Ministry of the Environment, Conservation and Parks

Priority Contaminants in Fish from Lake Superior and Lake Huron: Spotlight on PFAS in Rainbow Smelt

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April 2025

Ontario

Outline

- Fish Contaminant Monitoring Program
- Contaminants causing fish consumption advisories
- PCB, mercury: Spatial variation and temporal trends
- PFAS: introduction, levels, variation and trends
- PFAS in Smelt: binational levels 2021-2024

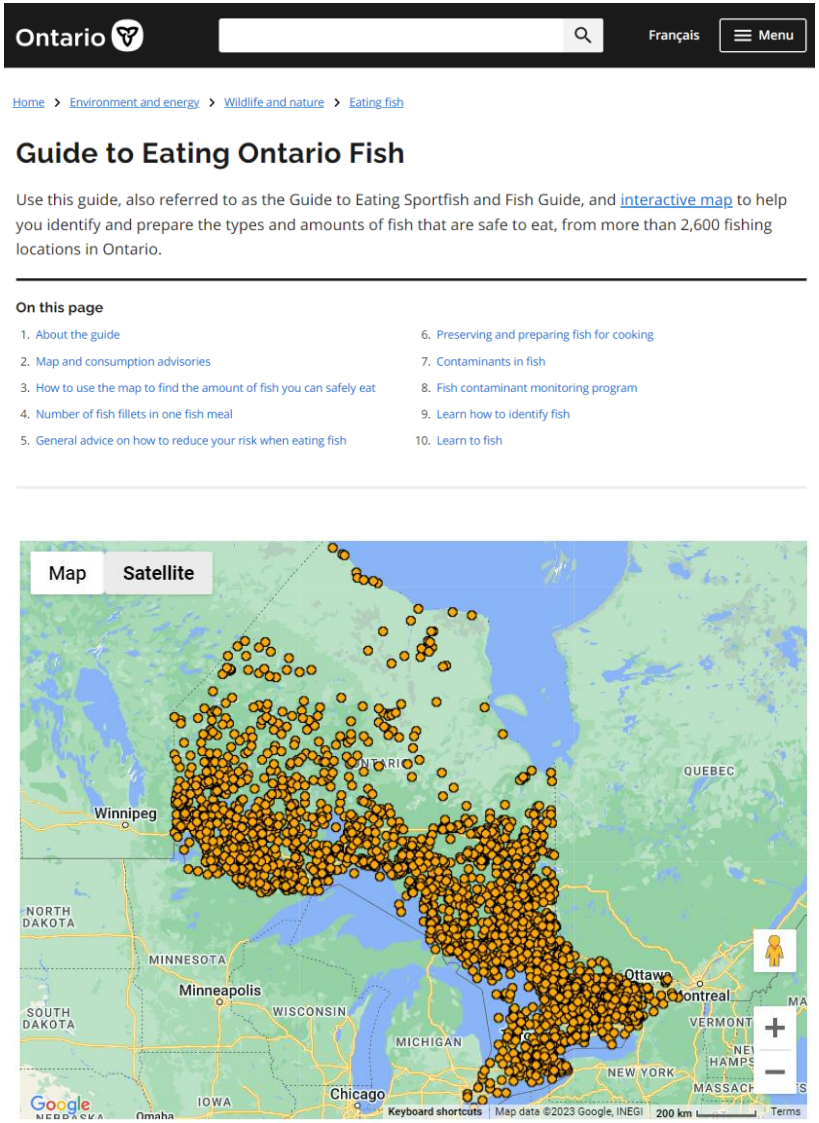
Fish Contaminant Monitoring in Ontario

Government of Ontario started monitoring contaminants in fish during the late 1960s

The Fish Contaminant Monitoring Program was initiated in 1976

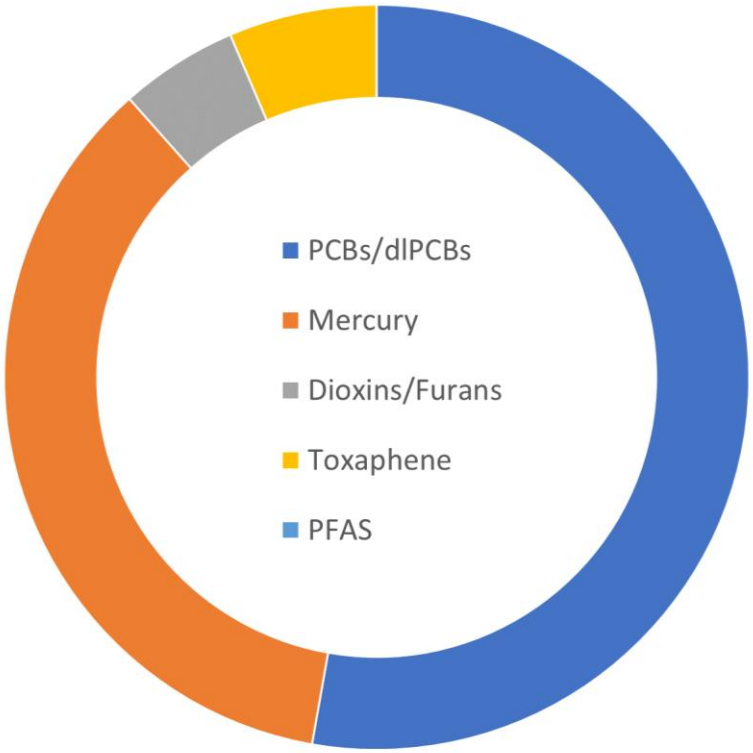
- to provide advice on safe consumption of Ontario's fish
- track contaminant levels in the fish

Ministry of the Environment, Conservation and Parks (MECP) lead; Ministry of Natural Resources (MNR) partner in sampling/outreach

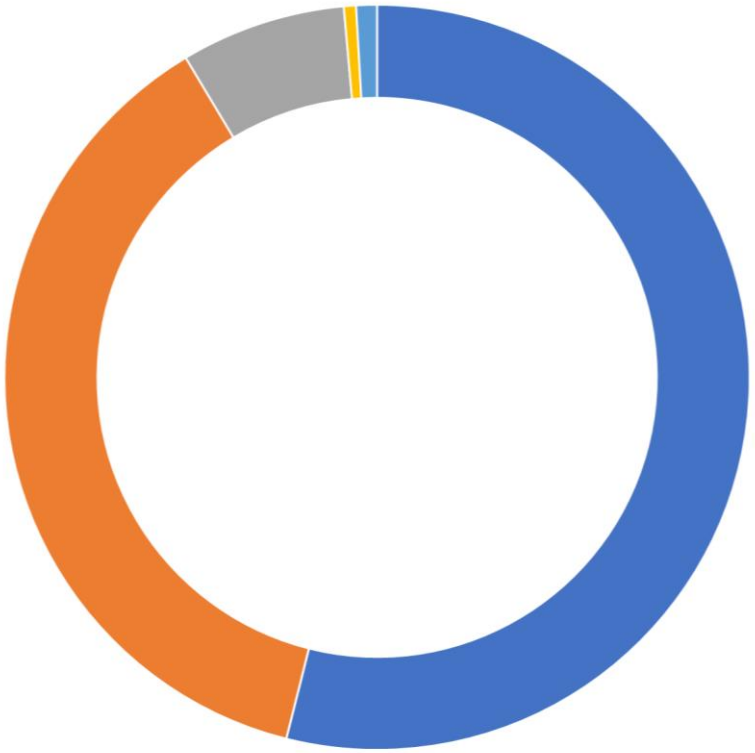


PCBs and mercury are the major drivers of Ontario's fish consumption advisories for Lake Superior and Lake Huron

Lake Superior



Lake Huron



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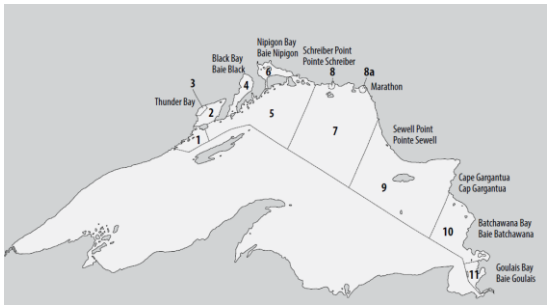
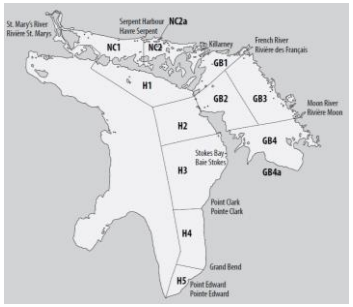
PCBs
Polychlorinated biphenyls

