St. Louis River Watershed Mercury Total Maximum Daily Load Study

Statewide Mercury TMDL Meeting

MINNESOTA POLLUTION CONTROL AGENCY

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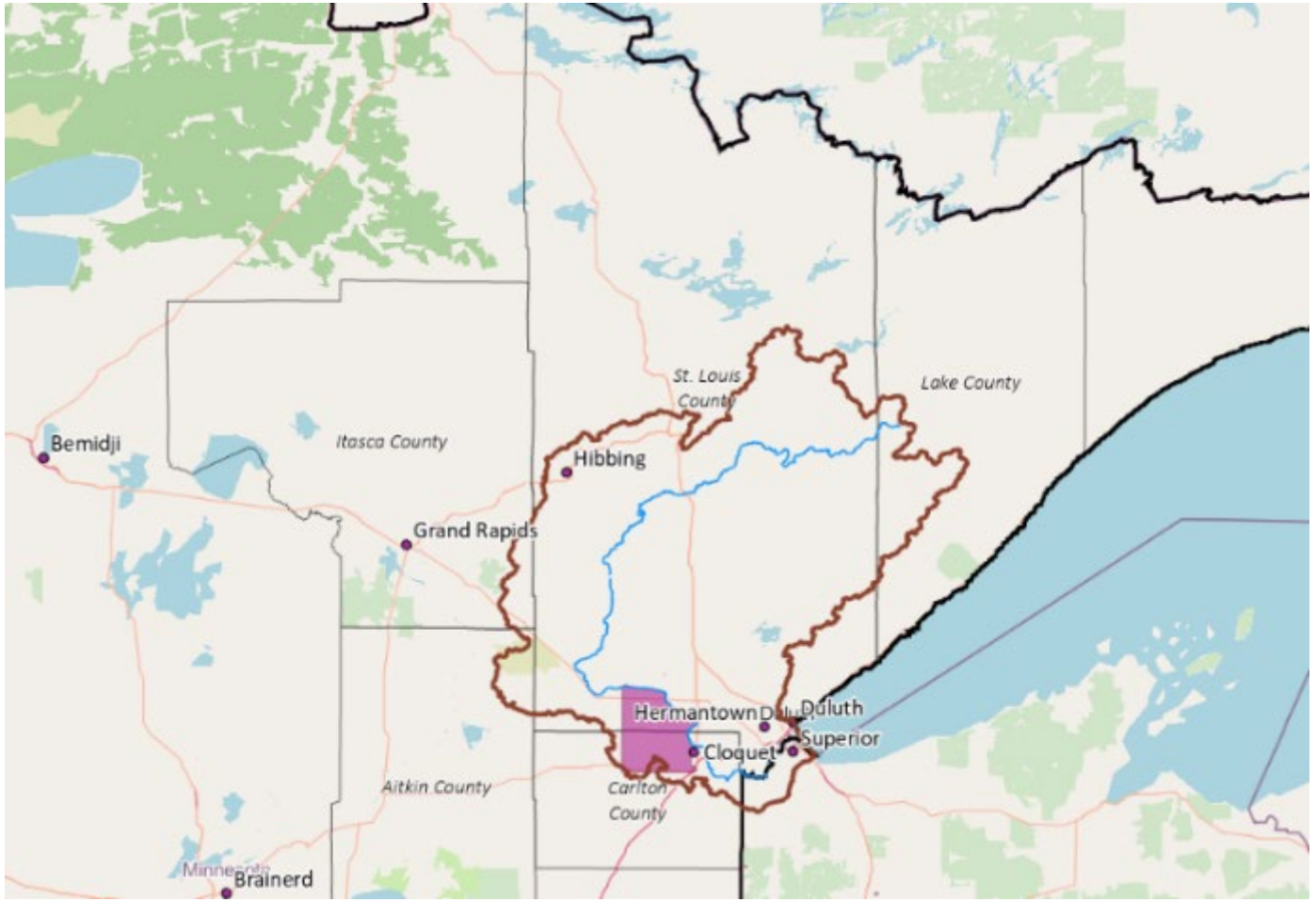
Agenda

- Introduction to the St. Louis River Watershed (SLRW) mercury TMDL study
- Mercury trends in the SLRW: water and fish
- Mercury deposition study

Why this project?

- Human health effects of consumption of mercury in fish: neurotoxin and reproductive toxin
- Many lakes and streams with high levels of mercury in fish and water in the St. Louis River Watershed



Multiple programs to reduce mercury

Addressing mercury — how multiple programs work together

Federal and state programs work to reduce mercury in the St. Louis River Watershed.

www.pca.state.mn.us/slr-mercury

MERCURY SOURCES

Legacy aquatic sediment contamination (before 1970s environmental regulations)

Atmospheric deposition
Local, regional, and global sources emit mercury to the air that is deposited on the landscape

PROGRAMS

St. Louis River Area of Concern (AOC)
Addresses legacy sediment sources

St. Louis River Total Maximum Daily Load (TMDL)
Addresses mercury concentration in fish >.572 mg/kg

Statewide Total Maximum Daily Load (TMDL)
Addresses mercury concentration in fish >.2 mg/kg

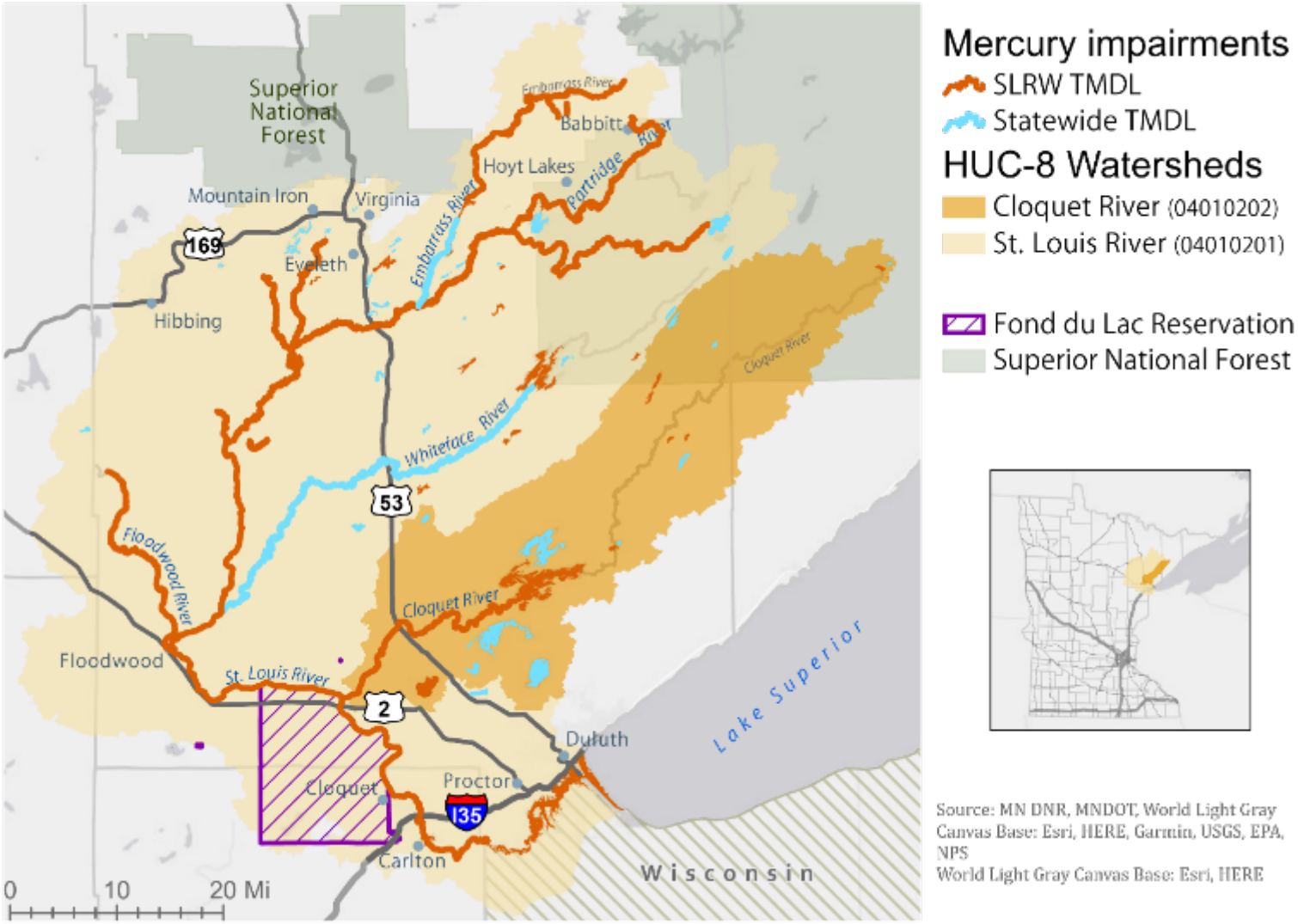
GOALS

Reduction of legacy mercury from sediment into the food web

Reduction of atmospheric mercury sources

Improve human and environmental health

Mercury impairments in St. Louis River Watershed



Mercury impairments

SLRW TMDL

Statewide TMDL

HUC-8 Watersheds

Cloquet River (04010202)

St. Louis River (04010201)

Fond du Lac Reservation

Superior National Forest

Source: MN DNR, MNDOT, World Light Gray Canvas Base: Esri, HERE, Garmin, USGS, EPA, NPS
World Light Gray Canvas Base: Esri, HERE

Refresher: Total Maximum Daily Load (TMDL)

Monitoring and assessment → **303(d) list of impaired waters** → **TMDL development**

- Lakes and streams that don't meet state water quality standards (impaired)
- TMDL: maximum amount of a pollutant a body of water can receive without exceeding WQS
- Identify sources & set reduction goals on pollutants entering impaired waters
- Planning tools for improving water quality

THE MATH AND THE PATH

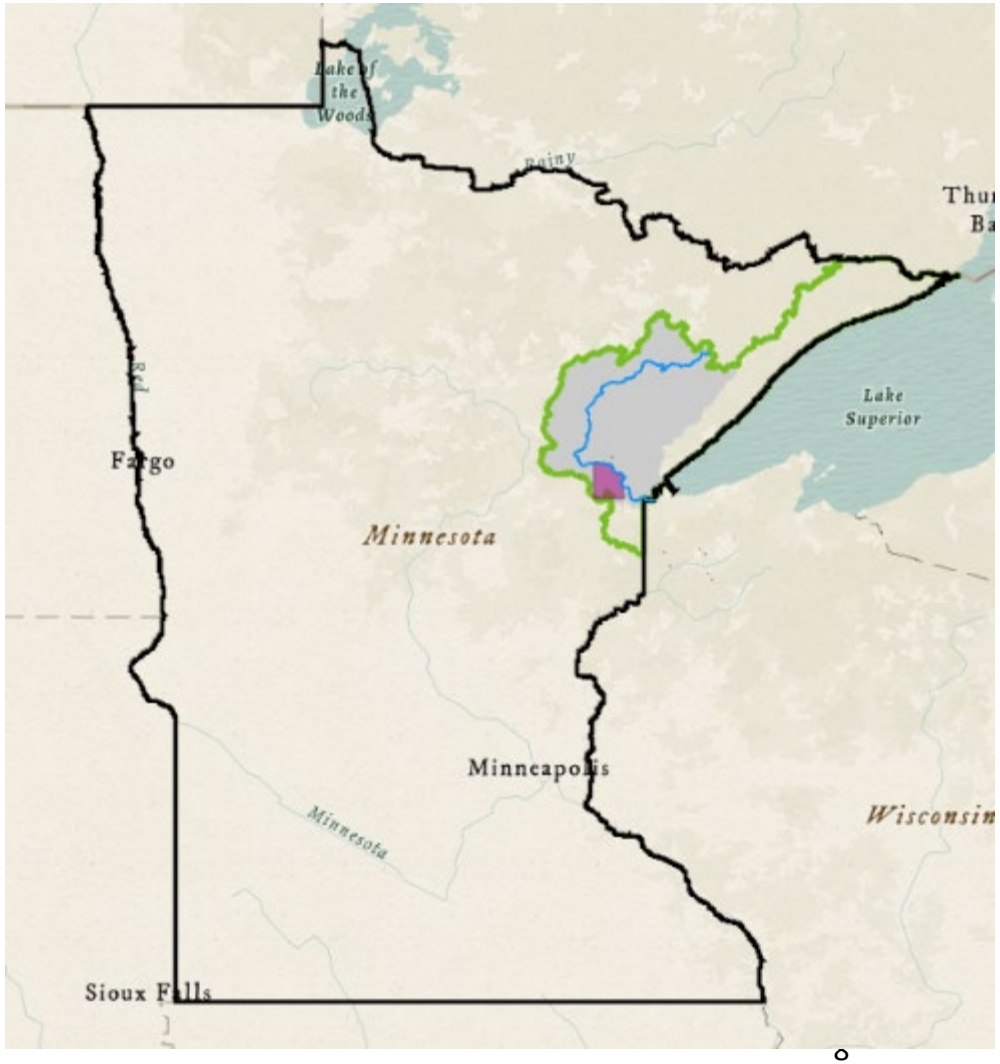
Project Progress

- Developed conceptual model of mercury cycling to support TMDL approach
  - Focus on DOC, sulfate, mercury air emissions
- Watershed and Estuary Modeling
  - Collaborated with consultants, reviewed model outputs & report
- Drafting TMDL Approach & Report
- Public Engagement
- Mercury Air Deposition Study

