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Current Use Pesticides that drain into Canadian tributaries: A potential threat to Whale habitats

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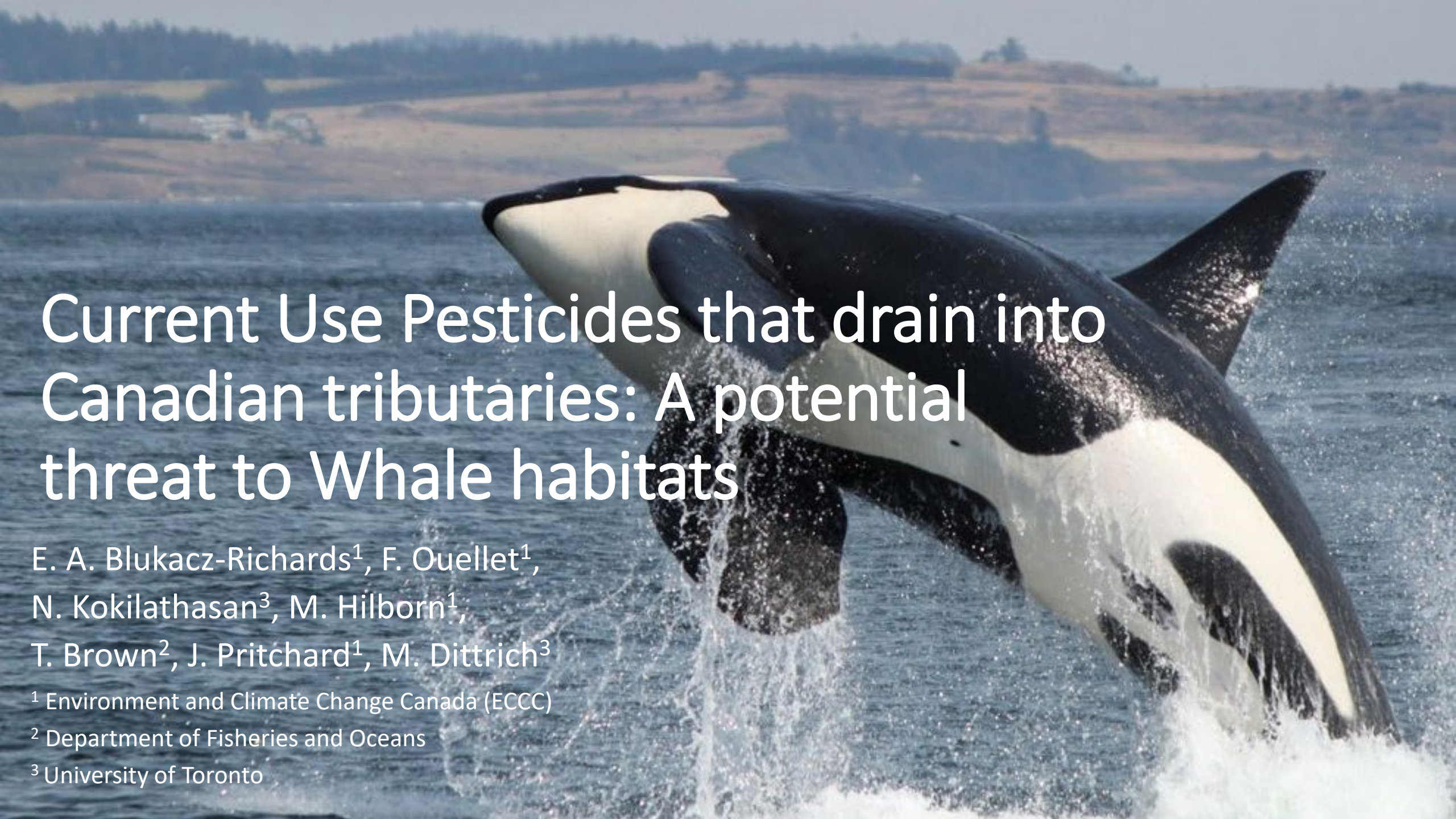

Current Use Pesticides that drain into Canadian tributaries: A potential threat to Whale habitats

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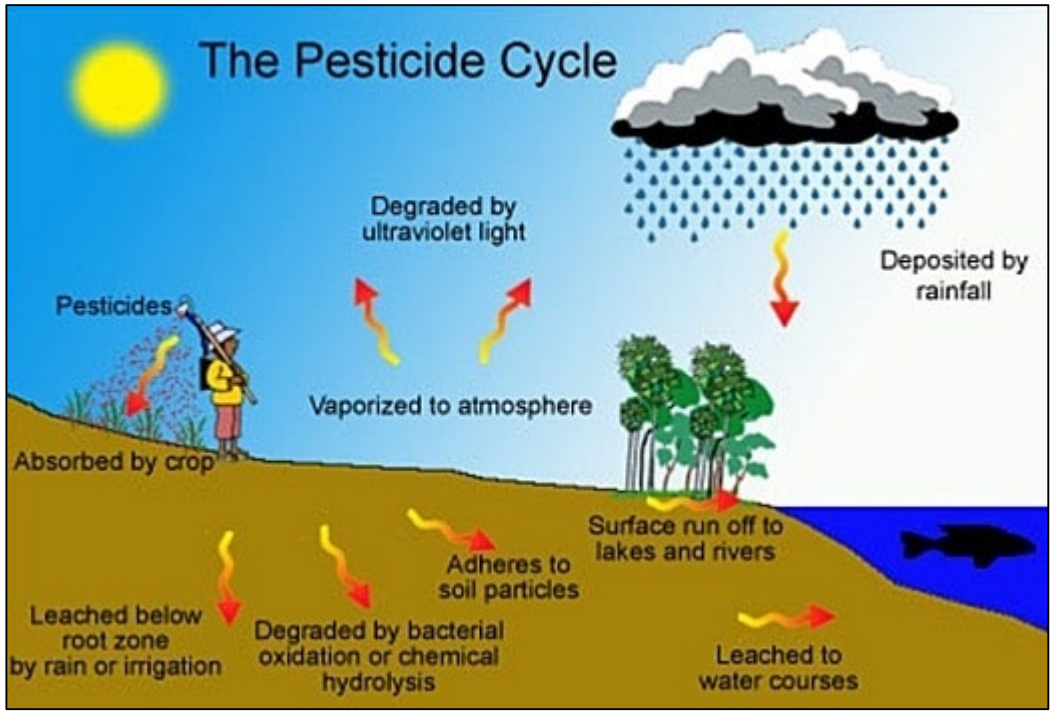
Background

