

# ESTIMATING THE IMPACT OF FRESHWATER FISH HARVEST LOCATION ON MERCURY EXPOSURES IN DENE COMMUNITIES OF THE NORTHWEST TERRITORIES

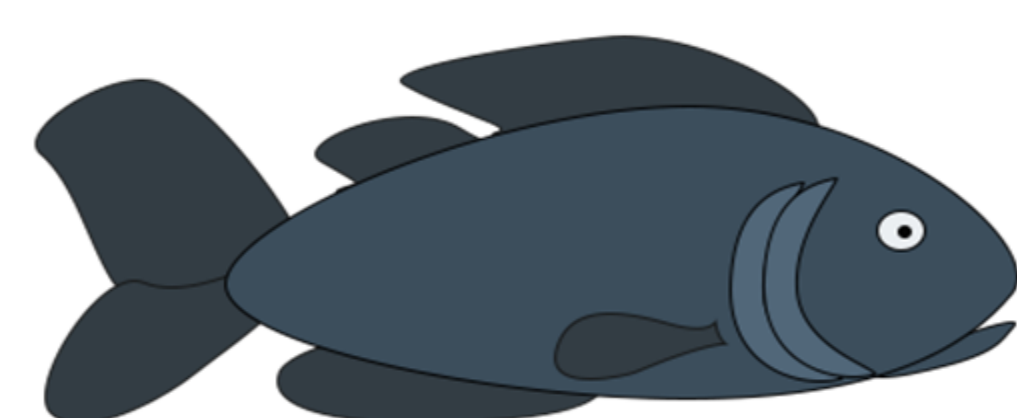
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## INTRODUCTION

### Fish Mercury Concentrations in the Northwest Territories

- Fish mercury concentrations have been tested in waterbodies of the Northwest Territories (NWT), Canada over the past 30 years<sup>1</sup>
- Elevated levels of mercury in some species of fish in certain lakes led to the release of consumption notices for several lakes<sup>2</sup>



### Human Biomonitoring Project

- To address the concerns of Dene communities, a human contaminant biomonitoring project was launched in nine communities<sup>3,4</sup>
- Mercury concentrations were measured in hair (n=443) and blood (n=276) samples of participants ranging from 6 to 88 years of age
- Generally, hair and blood mercury concentrations were low (< than 2% of participants had levels exceeding health-based guidance values)<sup>4,5</sup>
- Although mercury levels are occasionally elevated in specific fish species in certain lakes in the NWT, exposure is generally low
- Investigate how mercury levels of Dene communities of the NWT could change if people increased their consumption of fish from waterbodies with elevated mercury levels

## REFERENCES AND ACKNOWLEDGEMENTS

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## METHODS

### Input Data for Models

- Models were created using human fish consumption and demographic data, and regional fish mercury concentration data for the four most consumed fish species (Lake Whitefish, Lake Trout, Northern Pike, and Walleye)

