Exploring Changes to Mercury Cycling Across the Great Lakes in Response to Co-Occurring Stressors

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St. Louis River Assessments

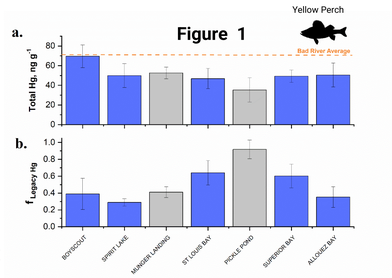
Why Do We Care?

Legacy mercury (from past industrial uses) is a widespread contaminant in the St. Louis River and other Areas of Concern (AOCs) within the Great Lakes. It is important to understand how legacy mercury and clean-up actions impact current fish consumption advisories.

Findings

Legacy mercury is ubiquitous in the St. Louis River AOC. This contaminated mercury source was detected in aquatic (fish and dragonflies) and terrestrial (spiders) food webs. Up to 50% of the mercury in yellow perch from the lower harbor was attributed to legacy contamination (Fig. 1), suggesting that remedial actions will decrease the amount of legacy mercury in fish tissues.

Figure 1



Publications and Data

2017 St. Louis River Mercury Isotope Survey: https://doi.org/10.1016/j.scitotenv.2021.146284

Tracking Legacy Mercury in Spiders: https://doi.org/10.1021/acs.estlett.3c00450

Estimating Legacy Mercury in Prey Fish: https://doi.org/10.1016/j.jglr.2024.102494

Collaboration is Key!

Questions? Please Contact Us!

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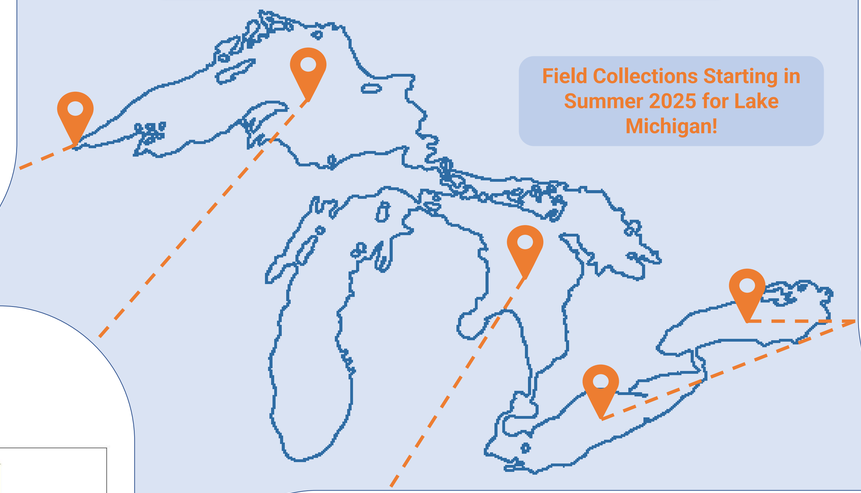


Field Collections Starting in Summer 2025 for Lake Michigan!

Mercury Methylation Dynamics in the Lower Lakes

Why Do We Care?

Despite ubiquitous fish consumption advisories for mercury in the Great Lakes, one key question remains: where exactly does mercury methylation occur? Mercury methylation is the primary step that connects mercury sources (i.e., emissions, overland runoff) to the bioaccumulation of methylmercury, the highly neurotoxic form. Currently, it is unclear what drives mercury methylation in offshore water columns or in nearshore coastal regions. Studies in Lakes Erie and Ontario were conducted to fill these gaps.

Figure 5

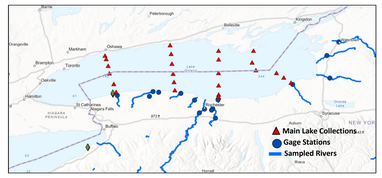
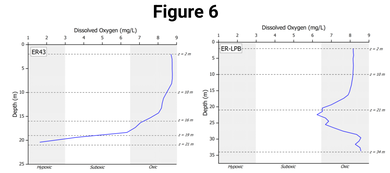