Water Quality and Fish Tissue Mercury Standards

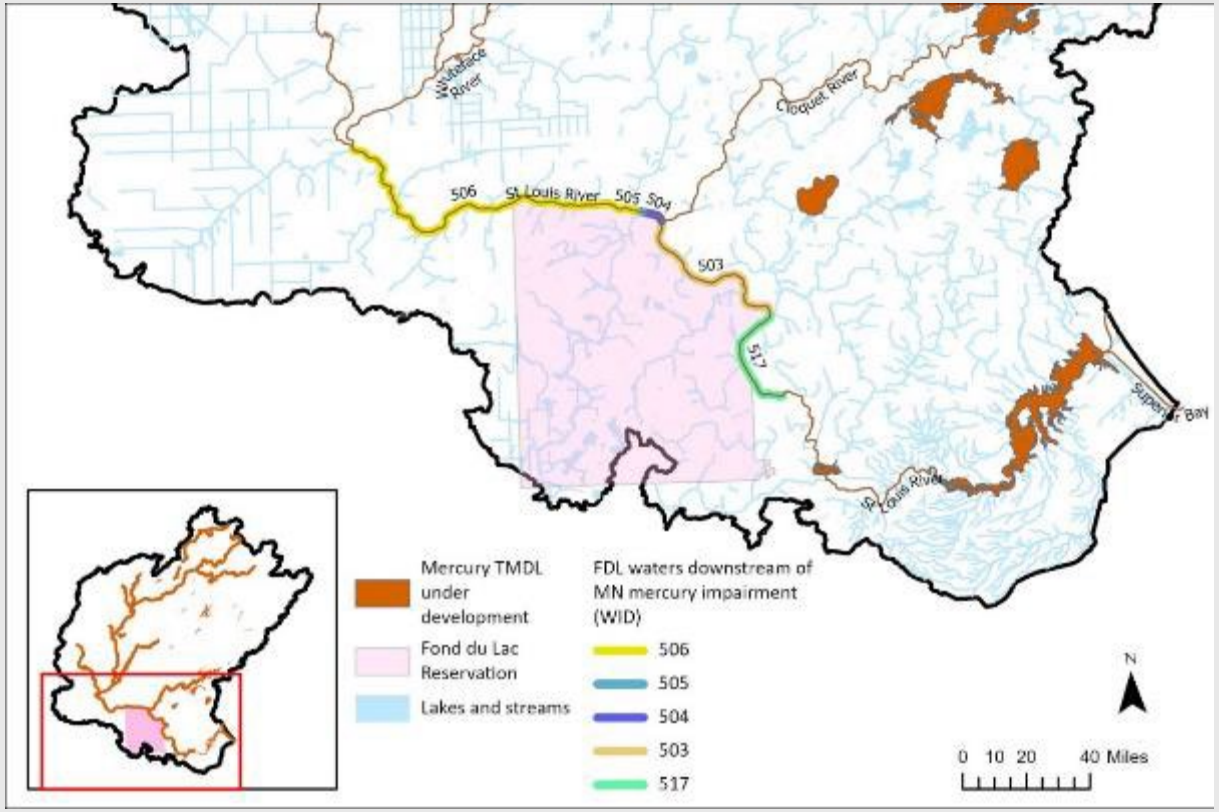
Jurisdiction	Total Mercury Water Quality Standard (ng/L)	Fish Tissue Mercury Standard (mg/kg)
Minnesota, Lake Superior Basin	1.3	0.2
Fond du Lac	0.77	0.3*
Wisconsin	1.3	0.22

** EPA criterion used for impairment assessment; not adopted formally by Fond du Lac Band as a water quality standard*

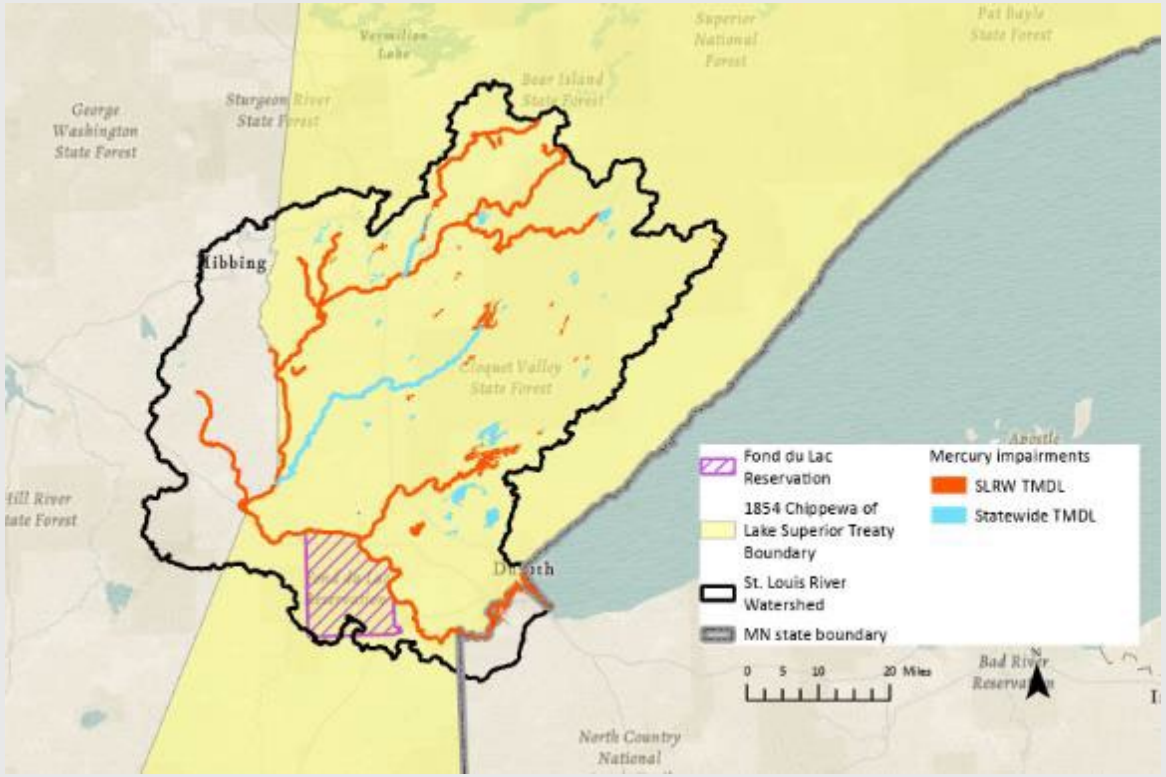


Mercury impairments and WQS

Fond du Lac Reservation border reaches

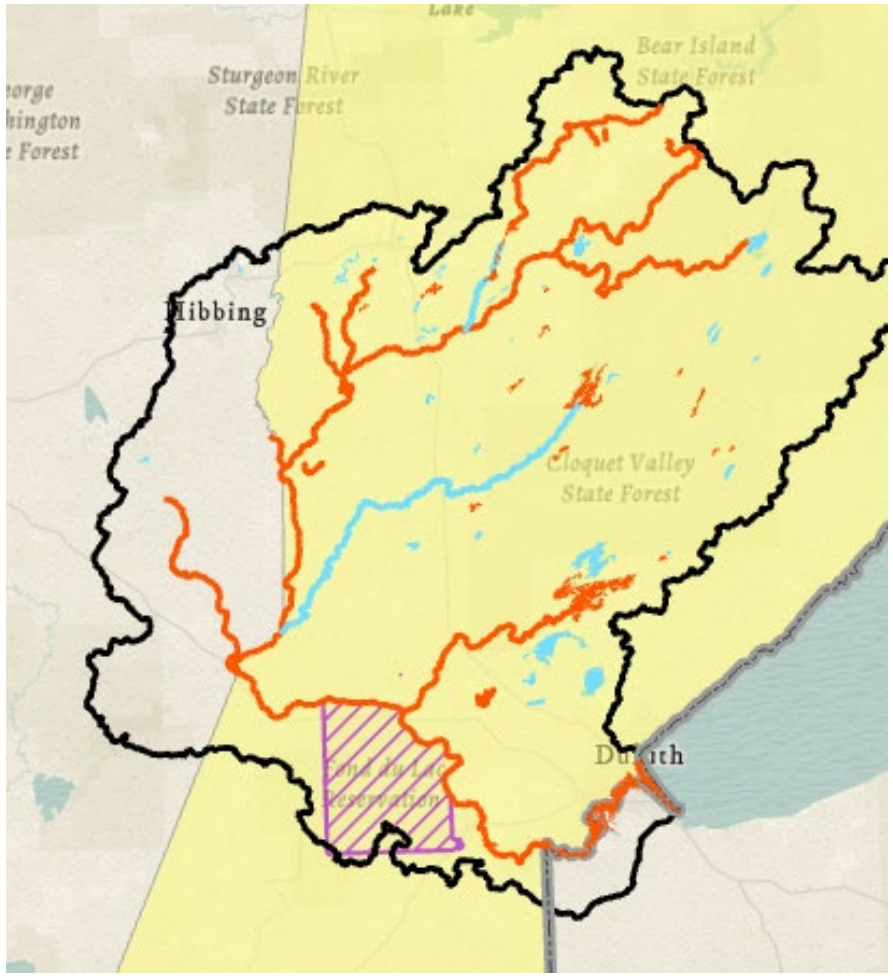


SLRW mercury impairments, Fond du Lac Reservation, and 1854 Treaty Boundary



TMDL endpoints

- For FDL WQS to be met at the FDL border reaches:
  - Load reductions need to be high (>90%) across the entire watershed
  - FDL WQS (0.77 ng/L) will be met in all impairments upstream of FDL



Project Schedule

2025

- Drafting TMDL report sections
  - TAT review
- Draft loading capacities and allocations
- Meetings with environmental groups and industry

2026

- Draft TMDL report for internal and TAT review
- Public forum and other outreach

