



Provincial Water Quality Datasets: Open Data for Applied Water Research

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Introductions and Outline

- Claire – hydrology, biogeochemistry, water quality
- Stephanie – spatial ecology [land-water ecosystems, species modelling]

- Provincial Water Quality Monitoring Network (PWQMN)
- Broad Scale Monitoring (BsM) Dataset
- Challenges and Steps Forward

Provincial Water Quality Monitoring Network (PWQMN)

- Some sites running since 1964
- 2001 sites active at different times

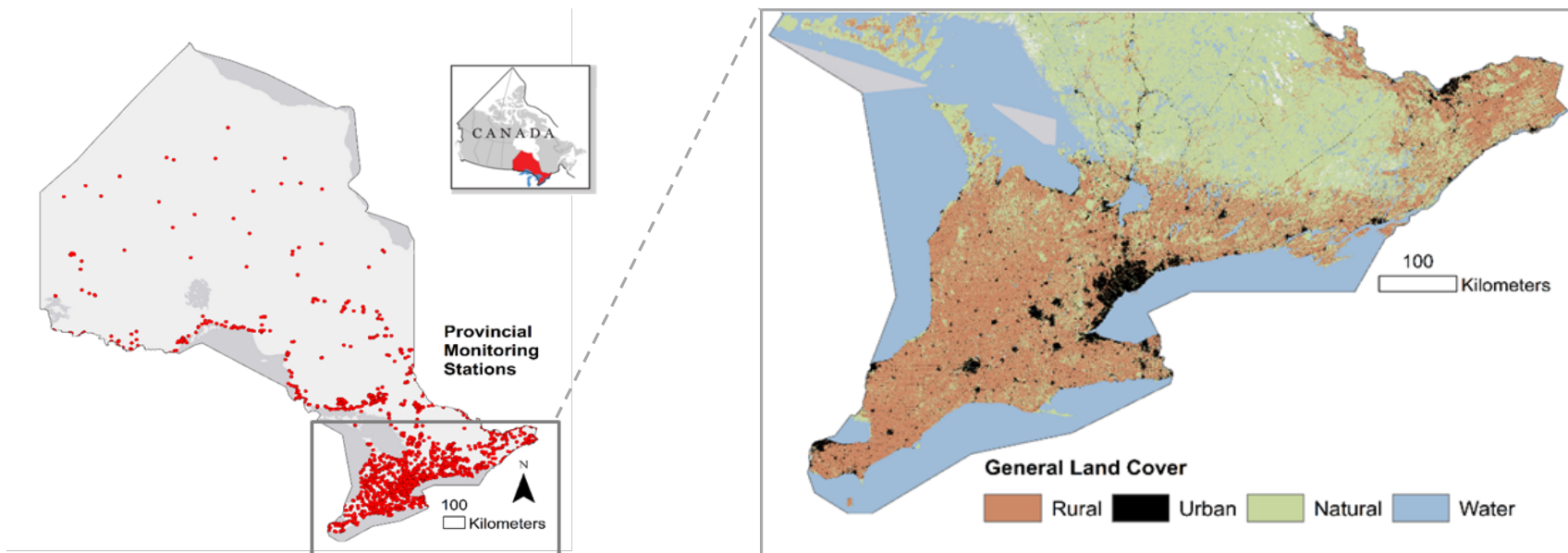


Figure courtesy of Bhaswati Mazumder

PWQMN Parameters and Sampling Frequency

- >40
- pH, alk, DO, EC, T
- Particulate residue
- Nutrients (N, P)
- Major ions (Cl, Na, etc.)
- Metals

