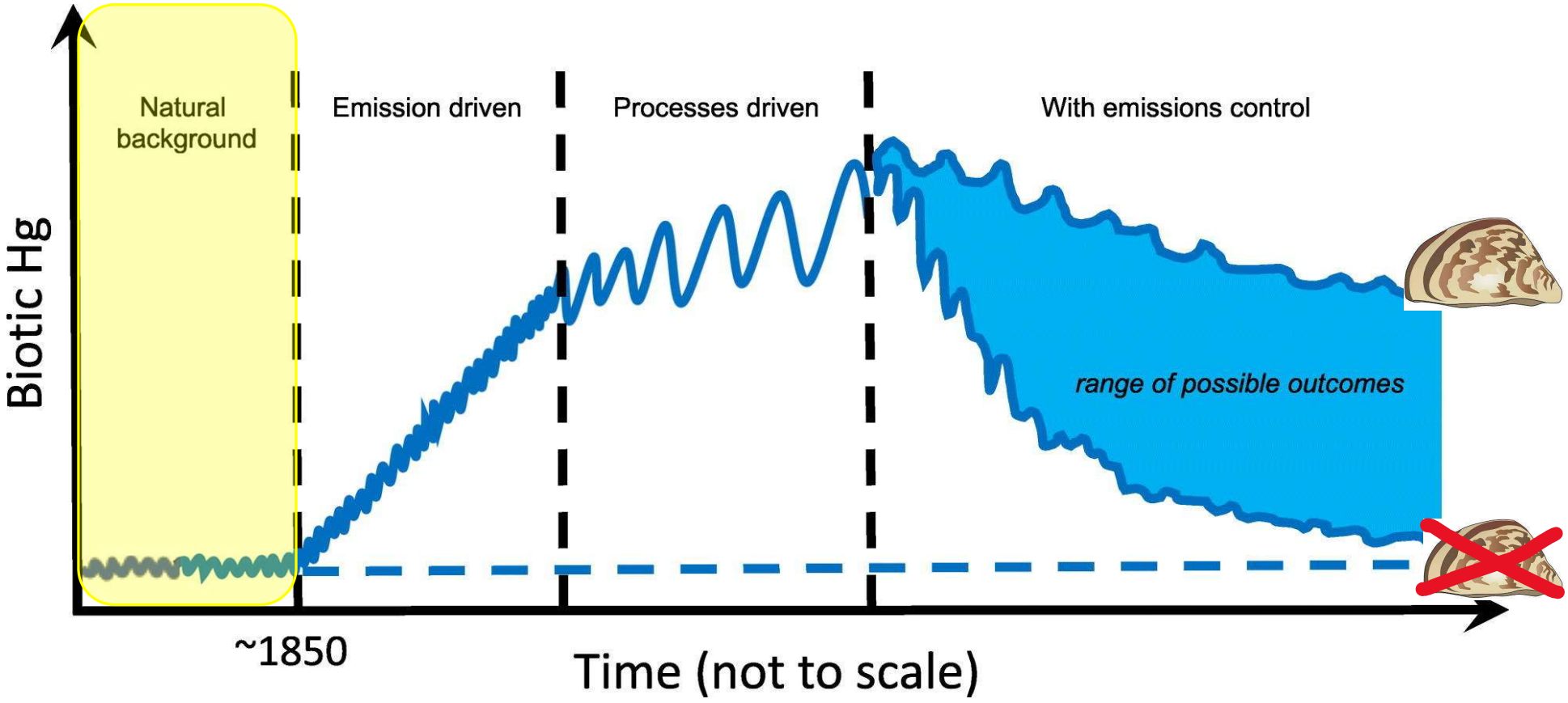
- Mercury is neurotoxin
  - Affects the brain and nervous system
- Risk varies by population
  - Unborn infants and children at most risk
  - Woman pregnant/planning to be pregnant
- Health effects
  - Nerve damage (vision, coordination)
  - Learning, memory, development problems in children
- Fish Health
  - Reduced growth and reproduction

The Mercury Cycle




Hg^{2+}
Hg^{2+}
Hg^{2+}
Hg^{2+}
MeHg
MeHg
MeHg


Bioaccumulation
Time



(Wang et al., 2019)

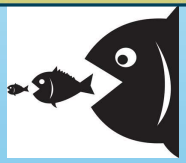
Why does lakes?

- Lakes are di
  - Watershed
    - Wetland
  - How big is
  - Within lake
    - Clarity, t
- Fish are diffe
  - Growth
  - Food web

Outline

1. Mercury in fish

2. Zebra mussels



3. Zebra mussel impacts on Hg in fish

4. Preview of New Project

5. Q/A

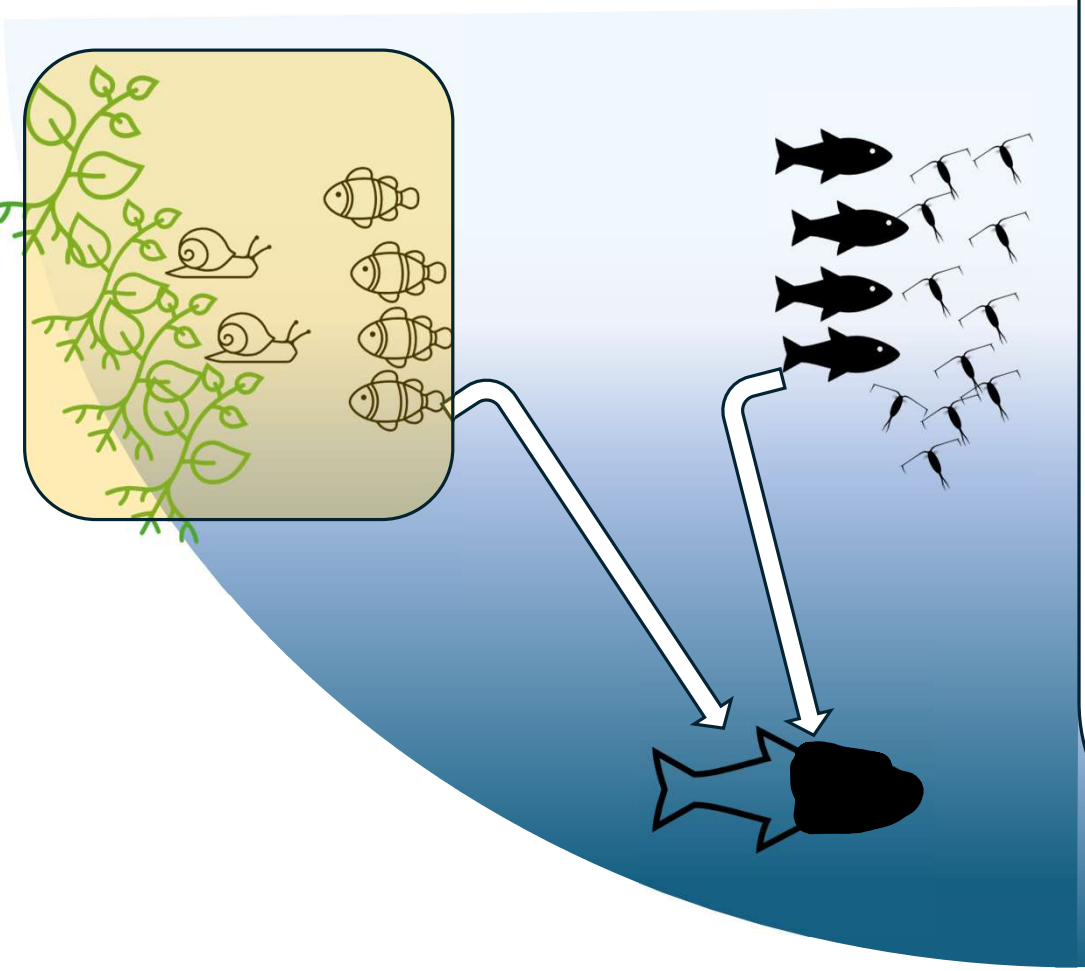
Zebra Mussel (*Dreissena polymorpha*)

- North America 1988
- 300+ Minnesota lakes
- Hinder basic lake enjoyment
- Cause ecological harm
  - Alter **food webs**, and **chemical processes**


MAISRC


UMN News

Uninvaded



Snopes

Science of The Total Environment
Volume 957, 20 December 2024, 177515

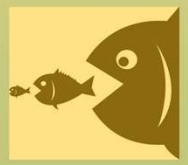
Increased mercury concentrations in walleye and yellow perch in lakes invaded by zebra mussels

Naomi S. Blinick [a], Denver Link [a], Tyler D. Ahrenstorff [b], Bethany J. Bethke [b], Abram B. Fleishman [c], Sarah E. Janssen [d], David P. Krabbenhoft [d], Jenna K.R. Nelson [a f 1], Heidi M. Rantala [b], Claire L. Rude [a e 1], Gretchen J.A. Hansen [a]

