Using a fish-based metric to track remediation and restoration effectiveness in Pickle Ponds and Ponds Behind Erie Pier

Gordon, Morgann,[1,2] Gerald Ankley[1], Adam Balz[1], Gale Beaubien[1], Joel Hoffman[1], Dave Krabbenhoft[3], Sarah Janssen[3], Jim Lazorchak[1], Todd Luxton[1], Marc Mills[1], Tammy Newcomer-Johnson[1], Mark Pearson[1], Greg Peterson[1], Dalon White[1] and Roger Yeardley[1]

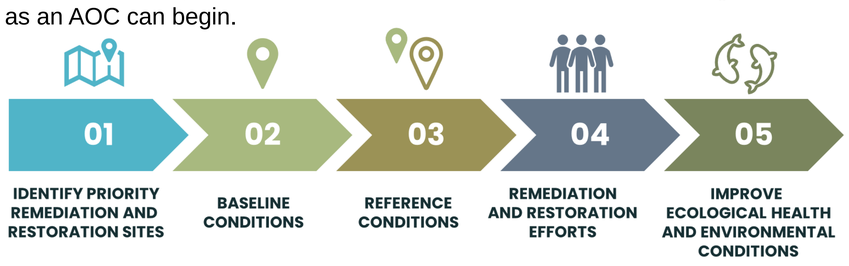
[1]U.S. Environmental Protection Agency , [2]Oak Ridge Associated Universities, [3]U.S. Geological Survey

Morgann Gordon | gordon.morgann@epa.gov

www.epa.gov

ABSTRACT

- In the St. Louis River estuary historical sediment contamination from mercury, dioxins, PCBs, and PAHs, have resulted in several beneficial use impairments (BUIs).
- As a result of the BUIs, the St. Louis River estuary is currently the second-largest area of concern (AOC) in the United States. Remedy and restoration effectiveness research initiatives are working to develop useful metrics to measure both the progress and success of AOC projects.
- Ponds Behind Erie Pier (PBEP) is a priority remediation site due to a wide array of contaminants of concern, including both organic and metal contaminants.
- Pickle Pond (PP) is a remediation and restoration site that is both contaminated and ecologically degraded. To measure remedy and restoration effectiveness, it is necessary to document both baseline and reference conditions before the start of the project.
- Once PBEP and PP undergo cleanup work and if future environmental monitoring indicates environmental status improvements, BUIs can be removed, and delisting the St. Louis River estuary as an AOC can begin.