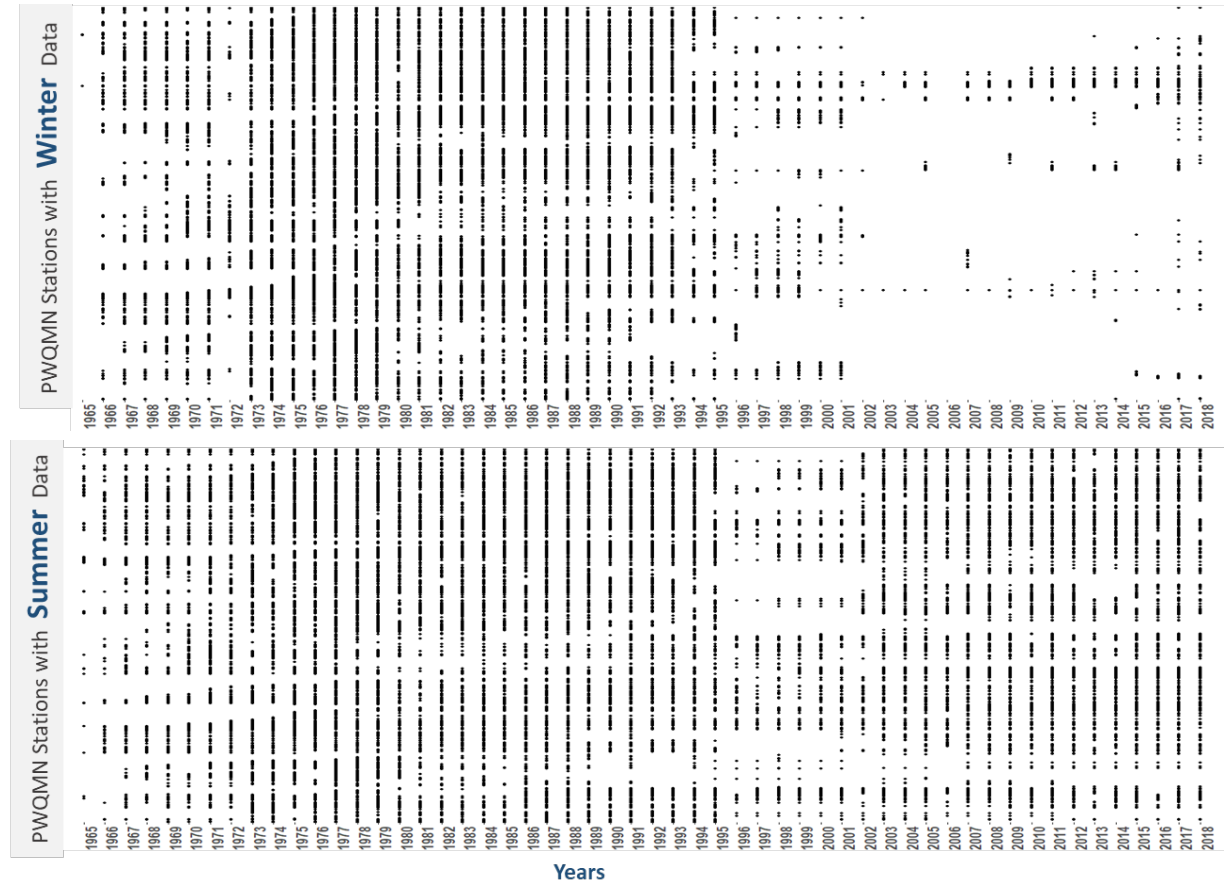
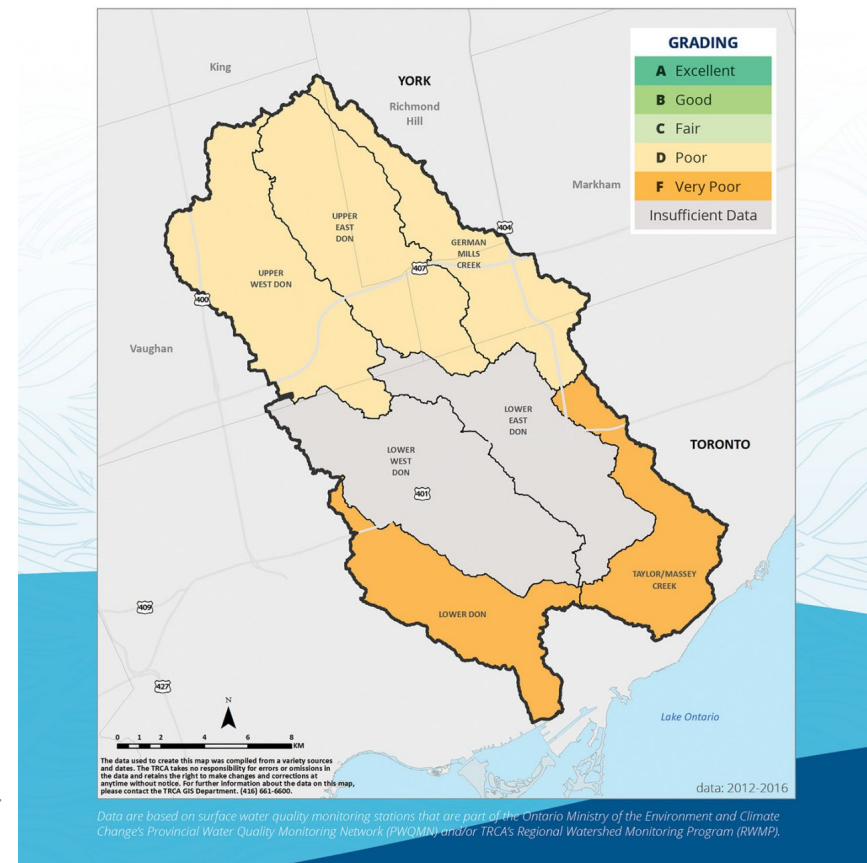