Outline

1. Mercury in fish

2. Zebra mussels



3. Zebra mussel impacts on Hg in fish

4. Preview of New Project

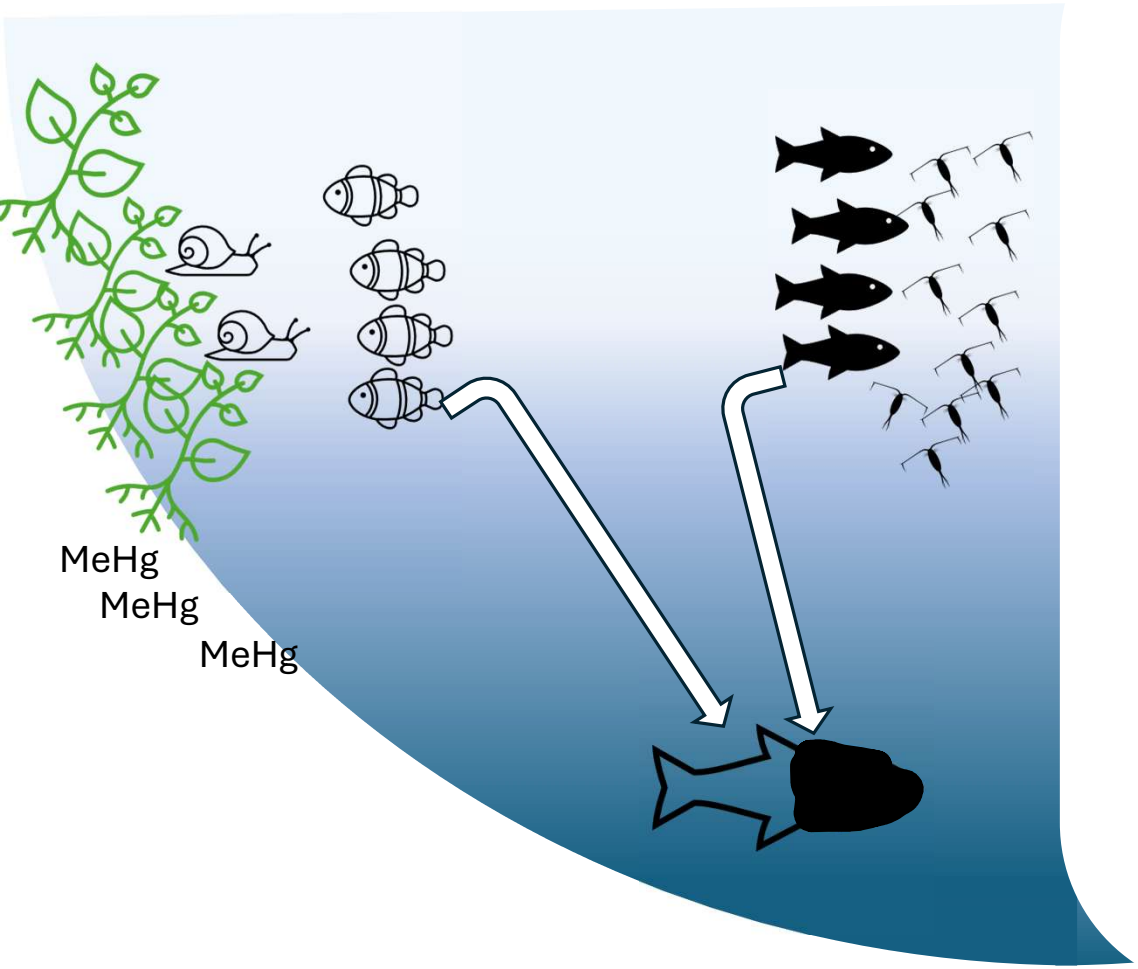
5. Q/A

Hg

Hg

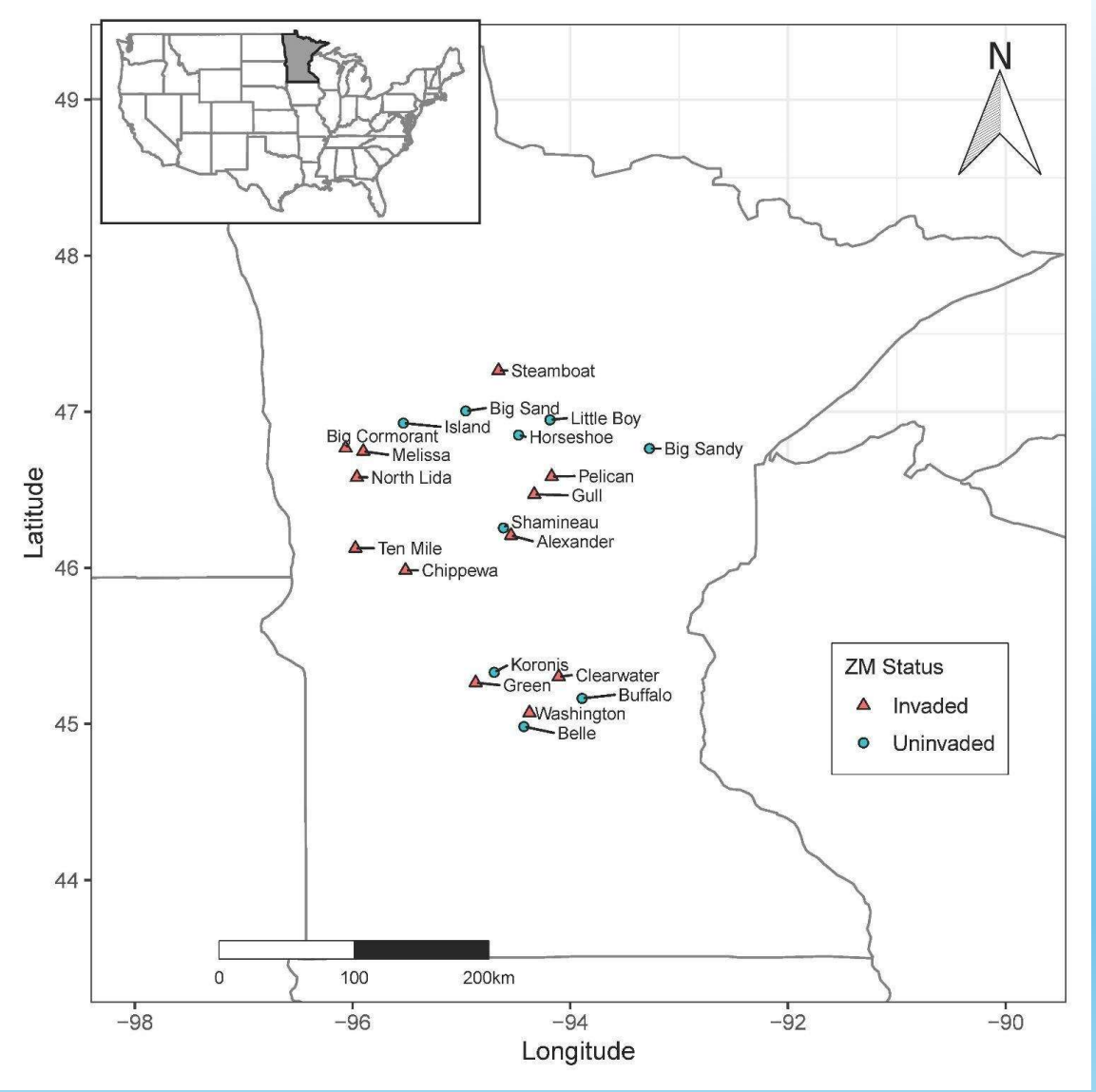
Hg

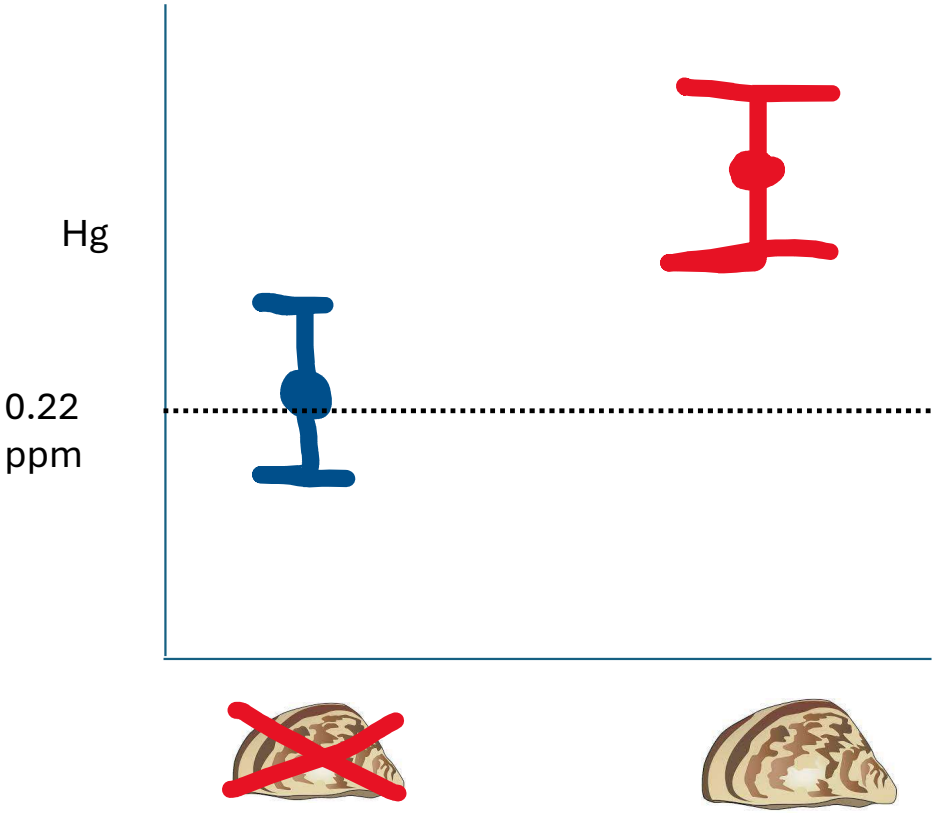