LOCATIONS

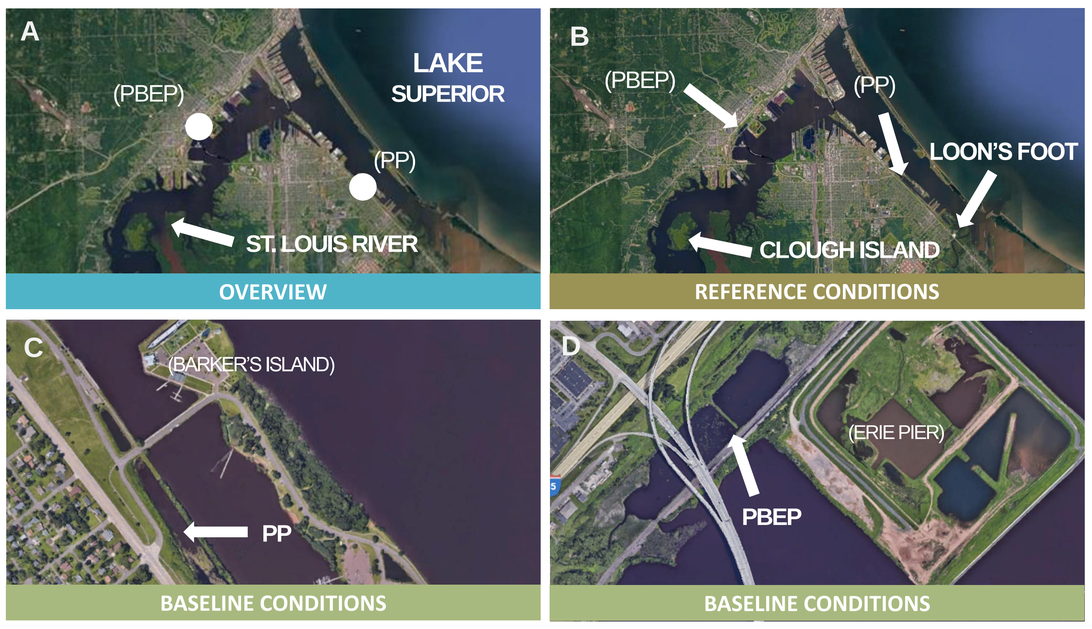


Figure 1. A) PBEP and PP are small embayments with historical contamination receiving mostly stormwater through hydrological connections on the Minnesota side and Wisconsin side of the estuary, respectively. Both sites are sheltered coastal wetlands of ecological importance, making it a priority for local agencies to improve environmental conditions and ecological health.

B) Reference condition sites were established for PP and PBEP, Loon's Foot and Clough Island respectively. To measure remedy and restoration effectiveness, it is necessary to document both baseline and reference conditions prior to the start of the project, these data include contaminant bioaccumulation, industrial mercury contribution indices of biotic integrity based on fish, and other indicators.

C) PP is located adjacent to Barker's Island in Superior, WI, it is a remediation and restoration site that is both contaminated and ecologically degraded

D) PBEP is a priority remediation site due to a wide array of contaminants of concern, including both organic and metal contaminants.

BASELINE CONDITIONS AND ASSESSMENT

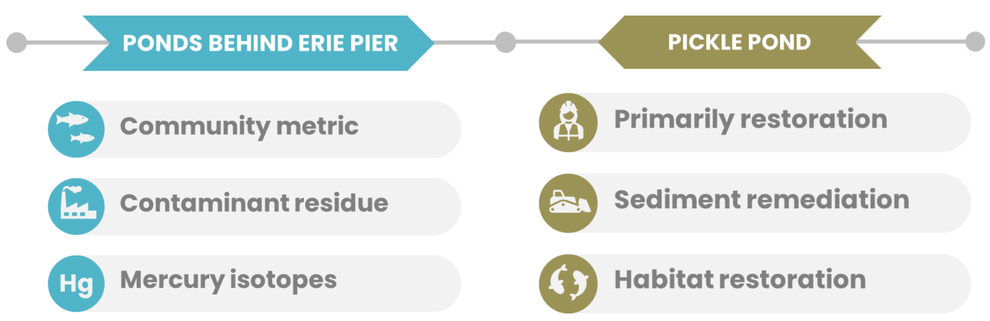


Figure 2. Baseline conditions have been established for both PBEP and PP, are spread across the entire aquatic ecosystem, and contain a variety of different metrics.

BACI SAMPLING DESIGN

BEFORE / AFTER / CONTROL / IMPACT

Figure 3. Using our baseline conditions, we focused on utilizing the BACI sampling design. The principles that this design centers around are that anthropogenic disruptions located in the targeted site(s) cause an altered configuration of change from before to after it starts and is then compared to changes that occurred naturally at the control site. In practice, this means that samples are taken at replicated, random intervals of time before and after the restoration starts. This allows us to monitor any other coincidental fluctuations in either location and document changes that are not caused by restoration effects.