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PWQMN → Watershed Report Cards

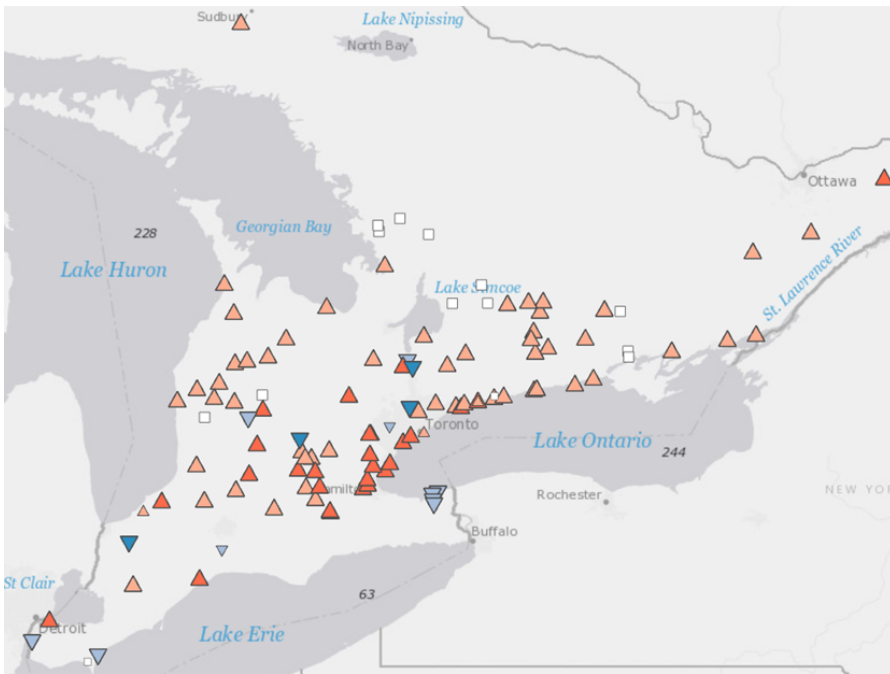
- Groundwater quality, surface water quality, forest conditions, land cover
- Surface water quality
 - Phosphorus
 - E. Coli
 - Chloride
 - BMI