Uninvaded

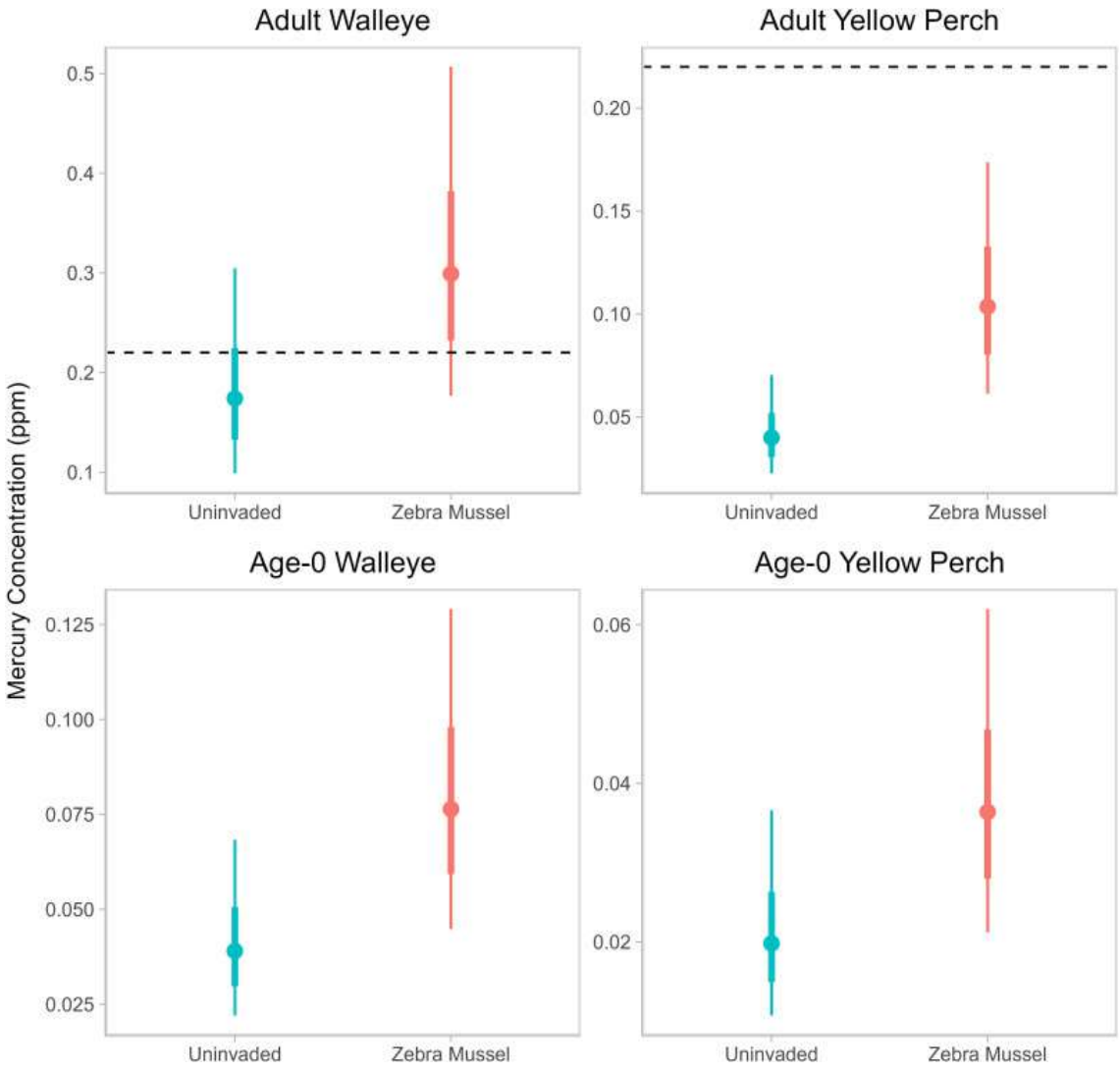


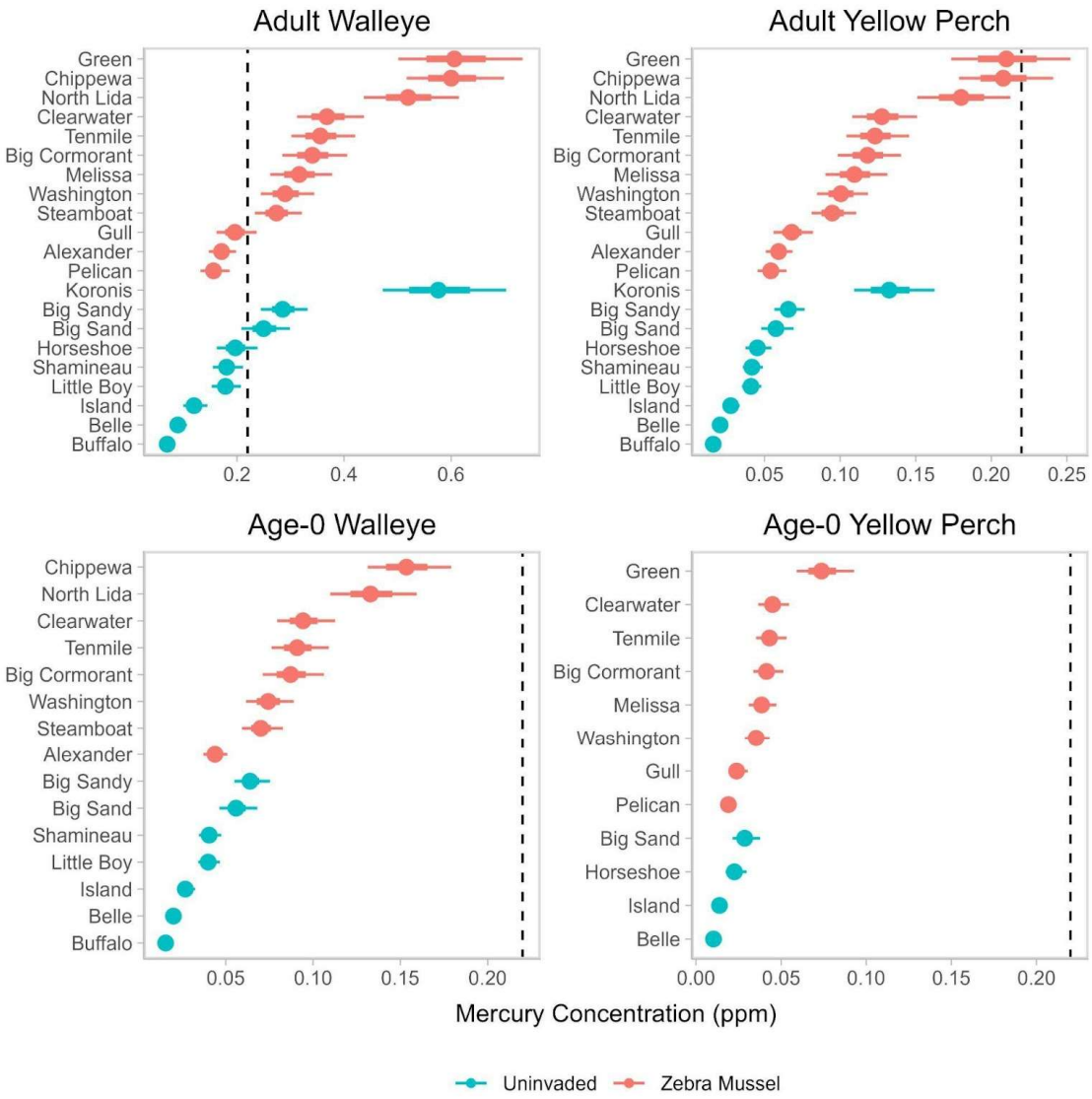
Initial study

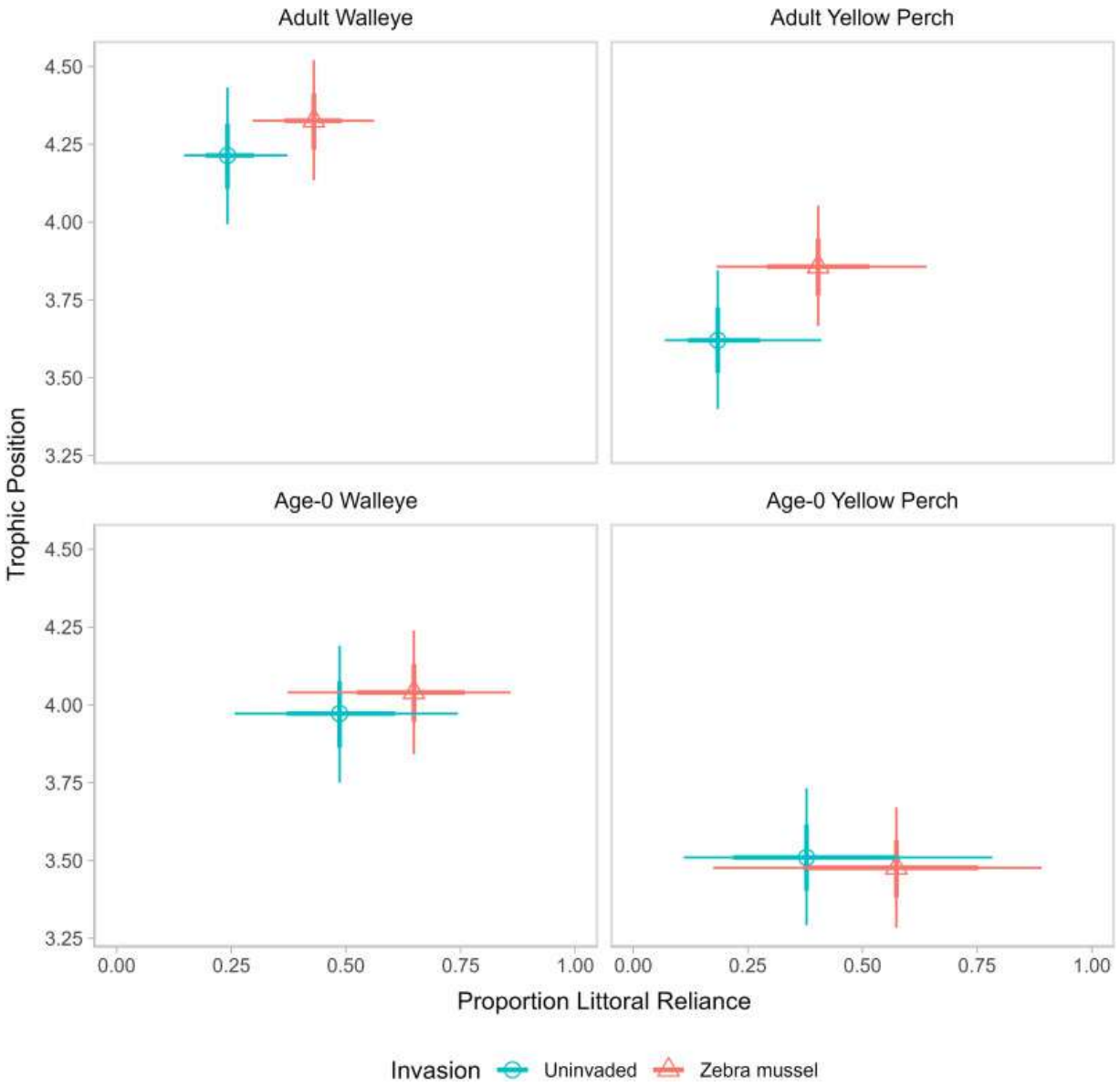
- Compare zebra mussel lakes to lakes not (yet) invaded
  - Careful lake selections
- Hg, energy resources




