

# Why do fish mercury levels vary among lakes in the Dehcho region?

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## Community Questions

- Which fish are safest and healthiest to eat?
- Why do some lakes have higher mercury (Hg) levels in fish than others?
- How do changes on the land affect fish Hg levels?
- Will fish be safe to eat in the future?

## Objectives

- Determine levels of Hg in commonly harvested fishes in Dehcho lakes – Walleye, Northern Pike, Lake Whitefish
- Relate Hg levels to suite of covariates in fish (e.g., trophic level, fish size, age), and to water quality (e.g., nutrient concentrations) and catchment (e.g., relative size, land cover) factors
- Determine best predictors of Hg levels in fish
- Create opportunities for capacity-building and two-way knowledge exchange both on the land and in the lab

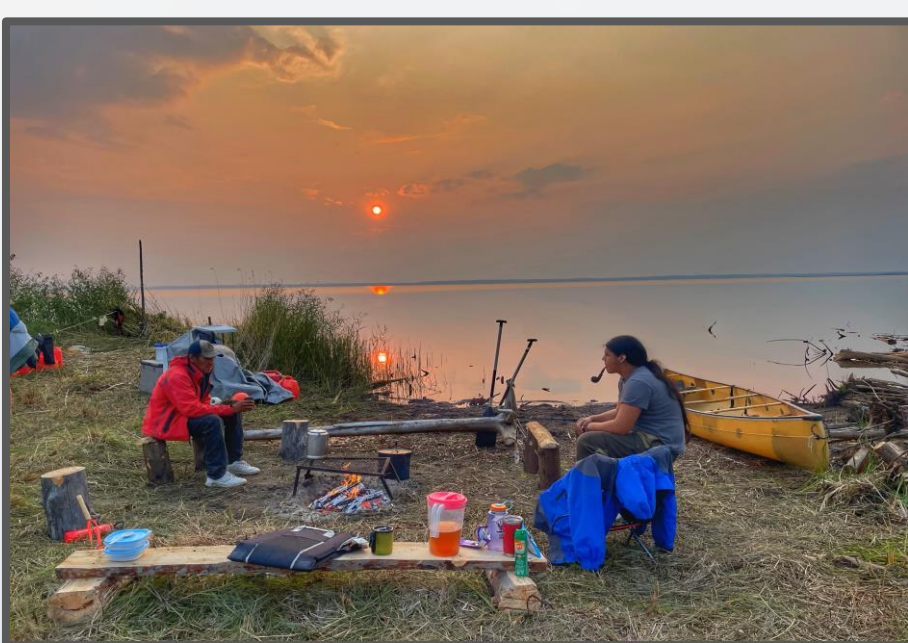
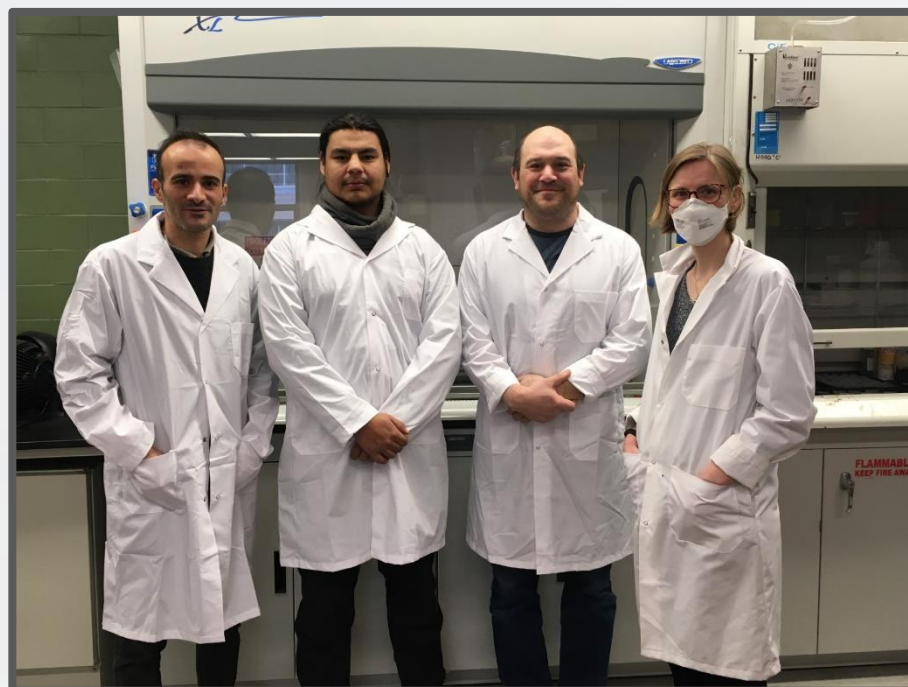
## Field and Lab Methods

