Seasonal and interannual variation of total mercury levels in lake trout (*Salvelinus namaycush*)

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INTRODUCTION:

- Mercury is a heavy metal contaminant that exists in two forms in aquatic systems: inorganic mercury (Hg^{2+}) and organic mercury, also known as methylmercury (CH_3Hg^+). Mercury speciation in aquatic environments is dependent on many biological, chemical and environmental characteristics of the ecosystem in question and is still not fully understood.
- Methylmercury is obtained by aquatic organisms through diet and is the only form of mercury that biomagnifies in aquatic food webs due to its high affinity for binding to sulfur rich proteins, thus accumulating in protein-rich tissue over time.
- High levels of mercury can be detrimental to the health of an organism as it can act as a neural and endocrine toxin.
- Fishes, especially top predators like lake trout, tend to occupy higher trophic positions and therefore obtain most of their mercury through diet as methylmercury, although a small portion of their total mercury content is inorganic and acquired through the gills.
- Lake trout have known seasonal dietary shifts, which likely impacts seasonal variation in the mercury levels of these fishes.

Objective: This study set out to explore how total mercury content in lake trout varies on a seasonal and interannual basis.

METHODS:

- Lake trout were sampled on a seasonal basis for two consecutive years in two lakes located in Algonquin Park: **Lake Opeongo** (n = 132) and **Lake of Two Rivers** (n = 148) from 2017 to 2019.
- Each lake has a different community structure that impacts the diet of the lake trout population residing there: Lake Opeongo (OPE) contains an offshore forage fish species that is available to lake trout year-round, whereas Lake of Two Rivers (LTR) does not.
- For each sampled lake trout, a subsection of their liver was oven dried at 60°C for 48 hours and subsequently homogenized.
- These dried and ground liver samples were then analyzed for total mercury content (THg) using the DMA-80 Direct Mercury Analyzer, which measures the amount of both inorganic and organic mercury in a given tissue sample.
- The same dried and ground liver samples were also analyzed for $\delta^{15}N$, which is indicative of the trophic position of an organism, using an Elemental Analyzer-Isotope Ratio Mass Spectrometer.

RESULTS:

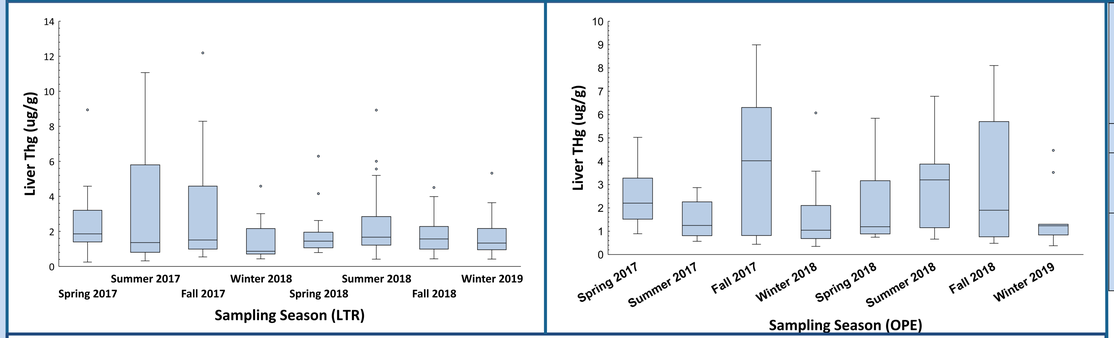

Fig 1. Boxplots showing seasonal variation in total mercury (THg in ug/g) of lake trout liver in Lake Opeongo (OPE) and Lake of Two Rivers (LTR) between 2017-2019.

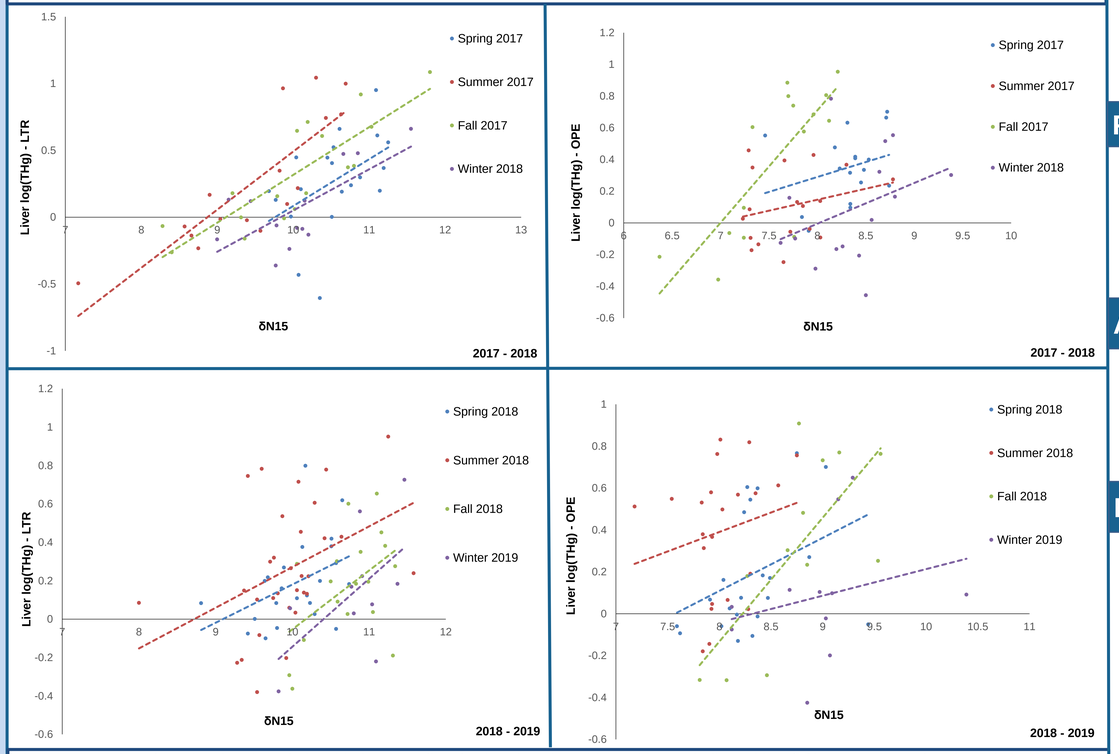

Fig 2. Regression plots showing the relationship between liver log(THg) and trophic position as indicated by $\delta^{15}N$ on a seasonal and yearly basis in Lake of Two Rivers (left) and Lake Opeongo (right).

WINTER	Lake trout across both lakes and sampling years consistently had the **lowest THg** in winter compared to other seasons.	
	LTR	OPE
2017 - 2018	Highest THg in the summer for both years	Highest THg in the fall
2018 - 2019		Highest THg in the summer

- Lake trout from OPE had more variable THg on a seasonal and annual basis than lake trout from LTR.
- From the linear plots, it is clear that log(THg) scales positively with trophic position as indicated by $\delta^{15}N$

FUTURE DIRECTIONS:

1. Analysis of THg in muscle tissue of the same lake trout specimens
2. Quantification of methylmercury content to determine the proportion of Hg coming from diet in liver and muscle.

ACKNOWLEDGEMENTS:

The authors would like to acknowledge the contributions of Faduma Jama, Stephanie Varty, Kristin Eccles and Taylor Luu for conducting the mercury analysis and to Emma Bloomfield for providing the $\delta^{15}N$ data.

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