2027

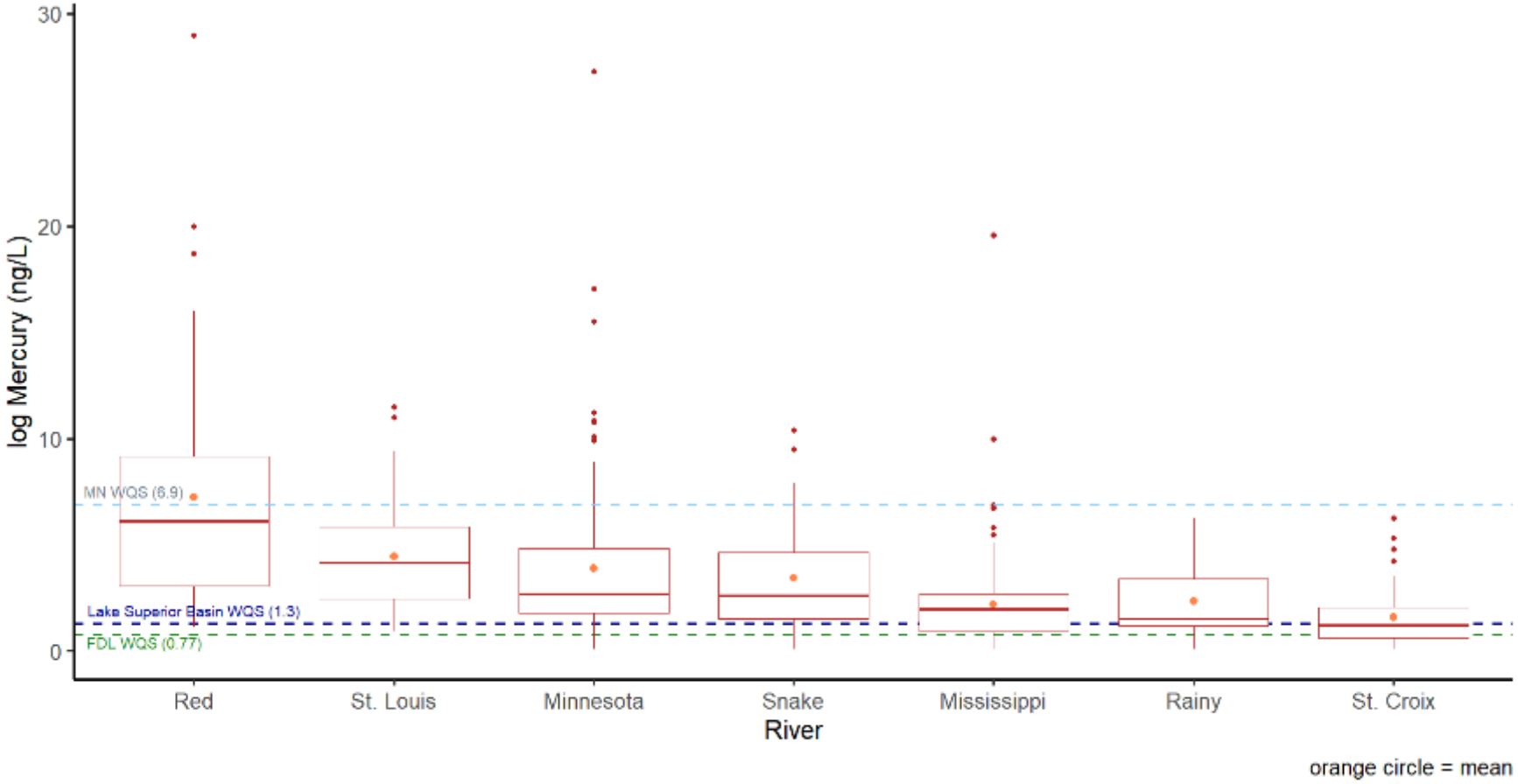
- Public notice

Data Collection

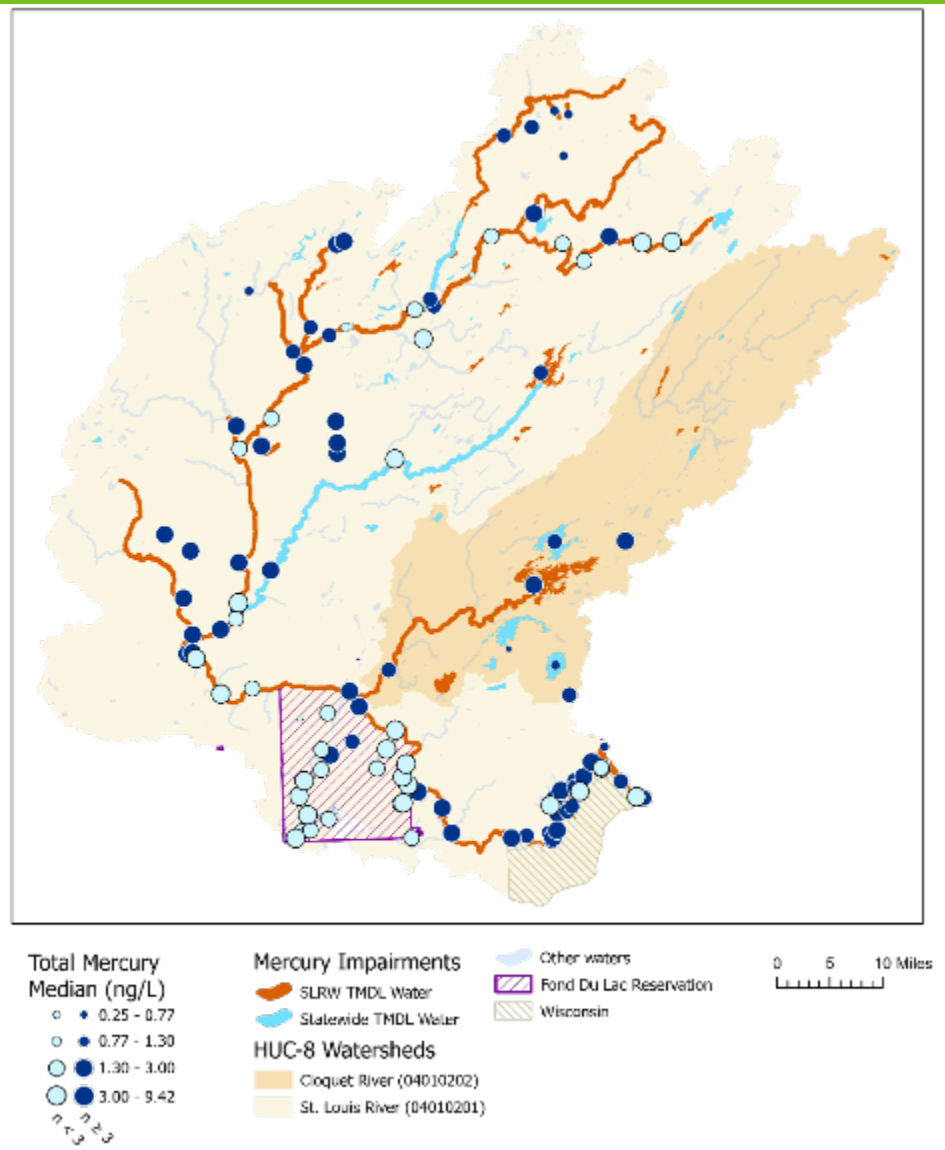
- Water data: 2005-2021
  - Total mercury (Hg) in surface water
  - Methylmercury (MeHg) in surface water
  - Water Quality Standards (ng/L = parts per trillion [ppt]):
    - 1.3 ng/L (Lake Superior Basin) & 0.77 ng/L (FDL)
- Fish data: 2000-2022
  - Mercury in fish tissue standardized by fish length
  - 3 species: Channel Catfish, Northern Pike, Walleye
  - Water Quality Standard (mg/Kg = parts per million [ppm]):
    - 0.2 mg/Kg (MN)
- Data collected by MPCA, Fond du Lac, MN DNR, WI DNR, UMD, EPA, USGS

Statewide River Mercury Concentrations

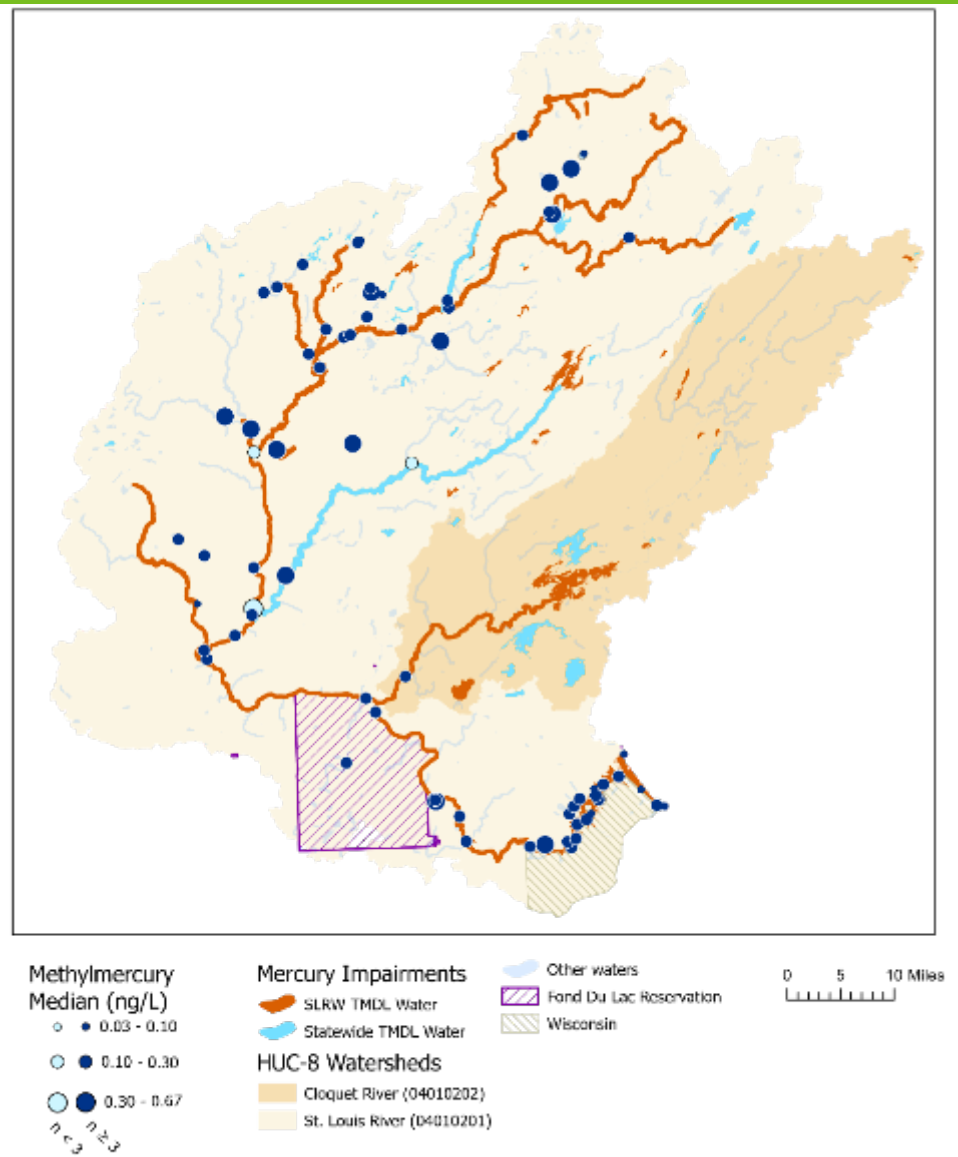
- Long-term monitoring of Hg in rivers statewide from 1991-2023
- St. Louis River has 2nd highest mercury concentrations compared to other major rivers in MN