Hg
0.22
ppm

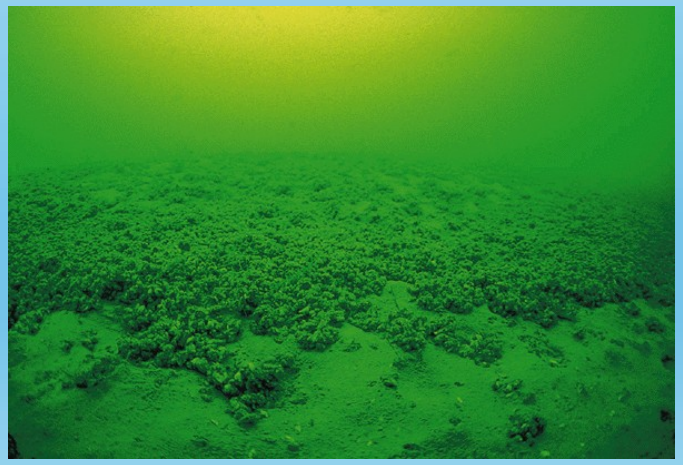

Adult Walleye
Adult Yellow Perch
Age-0 Walleye
Age-0 Yellow Perch
Mercury Concentration (ppm)
0.5
0.4
0.3
0.2
0.1
0.20
0.15
0.10
0.05
0.125
0.100
0.075
0.050
0.025
0.06
0.04
0.02
Uninvaded
Zebra Mussel

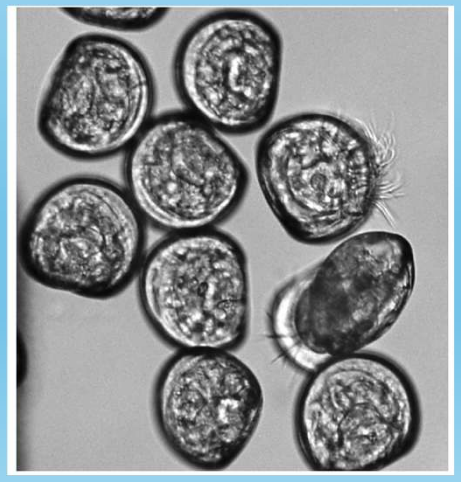

Adult Walleye
Green
Chippewa
North Lida
Clearwater
Tenmile
Big Cormorant
Melissa
Washington
Steamboat
Gull
Alexander
Pelican
Koronis
Big Sandy
Big Sand
Horseshoe
Shamineau
Little Boy
Island
Belle
Buffalo
0.2
0.4
0.6
Adult Yellow Perch
Green
Chippewa
North Lida
Clearwater
Tenmile
Big Cormorant
Melissa
Washington
Steamboat
Gull
Alexander
Pelican
Koronis
Big Sandy
Big Sand
Horseshoe
Shamineau
Little Boy
Island
Belle
Buffalo
0.05
0.10
0.15
0.20
0.25
Age-0 Walleye
Chippewa
North Lida
Clearwater
Tenmile
Big Cormorant
Washington
Steamboat
Alexander
Big Sandy
Big Sand
Shamineau
Little Boy
Island
Belle
Buffalo
0.05
0.10
0.15
0.20
Age-0 Yellow Perch
Green
Clearwater
Tenmile
Big Cormorant
Melissa
Washington
Gull
Pelican
Big Sand
Horseshoe
Island
Belle
0.00
0.05
0.10
0.15
0.20
Mercury Concentration (ppm)
Uninvaded
Zebra Mussel


Adult Walleye
Adult Yellow Perch
Age-0 Walleye
Age-0 Yellow Perch
Trophic Position
4.50
4.25
4.00
3.75
3.50
3.25
0.00
0.25
0.50
0.75
1.00
Proportion Littoral Reliance
Invasion
Uninvaded
Zebra mussel

Do these patterns hold for most lakes?

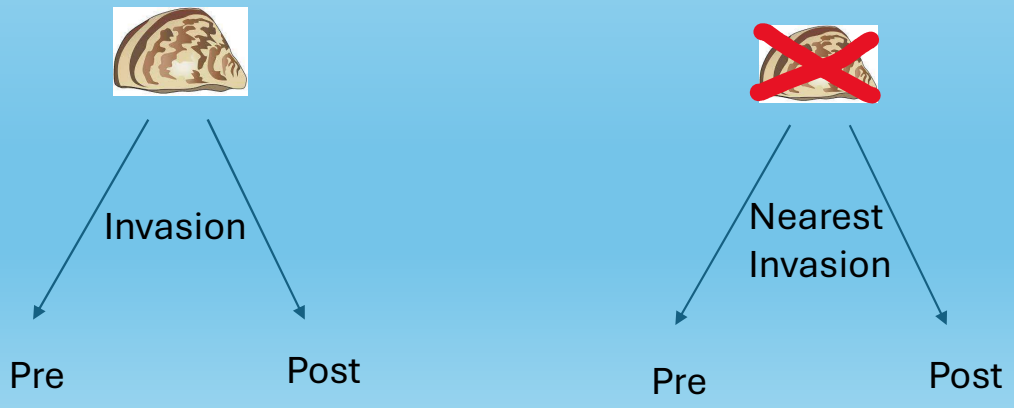
- Initial study focused on heavily invaded lakes
  - “worst-case” scenarios
  - ZM densities vary
- Do we see the same patterns everywhere?





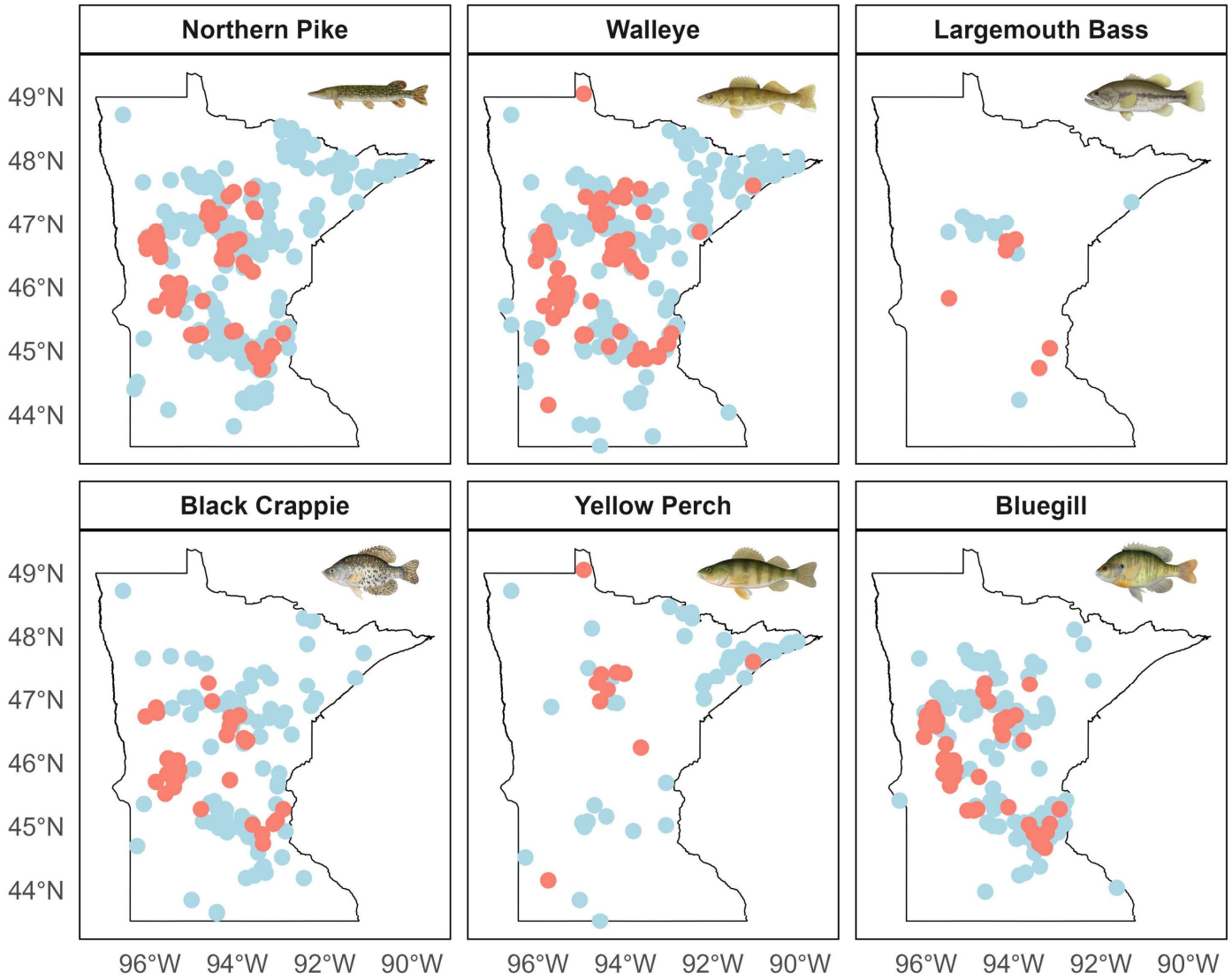
Mercury trends before and after ZM

- Comparing lakes has challenges
  - Naturally different, hard to “perfectly” match
- Before-After-Control-Impact (BACI)
  - Compare changes in the same lake after disturbance
  - How does this change compare to “reference” systems?

