PFAS Bioaccumulation and Tissue Distribution in Lake Michigan Fish

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Introduction

- Aquatic organisms are exposed to PFAS through water and diet.[1]
- There is limited research on species-specific bioaccumulation, transfer within food webs, and tissue distribution in fish.
- Most studies have evaluated fish muscle; however, the distribution in other fish tissues is poorly understood.

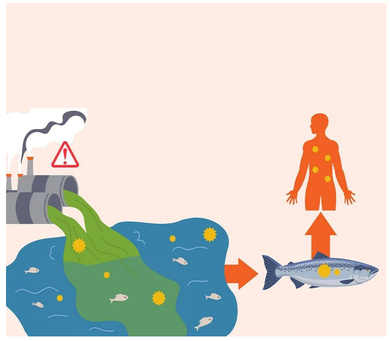


Fig. 1: Pathway of PFAS Contamination from Industrial Wastewater to Fish and Human Health [2]

- Investigation on the distribution of PFAS in different tissues provides information to understand their bioaccumulation, trophic transfer, toxic effects, and potential risks in organisms. [1]

Objective

Our aim is to expand knowledge of PFAS distribution within fish tissues and species, providing insights into how these contaminants move through aquatic food webs and their potential ecological impacts on the broader ecosystem.

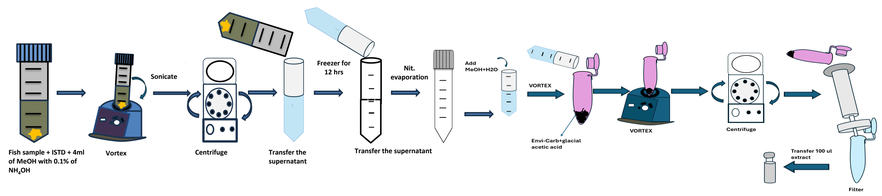
Methodology

- Samples were collected in 2020 and 2023 from Lake Michigan and streams.
- **Collected samples**: Fish (n= 216), water (n= 28), and sediment (n= 13)

Predator Fish		Prey Fish
Lake Trout, Lake White Fish, Rainbow trout, Burbot	Yellow Perch	Round Goby, Alewife, Rainbow Smelt, Sculpin

- **Selected tissues**: Liver, Kidney, Brain, Heart, Stomach, Muscles, Gills, Spleen and Gonads
- Stable isotopes $\delta^{13}C$ and $\delta^{15}N$ were analyzed to confirm the trophic levels and organic matter source.

Extraction for targeted analysis of 35 PFAS compounds



Research Insights

PFAS concentrations vary across fish species and ecosystem compartments in Lake Michigan

- Dietary patterns and habitat explain the PFAS accumulation in fish muscle, with benthic species showing higher concentrations than pelagic prey and top predators.[3]
- In this new investigation, emerging and legacy PFAS compounds will be evaluated in fish tissues to understand whether ecological factors (e.g., feeding habits, habitat, and trophic level) also lead to PFAS accumulation in tissues.

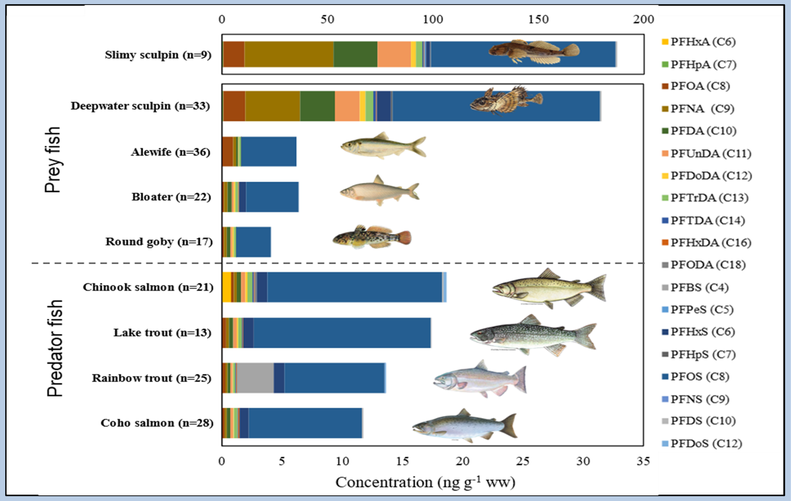


Fig. 2: $\sum_{21}$PFAS concentrations [ng g^{-1} wet weight (ww)] in muscle tissue of Lake Michigan fishes highlighting PFAS variations among species at different trophic levels (Miranda et al. 2023. STOTEN) [3]

- As for analyzing fish habitat and feeding habits, we will investigate how PFAS signatures vary between abiotic matrices to better understand the cycling of PFAS between ecosystem compartments.

PFAS accumulation in fish is influenced by a variety of biological and ecological factors

- Proteins such as serum albumin, found in lake trout, have a high binding affinity to PFOS, while some fish species, such as Alewife and Sculpins lack serum albumin, leading to potentially lower accumulation of PFAS. [4]
- In our research, we aim to investigate whether PFAS accumulation is specific to certain fish tissues and how it varies among a broader range of species.

Preliminary Results

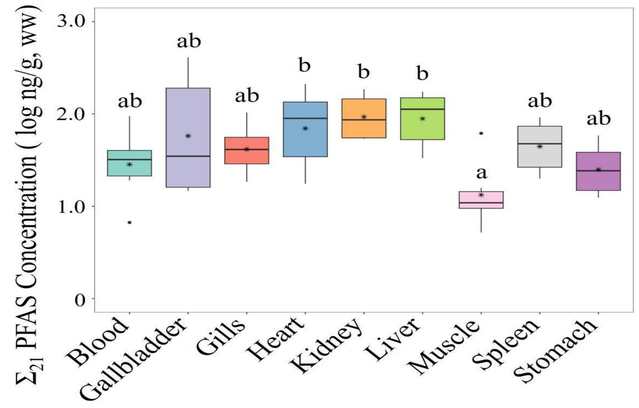


Fig.3: $\sum_{21}$PFAS tissue concentration across tissue for all fish species combined (i.e., Chinook salmon, Coho salmon, Steelhead) and sex

The initial analysis in salmonids from Lake Michigan found that PFAS concentrations varied significantly across fish tissues.

- Heart, kidney, and liver showed the highest levels of PFAS, probably because PFAS has high affinity to bind with liver fatty acid-proteins and accumulates in organs due to high blood flow rate.
- Muscle had the lowest concentrations, highlighting the importance of analyzing more fish tissues to gain a broader view of PFAS burden in fish.

Sulfonic compounds (PFSA) dominated in all tissues, with the kidney showing the highest percentage of PFSA (98%) and muscle the lowest (61%).

Preliminary Findings

Our preliminary results indicate the complex PFAS distribution across tissues and species, suggesting potential risks to ecosystems and human health. This emphasizes the need for further research into PFAS and its impact, guiding future management and policy efforts for the Great Lakes region.

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CEST Center for Environmental Science and Technology

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References