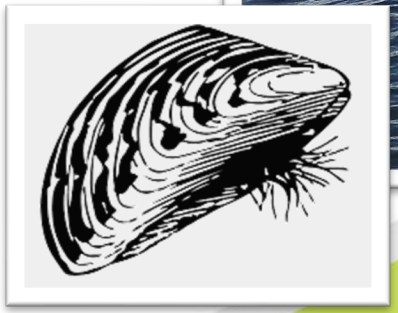
Re-evaluating Dreissena composition and distribution in the St. Louis River Estuary and Lake Superior

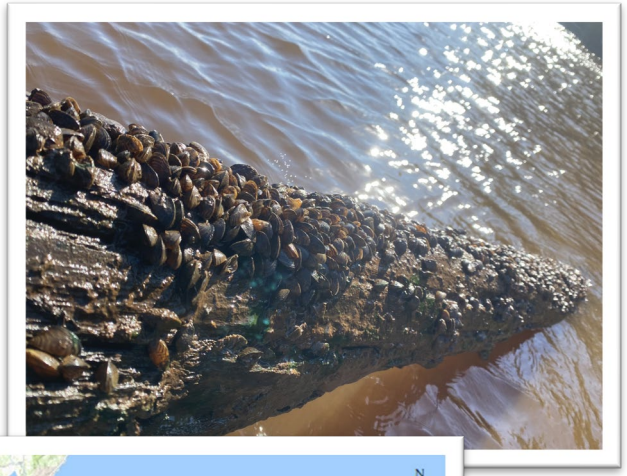
Aubree Szczepanski[2], Chelsea Hatzenbuhler[3], Joel Hoffman[1], Courtney Larson[1], Greg Peterson[1], Anett Trebitz[1]

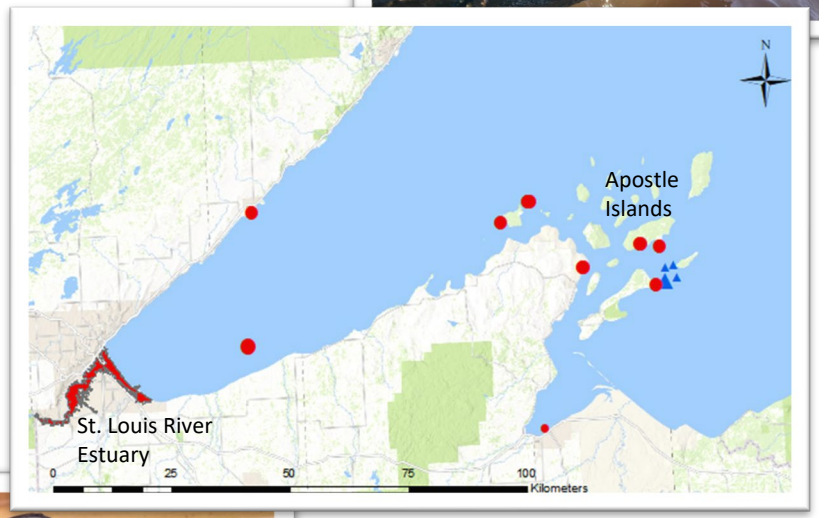
1) U.S. Environmental Protection Agency, Office of Research and Development, Duluth, MN
2) Oak Ridge Associated Universities, Oak Ridge, TN to US EPA
3) SpecPro Professional Services, contractor to US EPA



Background:

- *Dreissena polymorpha* (zebra mussel) introduced in 1986 and *Dreissena bugensis (*quagga mussel) in 1989 to the Laurentian Great Lakes
    - Invasive non-native to the United States
- Spread from shipping and recreational boating
- Impacts water clarity, nutrient & energy cycling, food webs and human infrastructure





(Trebitz et al, 2019)

Dreissena in Lake Superior & St Louis River Estuary:

- Zebra mussels were first introduced and dominated the St Louis River Estuary (SLRE) in 1989
    - Transported through shipping because it is the largest and busiest port on the Great Lakes
    - The conditions were ideal warmer, high nutrients and productivity
- Low spread to Lake Superior because conditions were not ideal
- In recent years, only a few isolated settled mussels were found in Lake proper (mostly Apostle Islands)

Zebra vs. Quagga Mussels

Zebra Mussels (*D. polymorpha*)

- Prefer shallow and warmer water
- Nearshore and estuarine environments
- Attach to hard substrate
- Byssal thread near middle and has a flat bottom