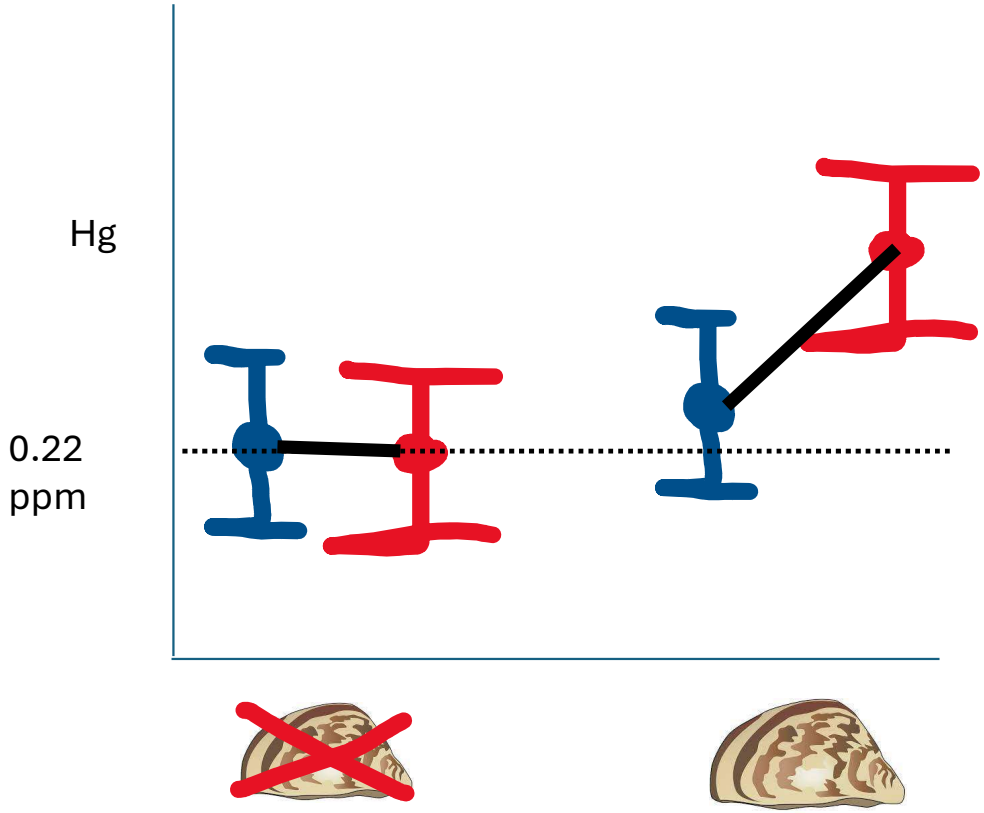


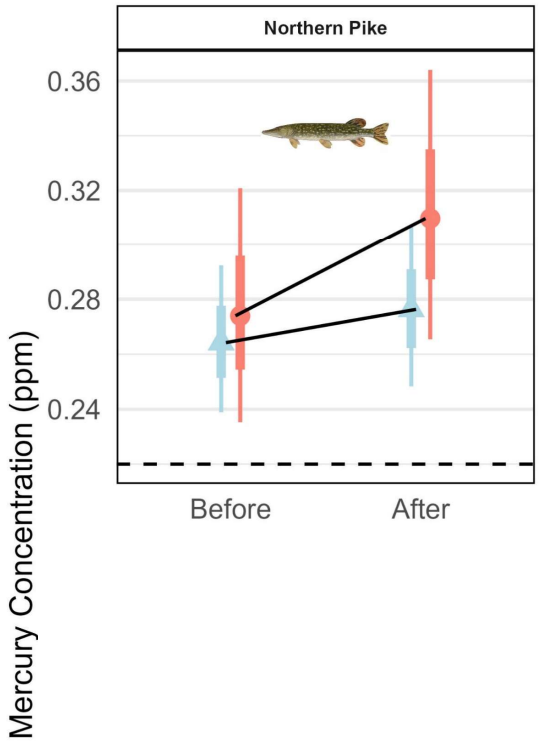
Statewide monitoring data

Updated for 2026!
https://www.health.state.mn.us/communities/environment/fish/guidance/updatehgpfas.html

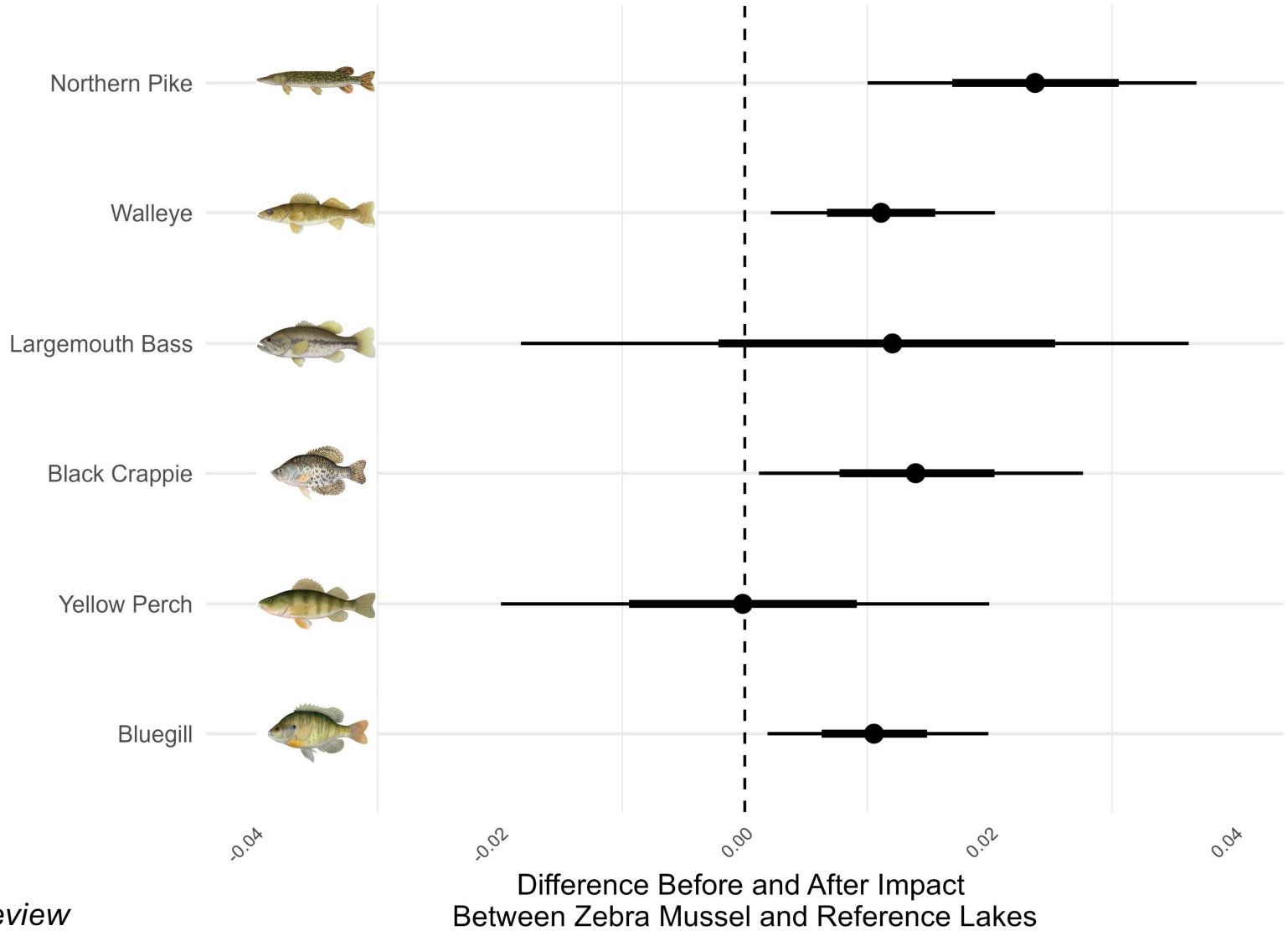

Northern Pike
Walleye
Largemouth Bass
Black Crappie
Yellow Perch
Bluegill
49°N
48°N
47°N
46°N
45°N
44°N
96°W
94°W
92°W
90°W

What might we expect? - BACI

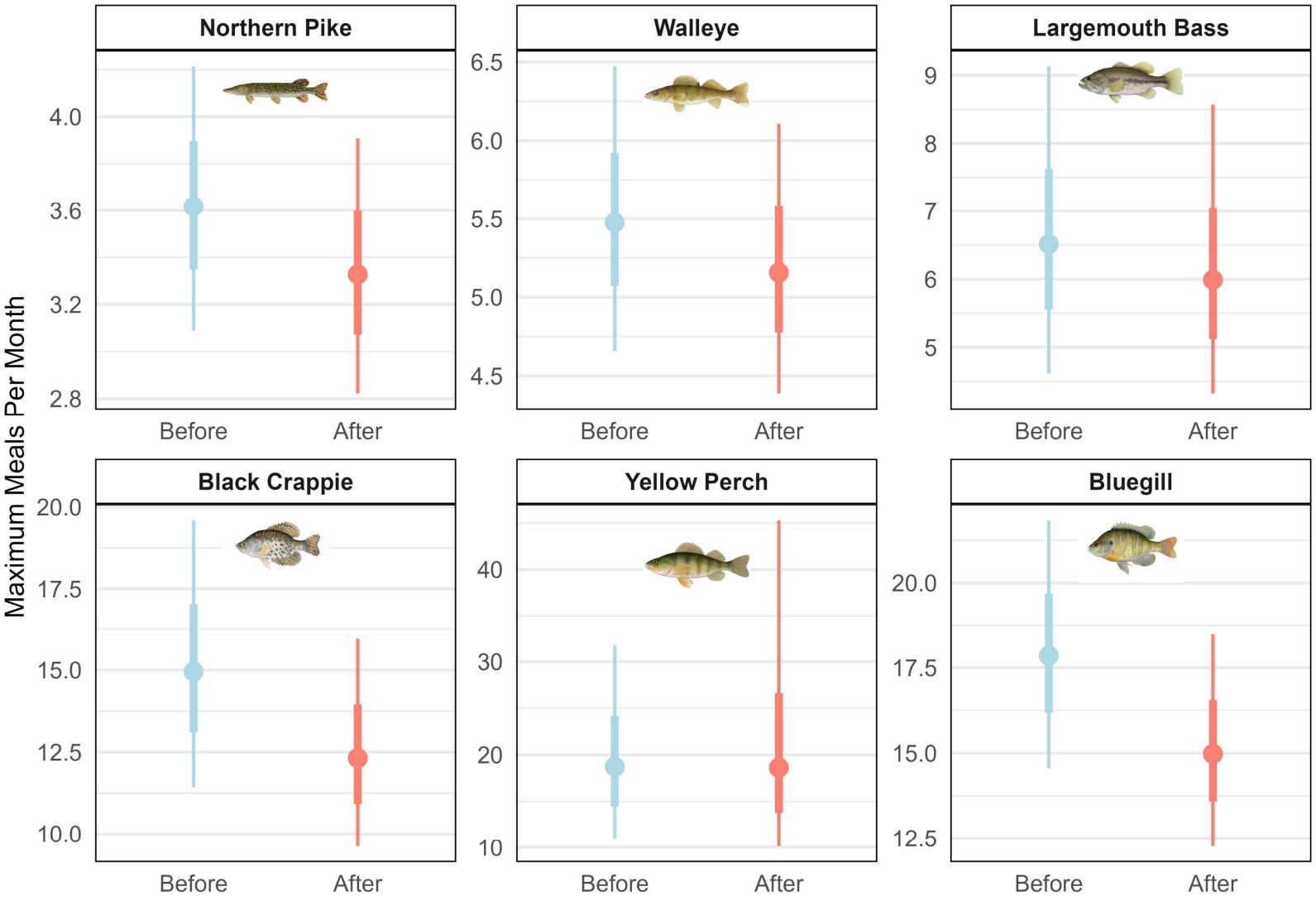




Link et al. *in review*



Link et al. *in review*



Does the change matter?