Source: <https://reportcard.trca.ca/watershed-report-cards/don-river/#surface-water>

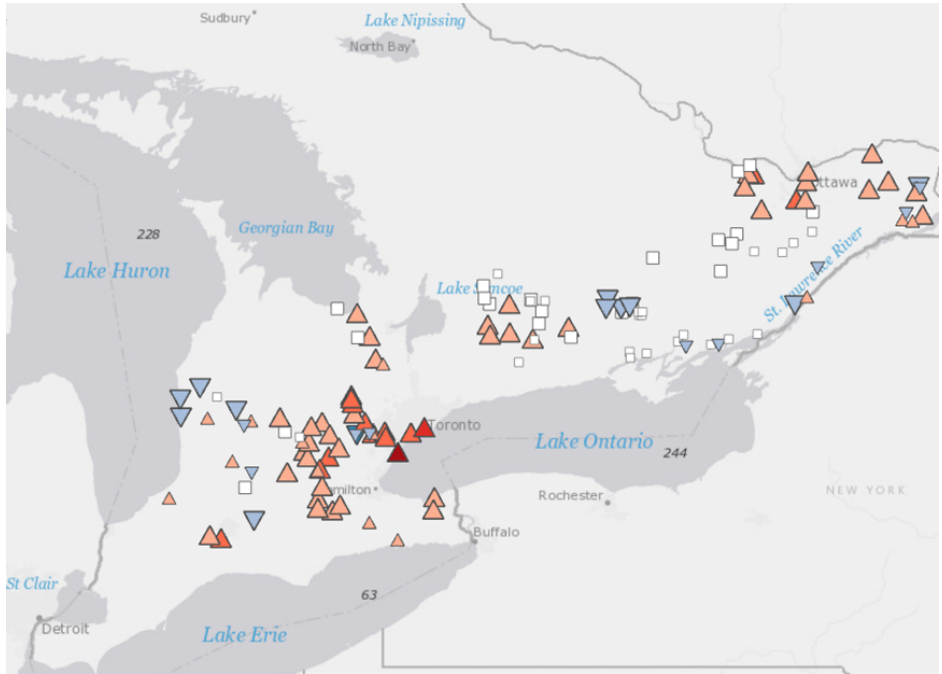


PWQMN → Long-term trend analysis (e.g., CI)

Non-Salting Period (May-Nov) : 1965 - 1995



Non-Salting Period (May-Nov) : 1996 - 2018



Moderate Decrease
(-5 to -1 mgL⁻¹yr⁻¹)

Slow Decrease
(-1 to -0.1 mgL⁻¹yr⁻¹)

Little to No Trend
(-0.1 to 0.1 mgL⁻¹yr⁻¹)

Slow Increase
(0.1 to 1 mgL⁻¹yr⁻¹)

Moderate Increase
(1 to 5 mgL⁻¹yr⁻¹)

Rapid Increase
(5 to 10 mgL⁻¹yr⁻¹)

Very Rapid Increase
(> 10 mgL⁻¹yr⁻¹)