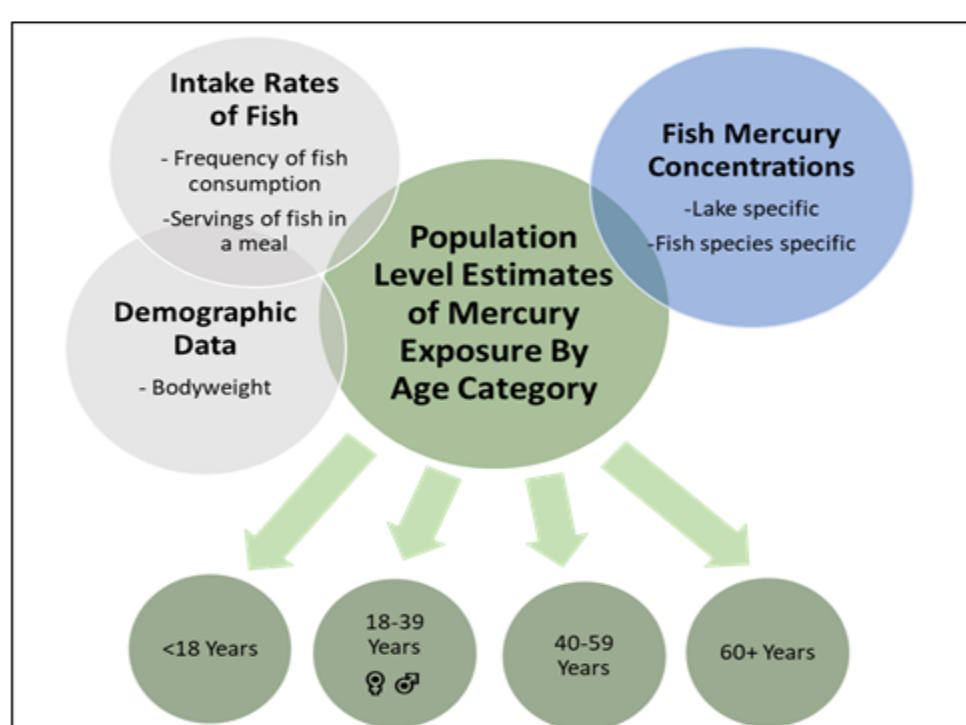


Figure 1: Types of human data (represented with grey circles) and fish data (represented with a blue circle) that were included in the model

- Distributions of fish intake rates for five age/sex categories (<18 years, women 18-39 years, men 18-39 years, 40-59 years, and 60+ years) for each fish species were calculated based on data collected in a Food Frequency Questionnaire (FFQ) and a serving size of 75 grams
- Due to overestimates of consumption in the FFQ, the data were capped at the 95<sup>th</sup> percentile and maximum fish consumption (of all species) was set to 7 meals per week
- Fish mercury concentration data were obtained from several sources and assigned to categories based on geometric means for each species and lake (see Table 1)

Table 1: Lake Categories and Criteria

Classification	Category	Fish Mercury
Low Fish Mercury	Category 1a	Geometric mean of fish mercury less than 0.4 µg/g. No consumption notice.
	Category 1b	Geometric mean of fish mercury less than 0.4 µg/g. Consumption notice released.
	Category 1	Geometric mean of fish mercury less than 0.4 µg/g. Category 1a and 1b combined.
Moderate Fish Mercury	Category 2	Geometric mean of fish mercury between 0.4 and 0.5 µg/g
High Fish Mercury	Category 3	Geometric mean of fish mercury above 0.5 µg/g.

### Model Set

- Models were created using Oracle Crystal Ball (Release 11.1.2.4.600) software
- To examine how people's exposure levels to mercury would change if they got fish from lakes with higher mercury levels, seven models were constructed that varied in proportion of fish consumed from each category (visualized in Figure 2)