- Several whale species are listed as Endangered under the Species at Risk Act (SARA).
- The Recovery Strategy for the Northern and Southern Resident Killer Whales (NRKW & SRKW) lists environmental contaminants, including pesticides as a key threat to whale populations and identifies urban and agricultural runoff and stormwater as pollutant sources.
- Whales are exposed to contaminants through their diet which consists mainly of fish.
- Contaminant bioaccumulation in whales within Canadian waters has been well documented (Muir et al. 1996, Ross et al 2000).

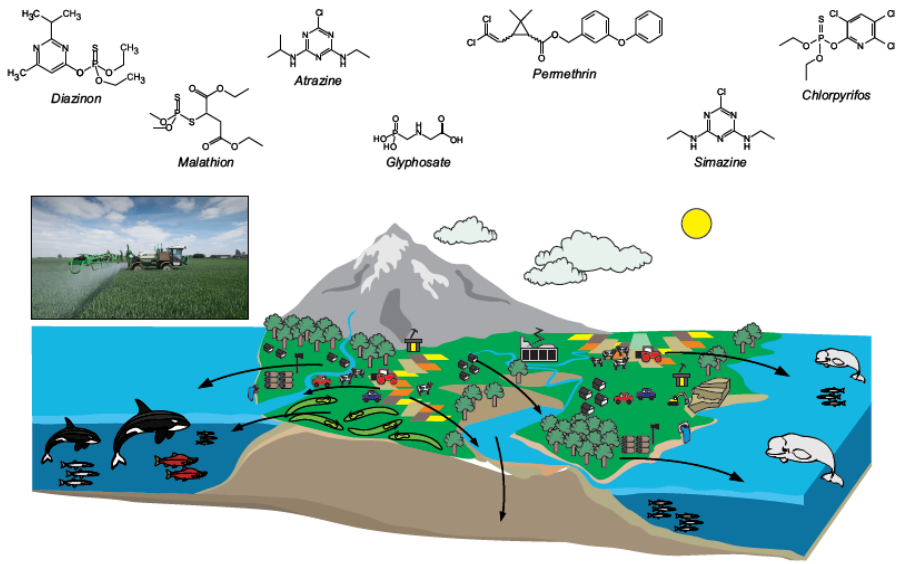
Background

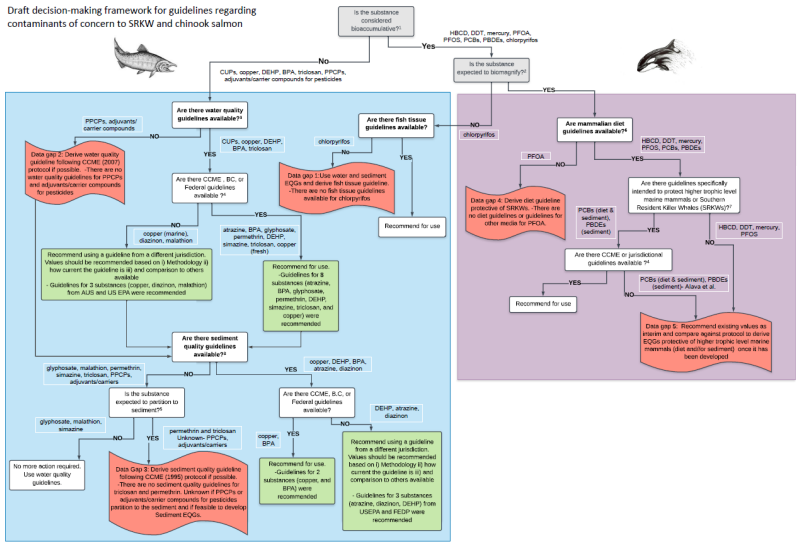
- Globally, Canada ranked 5th in pesticide use compared to China (1st) and US (2nd).
- For the past 20 years, pesticide use in Canada increased between 100 to 400% (Malaj et al. 2020).
- Commonly used pesticides are water soluble, persistent and enter tributaries through runoff, especially during extreme precipitation events.