- Fish, water, benthic invertebrates, and sediment collected from lakes selected by communities
- Sample 2-3 lakes each year with joint Guardian-University team during on-the-land camps
- Fish measured and weighed, analyzed for: stable isotope ratios (C, N), total mercury levels
- Water analyzed for: nutrients, chlorophyll-a, quantity and quality of dissolved organic carbon, major ions, pH, clarity, total Hg, methyl Hg
- Sediment analyzed for organic content, total Hg, methyl Hg
- Catchments delineated and land cover classified



## Data Analysis

- Fish mercury concentrations compared among lakes and to guidelines
- Fish mercury concentrations related to possible predictors that reflect fish ecology, water chemistry, and catchment size and composition



## Results Cont'd

- For all three species, catchment area: lake area (Figure 3) ratios explain a lot (>74%) of among-lake variability in fish Hg levels

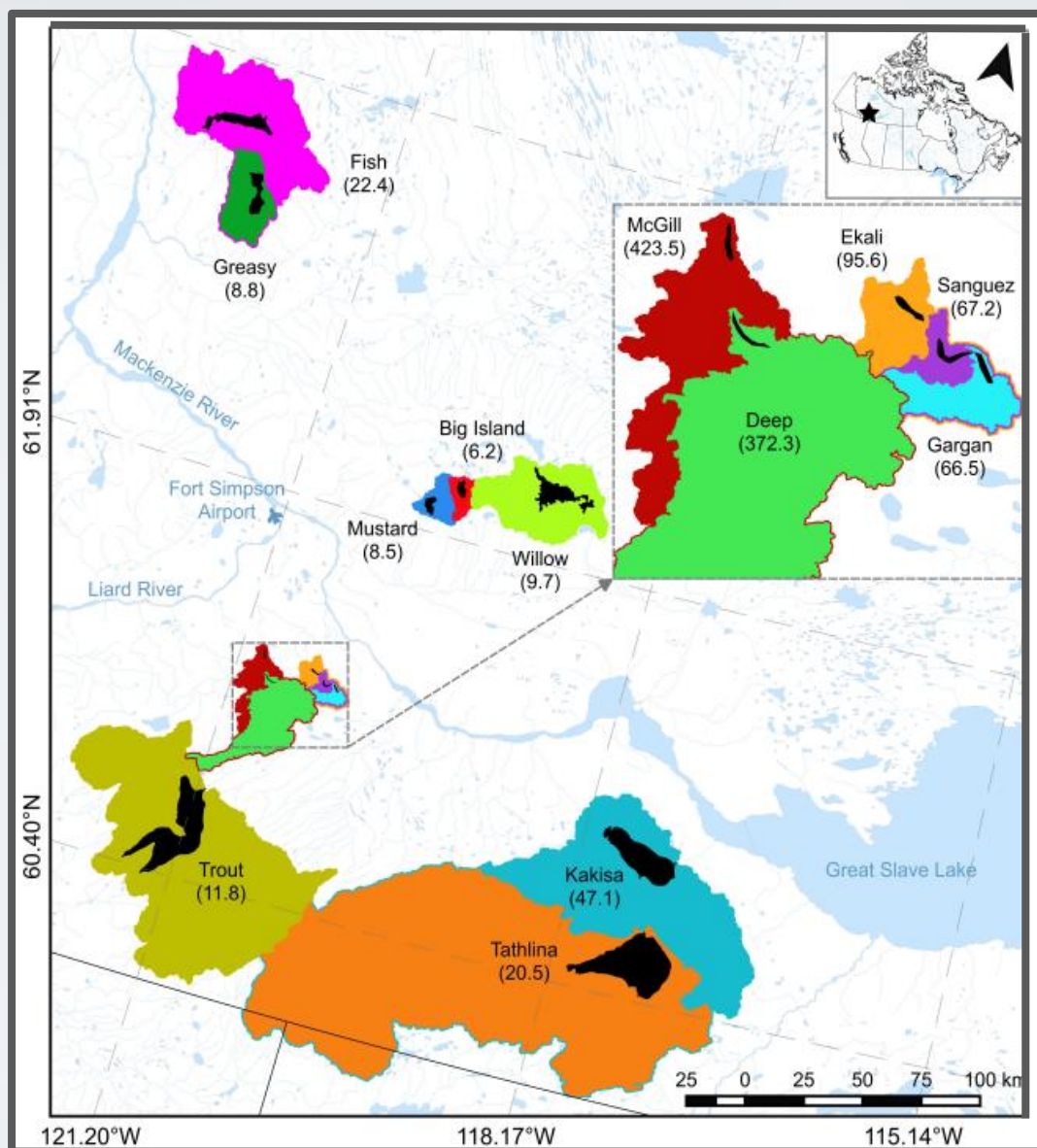


Figure 3. Delineated catchments and areas of each study lake. Some lakes, such as Big Island, Willow, and Mustard lakes are large relative to their catchments. This means that water chemistry is less affected by the catchment, and fish Hg levels are relatively lower. Lakes that are small relative to the catchment size, such as Deep Lake, have higher fish Hg levels.

## Discussion

- Interactions among the catchment, water chemistry, and fish and food web ecology explain why fish Hg levels vary among lakes in the Dehcho region
- Lakes that are smaller relative to their catchments have higher fish Hg levels.
- In Northern Pike, the relationship between catchment area : lake area ratios and fish Hg levels is mediated by dissolved organic carbon, Hg levels in water and sediment, and fish growth rates (Figure 4)