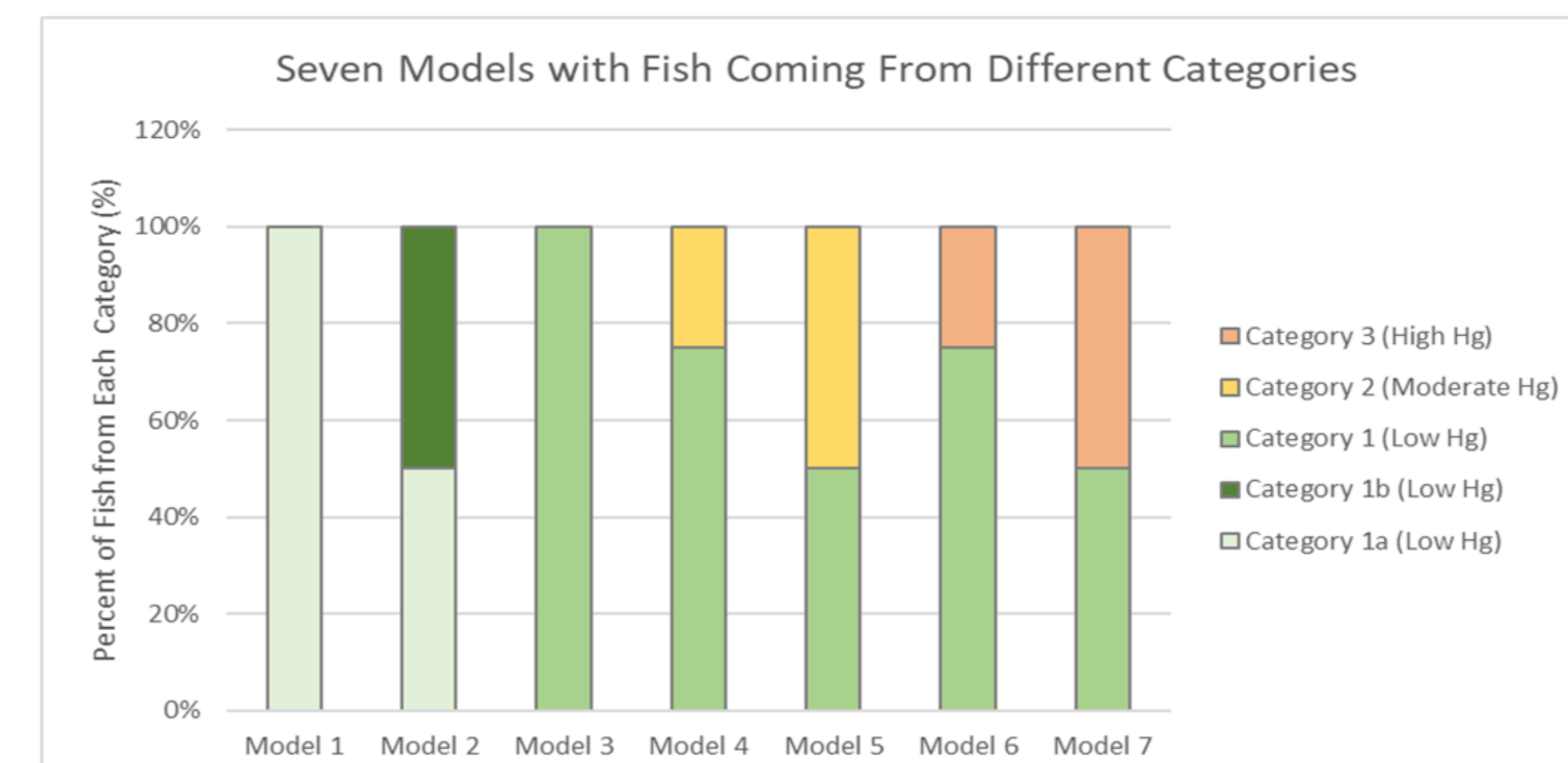


Figure 2: The percent of fish by lake category included in seven mercury exposure models

## RESULTS AND DISCUSSION

### Fish Consumption from "Low Mercury" Category Lakes

- Models 1 and 2 explore how mercury exposures may change if people harvested up to 50% of their predatory fish from lakes with relatively low mercury levels (e.g., geometric mean Hg less than 0.4 µg/g) but for which a consumption notice was released
- Median mercury exposures in both scenarios were similar and well below relevant Tolerable Daily Intakes (TDIs) and the majority of estimated mercury exposures fell below TDIs for all age/sex categories
- TDIs that were used are:
  - Males 18+ years; Females 40+ years: A methylmercury Tolerable Daily Intake (TDI) of 0.47 µg/kg/day was used<sup>6</sup>
  - Children; Females 18-39 years: A methylmercury TDI of 0.23 µg/kg/day was used<sup>7</sup>
- Given the similarity in results between Models 1 and 2, fish mercury data from Category 1a and Category 1b were pooled and used in Model 3 to compare to the next mercury models

### Consuming More Fish from "Moderate Mercury" or "High Mercury" Category Lakes

- Comparing Models 3, 4, and 5 explores how mercury exposures may change if people harvested up to 50% of their predatory fish from lakes with relatively moderate mercury levels (e.g., geometric mean Hg between 0.4 and 0.5 µg/g)
- Comparing Models 3, 6, and 7 explores how mercury exposures may change if people harvest up to 50% of their predatory fish from lakes with relatively high mercury levels (e.g., geometric mean Hg above 0.5 µg/g).