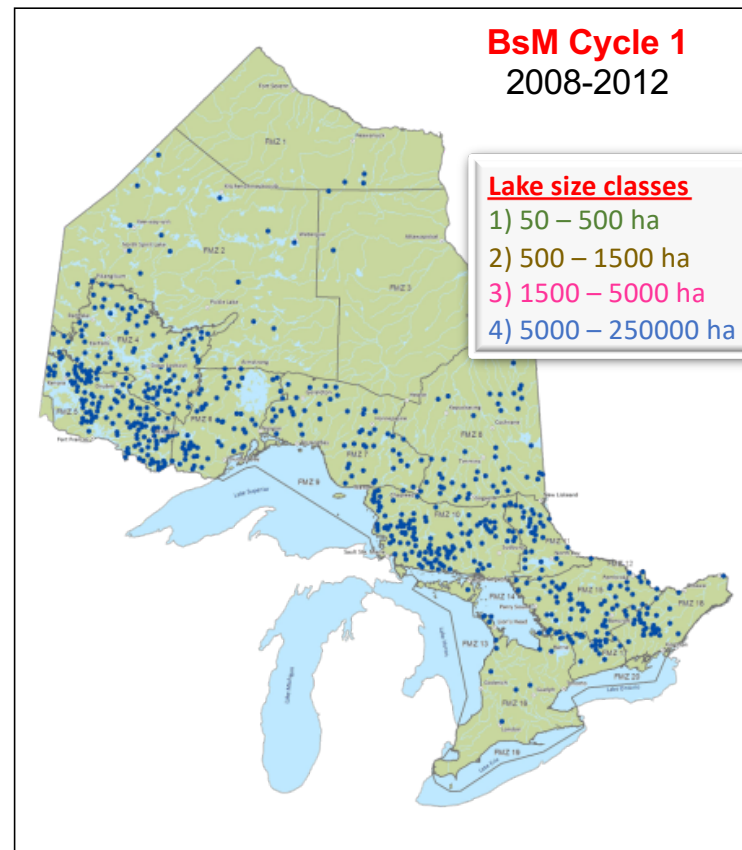
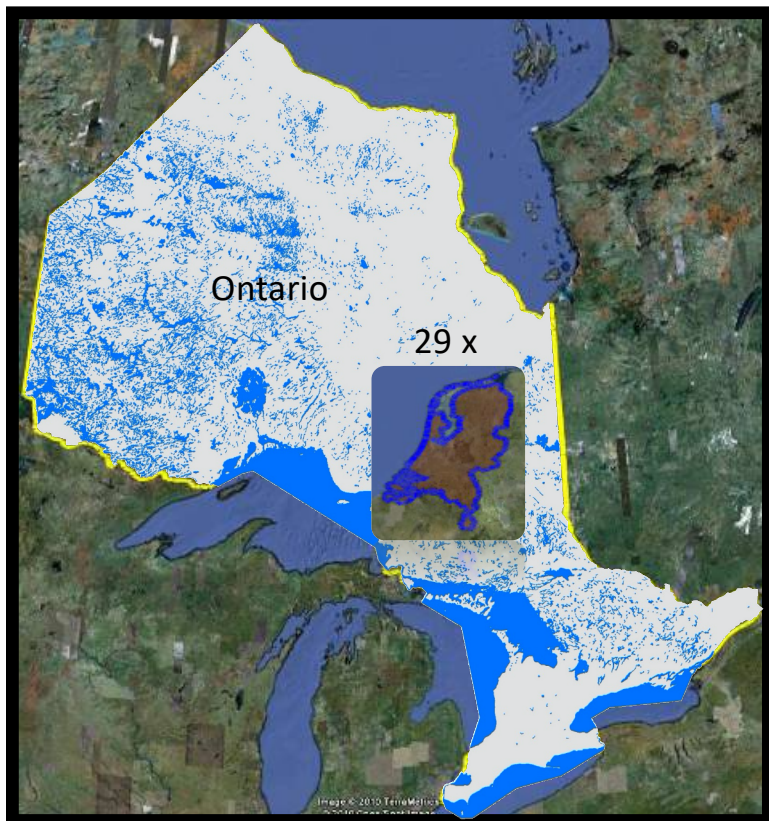


Figure courtesy of Bhaswati Mazumder

Broad-Scale Monitoring (BsM) Network



Note: information on next 3 slides adapted from OMNRF presentation by Dr. Nigel Lester



Target population of lakes
Surface area = 50 to 100,000 ha
Number of lakes \approx 9,000
Need a representative sample

Stratified random sampling
Fisheries Management Zone
Lake area (4 sizes)

Cycle 1(2008-2012)
Number sampled \approx 700
Proportion sampled \approx 8%

Cycle 2 (2013-2017)
Re-sample many lakes (**fixed**)
To better detect change
Sample additional lakes
(**variable**)
To better describe state
Far North not in current plan