## Results Highlights

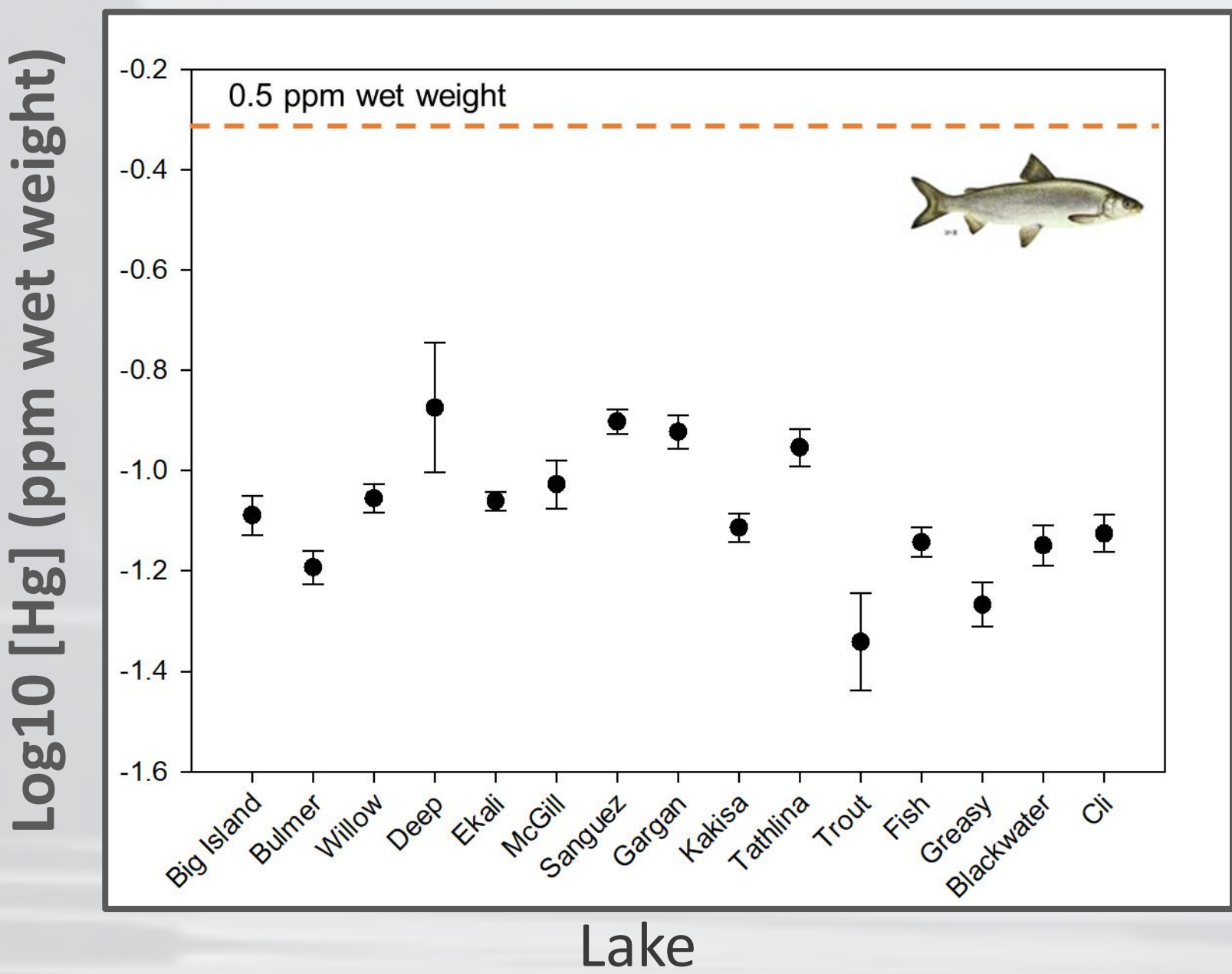


Figure 1. Size-standardized log<sub>10</sub> [Hg] (SE) in Lake Whitefish (450 mm fork length). Mercury levels in Lake Whitefish muscle are low in every lake.

- Mercury levels in three food fish – Lake Whitefish, Northern Pike, and Walleye – vary among lakes
- Patterns vary among species, but in general Hg levels are higher in lowland lakes
- For Lake Whitefish, mercury levels are low in all lakes sampled (Figure 1)
- >83% of among-lake variation in size-standardized Hg levels in Northern Pike is explained by interactions between the catchment, water chemistry, and fish ecology (Figure 2)