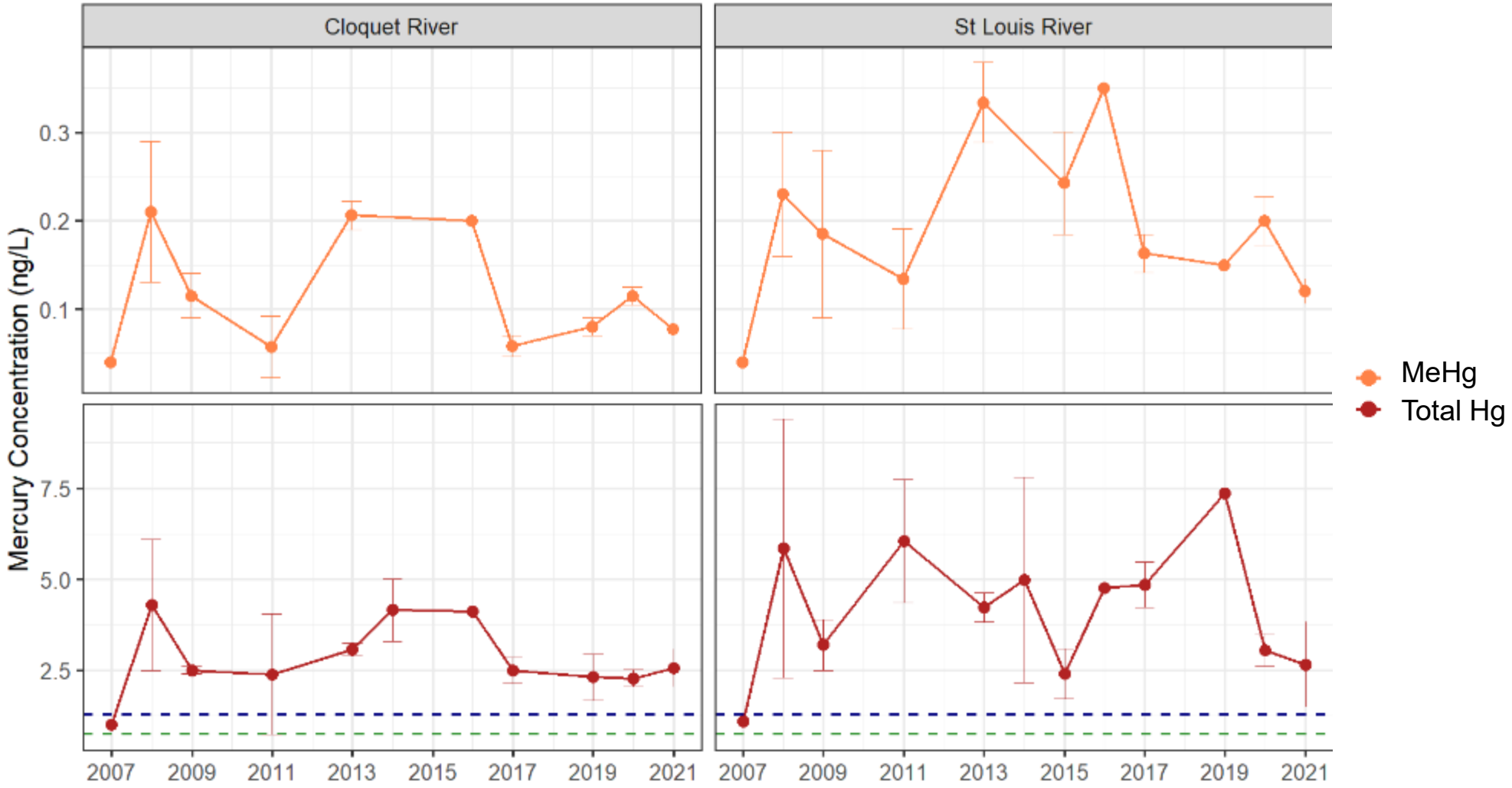
Total Mercury



Methylmercury

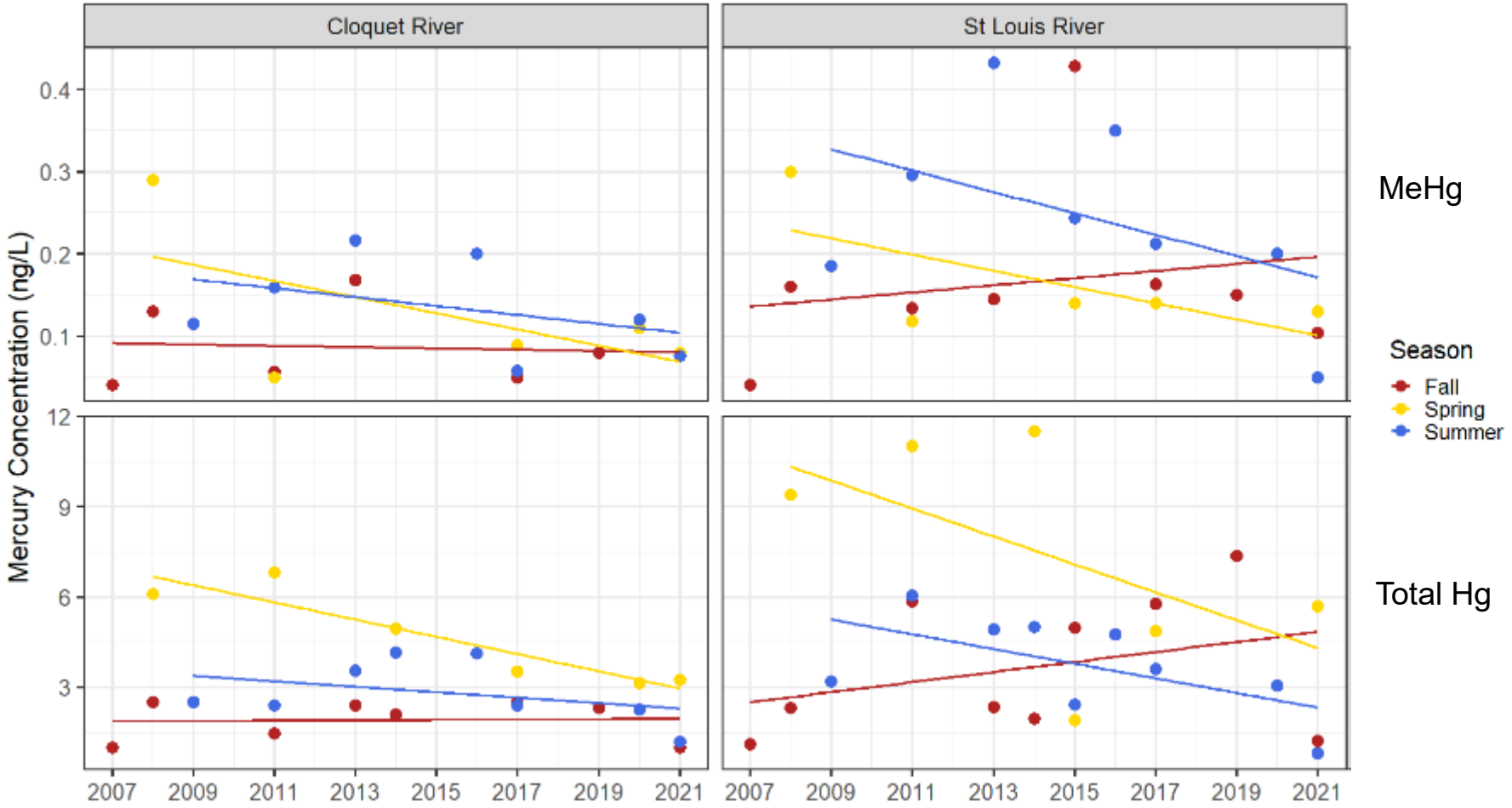


Long-term Mercury Trends at Cloquet River and St. Louis River



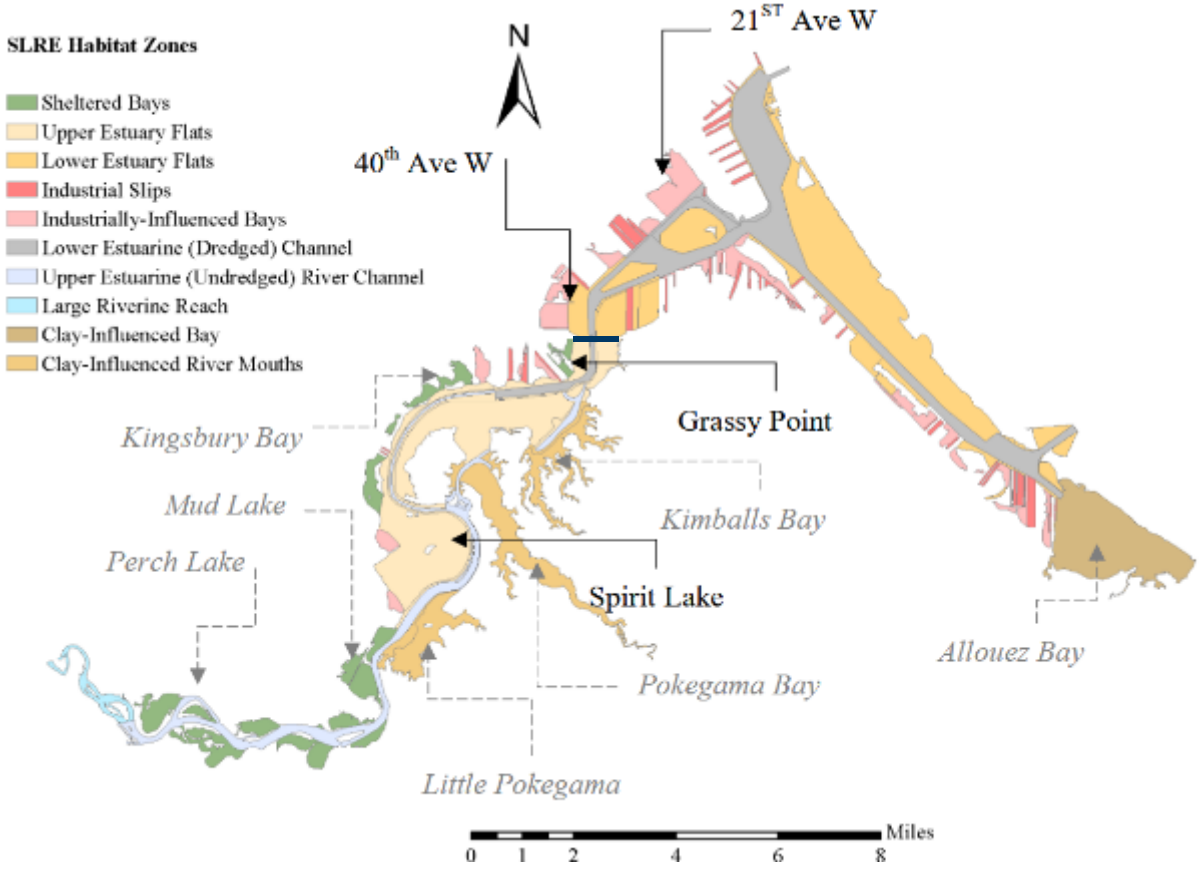
Seasonal Changes in Mercury at Cloquet River and St. Louis River