How many 8 oz meals can a pregnant woman eat per month before surpassing harmful threshold?

Link et al. *in review*

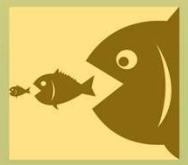
Quick recap

- Mercury is in our lakes
  - Stored in the sediment
- Lake conditions control risk
  - Some conditions flip on the methylation switch
- Zebra mussels change the risk
  - Methylation conditions, food webs, growth
- We see this pattern
  - Comparing across lakes
  - Within lakes over time

Outline

1. Mercury in fish

2. Zebra mussels



3. Zebra mussel impacts on Hg in fish

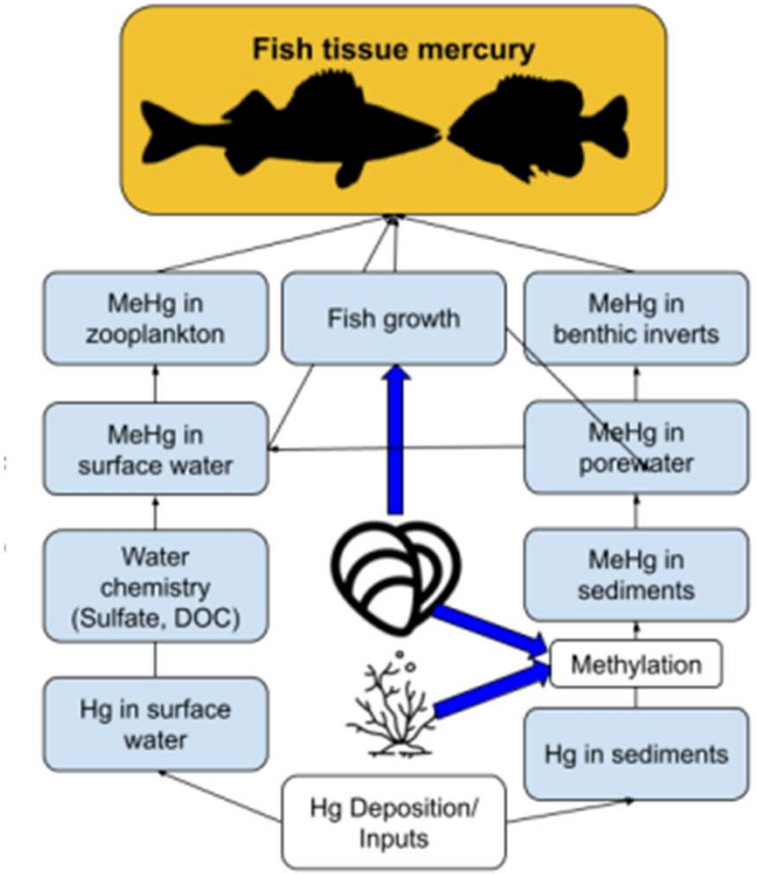
4. Preview of New Project

5. Q/A

Exploring the Mechanisms

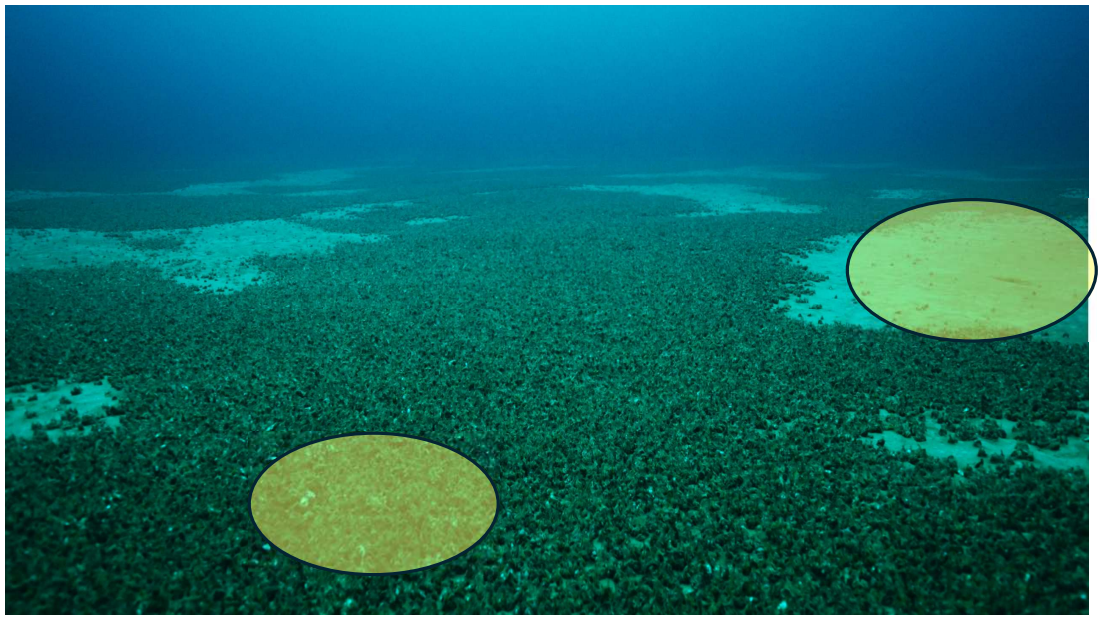
So far we have the “what”

Now we are exploring the “why”



Study design

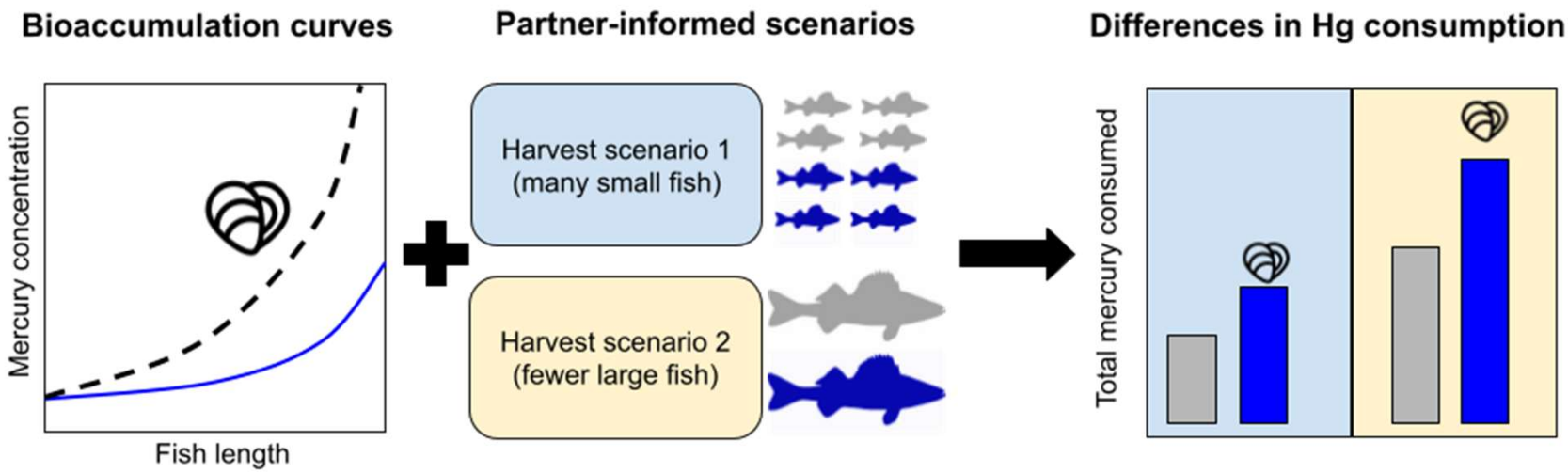
12 study systems: ZM, SSW, Both, Uninvaded



Collect:

- Sediment
- Porewater
- Surface water
- Primary producers
- Invertebrates
- Fish

How does mercury cycle in the same system at sites with and without AIS?


Bioaccumulation curves
Mercury concentration
Fish length
Partner-informed scenarios
Harvest scenario 1
(many small fish)
Harvest scenario 2
(fewer large fish)
Differences in Hg consumption
Total mercury consumed