PCBs in Lake Trout: Spatial Variation (2020-2022)

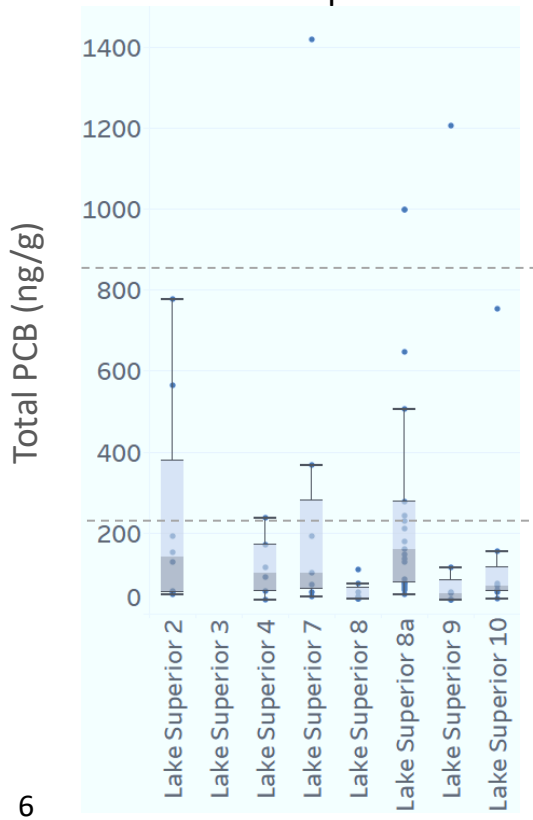


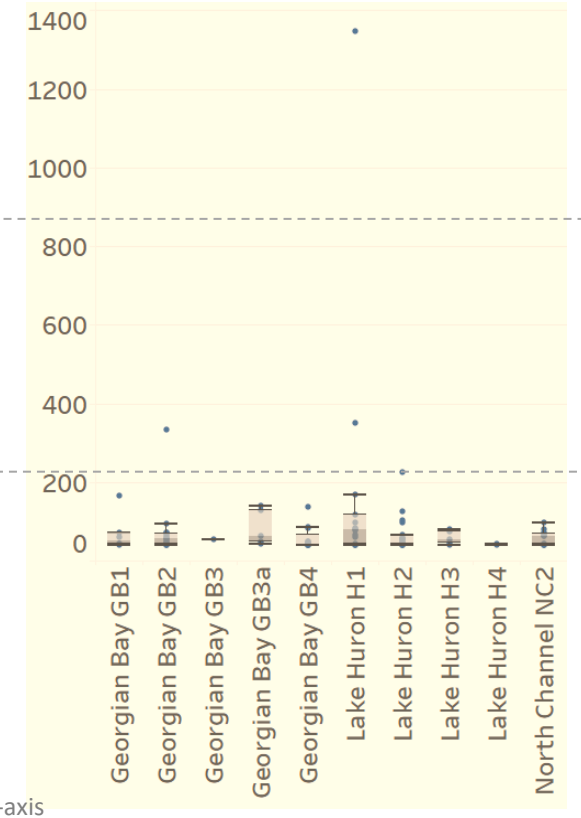
Lake Superior



Lake Huron

Lake Trout





"Do not eat" benchmarks

General population: >844 ng/g

Sensitive population: >211 ng/g

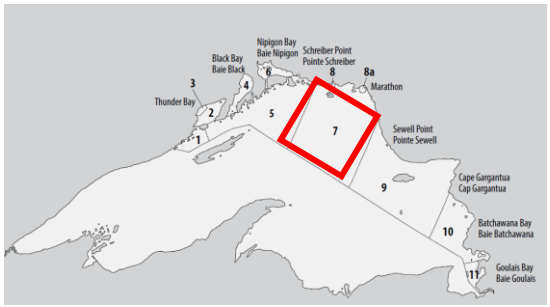
Sensitive population: People who are or may become pregnant, and children under 15

Some extreme values removed to trim scale on the Y-axis

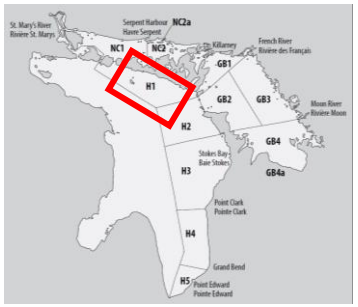
Ontario

PCBs in Lake Trout: Temporal Trend

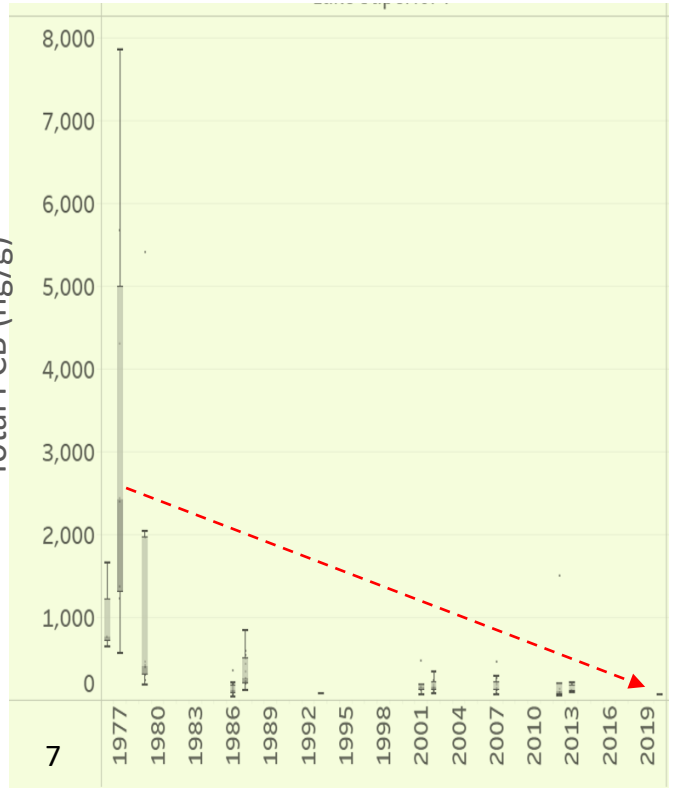
Lake Trout
55-65 cm

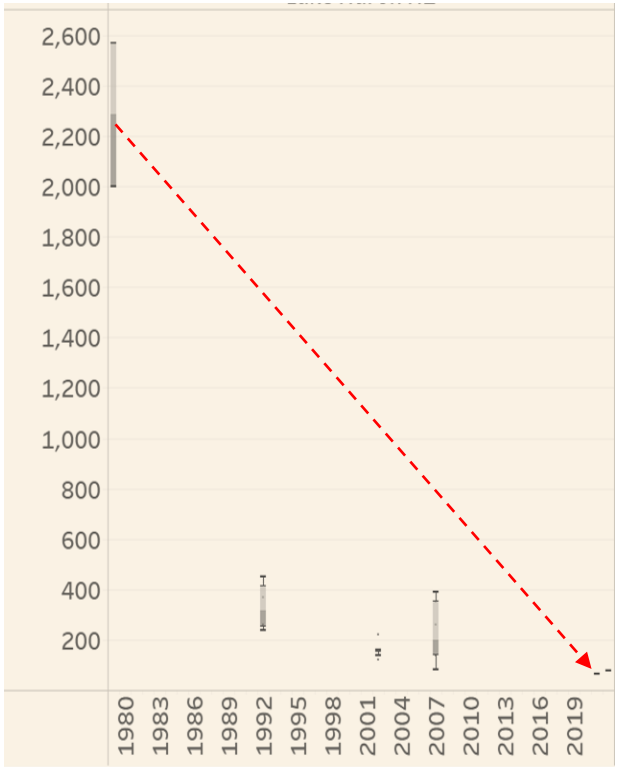


Lake Superior



Lake Huron





Some extreme values removed to trim scale on the Y-axis

PCB levels have improved substantially during the last 40-50 years

"Do not eat" benchmarks

General population: >844 ng/g
Sensitive population: >211 ng/g

Sensitive population: People who are or may become pregnant, and children under 15

