Peeling fish-eye lenses to create an archive of mercury exposure: a simplified and accessible method (project M86)

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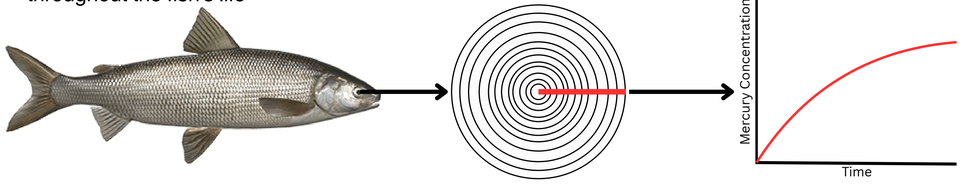
Context

- **Permafrost thaw** and climate driven changes are altering mercury cycling and biotic exposure in Arctic ecosystems[3]
- Mercury is a contaminant that bioaccumulates in the food chain, posing an **elevated risk for predatory fish and humans**[1]
- Information on mercury contamination in **country foods** is essential to protect the physical and cultural health of communities in the Arctic[1]
  - Current methods to asses mercury contamination in fish require **large sampling efforts** over multiple years
- **Fish-eye lense**s could be used as an alternative to significantly reduce sampling efforts
- Using laser ablation inductively coupled mass spectrometer (LA-ICPMS), mercury can be measured along a transect from the eye core to the outer edge to construct an **archive of mercury exposure** throughout the fish's life[4]



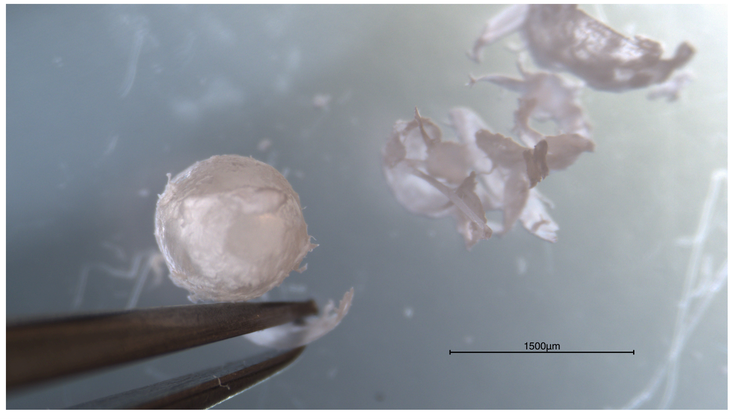
Fish-eye lenses grow in concentric rings from the lens core outward (like tree rings), As each new layer grows, the previous layer becomes metabolically stable – any mercury incorporated during the growth of that layer will be preserved.[2] The red line represents the path of the laser and corresponding results of mercury exposure over time.

Study Objectives

- Work in **partnership** with communities in Nunavik to incorporate **Indigenous Knowledge** into the project design and select fish species and lakes of interest
- Construct an **archive of mercury contamination** in predatory fish in Nunavik using fish-eye lenses
- Link changes in mercury exposure to **permafrost thaw** and other environmental changes in the Arctic
- Develop the peeling method as an **accessible mercury bio-monitoring tool** that the Nunavik Research Centre (NRC) could implement

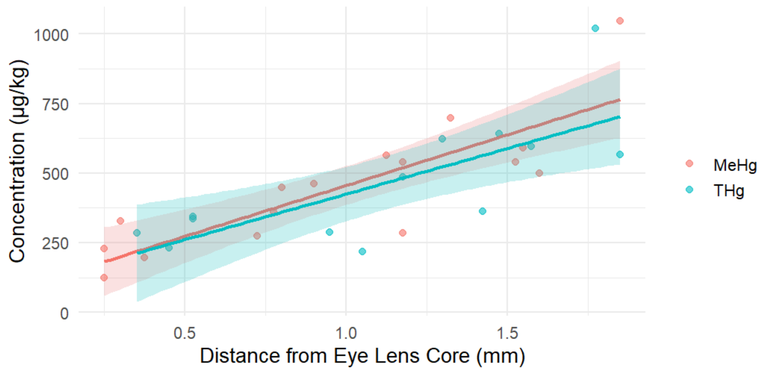
Peeling Method Development

- **Samples:** Eye lenses from 5 lake whitefish (10 lenses total) from the Romaine river, QC
- **Method comparison:** one eye is analyzed using LA-ICPMS, the other eye (from the same individual) is analyzed using the peeling method
- **Peeling method:** eye lenses are manually delaminated under a dissection microscope with fine-point forceps. The diameter of the eye lens is measured before and after each layer delamination
- **Analysis:** Mercury is measured in each eye lens layer using a direct mercury analyzer (DMA)