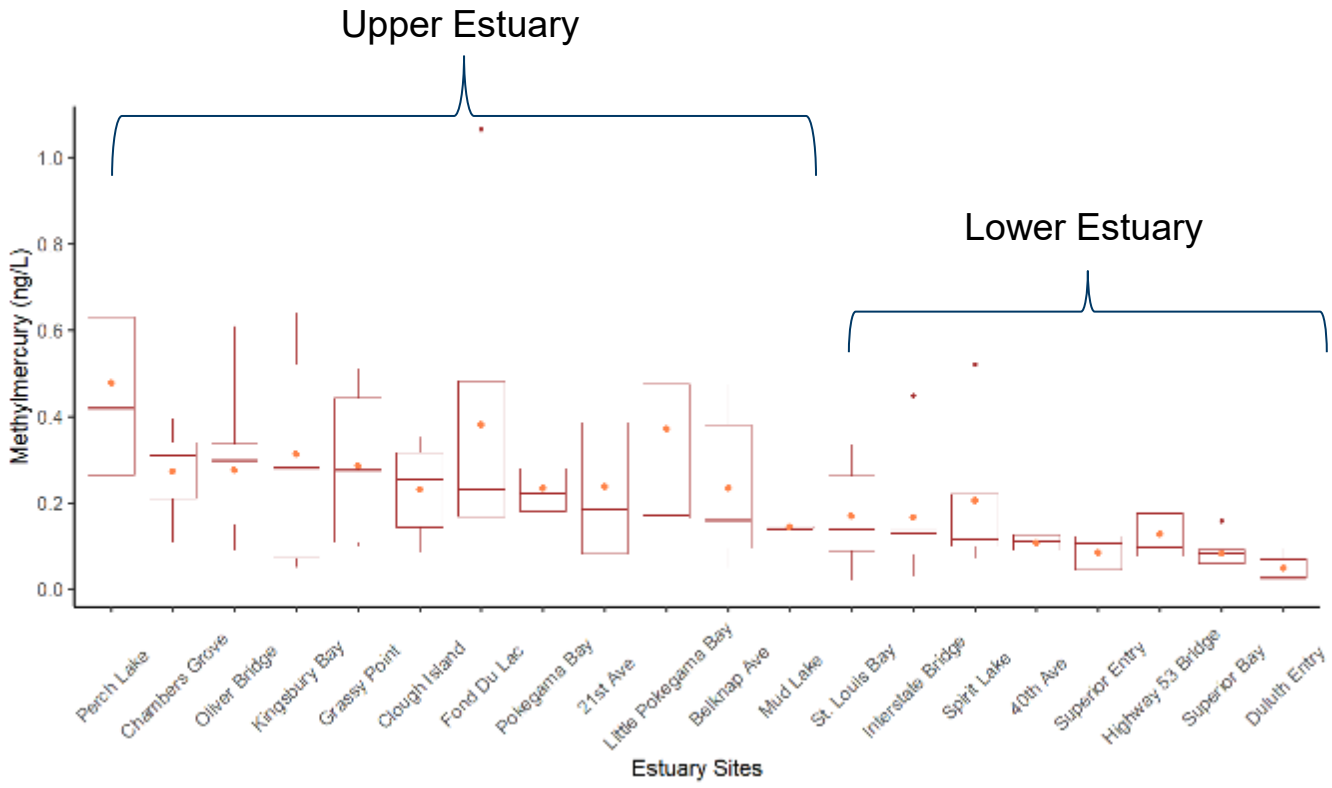
- **Cloquet River:** decreasing trends in spring and summer, no change in fall
- **St. Louis River:** Significant decreasing trend in MeHg and Total Hg in spring and summer but increasing in fall



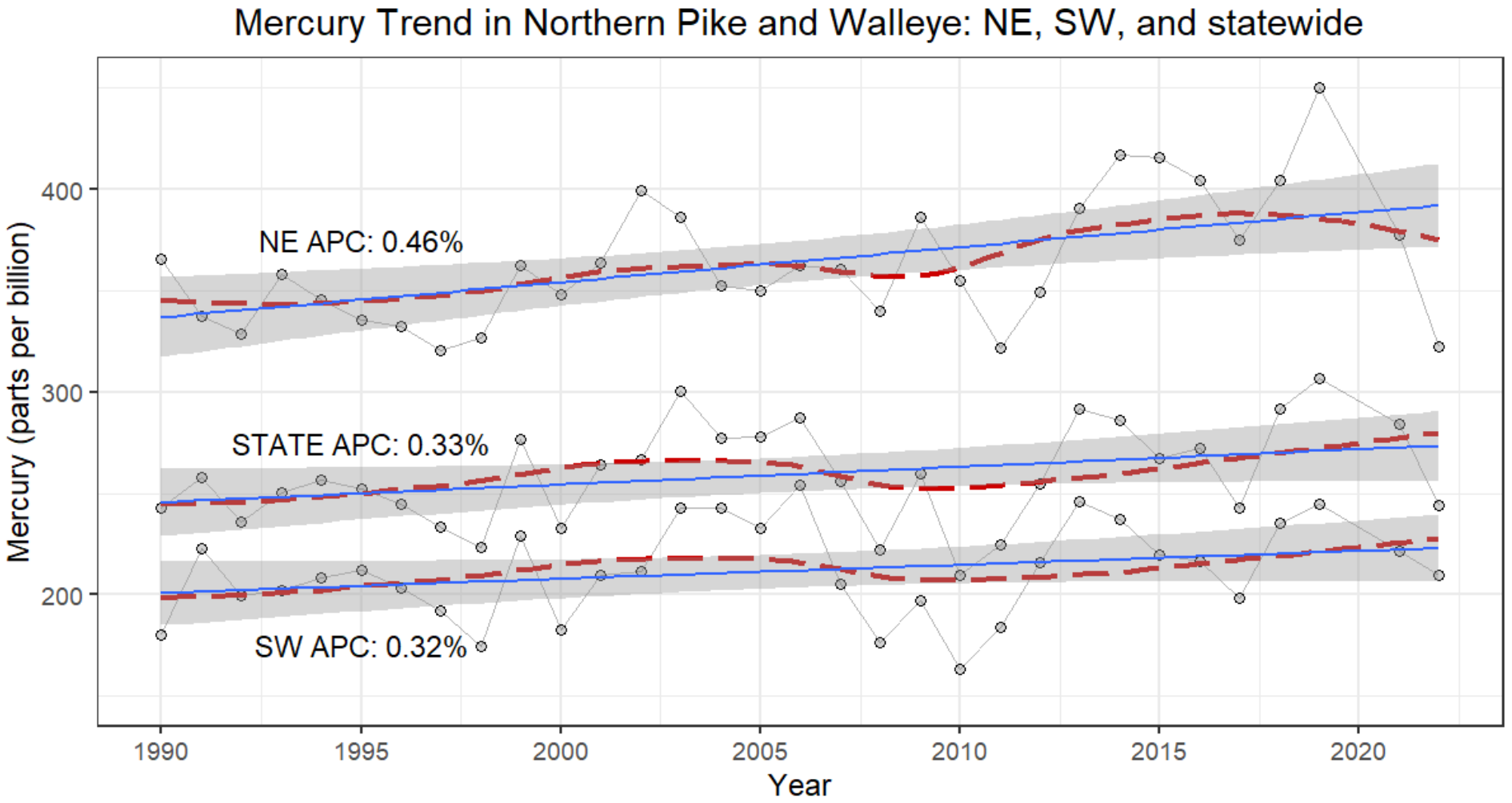
Methylmercury in Estuary

- MeHg concentrations in surface water in Upper Estuary vegetated areas are higher compared to Lower Estuary industrialized areas