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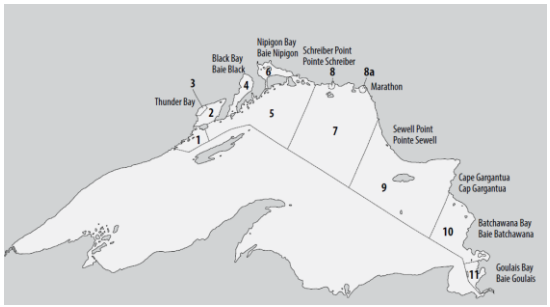
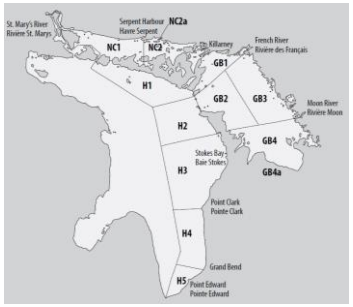
Mercury

Mercury in Walleye: Spatial Variation (2020-2022)

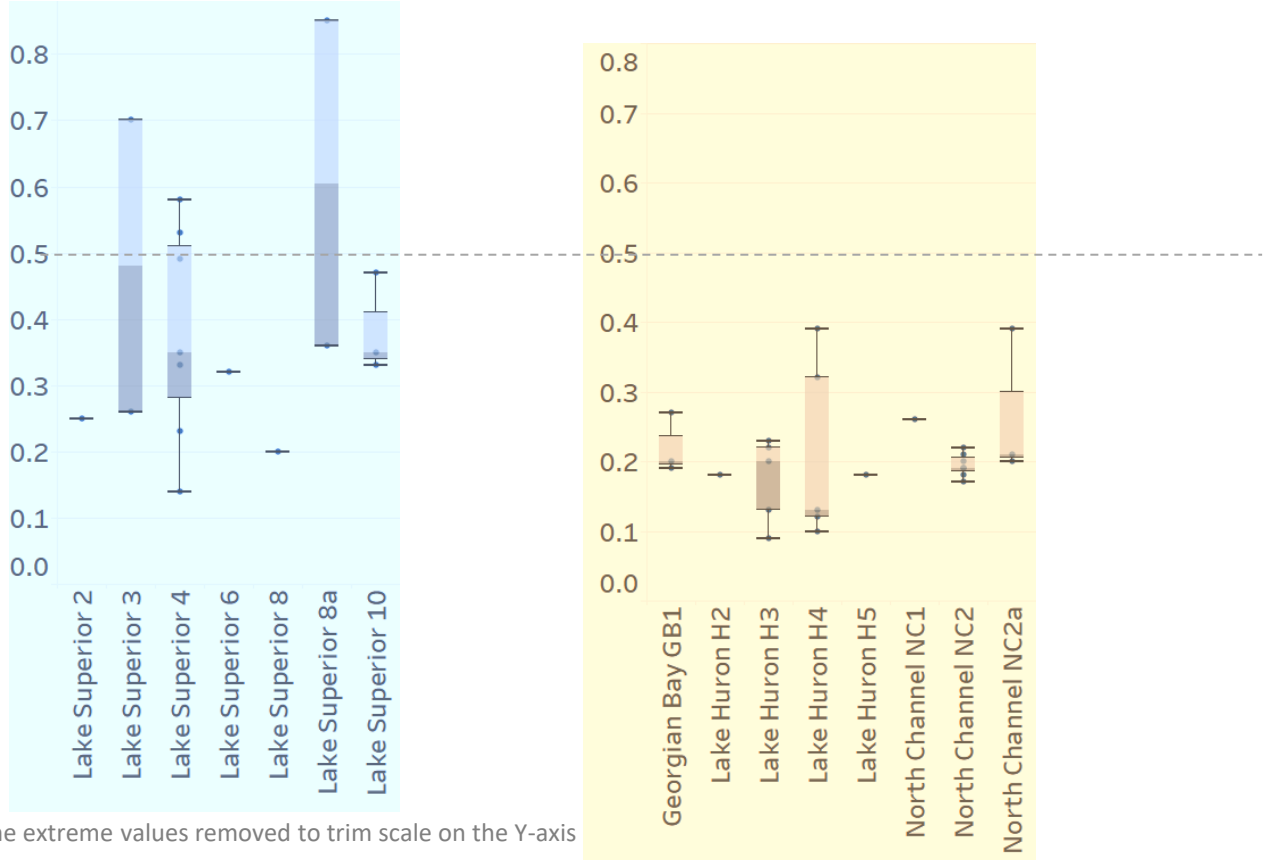


Lake Superior



Lake Huron

Walleye
45-55 cm



Some extreme values removed to trim scale on the Y-axis

"Do not eat" benchmarks

General population: >1.8 ug/g

Sensitive population: >0.5 ug/g

Sensitive population: People who are or may become pregnant, and children under 15

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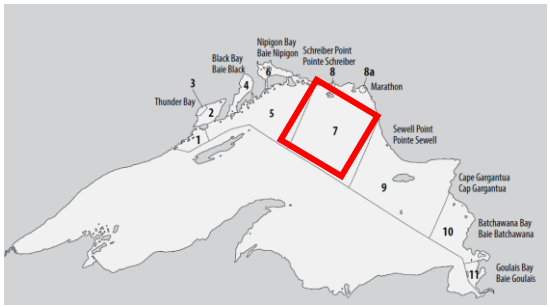
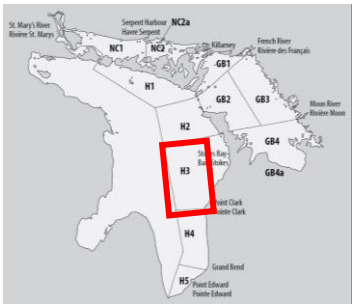
Mercury in Walleye: Temporal Trend

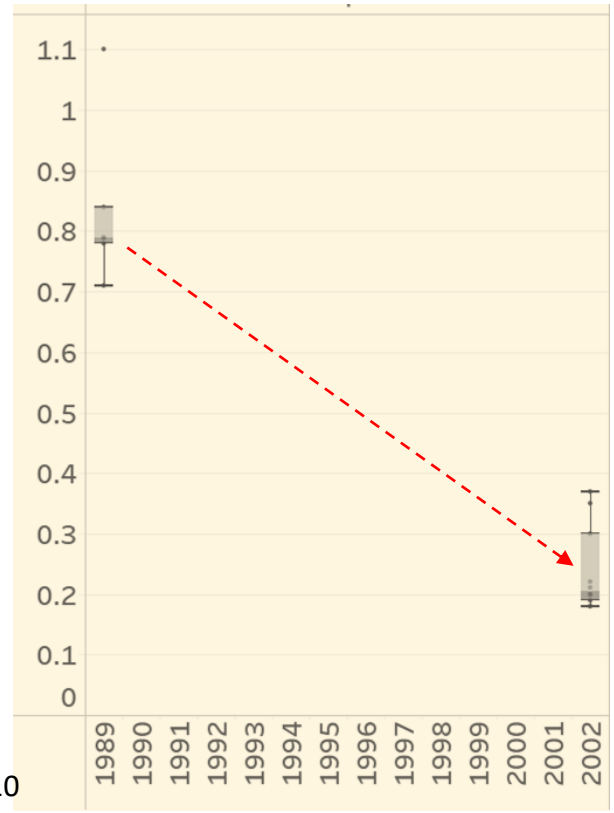
Walleye
45-55 cm

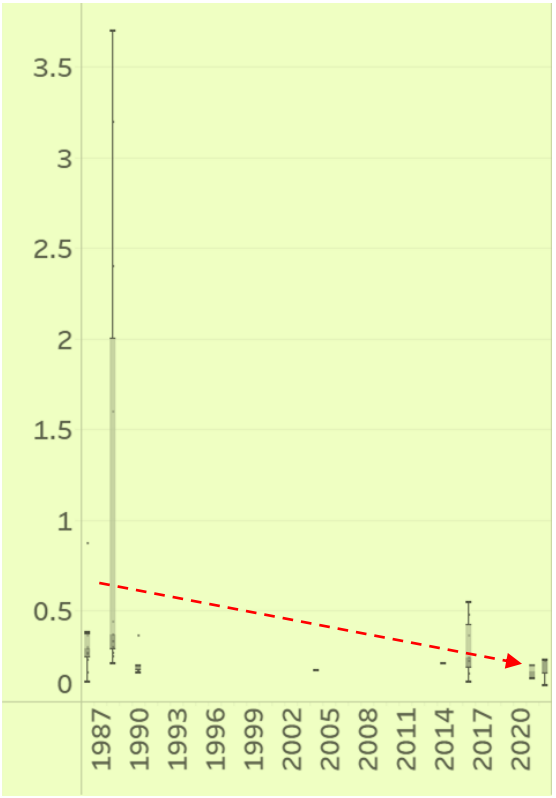


Lake Superior



Lake Huron





Some extreme values removed to trim scale on the Y-axis

Mercury levels have improved substantially during the last 40-50 years

"Do not eat" benchmarks

General population: >1.8 ug/g
Sensitive population: >0.5 ug/g

Sensitive population: People who are or may become pregnant, and children under 15