Mitigating Risk

Develop tools so that we can better assess mercury risk across the landscape

Waterbody Specific Fish Consumption Guidelines

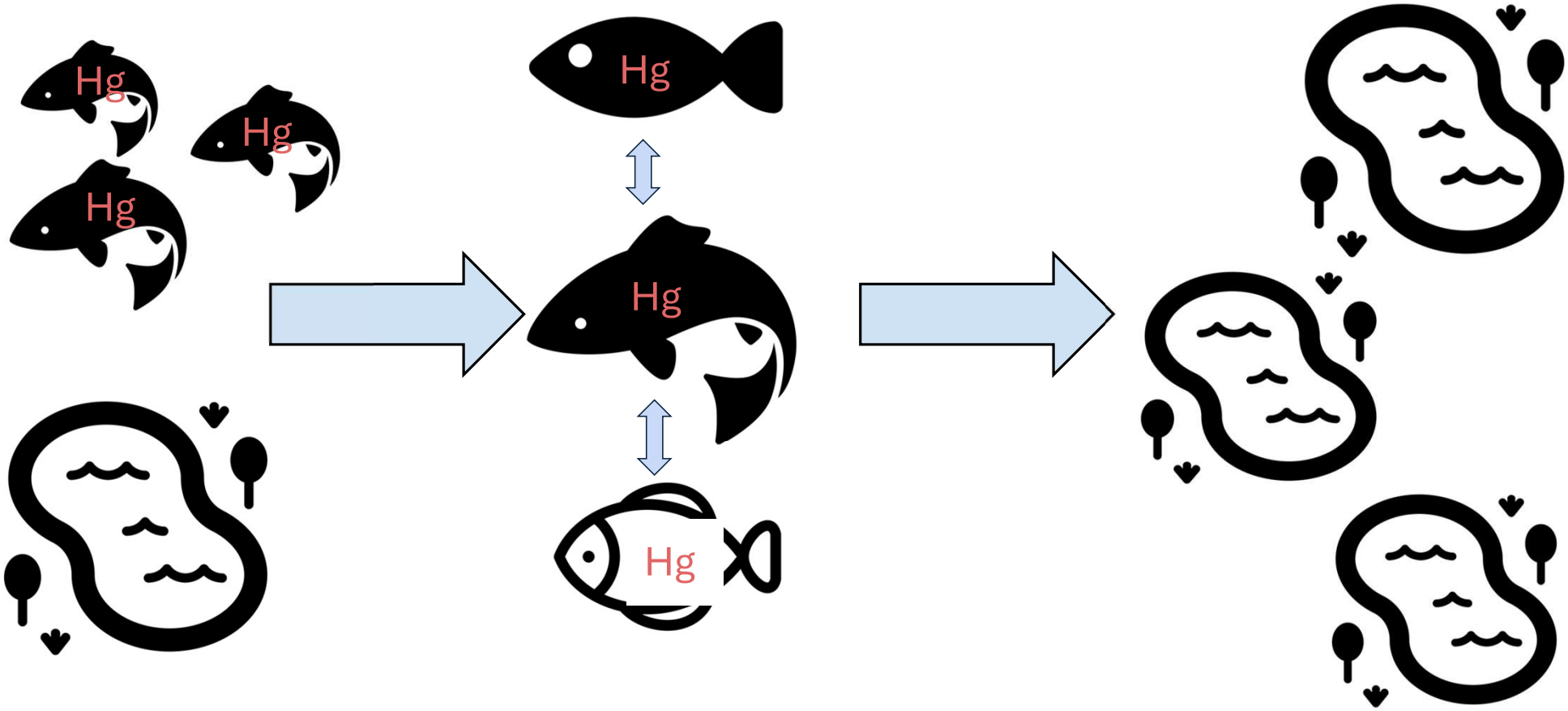
Sensitive populations: children under age 15; girls, women, and people age 15 and older who may become pregnant, people who are pregnant, people who are breastfeeding or plan to breastfeed

LAKE NAME County, DOWID	Species	Meal Advice: 1 serving/month	Meal Advice: do not eat	Contaminants
GREEN KANDIYOHI Co., 34007900	bullhead	all sizes		Mercury
	yellow perch	all sizes		Mercury

General populations: people not planning to become pregnant; boys and men age 15 and older

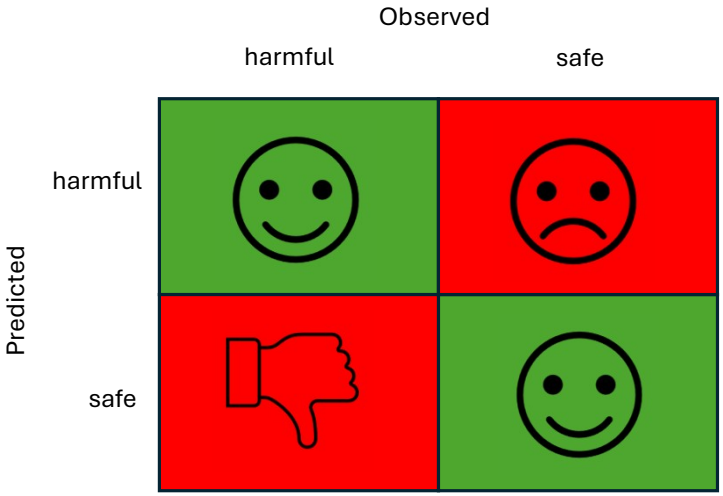
LAKE NAME County, DOWID	Species	Meal Advice: 2 servings/ week	Meal Advice: 1 serving/ week	Meal Advice: 1 serving/ month	Meal Advice: do not eat	Contaminants
GREEN KANDIYOHI Co., 34007900	bullhead		all sizes			Mercury
	yellow perch	all sizes				Mercury

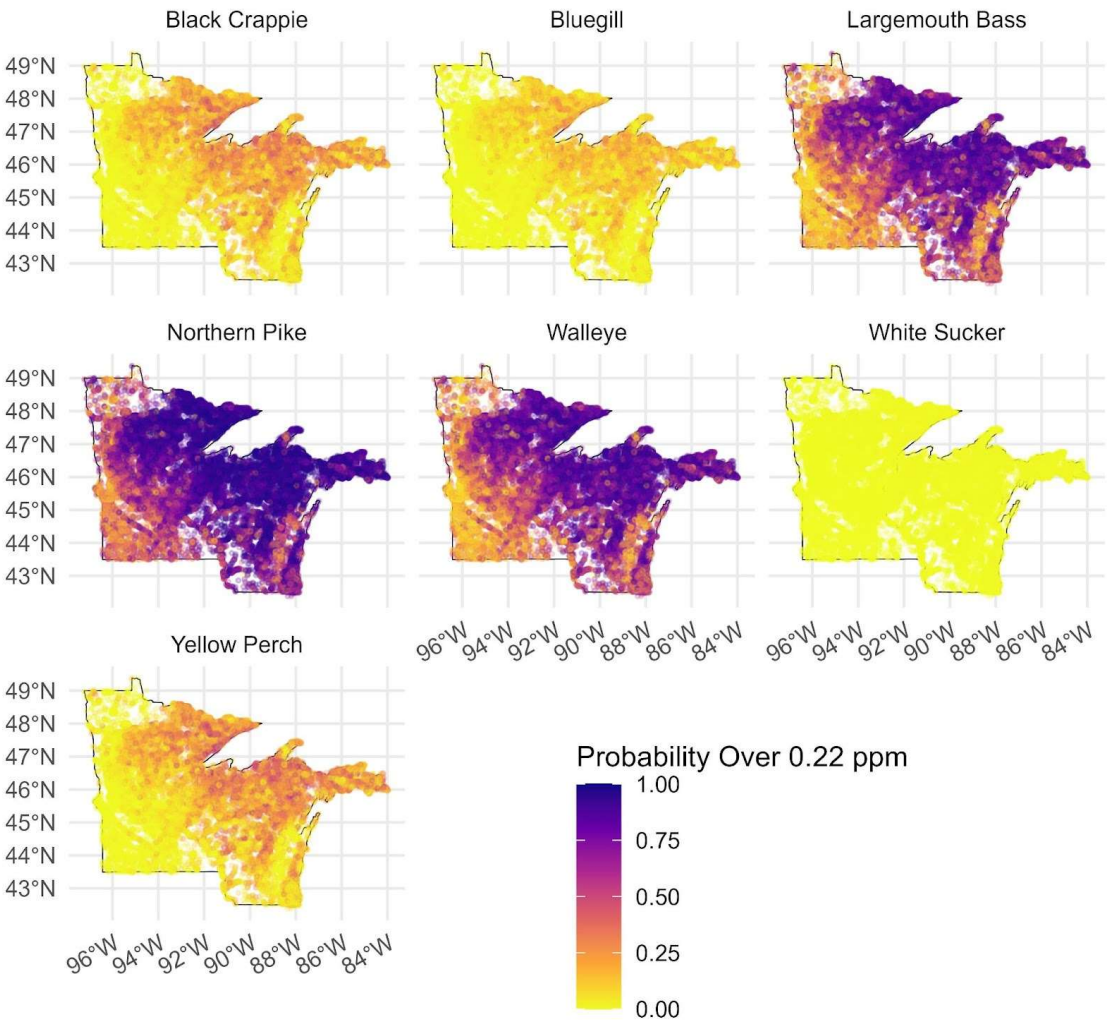
How well can we estimate mercury in unsampled lakes?

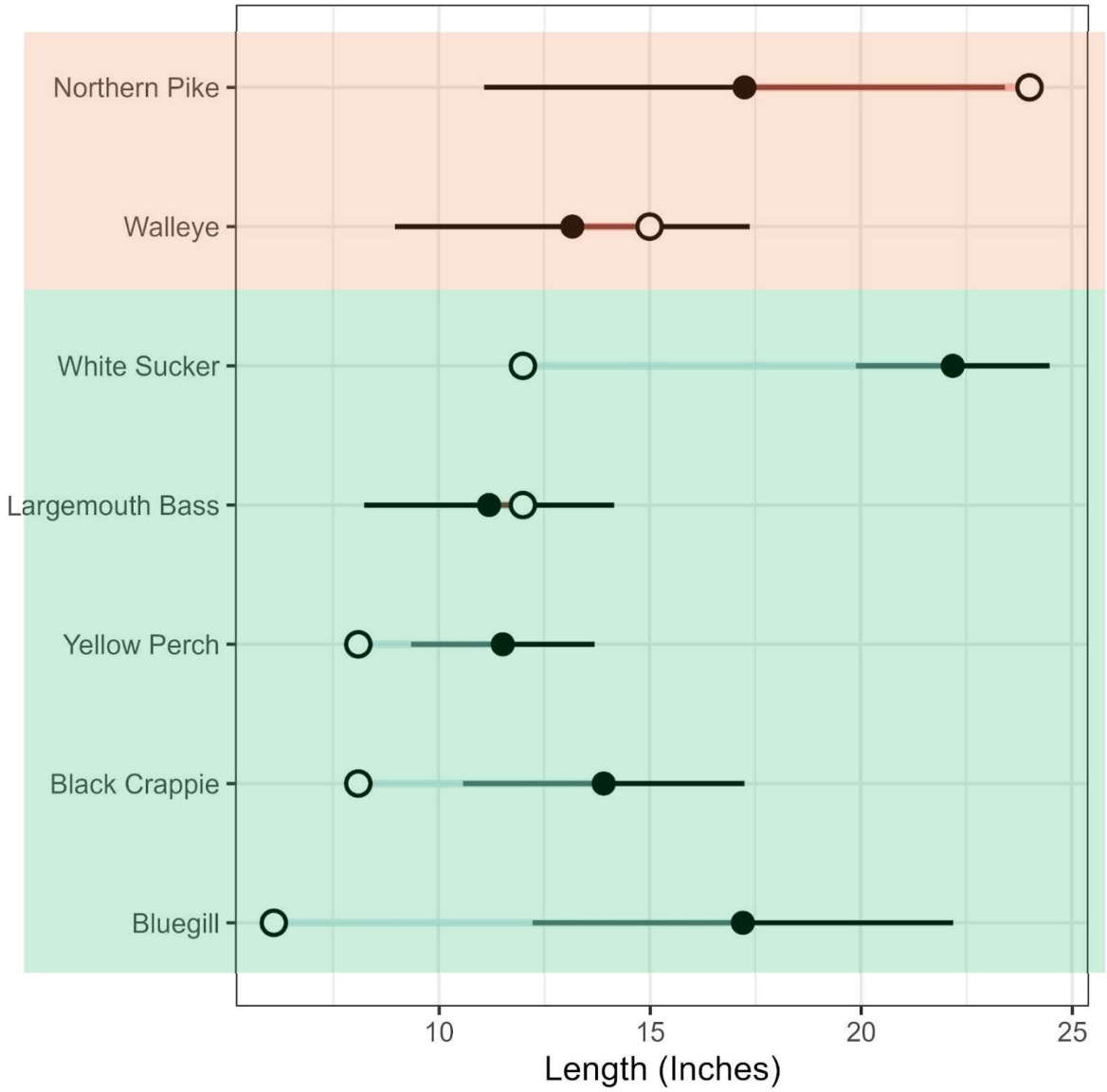


Can we predict if fish are above the advisory threshold?