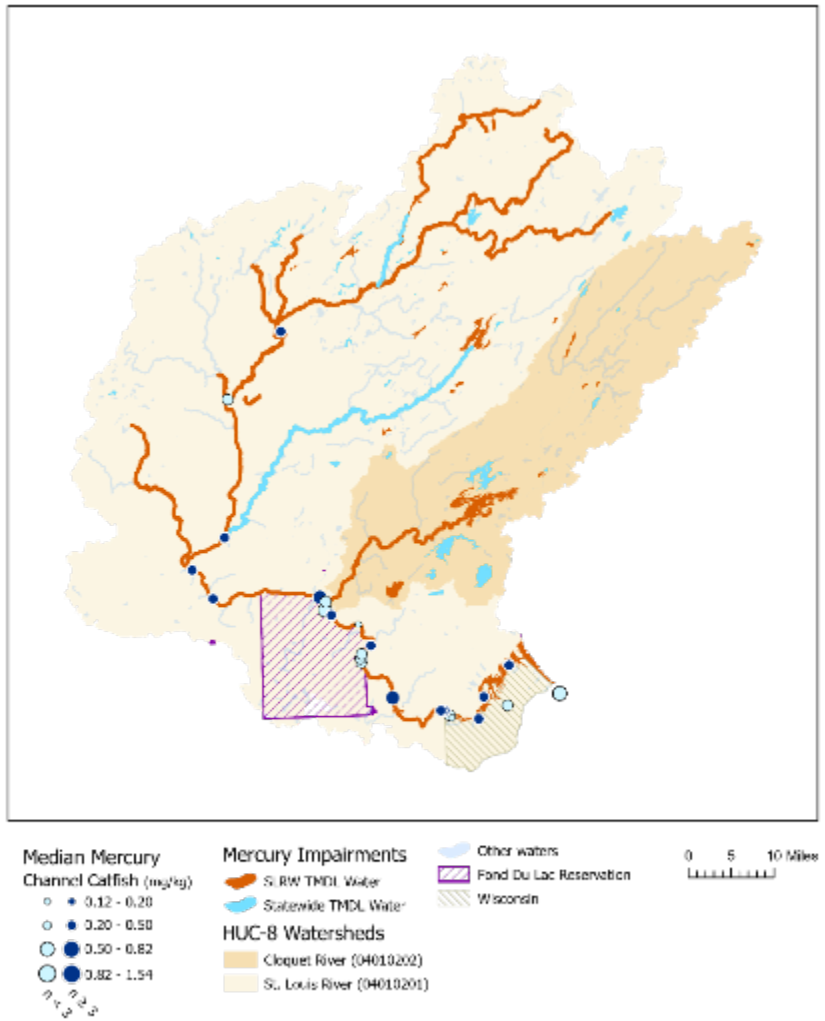


Mercury Trends in Northern Pike and Walleye

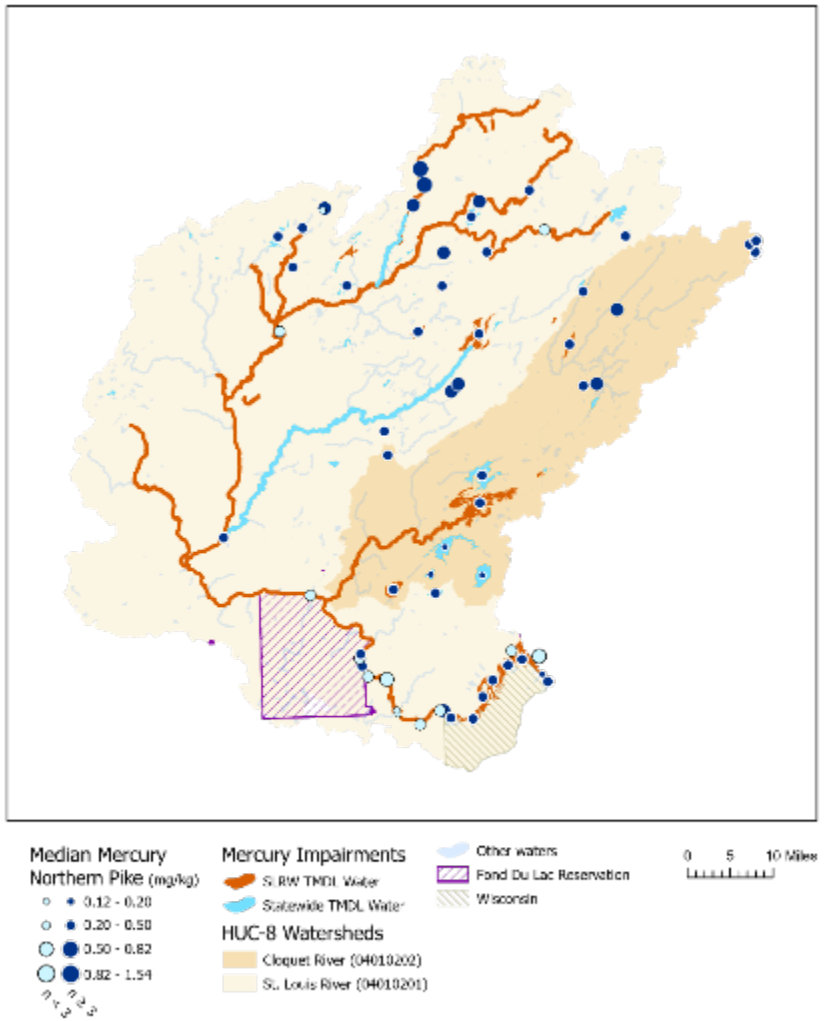


Spatial Variability in Fish Mercury Concentrations

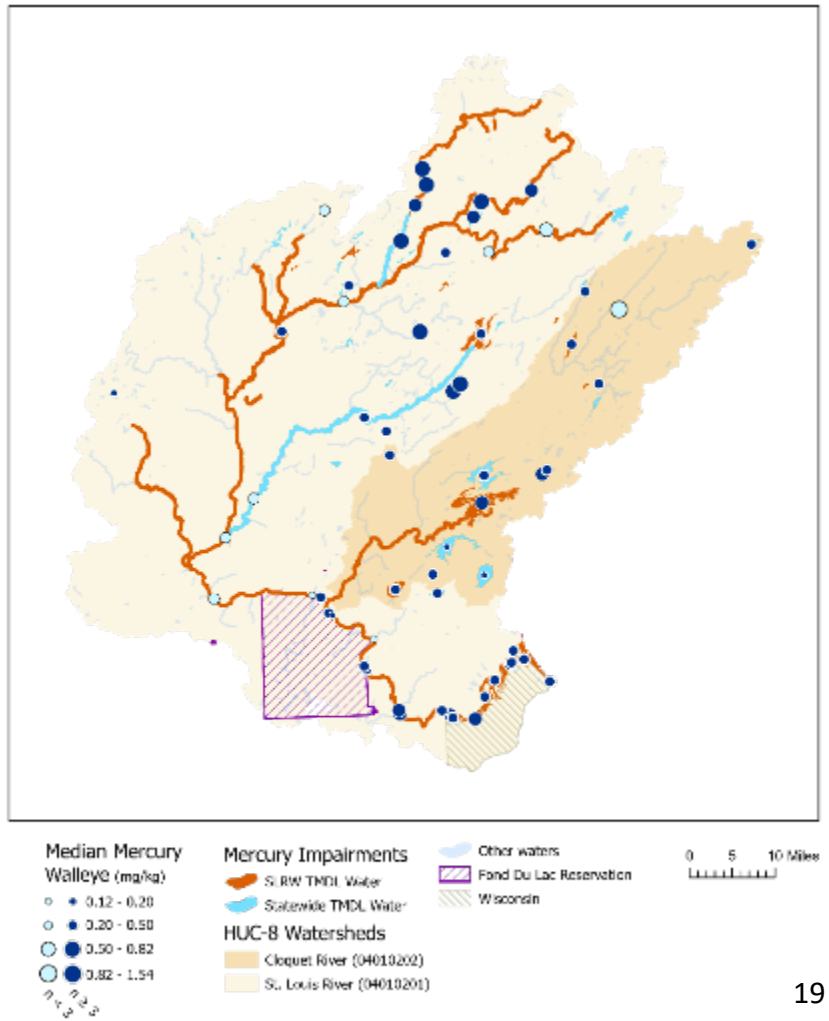
Channel Catfish



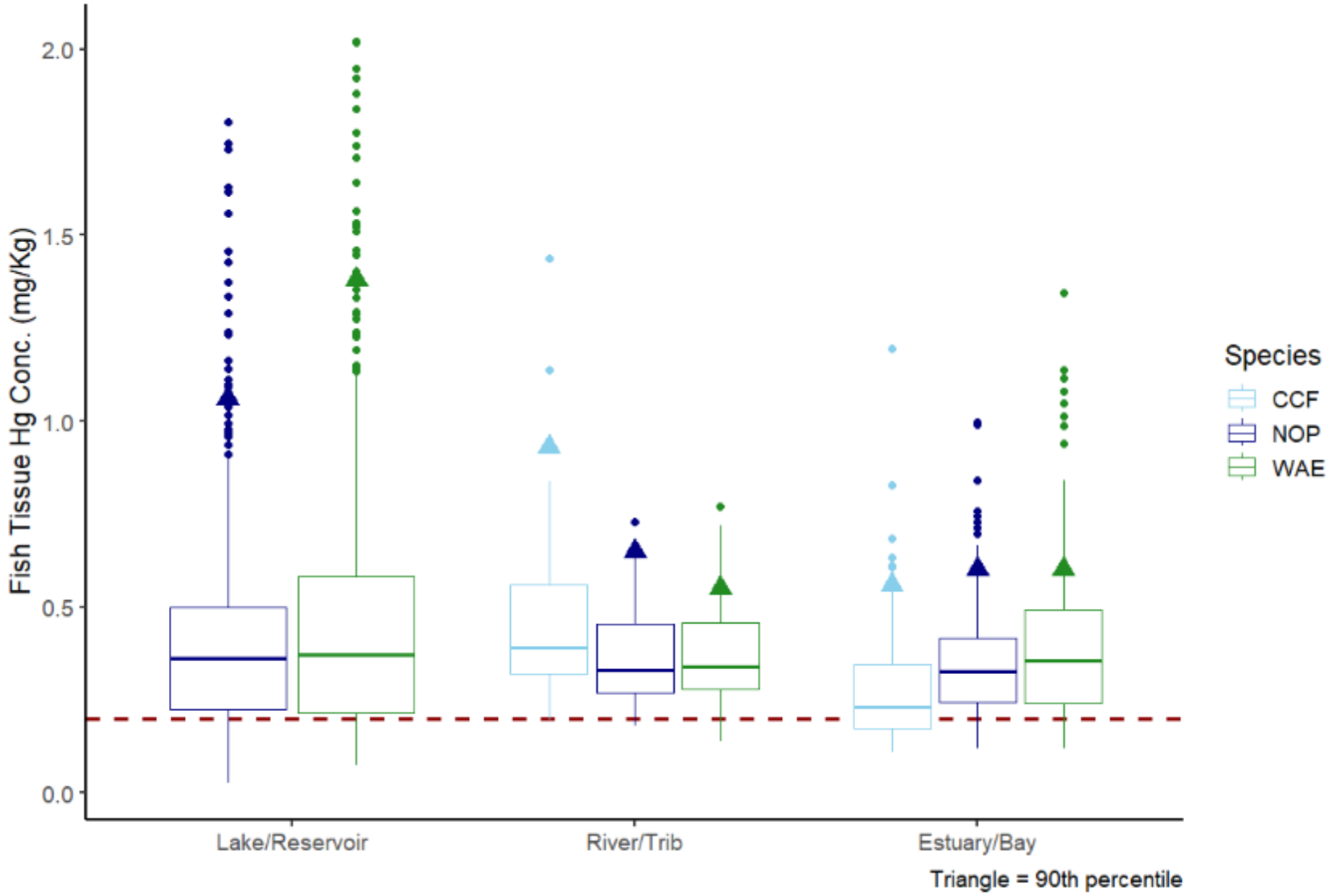
Northern Pike



Walleye

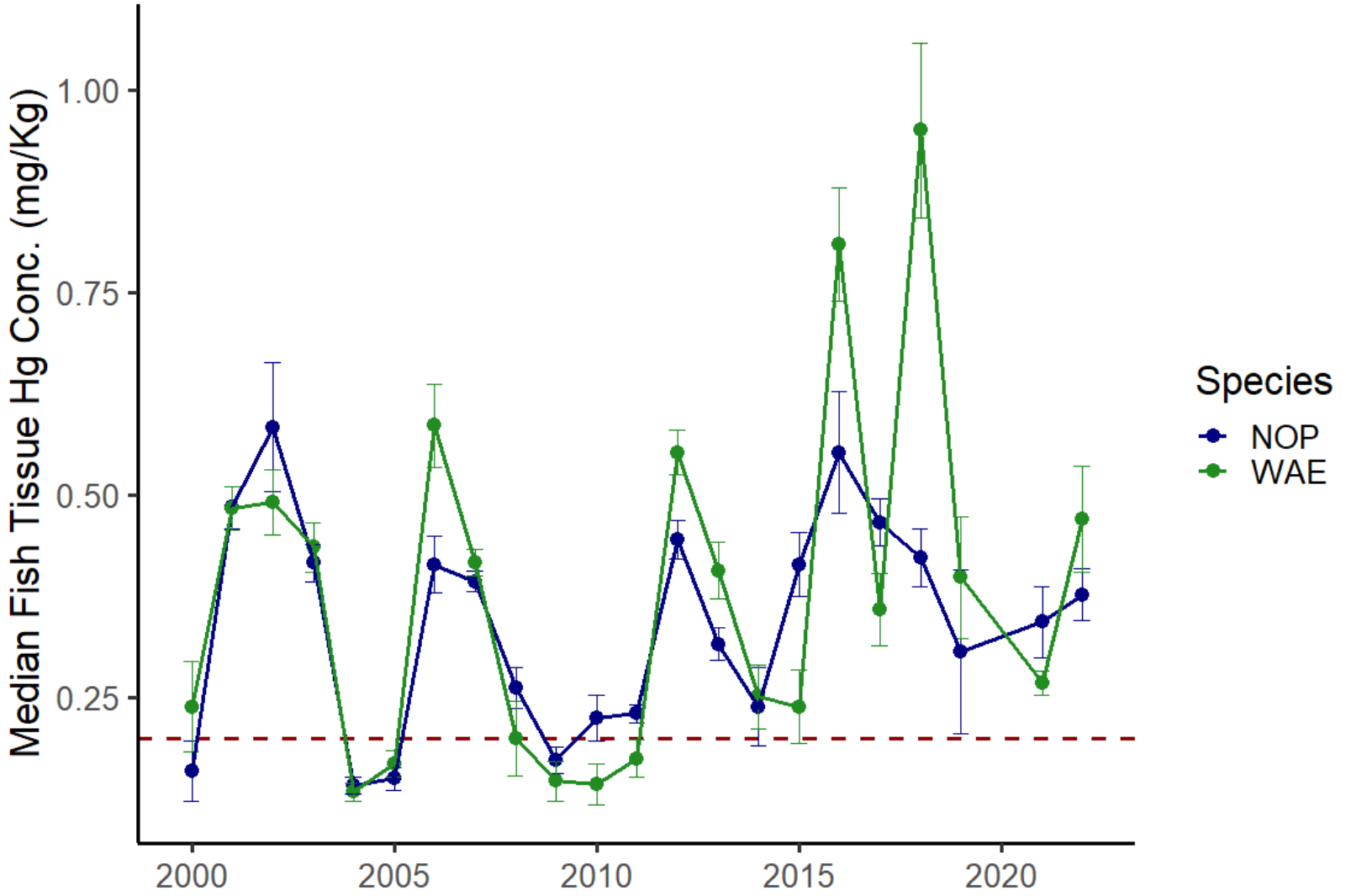


Fish Comparison by Waterbody Type

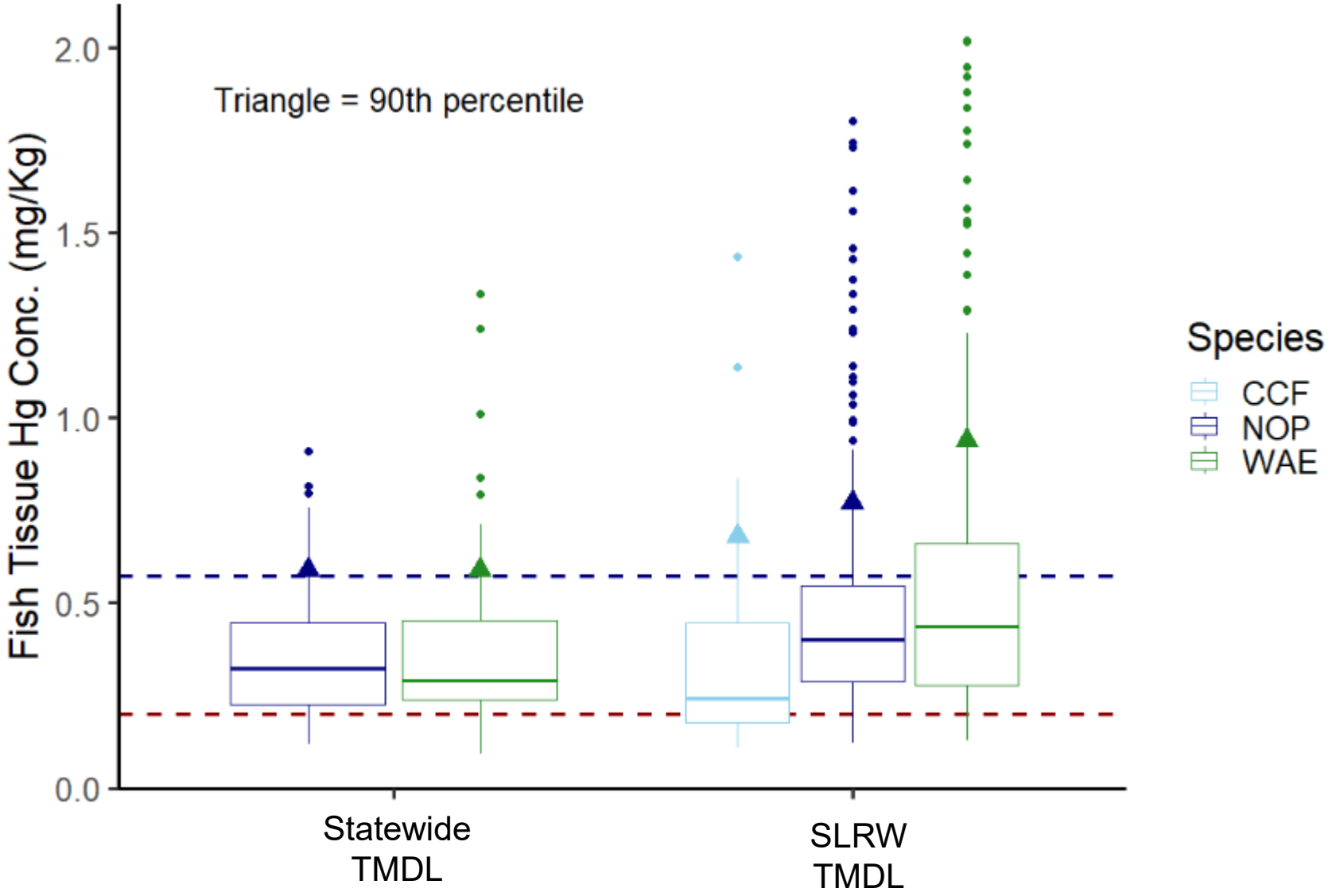


Walleye and Northern Pike Mercury Concentrations in Lakes

- Data from 40 lakes
- Cyclical changes in Northern Pike and Walleye
- Increasing trend 2015-2022

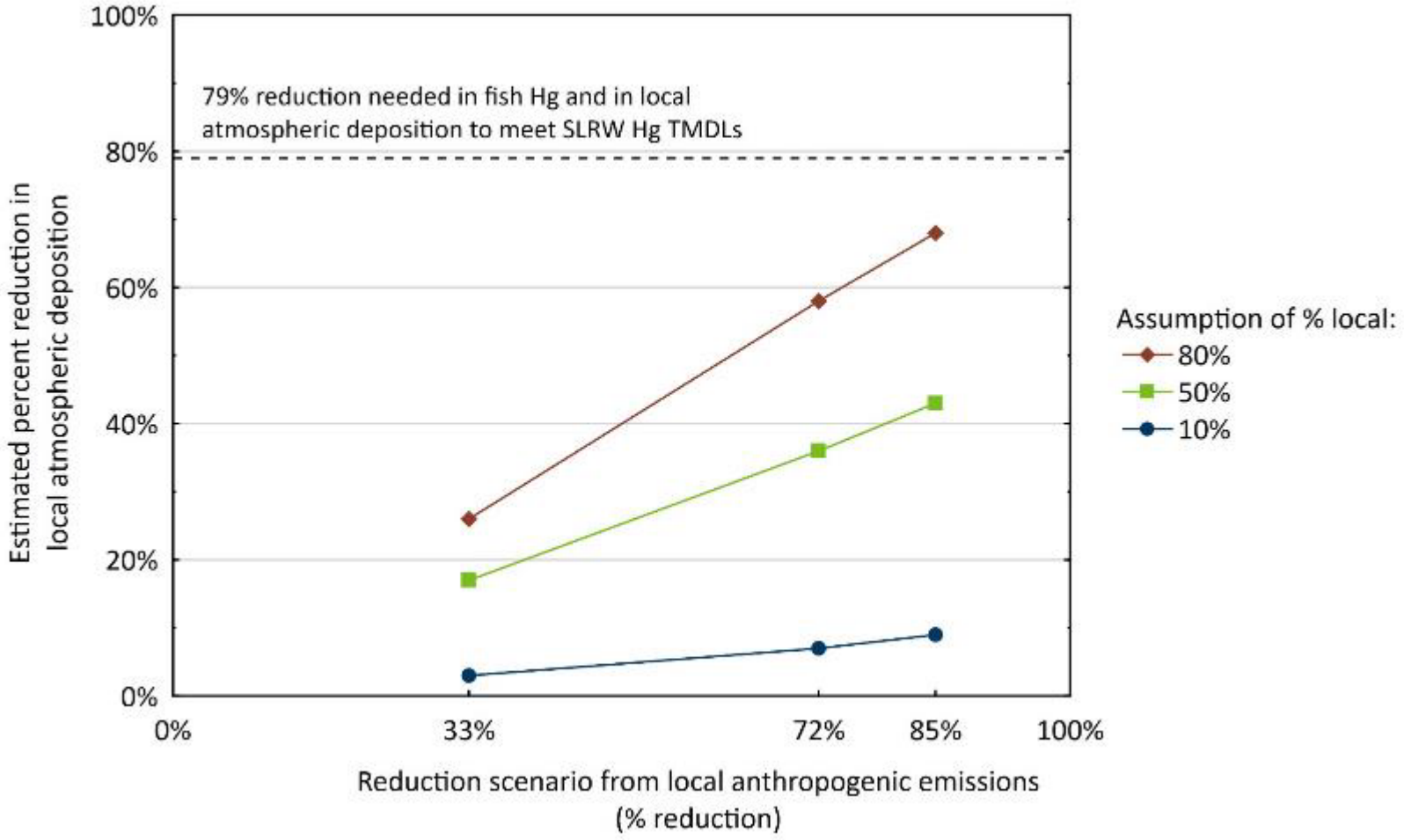


Mercury Reductions in Fish



Local contribution to atmospheric deposition: scenarios