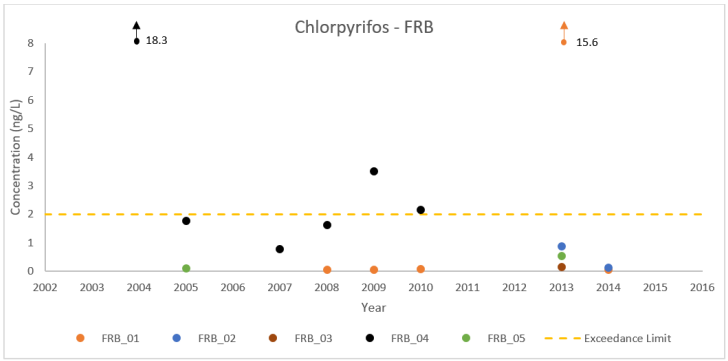


Objectives

- Our goal was to compare 7 commonly used pesticides (atrazine, chlorpyrifos, diazinon, glyphosate, malathion, permethrin, and simazine) that can potentially impact Whale habitats and their prey.
- We focused on major Canadian metropolitan and agricultural Regions: 1) Great Lakes, 2) St. Lawrence, and 3) Fraser River Basin.
- We estimated loads, yields, and evaluated contaminant levels against environmental quality guidelines (EQGs).







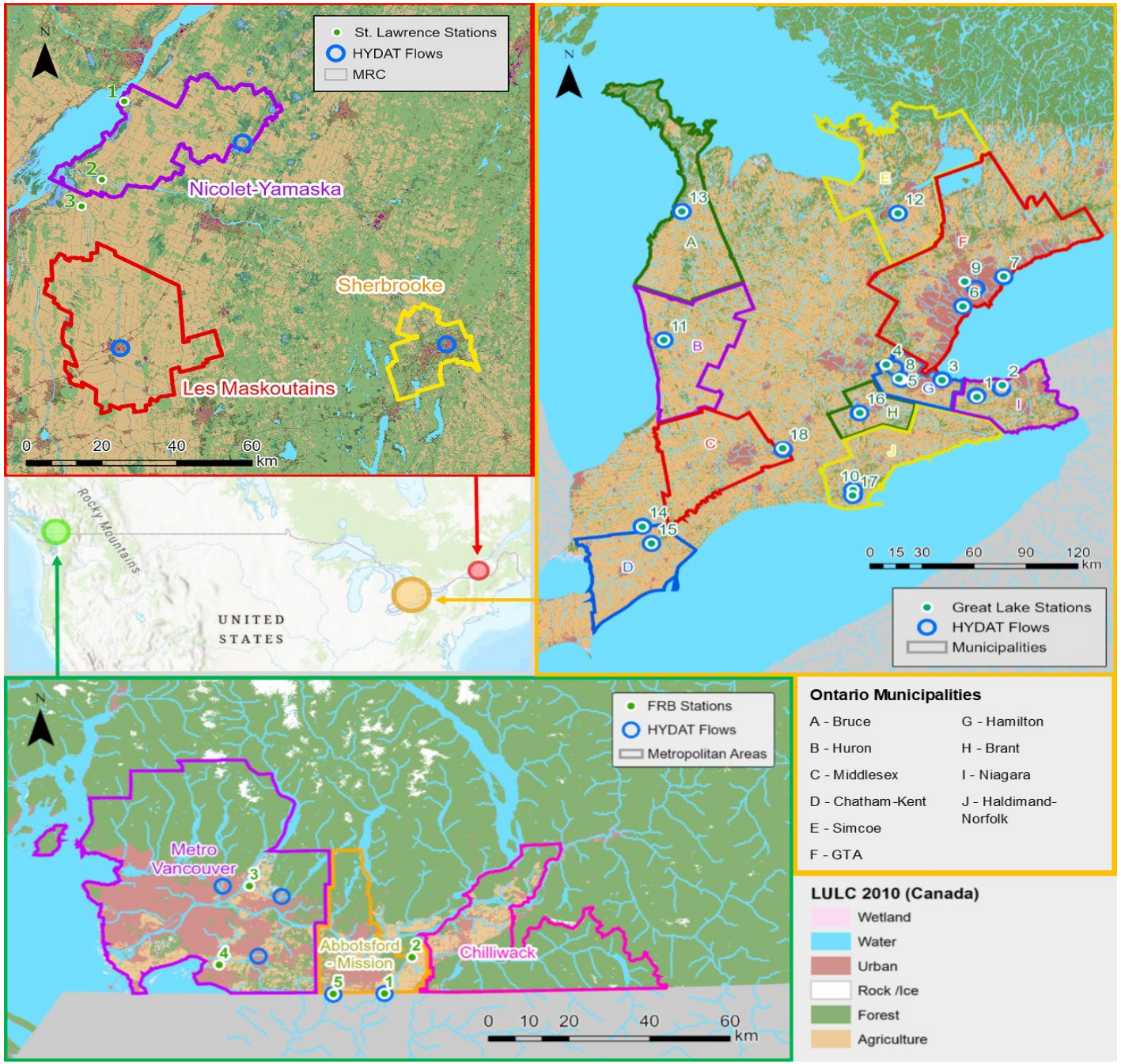
Methods: Sites and Data Sources

Water Sampling Sites

- **Great Lakes Region**
  - Greater Toronto Area (GTA) to Hamilton-Niagara
  - Lake Ontario is a major pesticide contributor to the St. Lawrence.
  - Sites from intense agricultural areas (Lakes Erie and Huron) were also included.
- **St. Lawrence**
  - Montréal to Québec.
- **Fraser River Basin**
  - Metro Vancouver, Abbotsford-Mission, and Chilliwack.