RESIDENT FISH

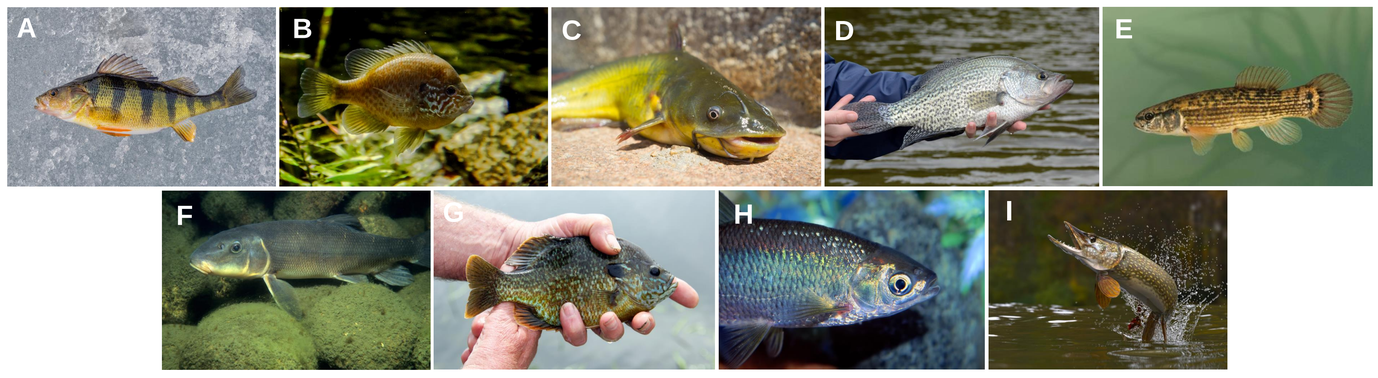


Figure 4. Existing resident fish communities are established to construct a fish-based metric for measuring remediation and restoration. A) Yellow Perch (YEP), B) Pumpkinseed (PUS), C) Bullhead (BUL), D) Black Crappie (BLC), E) Mud Minnow (MUM), F) White Sucker (WHS), G) Bluegill (BLG), H) Golden Shiner (GOS), I) Northern Pike (NOP)

CATCH DATA

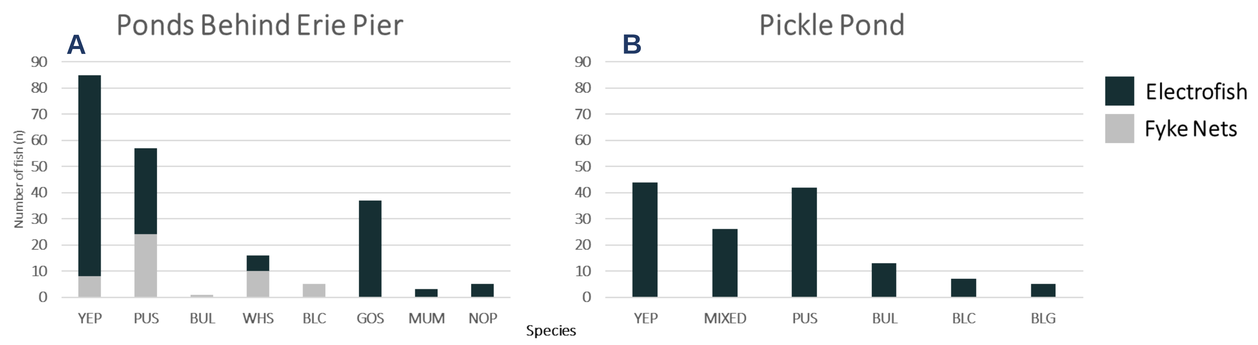


Figure 5. Using two methods of capture; electrofishing and fyke nets, we targeted nearshore heavily vegetated sites that our resident fish communities are known to inhabit. In PP, we were not able to use fyke nets due to environmental and access problems.