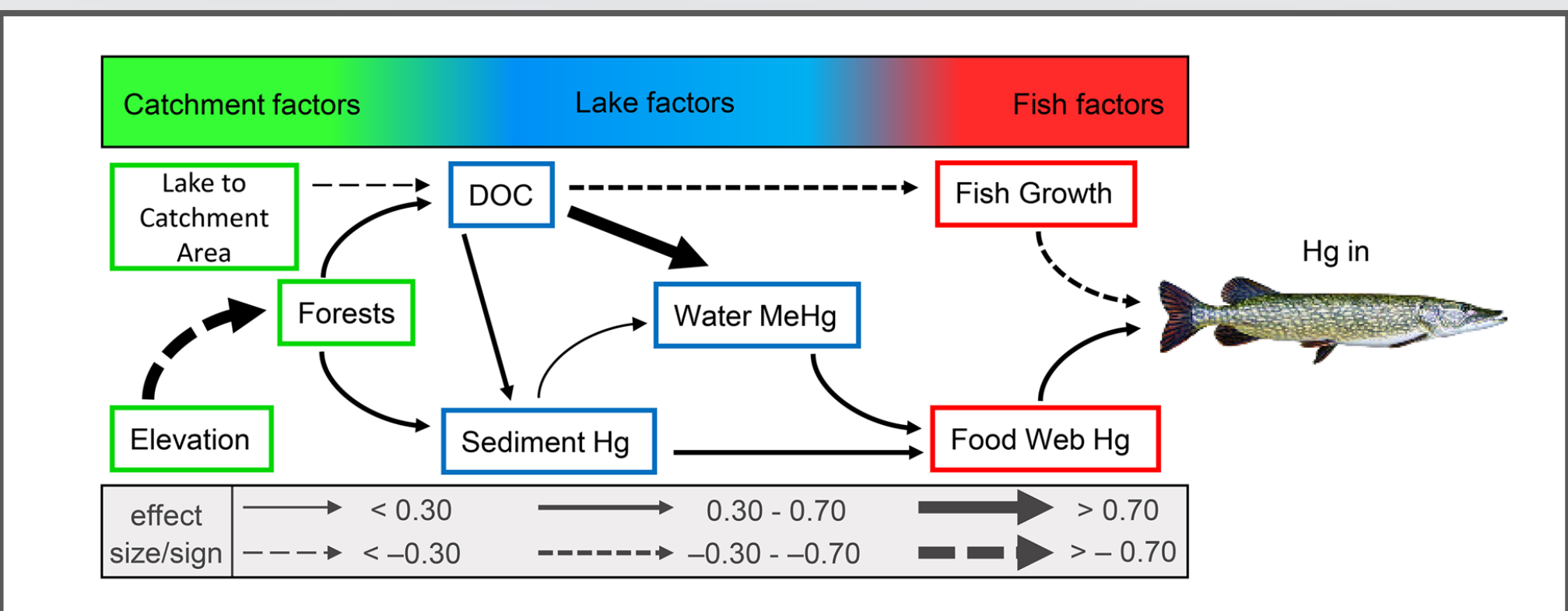


Figure 2. Graphical representation of results from a piecewise structural equation model that explains among-lake variation in mercury levels in Northern Pike. Relative catchment size, catchment elevation, and catchment vegetation drive concentrations of dissolved organic carbon and methyl mercury in water, as well as concentrations of mercury in sediment. These factors in turn drive fish growth rate (dissolved organic carbon) and mercury levels at the base of the food chain. Taken from: Moslemi-Aqdam et al. (2022). STOTEN 822: 153430