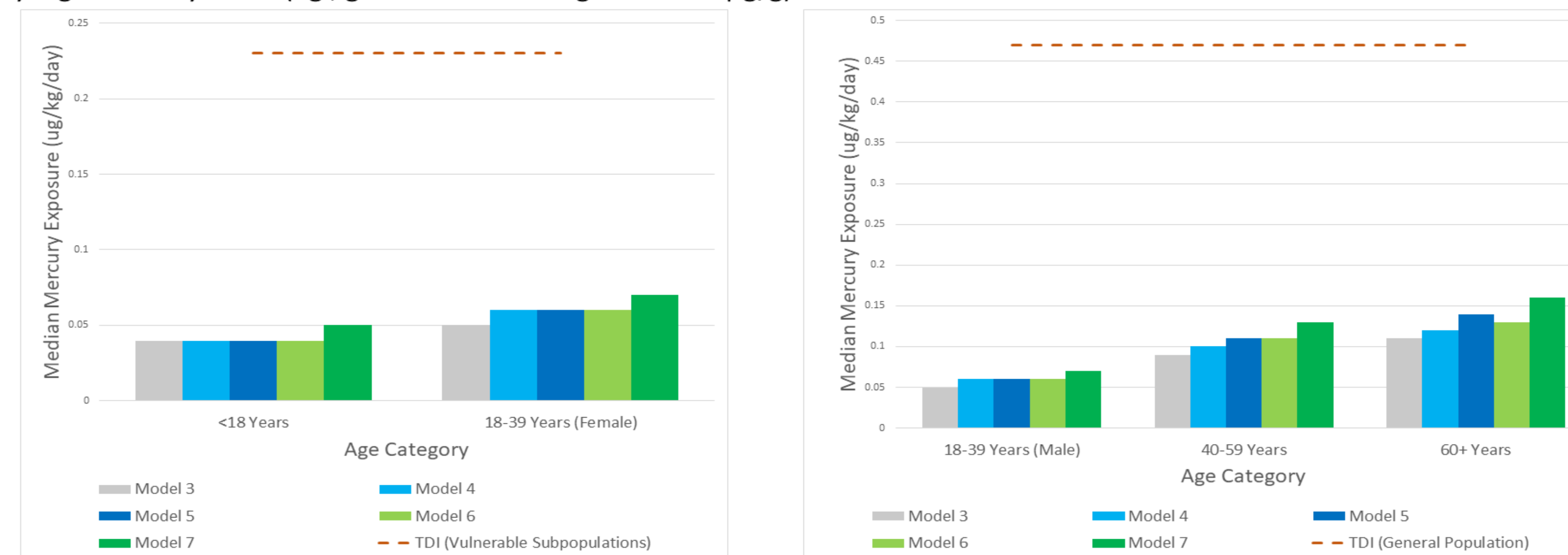


Figure 3: Median estimated mercury exposure under Models 3 – 7 by Age Category. Model 3: 100% of fish mercury data from Category 1 (low mercury) lakes (a + b combined). Model 4: 75% of fish mercury data from Category 1 (low mercury) lakes with the remaining 25% from Category 2 (moderate mercury) lakes. Model 5: 50% of fish mercury data from Category 1 (low mercury) lakes with the remaining 50% from Category 2 (moderate mercury) lakes. Model 6: 75% of fish mercury data from Category 1 (low mercury) lakes with the remaining 25% from Category 3 (high mercury) lakes. Model 7: 50% of fish mercury data from Category 1 (low mercury) lakes and 50% from Category 3 (high mercury) lakes.

- Median estimated doses for all age categories across all models were still well-below relevant TDIs
- When 25% - 50% of fish mercury data came from Category 2 (moderate mercury) lakes:
  - Median mercury exposures increased slightly in Models 4 and 5
  - The majority of exposure estimates were still below the relevant TDIs for all age categories and at least 95% of exposure estimates consistently fell below TDIs for four of the five age categories
- When 25% - 50% of fish mercury data came from Category 3 (high mercury) lakes:
  - Median estimated doses for all age categories increased from Model 3 to Model 7 but across all models the median estimated doses were still well-below relevant TDIs
  - However, when 50% of fish mercury data came from Category 3 (high mercury) lakes, over 5% of exposure estimates for most age categories were above relevant TDIs

### Sensitivity Analyses

- Conducted to see which variables contributed the most to the variance in estimated total mercury doses for each age category and each model
- In each model and for every age group, intake rates of the four fish species contributed the most variance
- The relative importance of the intake rates of each fish species varied between the age categories and models
- Other factors (like body weight and fish mercury levels) contributed less to the variation in mercury exposure estimates
- Messages and recommendations about the fish species that are most safe to eat may have the largest impact on their mercury exposure

## CONCLUSIONS

- Frequently harvesting fish from lakes with low mercury levels (including those with consumption notices) and occasionally harvesting fish from lakes with moderate mercury levels is unlikely to affect typical mercury exposures
- General messages and recommendations about the fish species that are most safe to eat may have the largest impact on mercury exposure in Dene communities in the NWT. It is particularly important that such messages and recommendations regarding fish mercury focus on women of child-bearing age and children
- Site-specific messages appear most warranted for lakes and waterbodies with high mercury levels