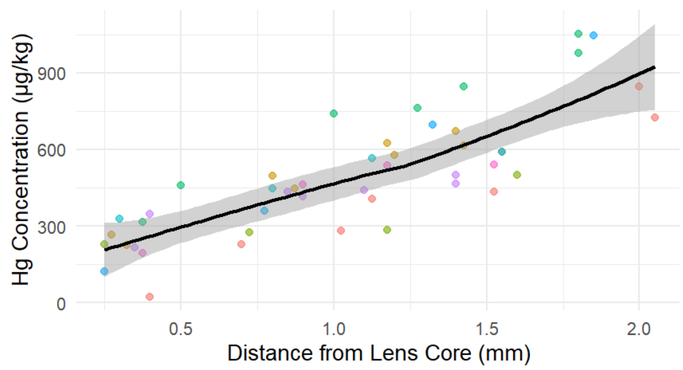
Preliminary Results

The Majority THg in Whitefish Eye Lenses is MeHg



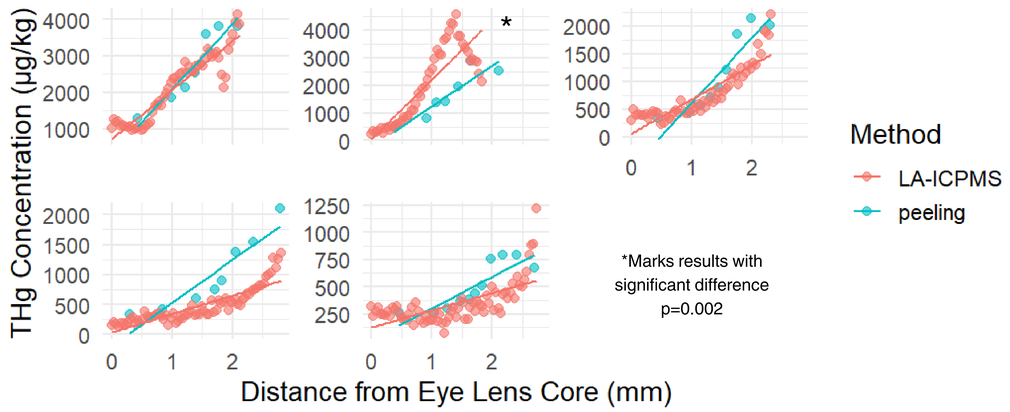
MeHg measured in the left eye using cold vapor atomic fluorescence (CVAF) and THg measured in the right eye using a direct mercury analyzer (DMA) of the same individual whitefish (n=4) reveals no significant difference in concentration p=0.58

Hg Exposure Increases with Age in George River Whitefish



Analysis of 8 whitefish eye lenses from the George River using the peeling method shows concentration of total mercury (THg) increases with distance from the lens core (each colour represents one individual fish).

Peeling Method Validated: Direct Comparison with LA-ICPMS



*Marks results with significant difference p=0.002

*Comparison between LA-ICPMS and peeling methods using a linear mixed effects model shows **no significant difference in concentration in 4/5 fish.** Distance from core is the main predictor of mercury concentration, and mercury concentration increases with fish age. Whitefish collected from the romaine river the top 3 panels are whitefish caught in hydroelectric damn reservoirs, the, bottom 2 panels are whitefish caught in unimpacted control lakes.*

What do there results mean?

- Almost all of the mercury (THg) found in fish eye lenses is methylmercury (MeHg)
- Methylmercury exposure in whitefish increases with fish age
- The peeling method works well for whitefish eye lenses in disturbed and pristine sites

Next Steps

1. Working with communities in Nunavik to establish key species and lakes of concern
2. Fieldwork in Nunavik in spring/summer 2026 to collect fish for analysis
3. Incorporate Indigenous Knowledge and scientific data to understand how permafrost thaw and climate change are impacting Hg cycling and contamination in the Arctic
4. Continue the development and validation of the peeling method with other fish species

Acknowledgments

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