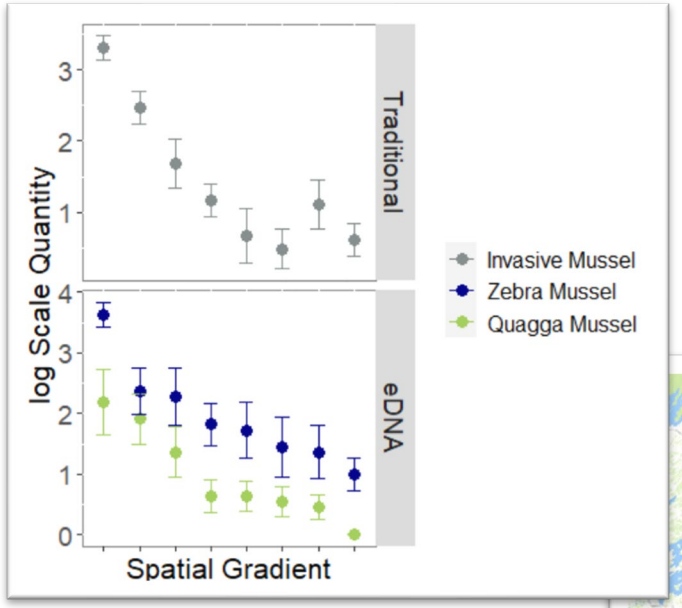
Quagga Mussel (*D. bugensis*)

- Prefer deep and cooler water
- Offshore environments
- Colonize soft and hard substrates
- Byssal thread near end and rounded bottom

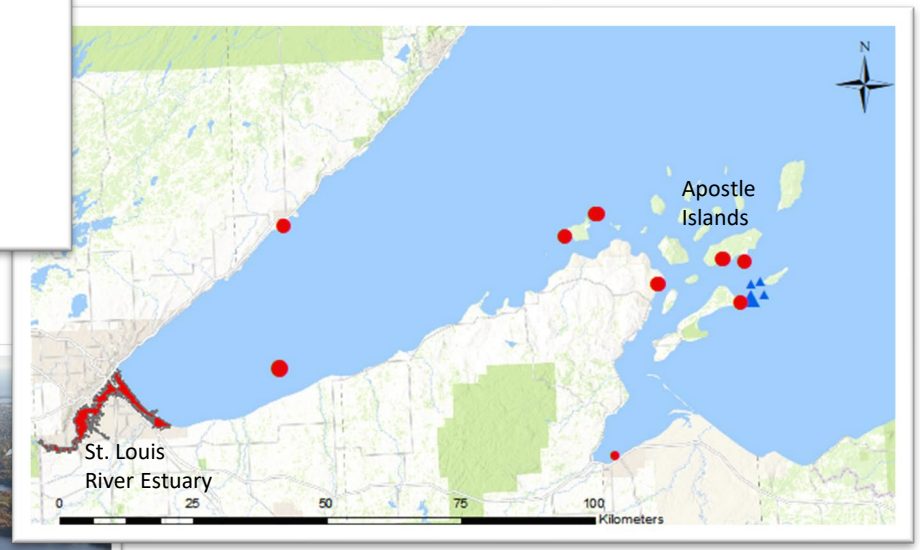
Photos from USGS

Why revisit SLRE Dreissena status now?