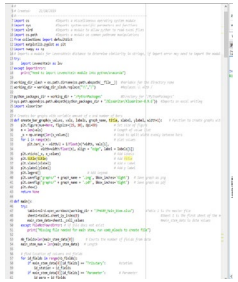
Pesticide Data Sources

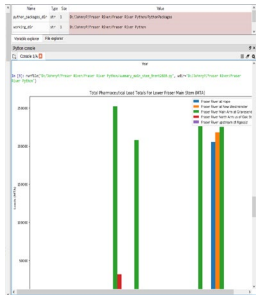
- Monitoring and Surveillance Division at ECCC also provided data (https://open.canada.ca/).
- Ontario Ministry of Environment Conservation and Parks (MECP) (https://data.ontario.ca/dataset)

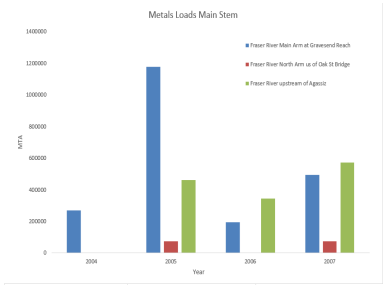


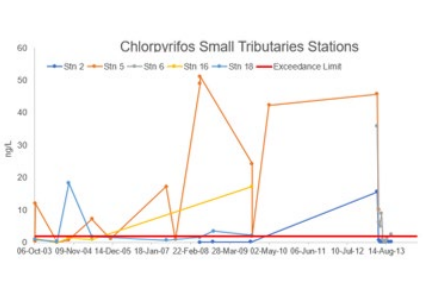
Contaminant Load Analysis

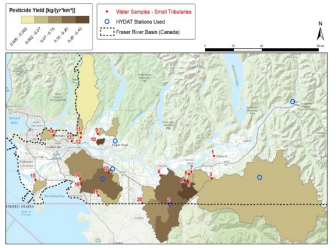
- To estimate loads time series of pesticides and water flows were required for the same locations. Water flows were obtained from ECCC's Hydrometric Station and Network Data (HYDAT) (https://wateroffice.ec.gc.ca/) and from Hydro Québec.
- Some of the pesticide stations were not co-located with HYDAT stations. Pro-rating was used to fill in these gaps.
- We developed a tool to read in data files, estimate loads, and post-process. Annual loads were estimated for all the Regions.
- Detection limits (DLs) were highly variable. We repeated calculations for scenarios: 1) DL, 2) DL=0, 3) DL/2, 4) DL from a random uniform distribution.
- Loads were similar for DL/2 and DL (uniform) compared to other scenarios. We are presenting results from the DL/2 scenario.