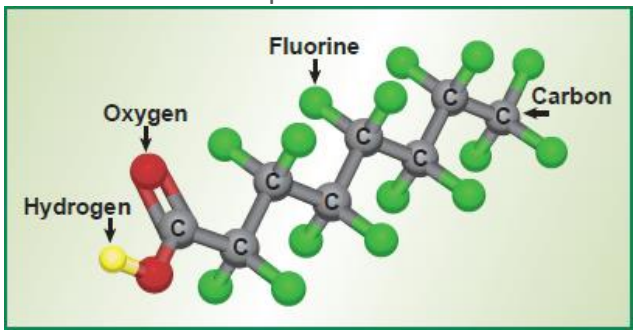
Ontario

PFAS
Per- and polyfluoroalkyl substances

PFAS Background

- Group of over 14,000 chemicals containing carbon-fluorine bond, one of the strongest chemical bonds
  - According to one definition of PFAS, there could be over 7 million compounds in the group
- Known as “forever chemicals” due to persistence in the environment
- No known natural sources
- Have lipid and water repellant properties
- Primarily used in industrial and consumer products: Aqueous Fire Fighting Foam (AFFF), carpets, non-stick cookware, food packaging (Teflon™), paper coatings (foods), stain repellants (ScotchGard™, Stainmaster™).
- The most studied PFAS are Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA)
- In Canada, PFOS (2006) and PFOA (2012) were declared “toxic” under the *Canadian Environmental Protection Act*
- **Neither PFOS or PFOA was manufactured in Canada**

PFAS structure Example



Ontario

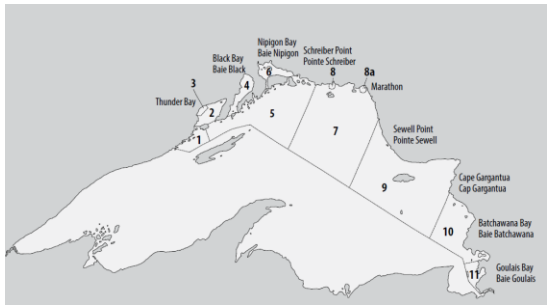
Monitoring of PFAS in Ontario fish

- **Started in 2003; among the first worldwide**
  - Over 40 types of large-bodied fish from about 200 locations monitored

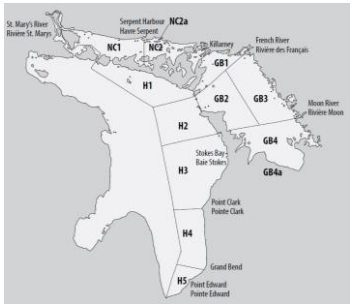
- **Fish advisories issued for 63 locations in Ontario**
  - First PFAS advisories issued in 2011; among the first jurisdictions worldwide
    - Typically, local contamination issue
  - First to issue PFAS advisories for Great Lakes fish (in 2020)
    - Great Lakes advisories are mostly driven by PCB/mercury
    - moderate PFAS levels result in 11% of the Great Lake advisories
    - Typical PFAS sources for the Great Lakes: urban, wastewater and diffuse

Some notable findings have been published

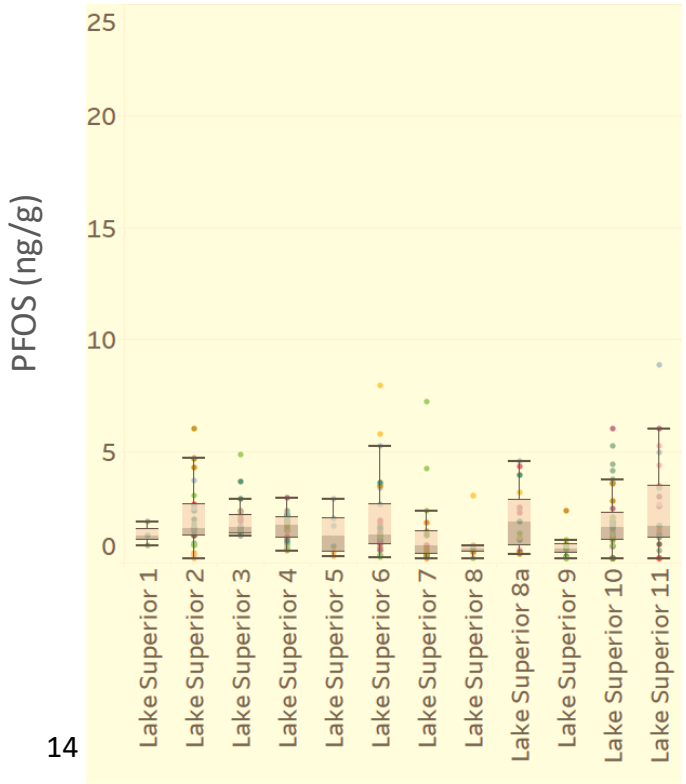
PFOS in Fish: Spatial Variation (2019-2022)

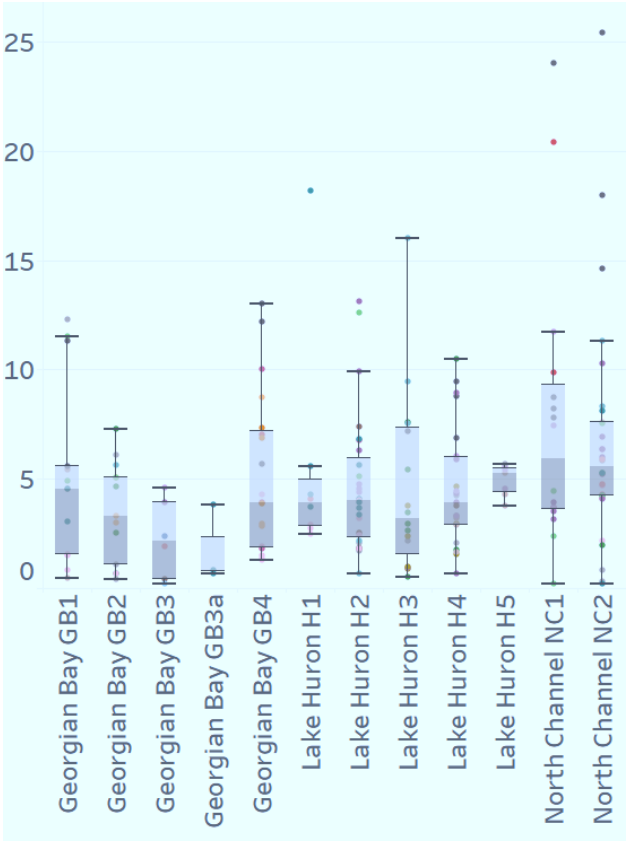


Lake Superior



Lake Huron





Species monitored

- Black Crappie
- Brook Trout
- Brown Bullhead
- Brown Trout
- Burbot (Ling)
- Chinook Salmon
- Cisco (Lake Herring)
- Coho Salmon
- Lake Trout
- Lake Whitefish
- Longnose Sucker
- Northern Pike
- Rainbow Smelt
- Rainbow Trout
- Redhorse Sucker
- Rock Bass
- Round Whitefish
- Smallmouth Bass
- Walleye
- White Sucker
- Yellow Perch