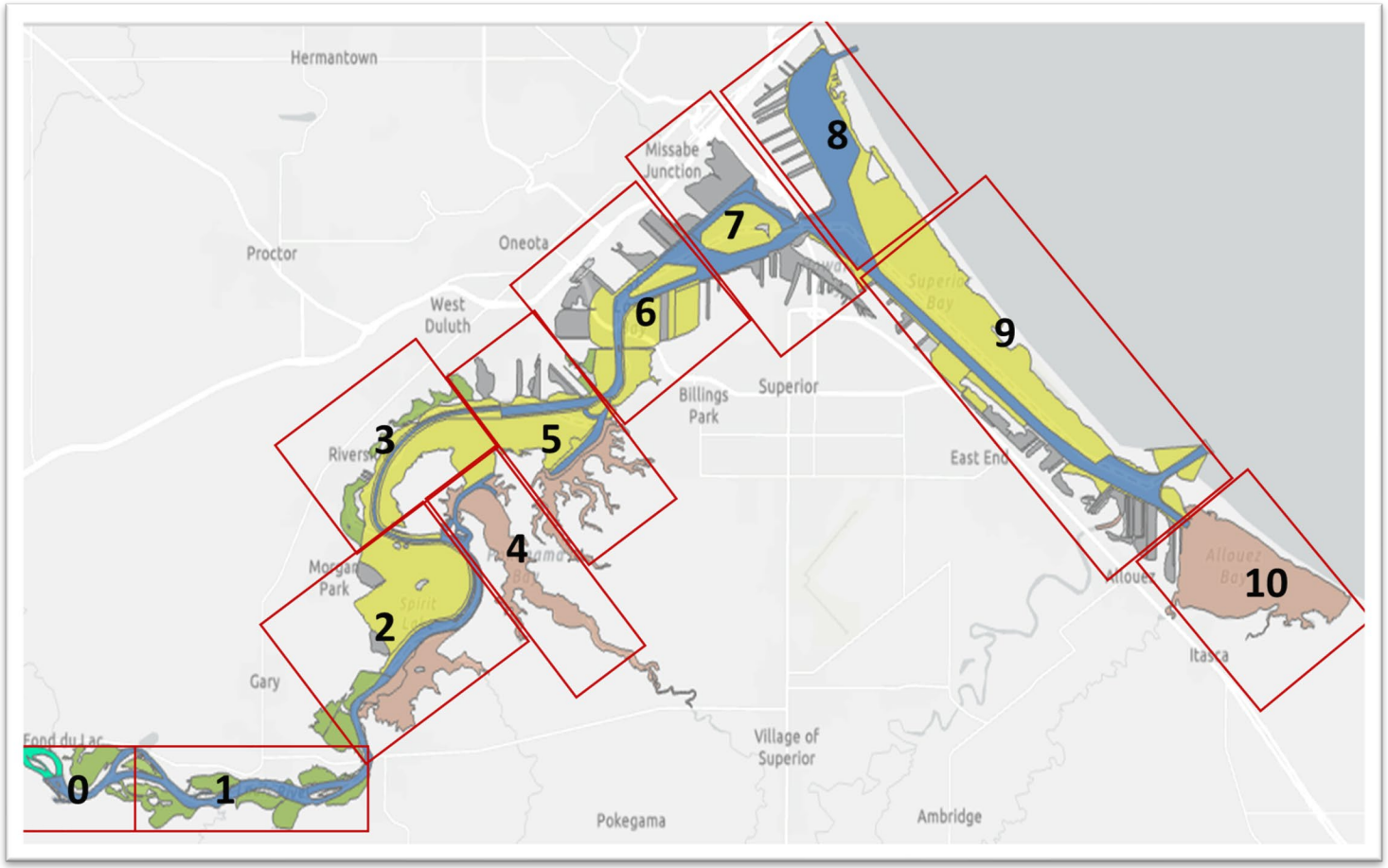
- Historically the SLRE has been dominated by zebra mussels
- Due to recent advances in DNA methods our 2019 survey detected DNA from zebra and quagga in the lower SLRE and Lake Superior
    - Allowing us to ID dreissena veligers (planktonic stage) which are only morphologically ID'd to genus in previous surveys



(Larson et al, 2022)



(Trebitz et al, 2019)



Site Design:

11 Site Blocks

- Chamber Grove (Block 0) to Allouez Bay (Block 10)

Stations per Block

- Adult Mussel from trawl bycatch (40 stations)
- eDNA
  - 4 shallow- bays/slips/backwater
- Zooplankton
  - 2 total- 1 thalweg, 1 backwater

Expected Dreissena Species Distribution:

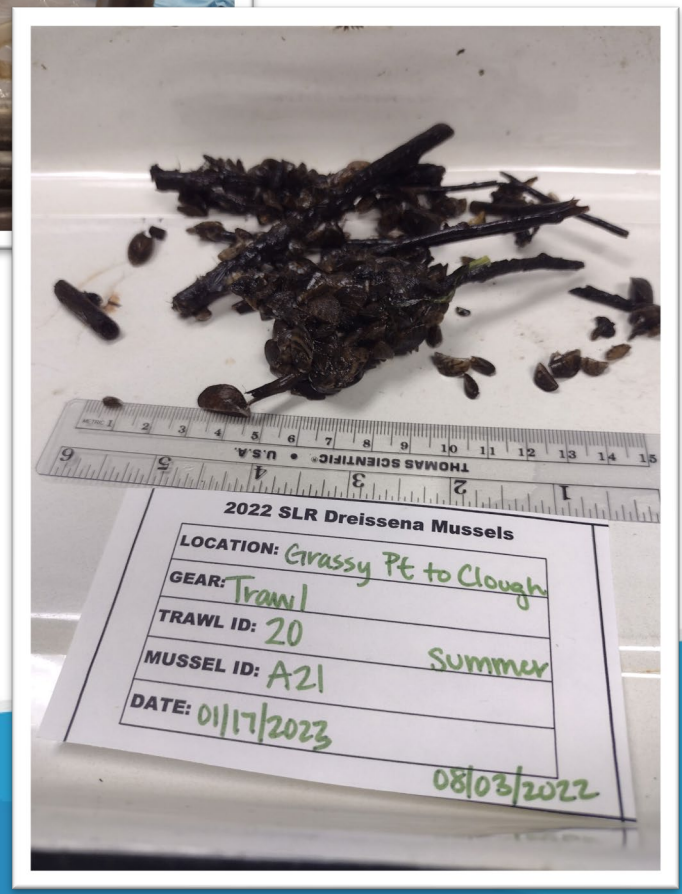
- Zebra mussels throughout the SLRE study area, increased abundance in lower harbor near lake
- Quagga present near lake at low levels

Sample Collection

- Adult Dreissena collected as bycatch from 1854 Treaty Authority bottom trawls, and by picking mussels off stuck/sunken logs
- Zooplankton collected from towed 64 µm nets (and 153 µm nets in open lake)
- Surface Water eDNA collected by grab samples