- What are the potential mercury reductions that could be achieved in atmospheric deposition as a result of reductions from local point source emissions?



Why is additional research needed?

- Mercury science has improved
  - Atmospheric mercury deposition estimates to state waters are **based on very limited data from over 25 years ago**
  - Current estimates of natural emissions = 6% (Geyman et al. 2025)
  - Important to understand impact of local mercury emissions to deposition in SLRW

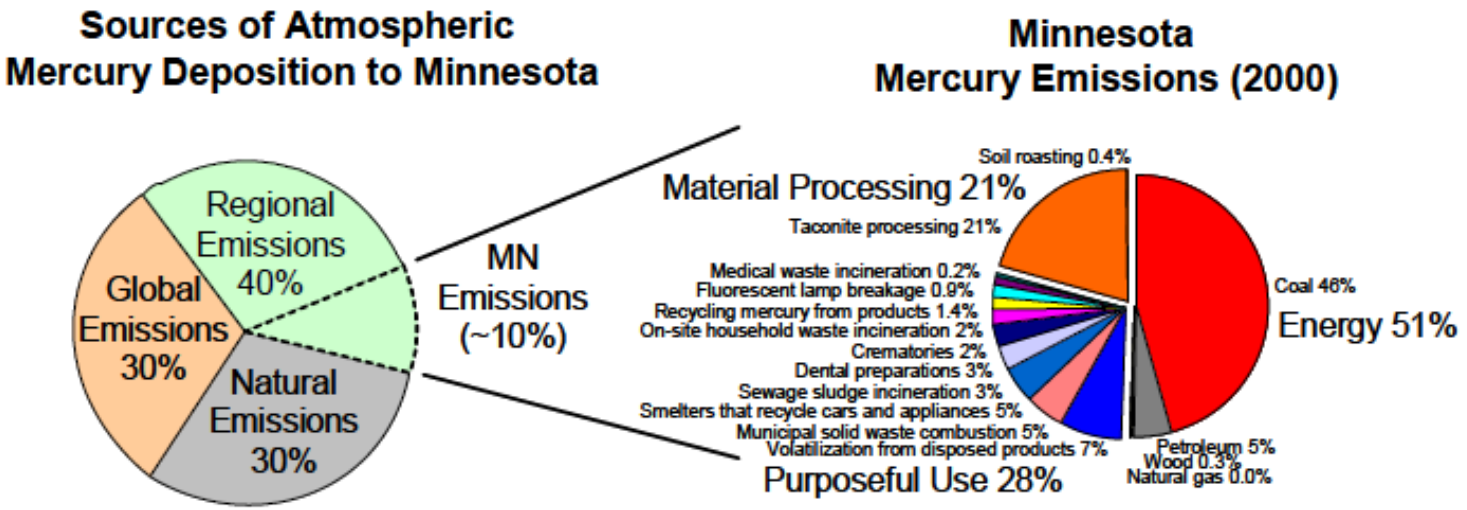
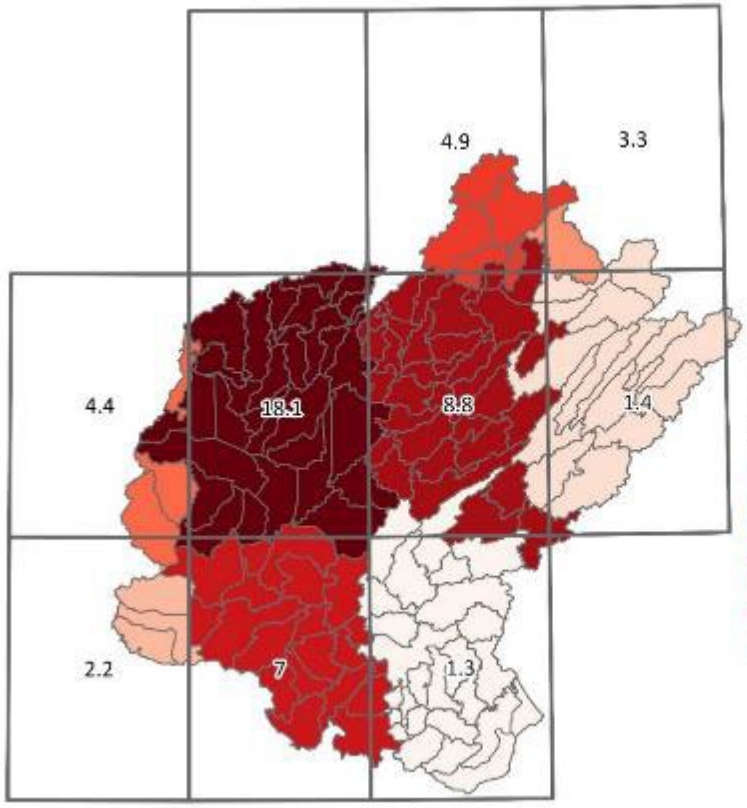
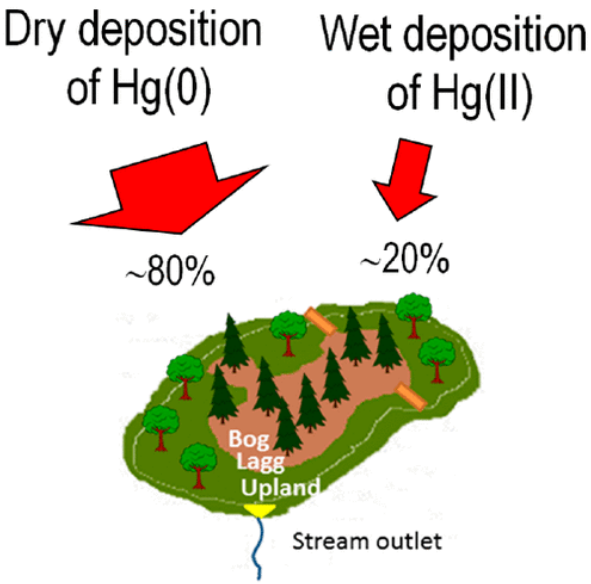


Figure 9 Sources of Mercury Deposition and Estimated Mercury Emission Sources in Minnesota