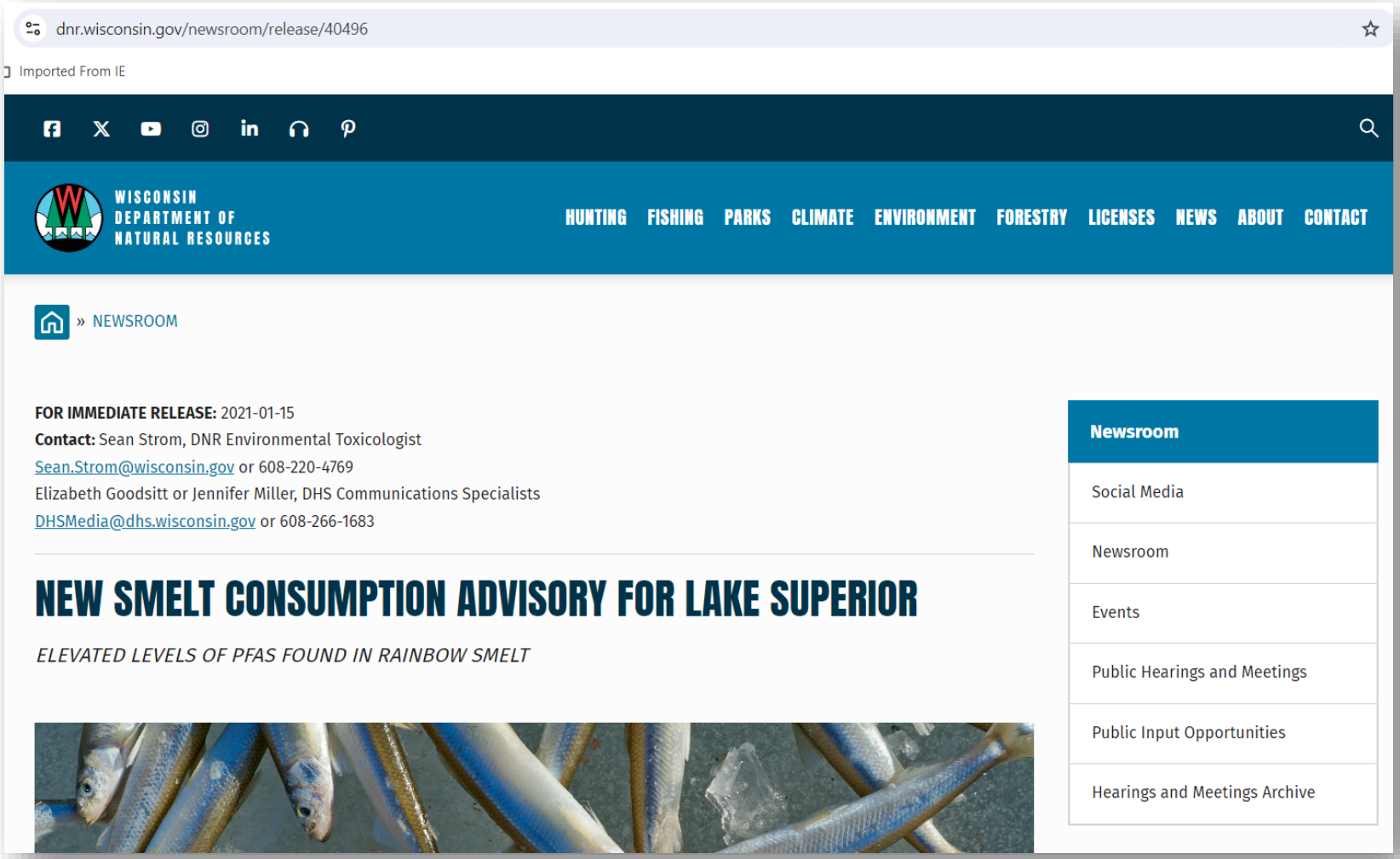
"Do not eat" benchmarks
For total PFAS monitored
General population: >560 ng/g
Sensitive population: >140 ng/g

Sensitive population: People who are or may become pregnant, and children under 15

Ontario

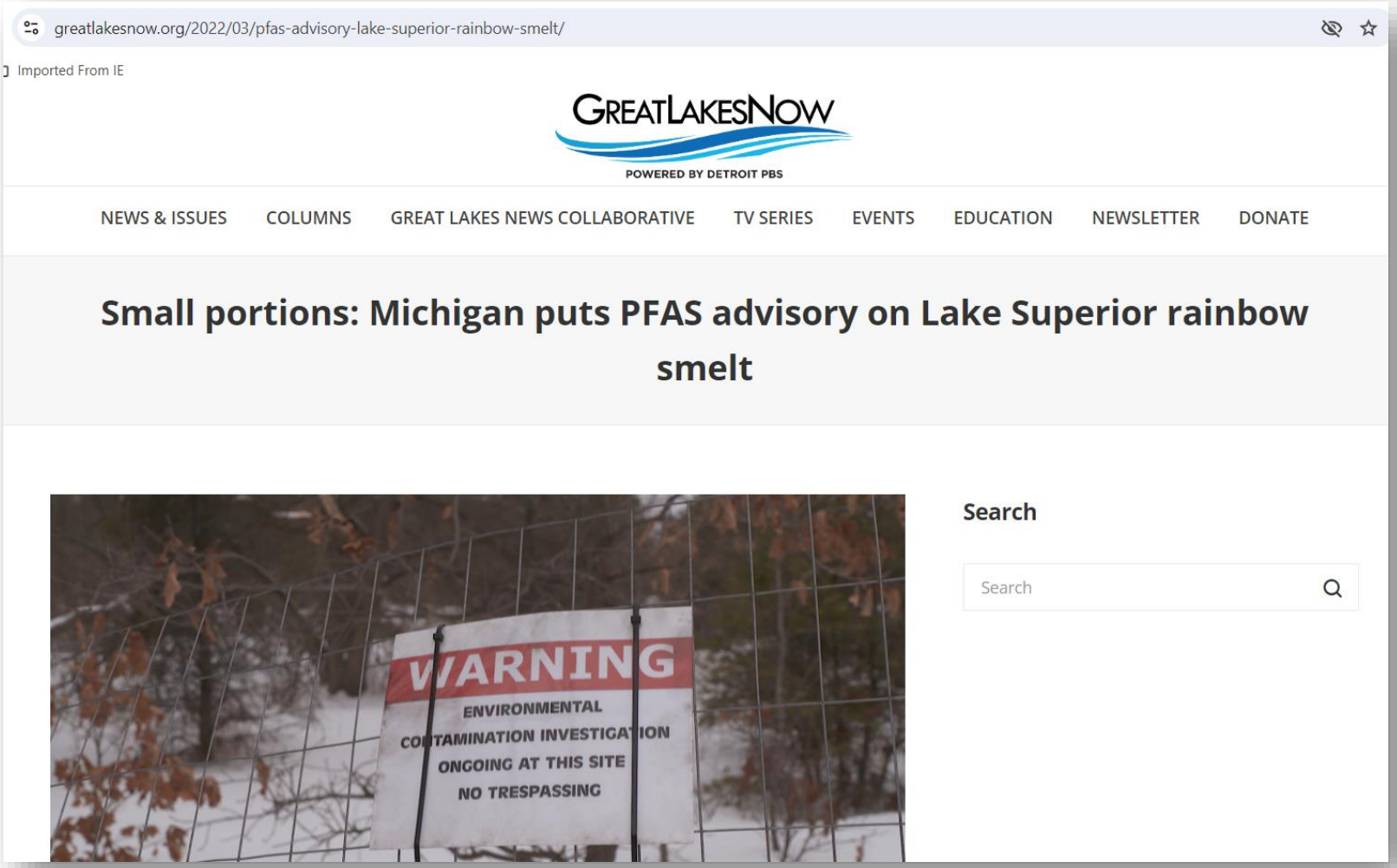
US-Wisconsin Lake Superior PFAS Smelt Advisory 2021