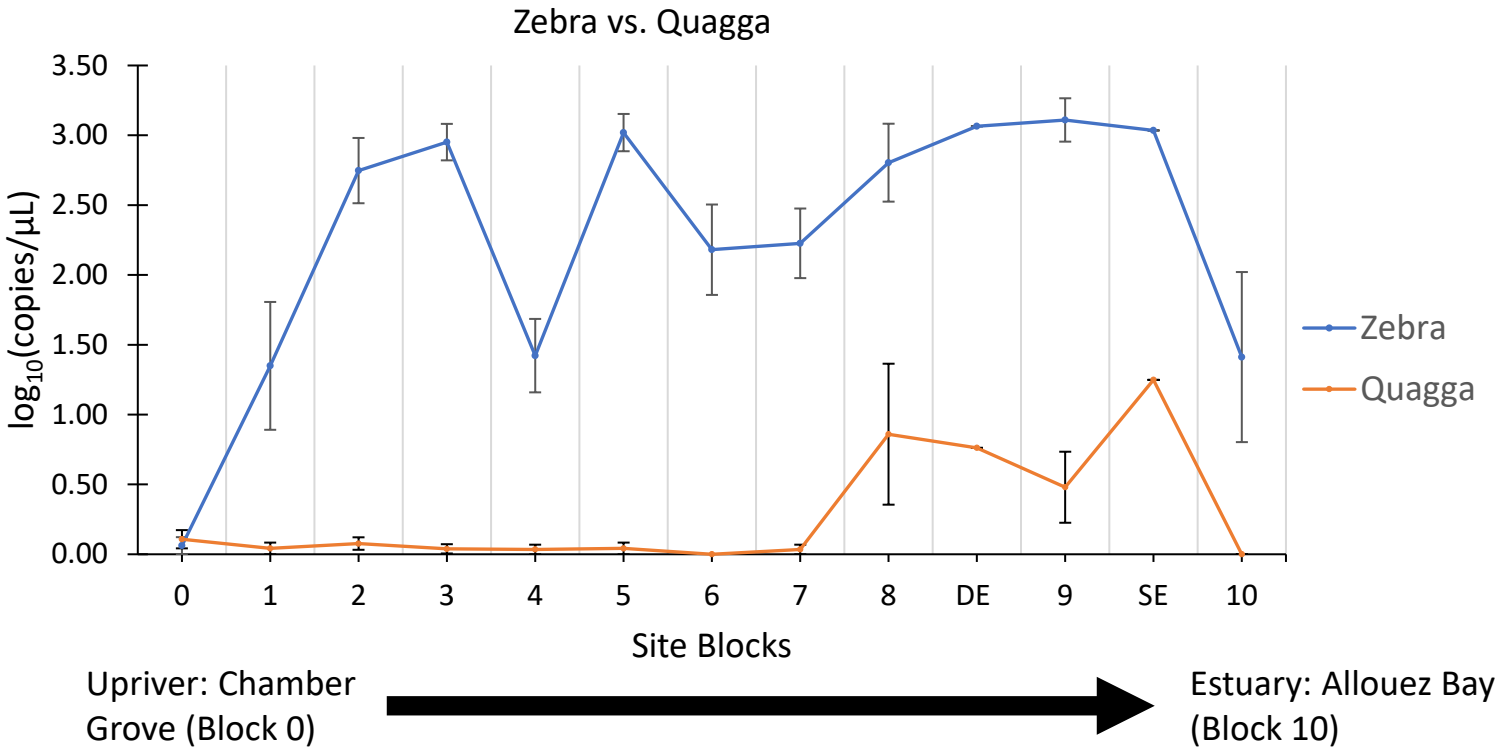
Sample Processing

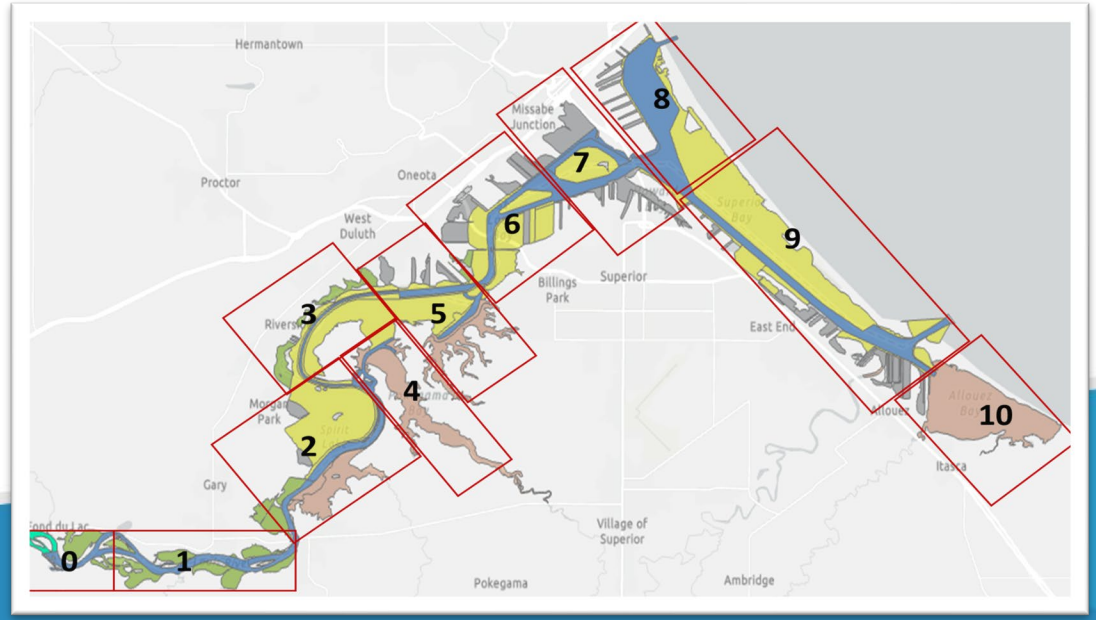
- EtOH used to preserve zooplankton samples decanted to create a DNA sample
- Both EtOH and Water samples filtered to capture DNA and
- DNA extracted from filters using Power Water and Tissue Qiagen Kits
- Extracted DNA will be analyzed for zebra and quagga mussel presence via qPCR using species specific genetic markers
- Adult mussels frozen when collected then weighed to estimate abundance – additional processing TBD