Mercury Dry Deposition

- Published studies estimate dry deposition from leaf uptake contributes 70-80% of mercury to land and downstream waterbodies
- Lack of consistent monitoring of mercury dry deposition & litterfall near emission sources
- Models underestimate dry deposition and litterfall mercury contribution especially in forested areas

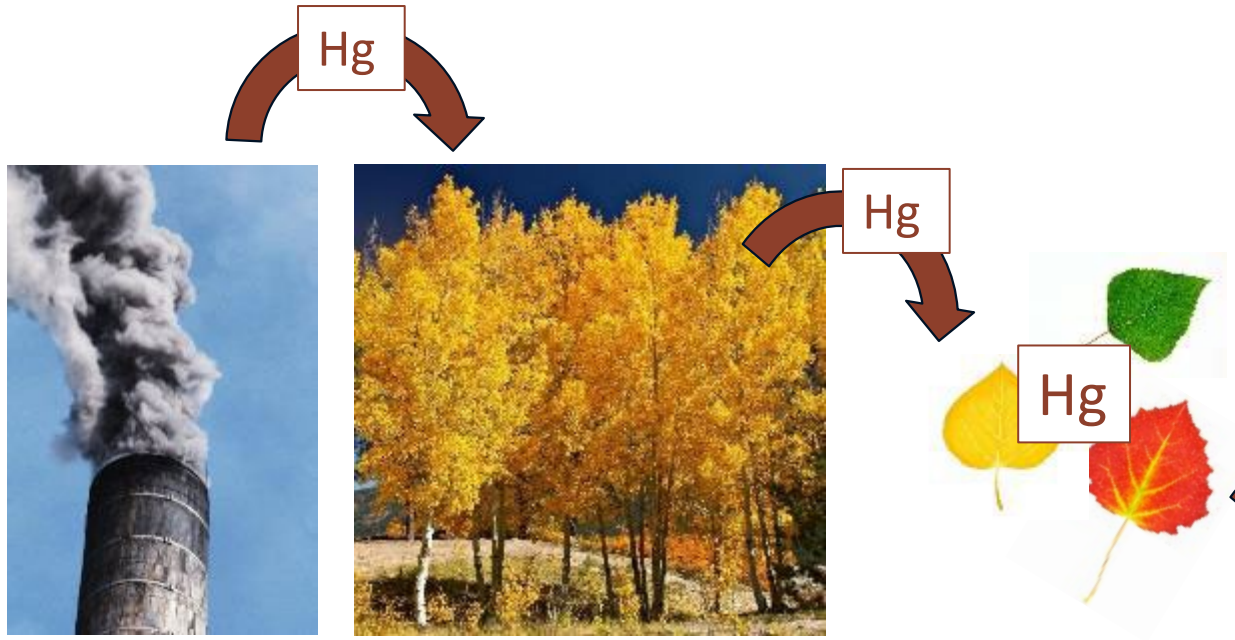


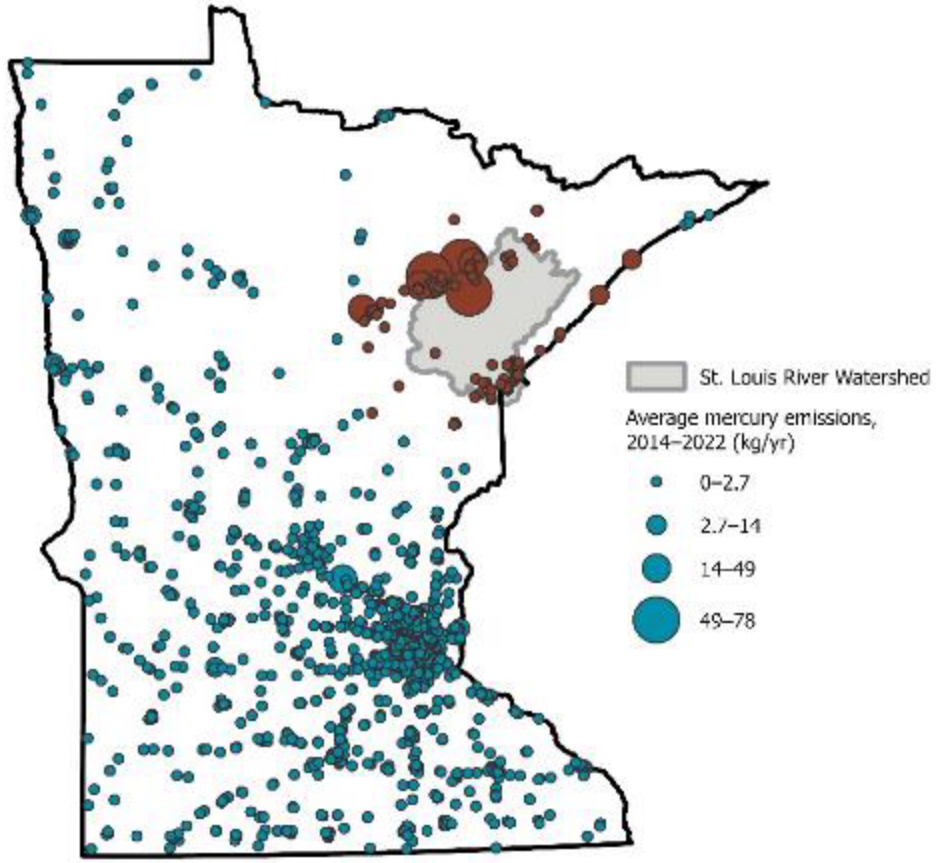


Woerndle et al. 2018

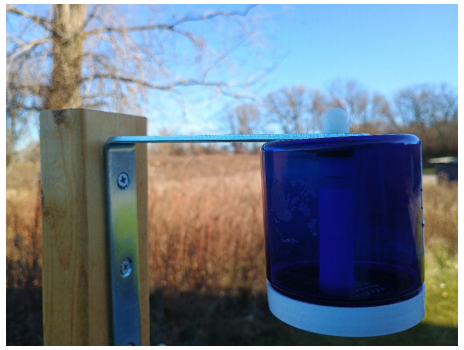
St. Louis River Watershed Mercury Deposition Study

- Study Objective: quantify whether atmospheric mercury inputs to landscape differ in proximity to local mercury emission sources

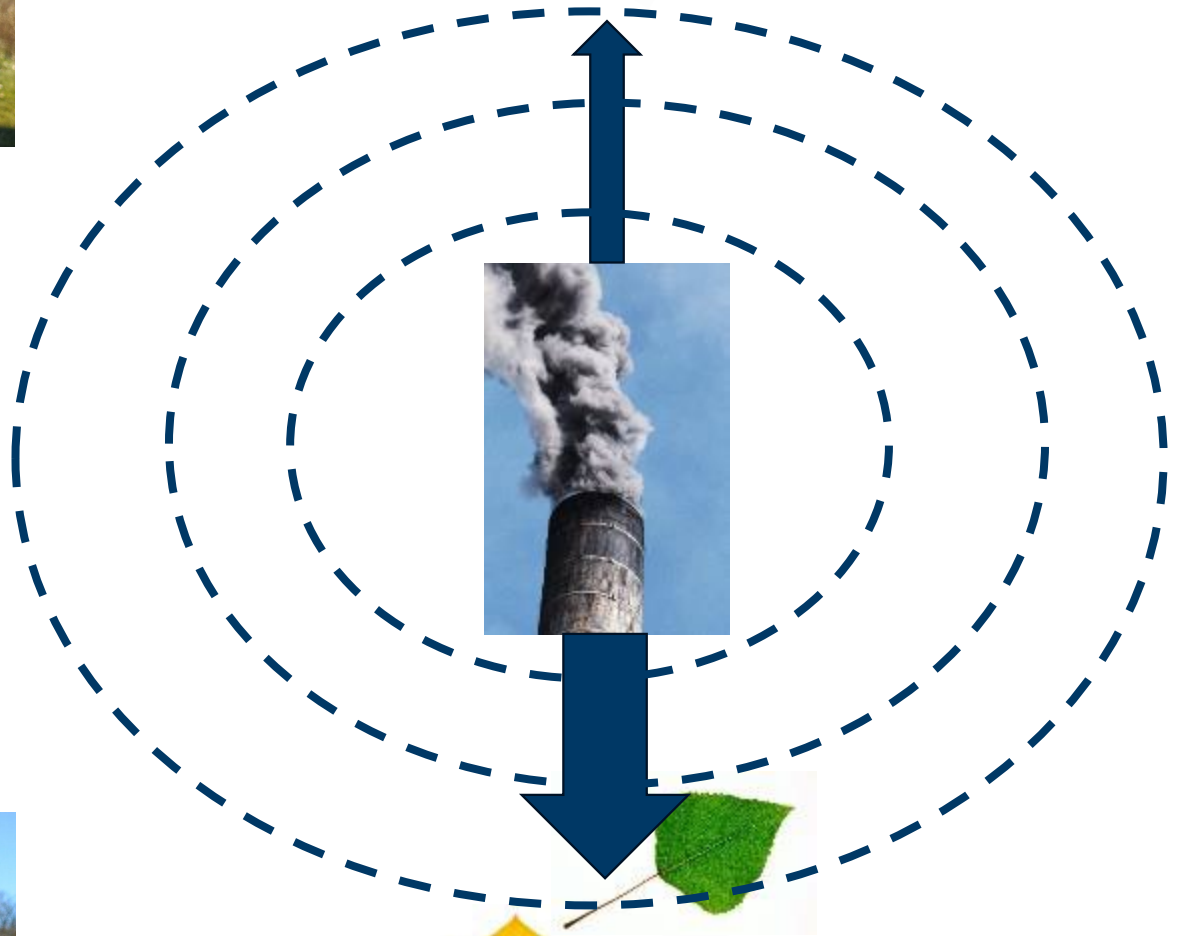


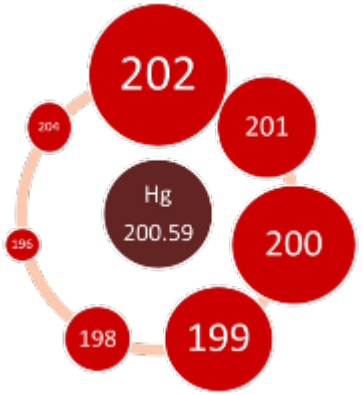


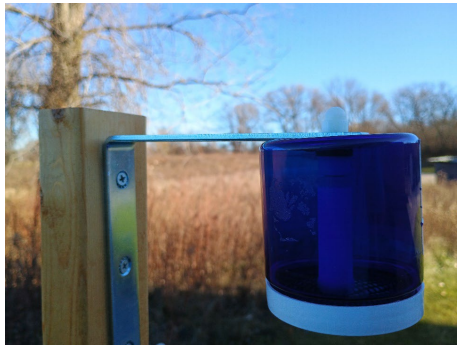
Mercury Deposition Sites



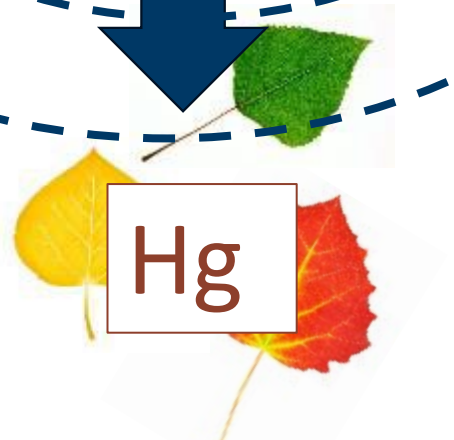
Upwind Site







Downwind Site



Summary

- Long-term trends in mercury and methylmercury in water have not changed but there are seasonal differences
- Fish mercury concentrations are increasing statewide and trending up in the watershed
- Additional reductions in mercury deposition beyond statewide mercury TMDL goal will be necessary to meet water quality standards in St. Louis River Watershed
- Improved estimates of mercury concentration in air and leaves will quantify impact of local deposition

Contact Information

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Thank you!

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