https://dnr.wisconsin.gov/newsroom/release/40496



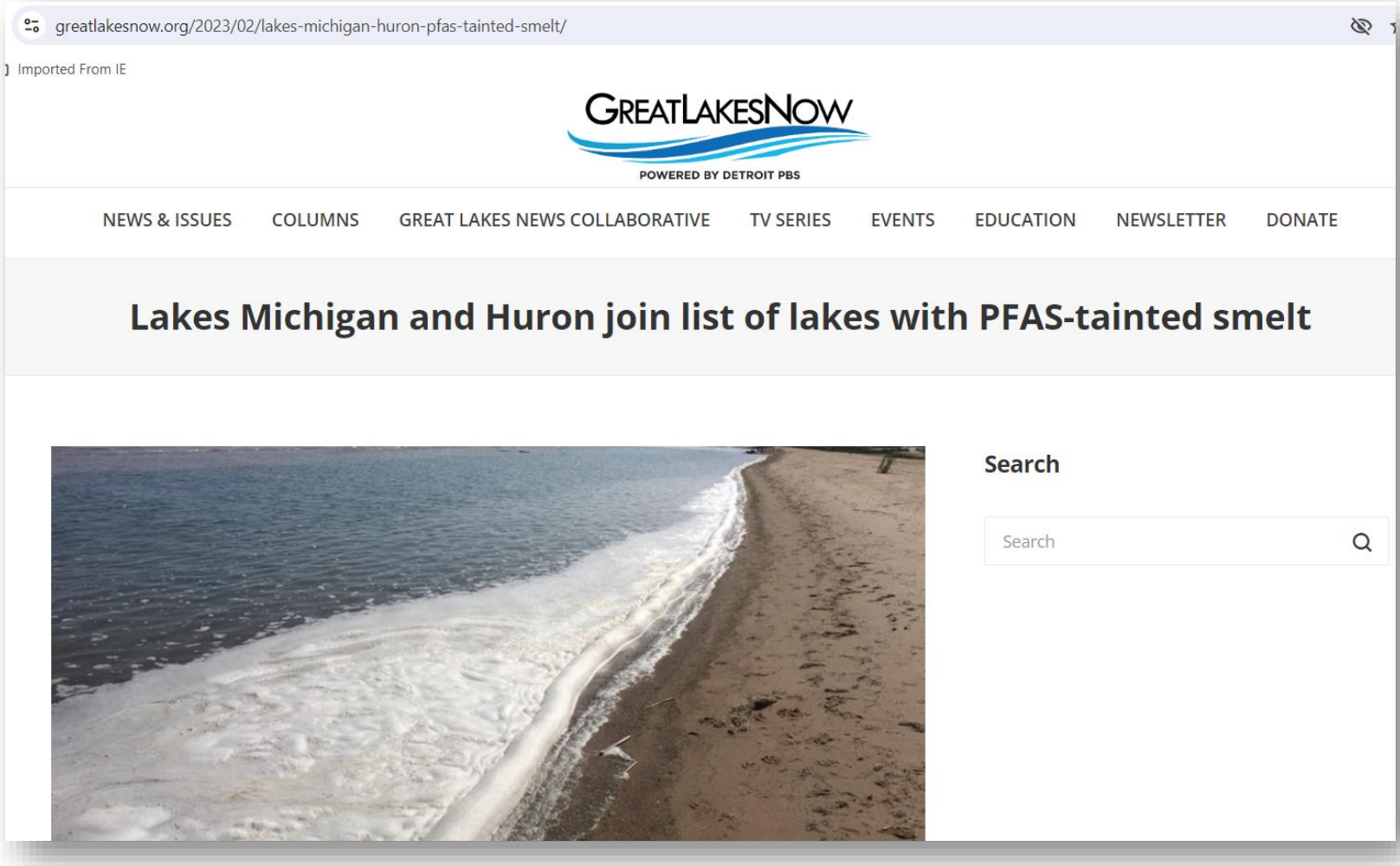
US-Michigan Lake Superior PFAS Smelt Advisory 2022

https://www.greatlakesnow.org/2022/03/pfas-advisory-lake-superior-rainbow-smelt/



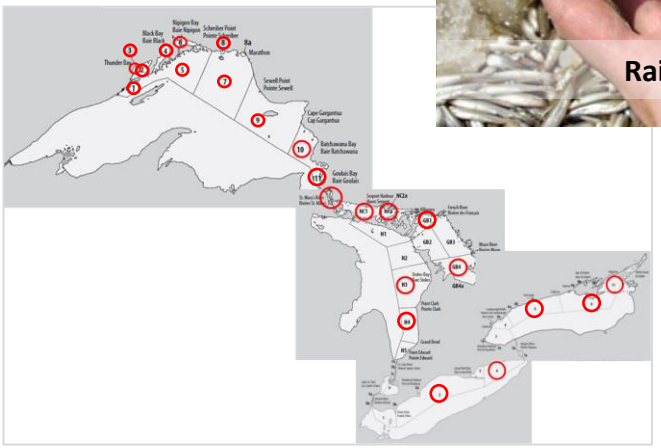
US Lakes Michigan and Huron PFAS Smelt Advisory 2023

https://www.greatlakesnow.org/2023/02/lakes-michigan-huron-pfas-tainted-smelt/

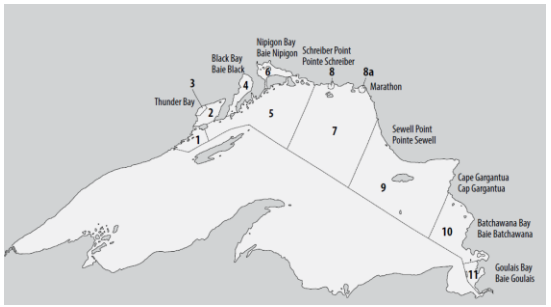


Ontario's Rainbow Smelt PFAS monitoring

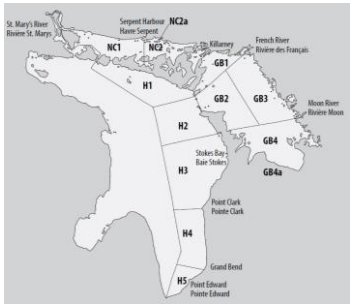
- In 2013, Eastern Lake Erie Smelt monitored
  - PFAS did not result in advisories more restrictive than PCBs
- 36 locations monitored in 2019-2022. Total of 184 composite samples analyzed.
  - 18 locations in Lake Superior
  - 2 locations in the St. Marys River
  - 7 locations in Lake Huron (North Channel, Georgian Bay, main basin)
  - 2 locations in Lake Erie
  - 3 locations in Lake Ontario
  - 4 inland locations
- The samples were analyzed for a suite of contaminants, including PFAS, mercury, PCBs



PFOS in Smelt: Spatial Variation (2020-2022)