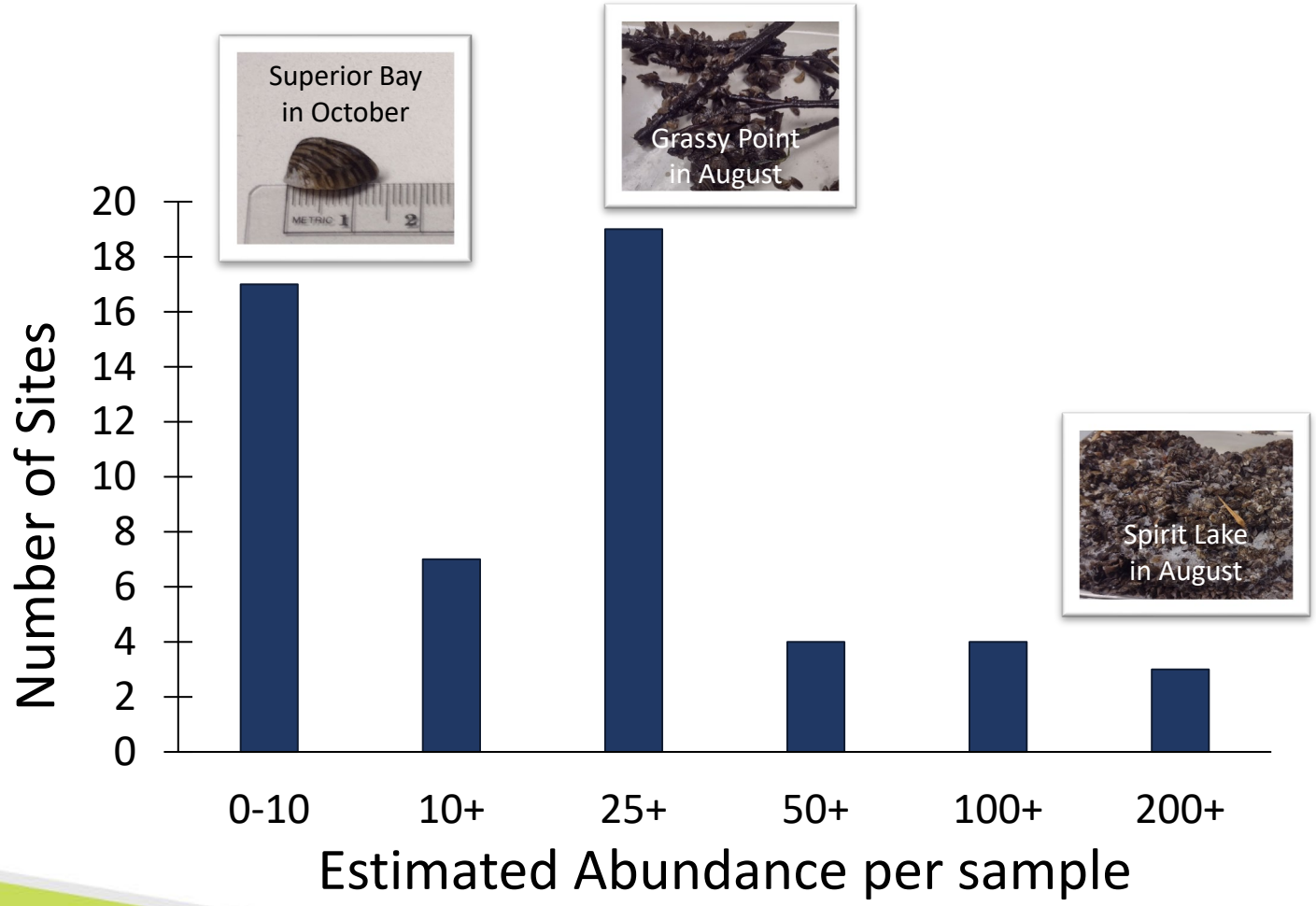
SLRE eDNA Results

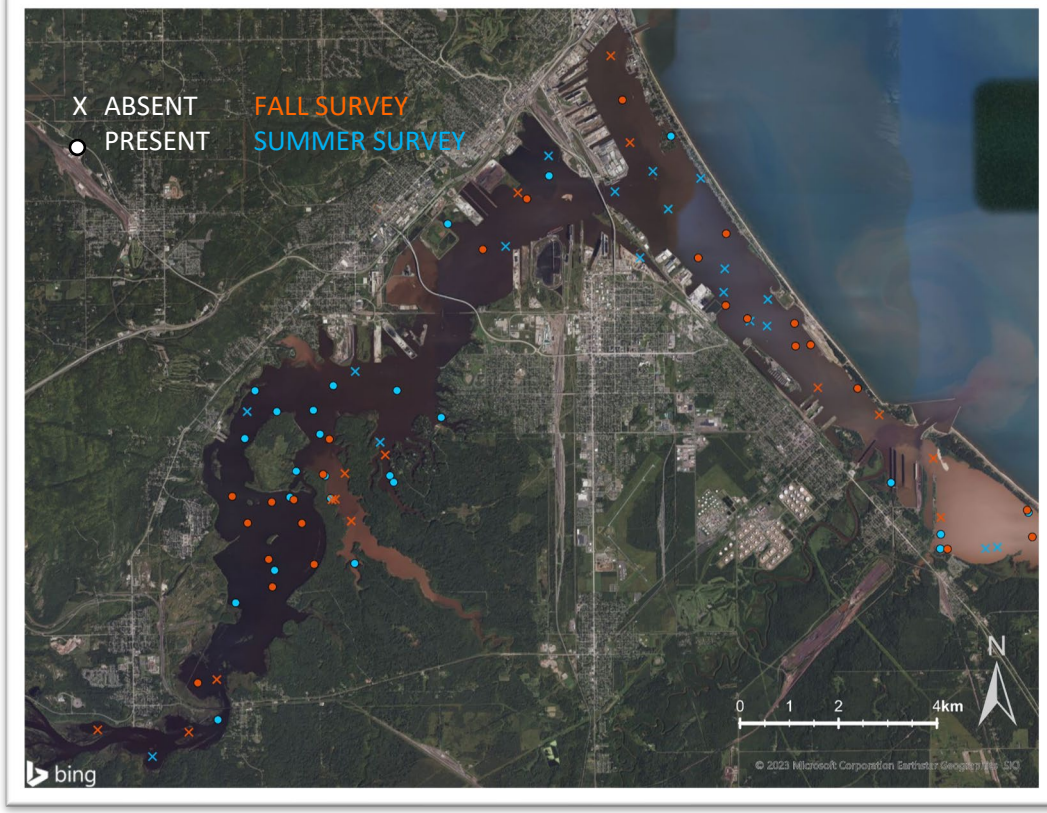
- Low levels of quagga throughout the SLRE
  - Higher levels of eDNA near entries to Lake Superior
- Zebra the dominant species in the SLRE
- Sharp declines in mussel eDNA the higher turbidity backwater bays
  - Site Blocks 4 & 10
  - Inhibition?