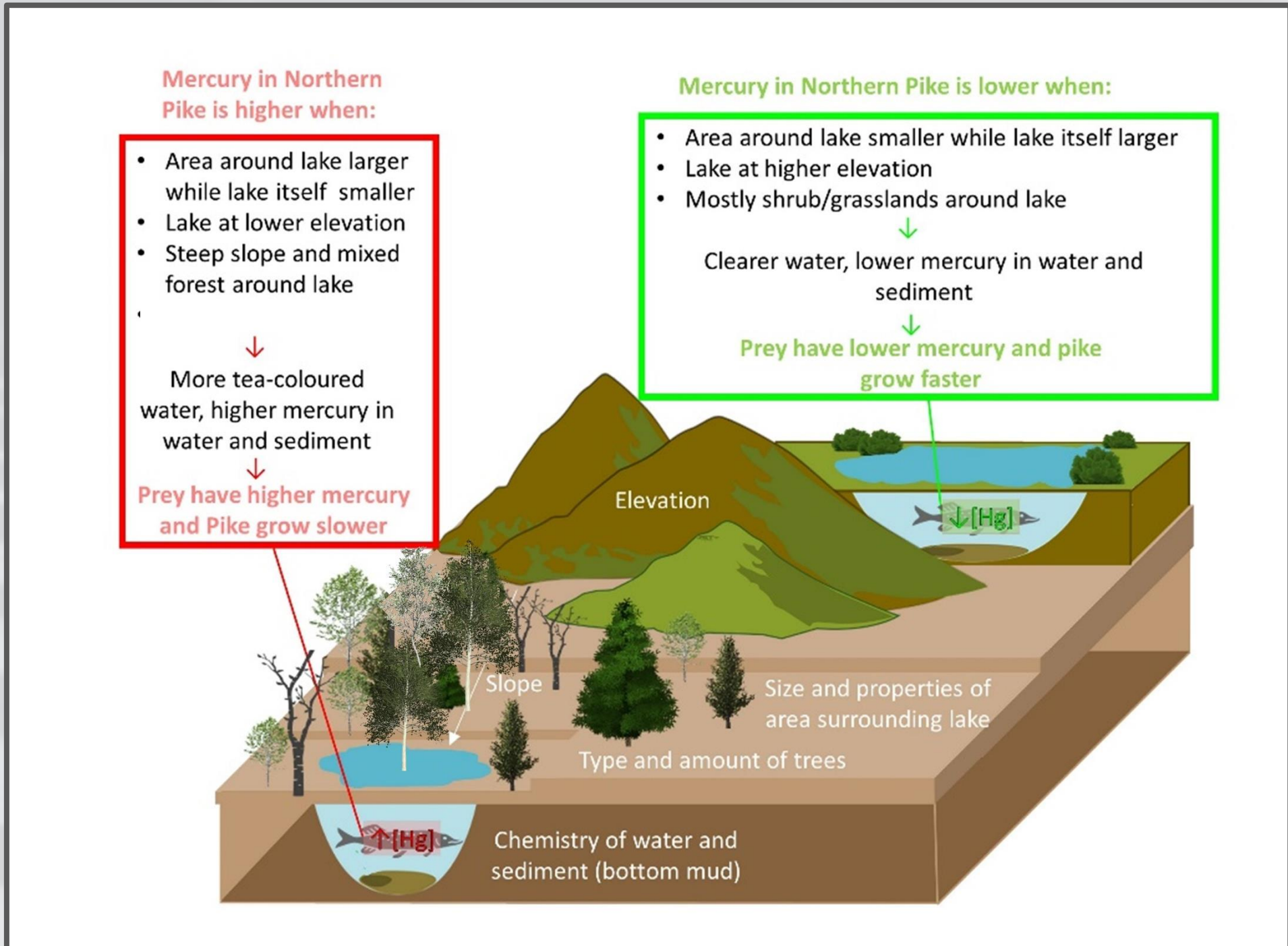


Figure 4. Graphic illustrating interactions among catchment, lake, and fish growth rates that drive Hg levels in Northern Pike.

## Ongoing Analyses

- Bioaccessibility analyses – how might different preparation methods affect amount of Hg available for uptake into people (Dr. Brian Laird)
- Additional lakes and ecoregions
- Detailed modeling for Lake Whitefish and Walleye

## Acknowledgements