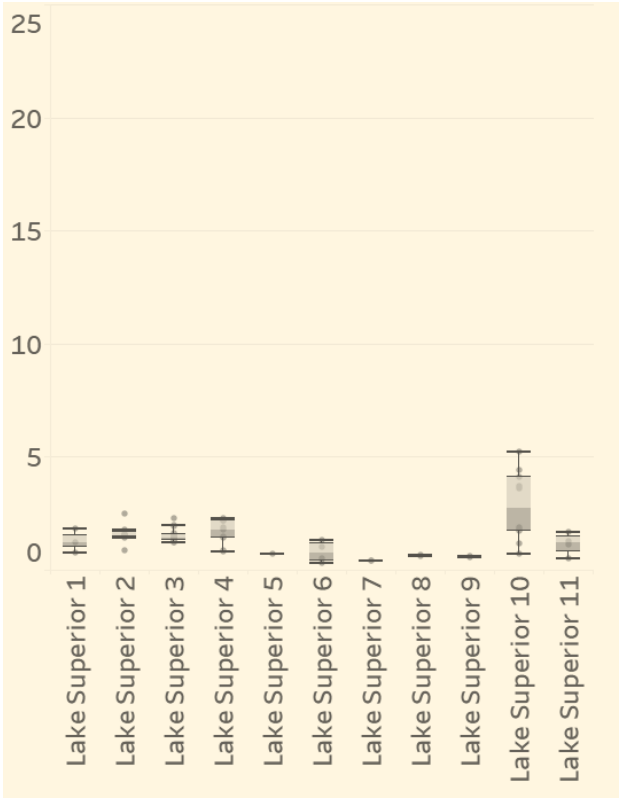


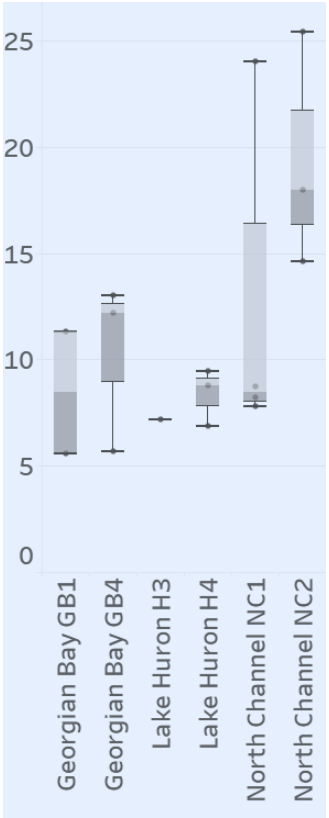
Lake Superior



Lake Huron

Rainbow Smelt





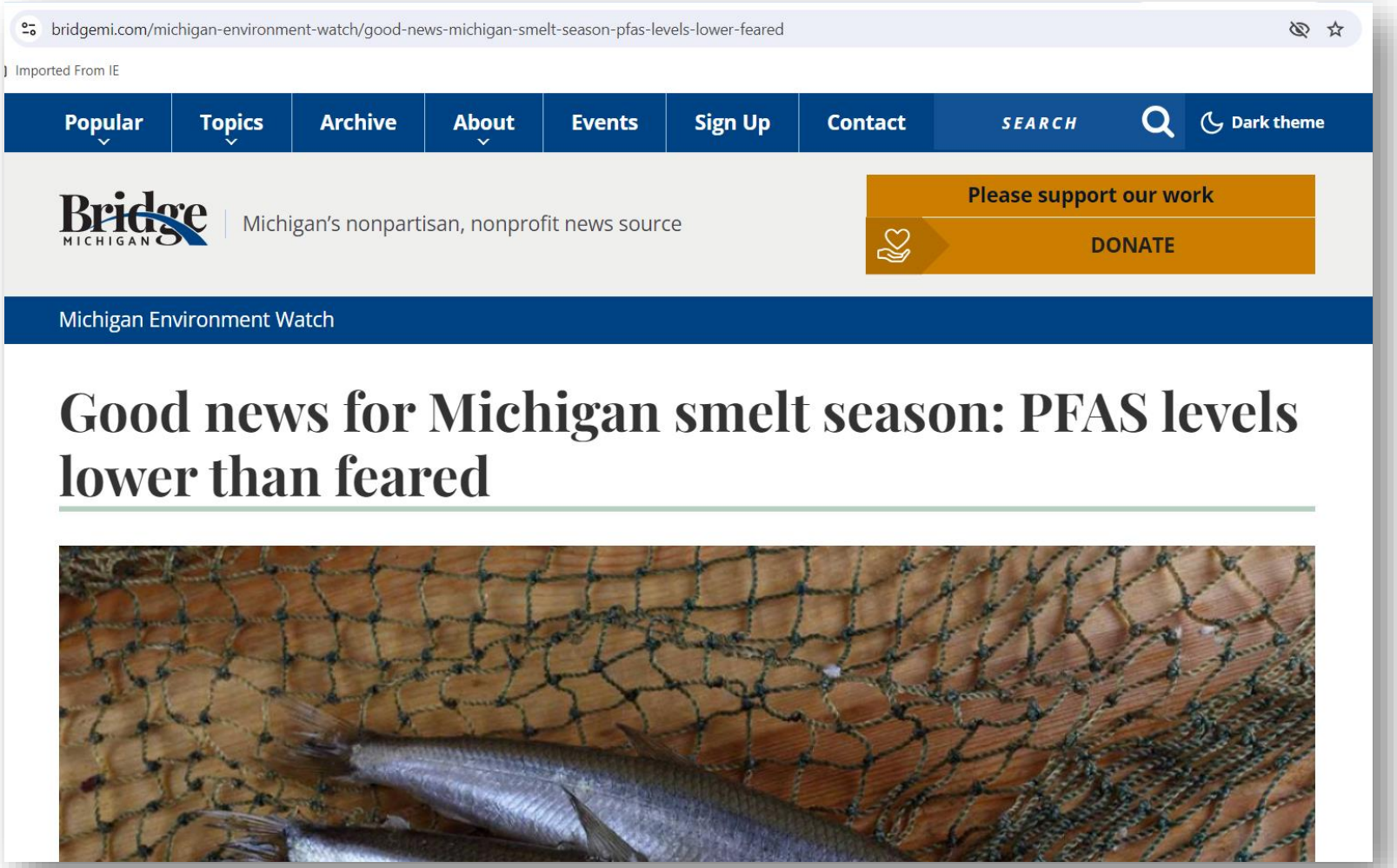
"Do not eat" benchmarks
For total PFAS monitored
General population: >200 ng/g
Sensitive population: >50 ng/g

Sensitive population: People who are or may become pregnant, and children under 15

Ontario

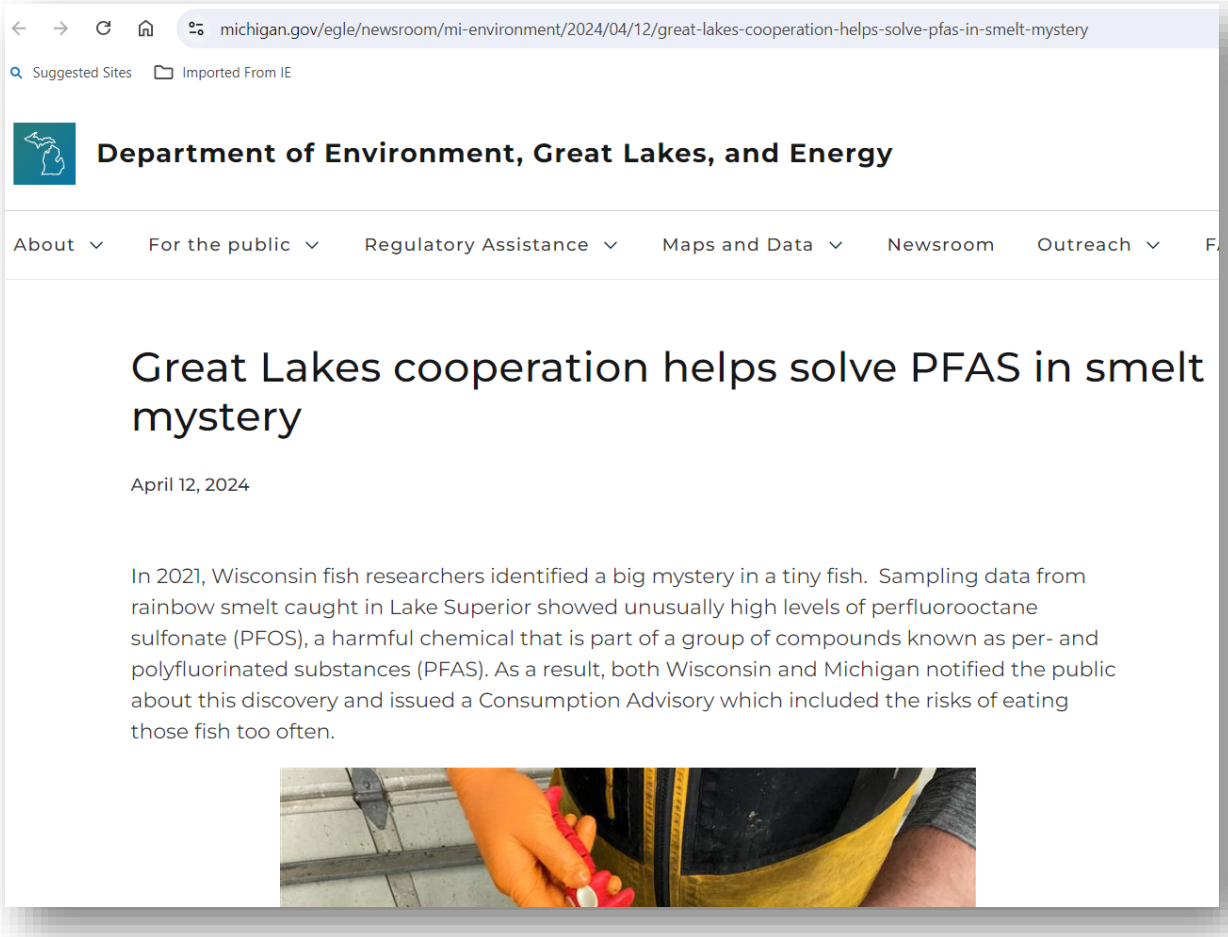
US-Michigan Reported Lower Smelt PFAS Levels 2024

https://www.bridgemi.com/michigan-environment-watch/good-news-michigan-smelt-season-pfas-levels-lower-feared



Great Lakes Cooperation Solved Smelt PFAS Mystery 2024

www.michigan.gov/egle/newsroom/mi-environment/2024/04/12/great-lakes-cooperation-helps-solve-pfas-in-smelt-mystery



Interference: Taurodeoxycholic acid (TDCA), a bile acid in smelt, may inflate branched-PFOS levels

Similar Traits: TDCA and branched-PFOS have similar molecular mass and sulfonate groups

New Findings: Michigan's new method found low branched-PFOS, confirming bile acid interference.