Adult Tissue Mussel Samples

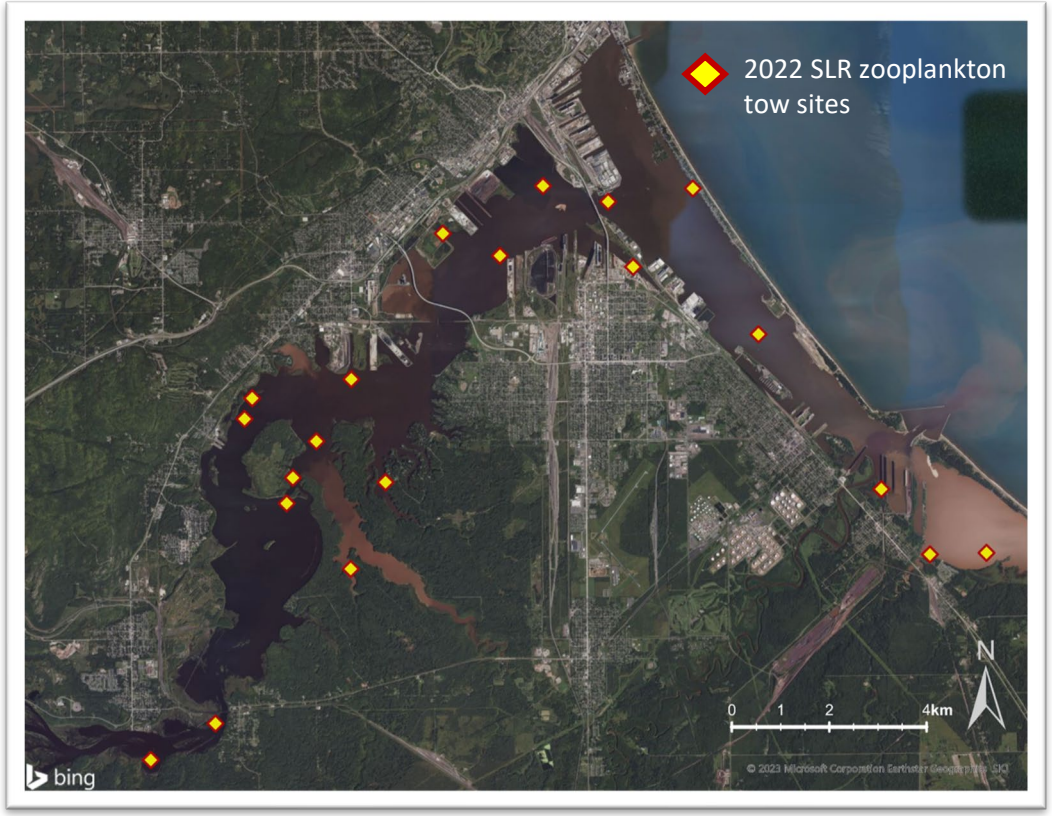




Progress and Moving Forward

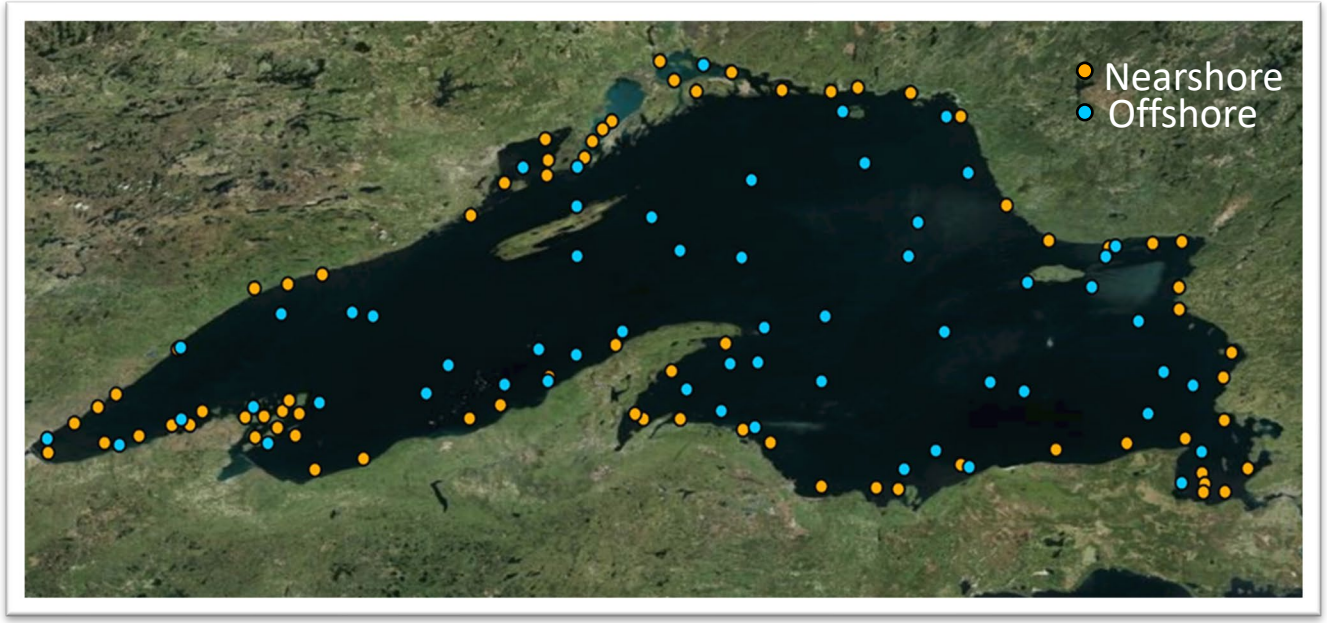
- Weight and estimated abundances completed
- DNA on bottom settled *Dreissena* tissue samples

Zooplankton Samples



SLRE Sampling

- Zooplankton (64µm zooplankton tows)



Lake Superior CSMI

- Nearshore (153µm zooplankton tows)
- Offshore (153µm and 64µm zooplankton tows)

Progress and Moving Forward

- SLRE and Offshore CSMI samples extracted
- Nearshore samples to be extracted
- Completing both quagga and zebra qPCR

Conclusions

- Quagga mussels have expanded their reach in recent years
  - Very low abundances throughout the SLRE
- Zebra mussels are dominant species but there is an increase of quagga in the lower SLRE
- Completion of zooplankton and adult tissue samples will give insight
  - Management of Dreissena within the SLRE
  - Prevention of their spread to Lake Superior

Questions?

Acknowledgements

Sample collection and processing help from 1854 Treaty Authority field crew (adult mussels), USGS ship and crew (zooplankton in Lake Superior), GLTED field crews. Funding and support from EPA-ORD, GLNPO, and GLRI.