Figure 6



IAGLR Talk: Friday, Rm N208C, Number 85

Current Work

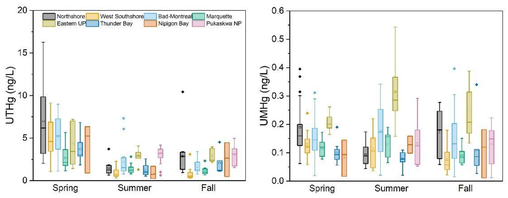
For Lake Ontario, a food web and tributary assessment, incorporating designs from the Lake Superior and Huron studies, was conducted with a special focus on methylmercury in nearshore regions **(Fig. 5)**. In Lake Erie, the role of hypoxia on mercury methylation was explored by collecting total mercury, methylmercury, and metagenomic samples across depth profiles (**Fig. 6**). Analyses are finishing up in 2025, so stay tuned!

Mercury Inputs to Lake Superior

Why Do We Care?

Lake Superior has the most undeveloped watershed area (i.e., less urbanized regions) of all the Great Lakes, yet mercury bioaccumulation is still prevalent in nearshore and offshore regions. Understanding the seasonal mercury loads from the Lake Superior watershed will be critical in predicting how climate and land use changes will impact mercury release and bioaccumulation in Lake Superior.

Figure 2



Findings

Watershed mercury loads were highest during spring runoff (Fig. 2). Regions of the US Northshore and Canada's Pukaskwa National Park had the highest mercury yields per watershed size. The largest loads came from the St. Louis River and Thunder Bay due to the size and urbanization of these watersheds. Methylmercury production was evident in summer months and most pronounced in the Upper Peninsula of Michigan (Fig. 2). Mercury isotope results highlighted that watershed runoff can travel and be preserved in nearshore and offshore sediments.

Publications and Data

Lake Superior Mercury Data Release: https://doi.org/10.1016/j.scitotenv.2021.146284

Assessing Mercury Loads to Lake Superior: https://doi.org/10.1016/j.jglr.2024.102494

Mercury Bioaccumulation Dynamics in Lake Huron

Why Do We Care?

Mercury concentrations in sport fish from Lake Huron have not declined in the past decades unlike the lower Great Lakes. Food web changes, such as invasive species, can have drastic impacts on contaminant bioaccumulation and potentially alter long-term concentration trends, as observed in Lake Michigan (**Lepak et al. 2019**, **Fig. 3**). Lake Huron is highly understudied for mercury cycling and little information exists for the lower food web (i.e., plankton and mussels). To understand the long-term trajectory of fish tissue mercury concentrations, it is imperative to examine how mercury enters the food web.

Figure 3 -Lake Michigan

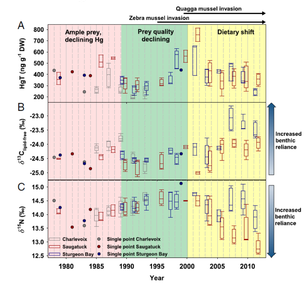
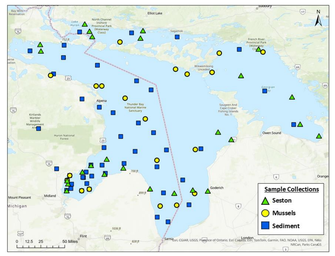
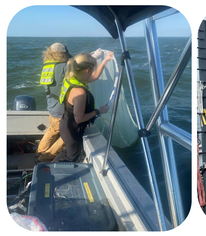
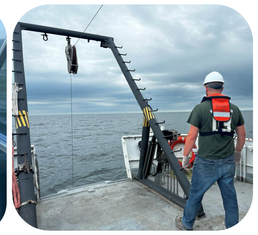


Figure 4







Findings

Lake-wide surveys of mercury concentrations in plankton, mussels, and sediments (**Fig. 4**) highlighted that Lake Huron has different zones of mercury bioaccumulation. Saginaw Bay, a current AOC, had the highest sediment concentrations and lowest amounts of mercury bioaccumulation. Benthic and pelagic prey sources contribute to fish mercury burdens, providing insight on how mercury enters the Lake Huron food web.

Publications and Data

How do declines in mercury emissions and food web shifts impact fish mercury in Lake Michigan? www.pnas.org/cgi/doi/10.1073/pnas.1907484116

Great Lakes Sediment Surveillance Program Data Release: https://doi.org/10.5066/P9VB8GO6

Lake Huron Food Web Assessment Data Release: https://doi.org/10.5066/P13E2GZC