US-Minnesota Lake Superior Smelt PFAS Levels 2024

FINAL REPORT: PER- AND POLYFLUOROALKYL SUBSTANCES IN FISH IN THE MINNESOTA PORTION OF THE LAKE SUPERIOR BASIN

Lead Organization: Minnesota Pollution Control Agency

Authors of this report:

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Jesse Martus[1]

[1]Minnesota Pollution Control Agency
[2]Minnesota Department of Health
[3]Minnesota Department of Natural Resources

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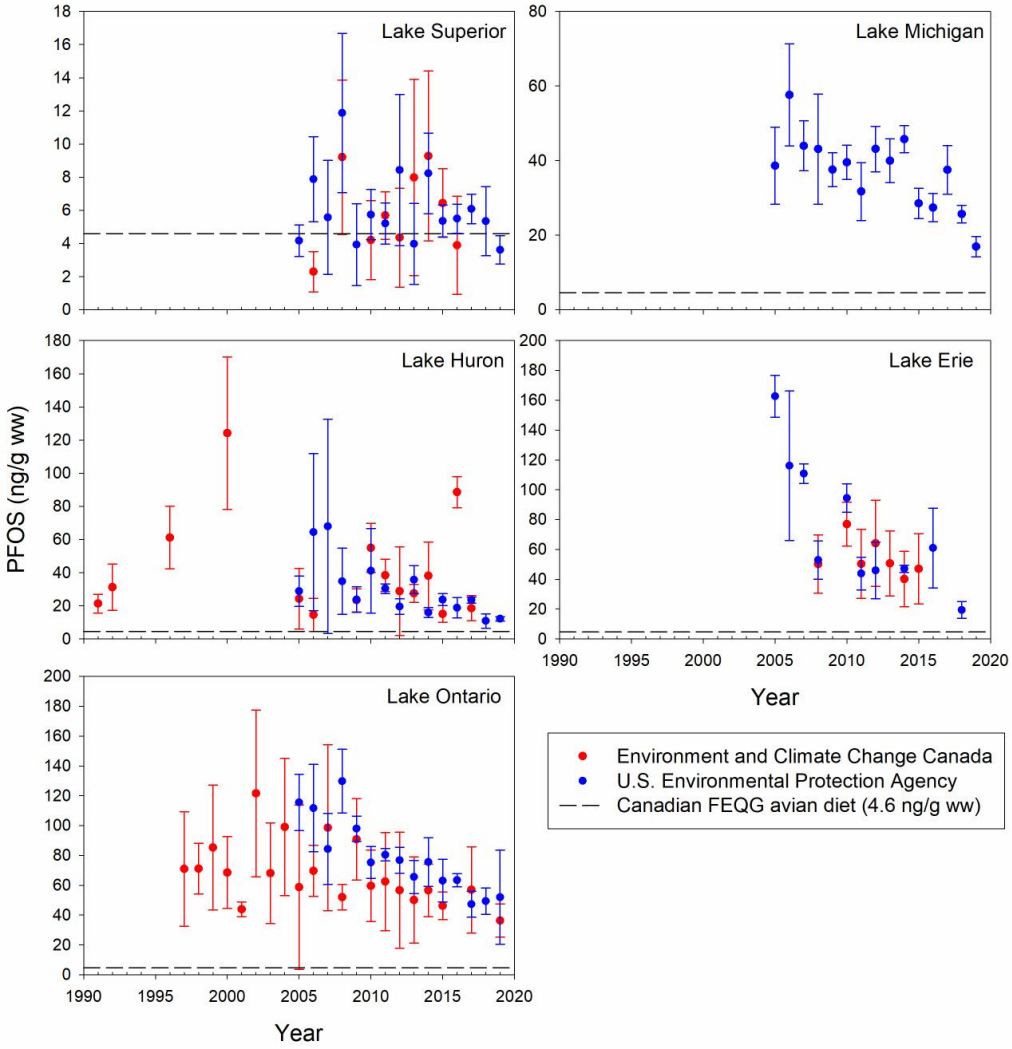
Grant Number: 00E02974-1

Final Report Submitted: December 20, 2024

- Smelt samples in Minnesota Lake Superior waters were tested for PFAS for the first time in 2024.
- Found very low PFAS concentrations, averaging 3.0 ng/g ww for 14 detected PFAS.

Long-term PFOS trends and binational actions

Mean annual PFOS concentrations for individual and composited whole body Lake Trout or Walleye



PFOS, PFOA and LC-PFCAs designated as a Chemical of Mutual Concern (CMC) under the Great Lakes Water Quality Agreement

Commits Canada and the U.S. to target these chemicals for additional risk mitigation and management options

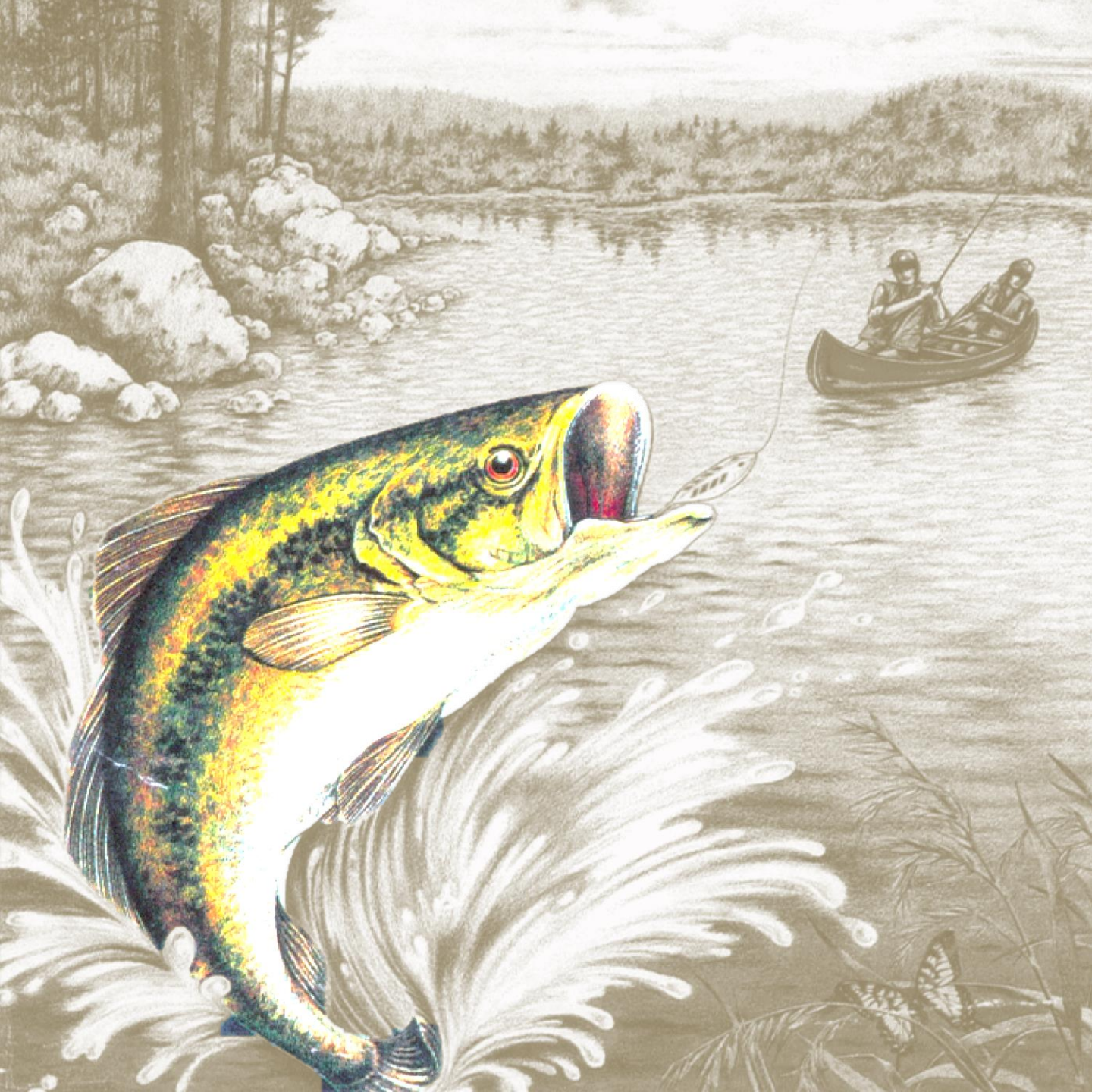
Reporting on trends in the Great Lakes environment

Summary and next steps

Summary

- PCBs and mercury are still major drivers of fish consumption advisories for Lake Superior and Lake Huron fish
  - Levels have declined substantially over the last 40+ years
- PFAS have been monitored in a variety of fish from Lake Superior and Lake Huron, including Rainbow Smelt
  - Levels have been generally low
  - Slightly elevated levels in Smelt from North Channel, Lake Huron
  - Levels of traditionally monitored PFAS in Great Lakes fish are declining
  - Concentrations of non-targeted PFAS are largely unknown
  - Science on health impacts of PFAS has been evolving. The ministry continues to track jurisdictional approaches and developments. Ontario's fish consumption advisory benchmarks are regularly reviewed and updated as necessary.
  - More PFAS advisories may result in future if benchmarks are lowered.

Ontario's fish consumption advisories are available at **Ontario.ca/fishguide**



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