A) YEP n=85, PUS n=57, BUL n=1, WHS n=16, BLC n=5, GOS n=37, MUM n=3, NOP n=5

B) YEP n=44, MIXED (sunfish) n=26, PUS n=42, BUL n=8, BLC n=7, BLG n=5

LEGACY CONTAMINANTS

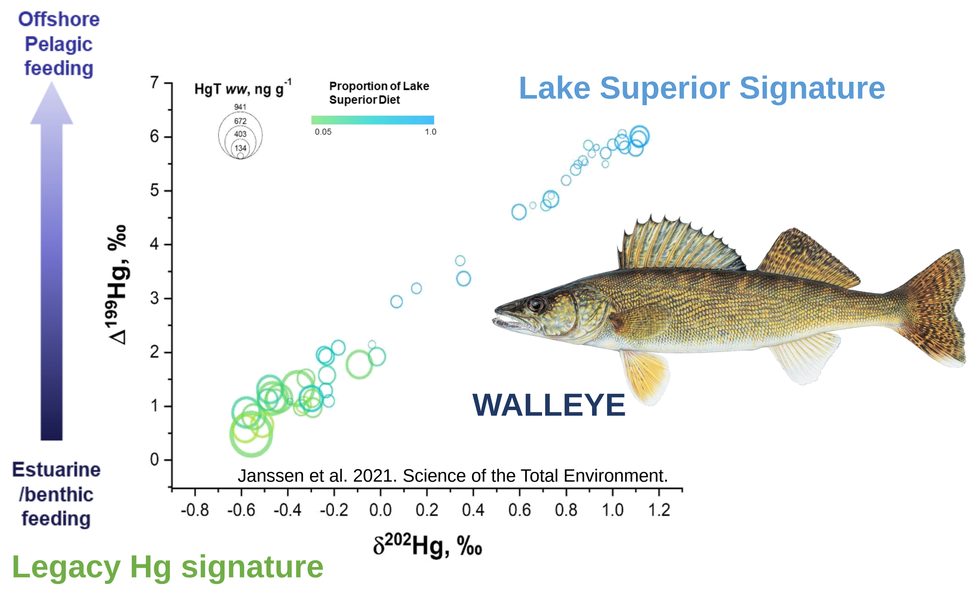


Figure 6. Mercury studies in the St. Louis River estuary (SLRE) used walleye to assess mercury sources to the food web and determine if different sources contributed to Hg burdens. Concentrations were a function of Hg source in this study. While all walleye were caught in SLRE, diet and mercury isotope analysis indicated that fish feeding offshore in Lake Superior were receiving a different Hg source and subsequently had lower Hg concentrations than those feeding in the estuary.

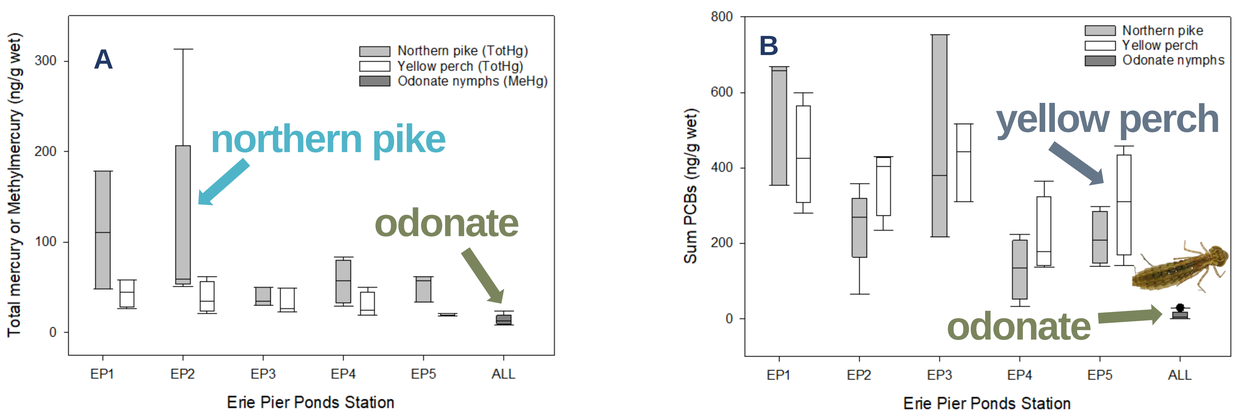


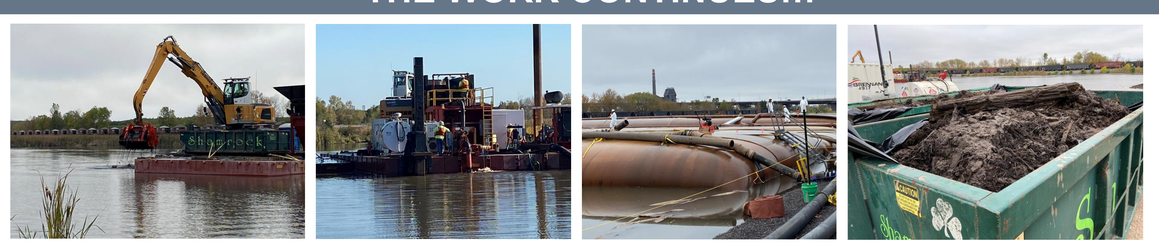
Figure 7. A) Total mercury and methyl mercury concentrations in Northern Pike, Yellow Perch, and Odonate nymphs from five stations within Erie Pier Pond**.** Increases in total mercury significantly increase in Northern Pike in comparison to food items (odonates). Methylation of inorganic mercury produces organic methyl mercury, which is biomagnified in food webs.

B) PCB concentrations in Northern Pike, Yellow Perch, and Odonate nymphs from five stations within Erie Pier Pond**.** Increases in PCBs significantly increase in Northern Pike and Yellow Perch in comparison to food items (odonates).

CHALLENGES ASSOCIATED WITH SAMPLING DEGRADED WETLANDS

1. CLEARLY DEFINED OBJECTIVES
2. SITE SELECTION
3. IDENTIFYING AND CHARACTERIZING REFERENCE SITES

THE WORK CONTINUES…



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