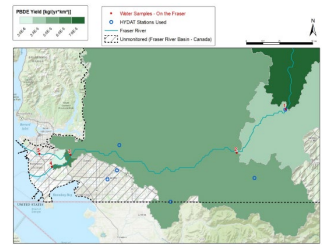








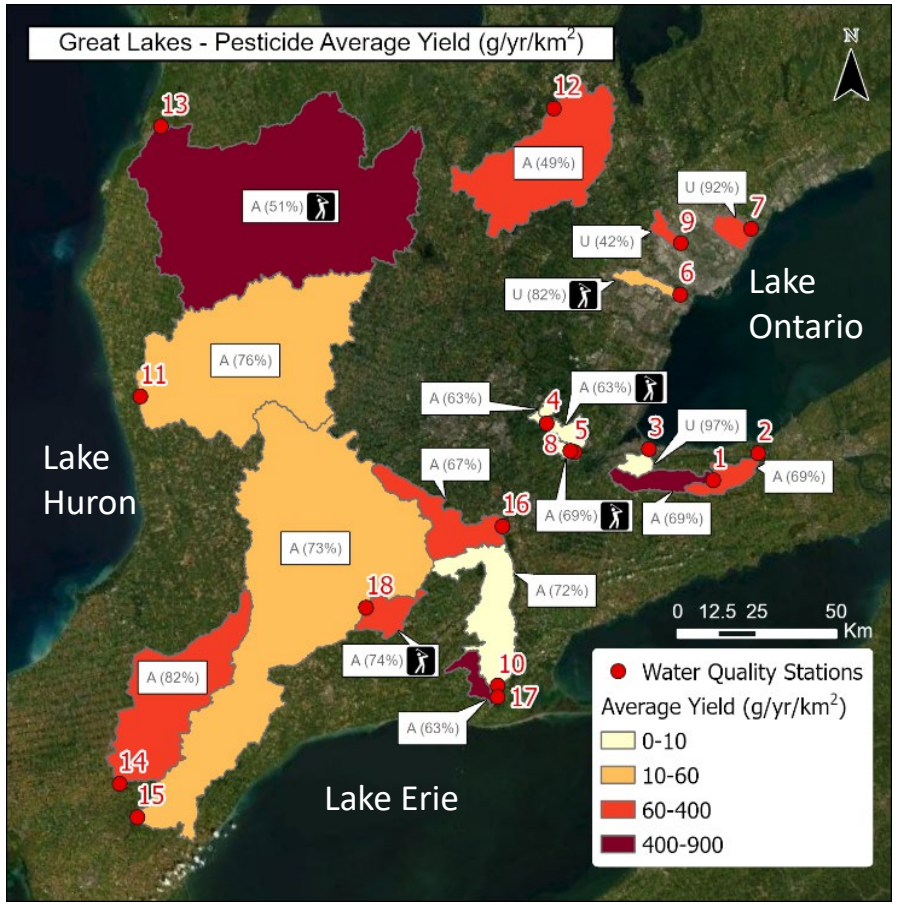


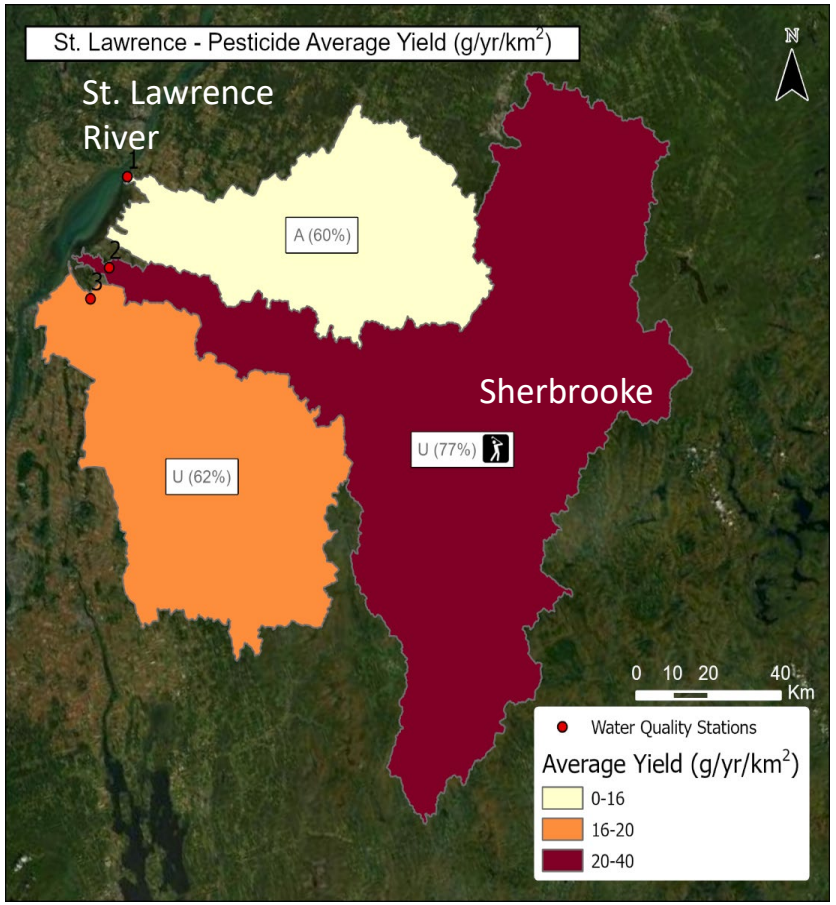


Contaminant Load Analysis: Yields

Yields

- For comparisons across regions, yields were calculated by dividing each load by the respective upstream area.
- **Great Lakes Region**
  - On average, Lake Erie had the highest yields followed by Lake Ontario.
  - Pesticide yields varied: glyphosate>atrazine> diazinon > simazine > malathion> chlorpyrifos.
  - Permethrin was not monitored.
- **St. Lawrence**
  - On average, Sherbrooke region had the highest yields.
  - Pesticide yields varied: permethrin> diazinon> chlorpyrifos> malathion > simazine.
  - Glyphosate was not monitored.





Contaminant Load Analysis: Yields

Yields:

- **Fraser River Basin**
  - On average, Abbotsford-Mission had the highest yields.
  - Pesticide yields varied:

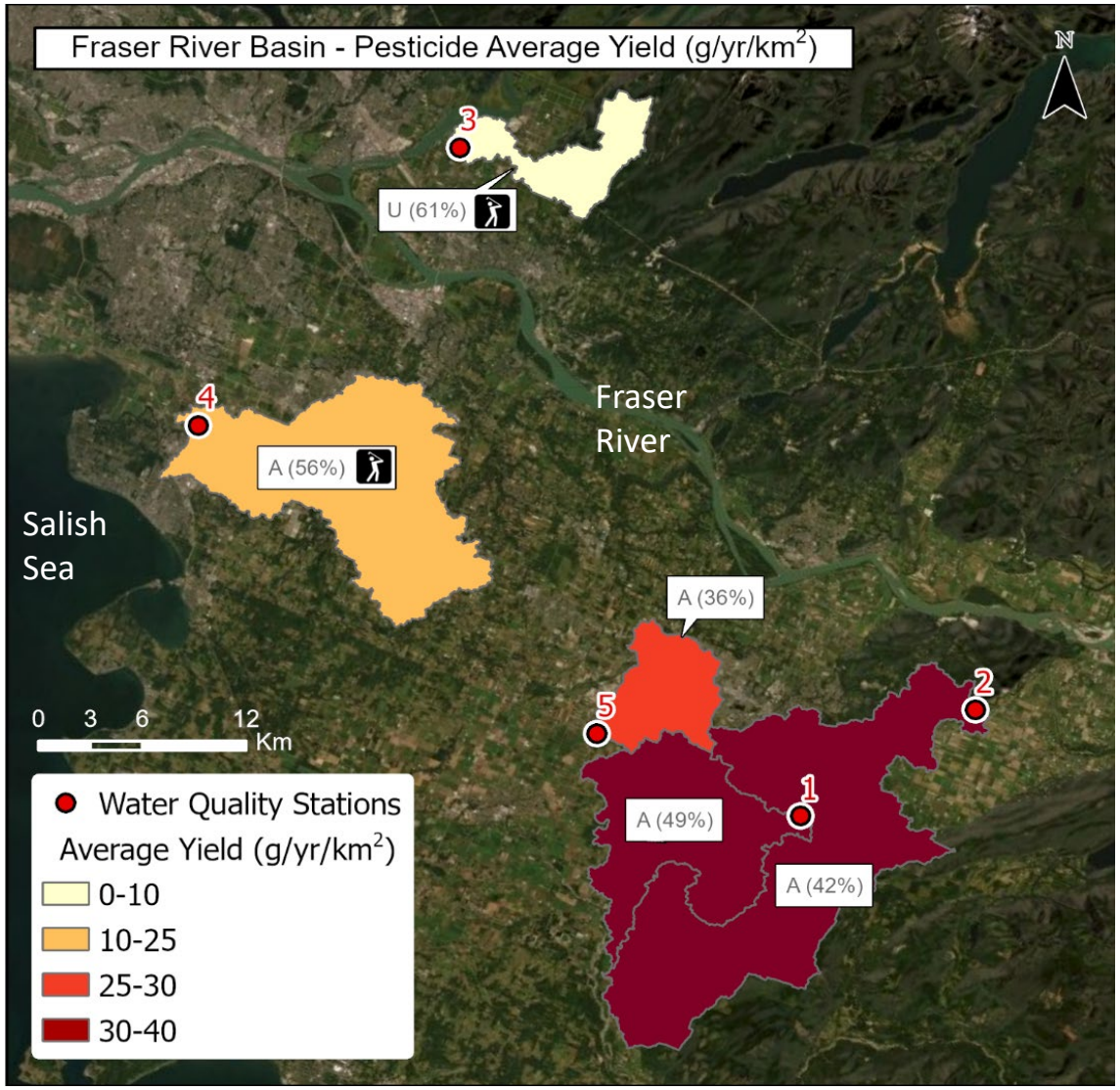
    glyphosate>simazine>diazinon>

    atrazine> chlorpyrifos>

    malathion>permethrin

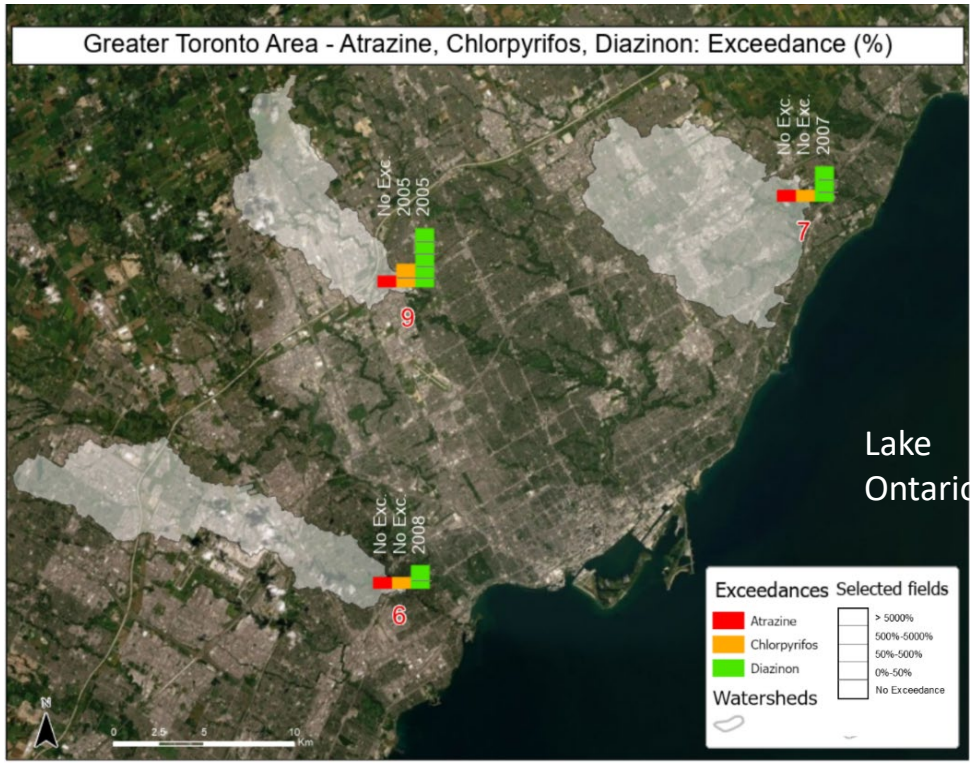
Regional Comparisons:

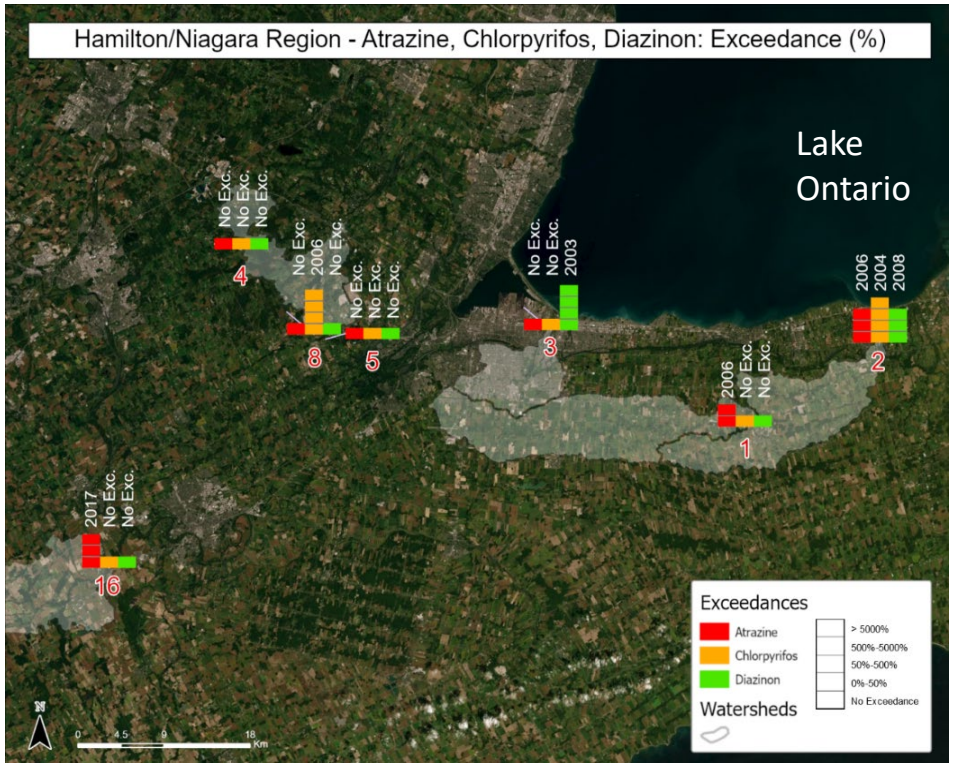
- On average, the Great Lakes Region had the highest pesticide yields (234 g/km²), followed by the Fraser River (23 g/km²) and the St. Lawrence (21 g/km²).
- Highest yields were observed in agricultural areas.