Cycle 3 (underway)

BsM Parameters

Cost Summary \$\$\$				
Fixed sample	Variable sample	Total sample	Annual Cost	
823	416	1239	\$2,076 k	Operations
			\$1,065 k	Support
			<u>\$75 k</u>	<u>Capital</u>
			\$3,215 k	Total

State Indicators

“Fishery” species

- Abundance
- Size
- Age
- Maturation
- Contaminants
- Parasites and Disease



Large fish netting

Pressure Indicators

Habitat

- Bathymetry
- Temperature
- Oxygen
- Water clarity
- Water chemistry



Spring water sampling

Community

- Fish species
- Zooplankton
- Benthos



Small fish netting

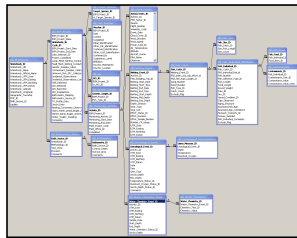
Exploitation

Angling effort



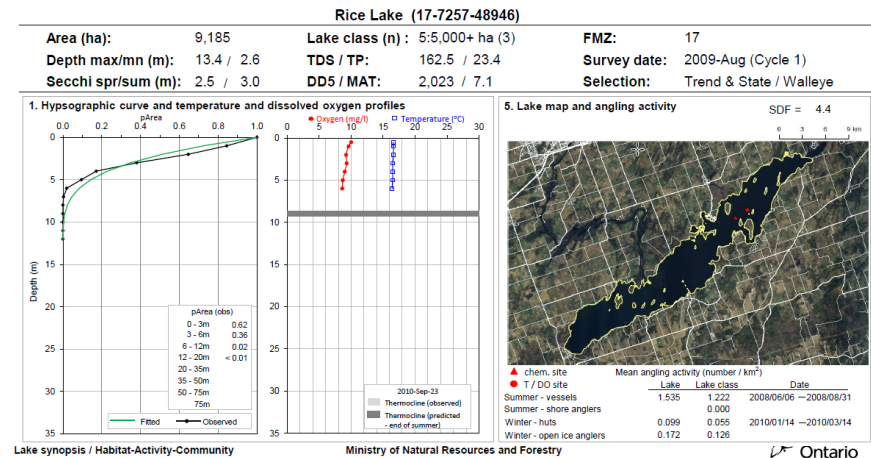
Aerial effort survey

BsM → Application 1: Reporting



BsM Database

- Lake Bulletins
- Zone Data Report
- Data Visualization
- Lake Summary
- Zone Status Report
- Zone Diagnostics Report



water **MDPI**

Article

Spatiotemporal Variations in Mercury Bioaccumulation at Fine and Broad Scales for Two Freshwater Sport Fishes