- Predict based on lake data
- Is that prediction above or below 0.22 ppm?




Black Crappie
Bluegill
Largemouth Bass
Northern Pike
Walleye
White Sucker
Yellow Perch
49°N
48°N
47°N
46°N
45°N
44°N
43°N
96°W
94°W
92°W
90°W
88°W
86°W
84°W
Probability Over 0.22 ppm
1.00
0.75
0.50
0.25
0.00


Northern Pike
Walleye
White Sucker
Largemouth Bass
Yellow Perch
Black Crappie
Bluegill
10
15
20
25
Length (Inches)

Fish Mercury Explorer

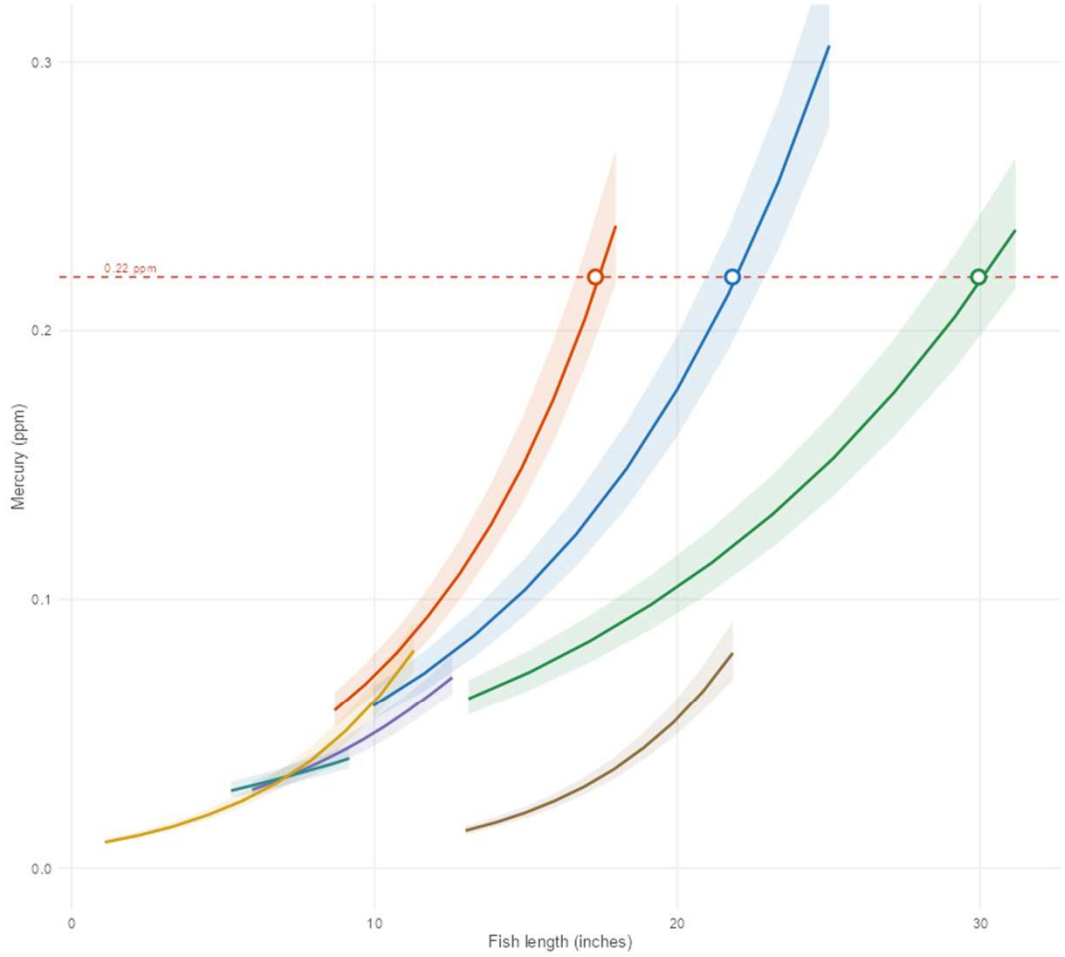
Select lake

Forest Lake (ID: 552)

DATA AVAILABLE BY SPECIES

- Black Crappie — Other species
- Bluegill — This species (n=2)
- Largemouth Bass — This species (n=6)
- Northern Pike — This species (n=16)
- Walleye — Other species
- White Sucker — Other species
- Yellow Perch — This species (n=1)

Forest Lake, Minnesota



Lake Information

Variable	Value
Year last sampled	2023
Lake area (ha)	914
Watershed:lake ratio	2
Wetland woodland %	4
Emergent wetland %	15
Mixed forest %	7
Conifer forest %	1
Deciduous forest %	18

Fish Mercury Explorer

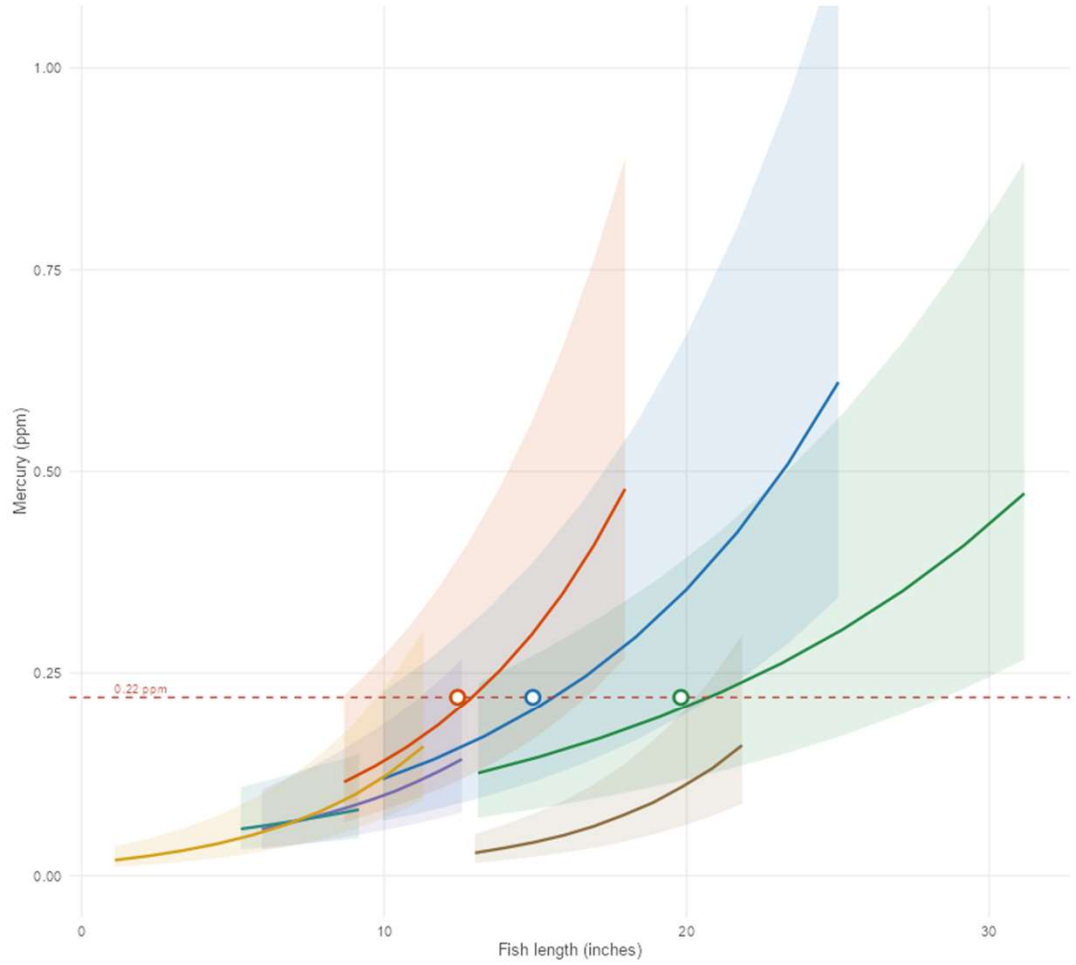
Select lake

Comfort Lake (ID: 4115)

DATA AVAILABLE BY SPECIES

- Black Crappie — No data
- Bluegill — No data
- Largemouth Bass — No data
- Northern Pike — No data
- Walleye — No data
- White Sucker — No data
- Yellow Perch — No data

Comfort Lake, Minnesota



Lake Information

Variable	Value
Year last sampled	1990
Lake area (ha)	86
Watershed:lake ratio	23
Wetland woodland %	5
Emergent wetland %	28
Mixed forest %	2
Conifer forest %	1
Deciduous forest %	12

Dr. Gretchen Hansen
ghansen@umn.edu

Denver Link
linkx168@umn.edu

Naomi Blinick
nblinick@umn.edu

Lab Website:
https://gretchenhansen.squarespace.com/