Environmental Quality Guidelines (EQGs)

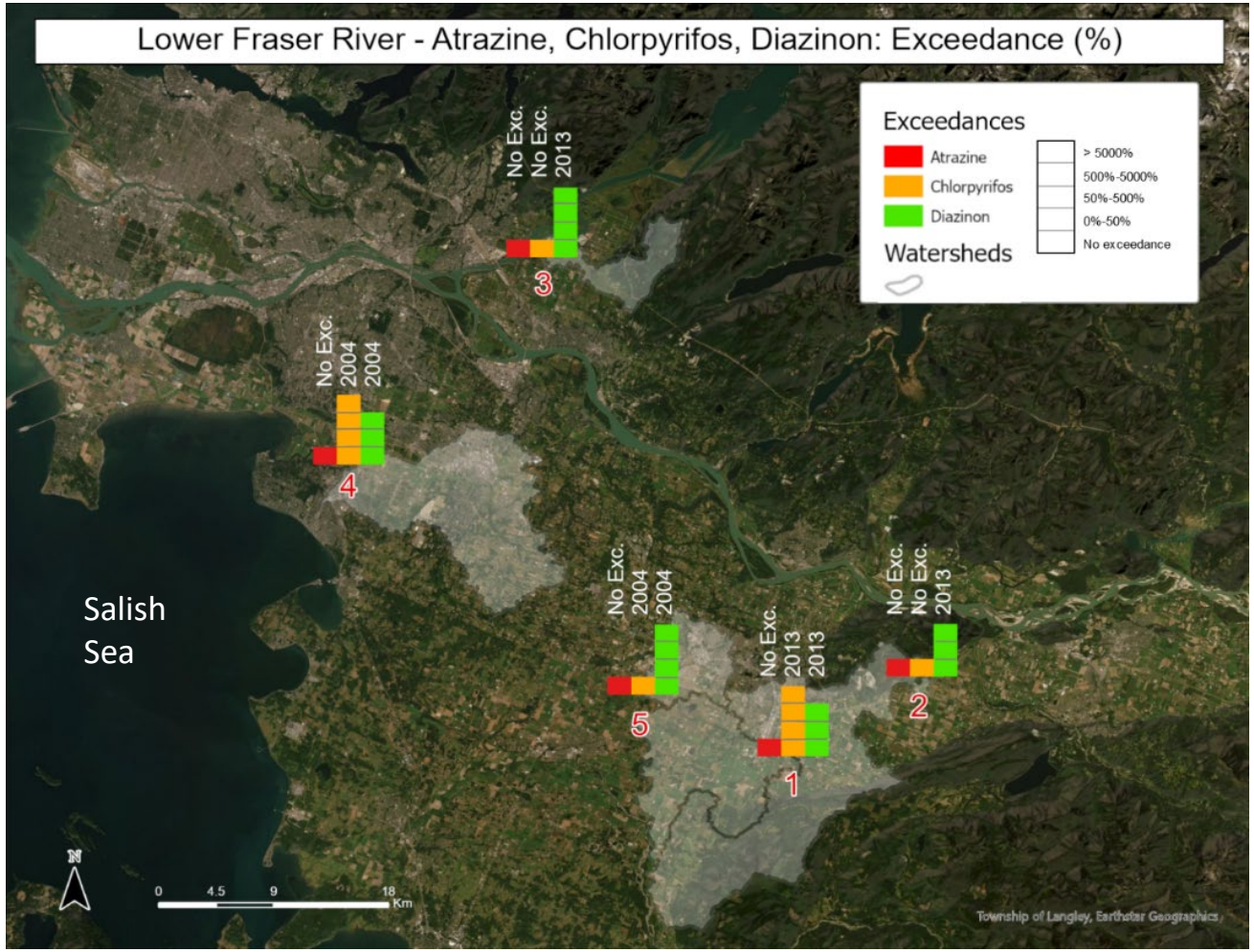
- In the Fraser River Basin, EQGs recommended for the protection of SRKW and their prey were evaluated https://www.canada.ca/content/dam/eccc/environmental-protectionouthern-resident-killer-whales. In the other Regions, these EQGs served as a conservative bench mark for the St. Lawrence-Estuary Beluga (SLEB).
- Exceedances were observed for: atrazine, chlorpyrifos, and diazinon.In the Great Lakes, diazinon (75% to 28,000%) had the highest exceedances followed by chlorpyrifos with peaks of 2500%.