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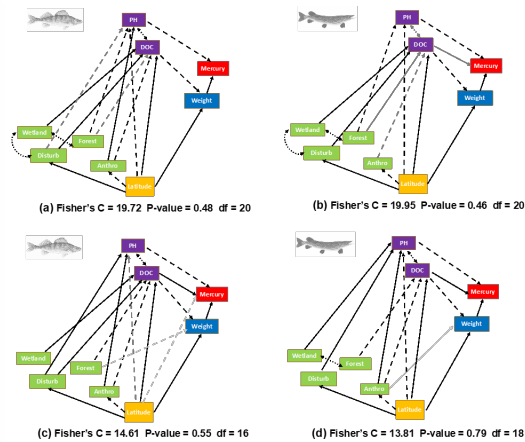
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Abstract: Bioaccumulation of mercury in sport fish is a complex process that varies in space and time. Both large-scale climatic as well as fine-scale environmental factors are drivers of these space-time variations. In this study, we used a long-term monitoring program from Ontario, Canada to better understand spatiotemporal variations in fish mercury bioaccumulation at two distinct scales. Focusing on two common large-bodied sport fishes (Walleye and Northern Pike), the data were analyzed at fine and broad-scales, where fine-scale implies variations in bioaccumulation at water-body- and year-level and broad-scale captures variations across 3 latitudinal zones (~5° each) and eight time periods (~5-year each). A series of linear mixed-effects models (LMEs) were employed to capture the spatial, temporal and spatiotemporal variations in mercury bioaccumulation. Fine-scale models were overall better fit than broad-scale models suggesting environmental factors operating at the water-body-level and annual climatic conditions matter most. Moreover, for both scales, the space-time interaction explained most of the variation. The random slopes from the best-fitting broad-scale model were used to define a bioaccumulation index that captures trends within a climate change context. The broad-scale trends suggest of multiple and potentially conflicting climate-driven mechanisms. Interestingly, broad-scale temporal trends showed contrasting bioaccumulation patterns—increasing in Northern Pike and decreasing in Walleye, thus suggesting species-specific ecological differences also matter. Overall, by taking a scale-specific approach, the study highlights the overwhelming influence of fine-scale variations and their interactions on mercury bioaccumulation, while at broad-scale the mercury bioaccumulation trends are summarized within a climate change context.

Keywords: fish growth rates; mixed-effects models; Northern Pike; Ontario; spatiotemporal trends; temperature effects; Walleye



BROAD-SCALE ASSESSMENT OF THE INFLUENCE OF WETLAND-TO-LAKE CONNECTIVITY ON LAKE CHEMISTRY AND FISH MERCURY LEVELS

by

Krystal Siebert

A thesis

presented to Ryerson University

in partial fulfillment of the requirements for the degree of Master of Spatial Analysis

Toronto, Ontario, Canada

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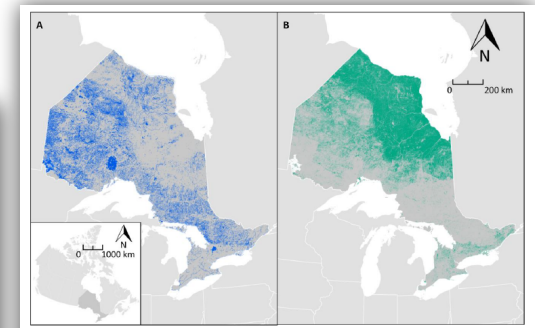


Figure 4.1 - Areal coverage of A) lakes and B) wetlands in Ontario. The inset on panel A) shows Ontario's location in Canada.

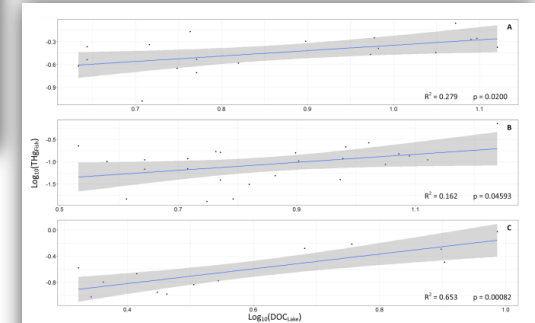


Figure 5.13 - Relationship between [THg]_{Fish} vs [DOC]_{Lake} for A) Walleye, B) Northern Pike, C) Lake Trout.

BsM → Target audience

Fisheries managers, Zone Councils, Biologists, and Research community (E.g., Postdoctoral Research Associates and Graduate Student Theses)

Challenges and Steps Forward

- PWQMN
 - Maintaining consistent sampling frequency at all sites
 - Co-locating with flow gauging
 - Resources to maintain sites and regular sampling
 - Researchers and practitioners showing the power of a province-wide long—term dataset to address theoretical and applied questions
- BsM
 - Linking lake data to watershed attributes (incl. stream water quality)
 - Far North, Southwestern Ontario
 - Data management and open data
 - Resources to re-sample lakes on regular basis
 - Continued stakeholder input through Fisheries Management Zone Councils

Thank you! Questions?