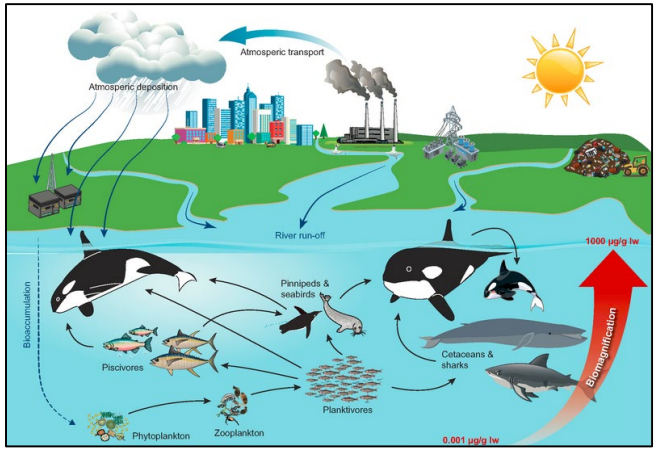
Environmental Quality Guidelines (EQGs)

- St. Lawrence, exceedances only observed for atrazine.
- In the Fraser River Basin, diazinon followed by chlorpyrifos.



Next Steps

- Examine the relationships between pesticide loads and golf courses that are within 3km radius of sampling stations. Submit manuscript to a scientific journal.
- Additional manuscripts are in preparation for metals and other organics.
- While the focus to date has been on water, we have begun examining contaminants in the sediments. Remote sensing information will be used to fill in data gaps, especially changes in Land Use / Land Cover (LULC) .
- This research will inform the recovery efforts for Northern and Southern Resident Killer Whales and St. Lawrence Estuary Beluga Whale.



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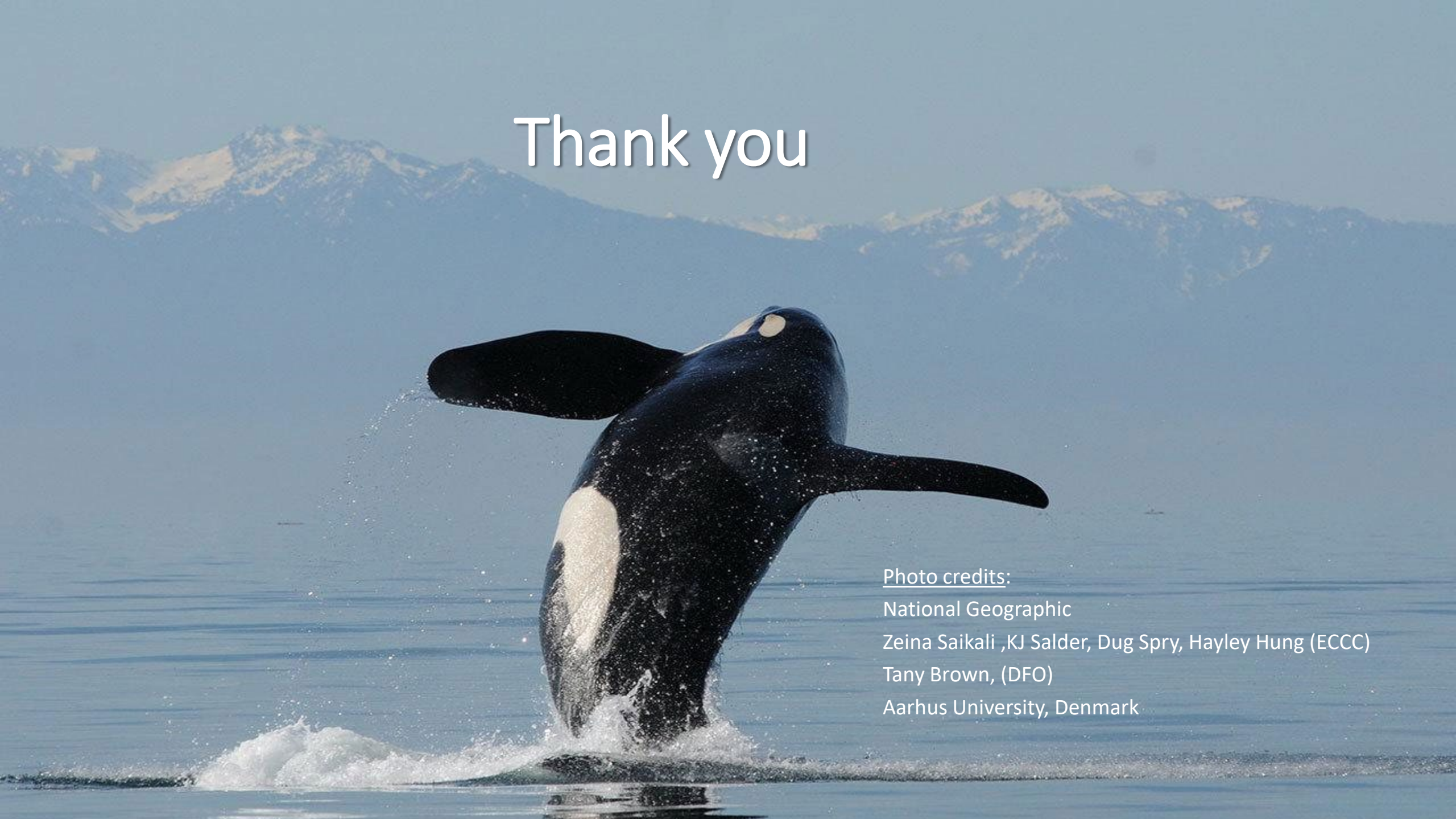
Thank you



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Tany Brown, (DFO)

Aarhus University, Denmark