

Long-term environmental trends in Ontario lakes that support a Lake Trout population

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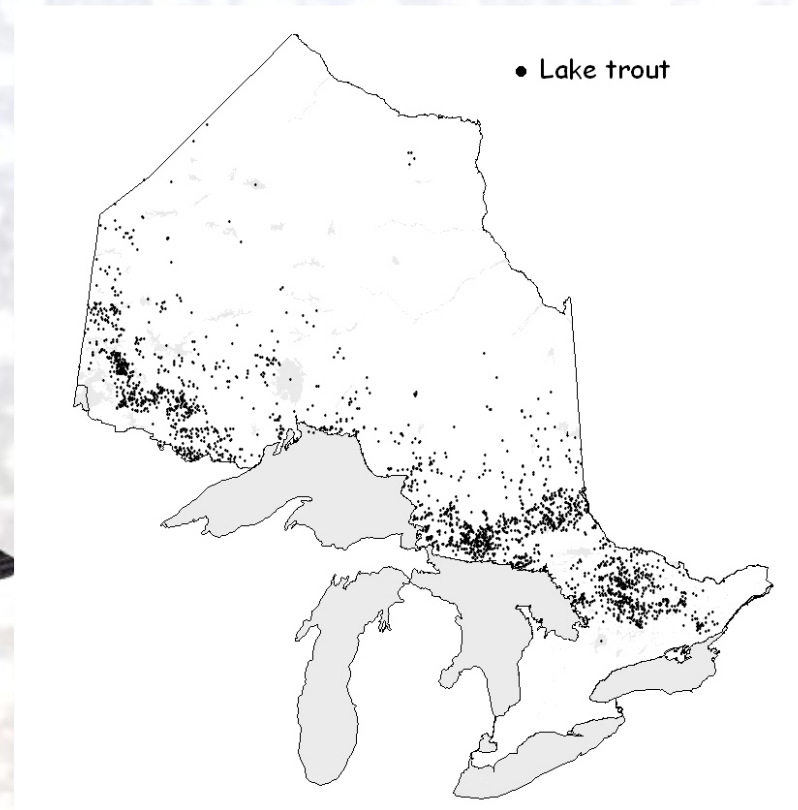


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PEARL 

Lake Trout in Ontario

- Rare and valuable resource
 - Present in ~1% of Ontario's 250,000 lakes
 - Ontario contains 20-25% of all Lake Trout lakes worldwide
- Important to recreational fisheries
- Specific habitat requirements make them particularly sensitive to environmental stressors



Habitat Requirements

Warm Surface Waters

Usable: $< 15\text{ }^{\circ}\text{C}$, Lethal: $> 23.5\text{ }^{\circ}\text{C}$

Cold Bottom Water

Usable: $> 4\text{ mg O}_2/\text{L}$, Lethal: $< 3\text{ mg O}_2/\text{L}$



Habitat Requirements



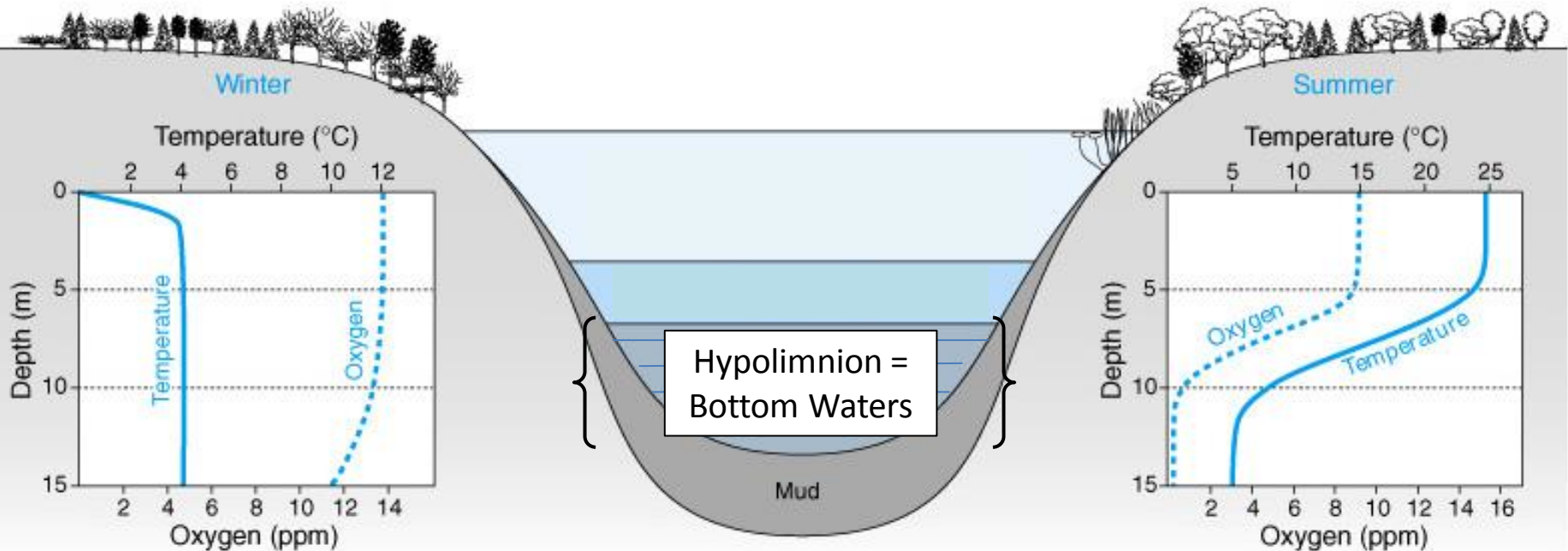
Increased Temperatures



Decreased Oxygen



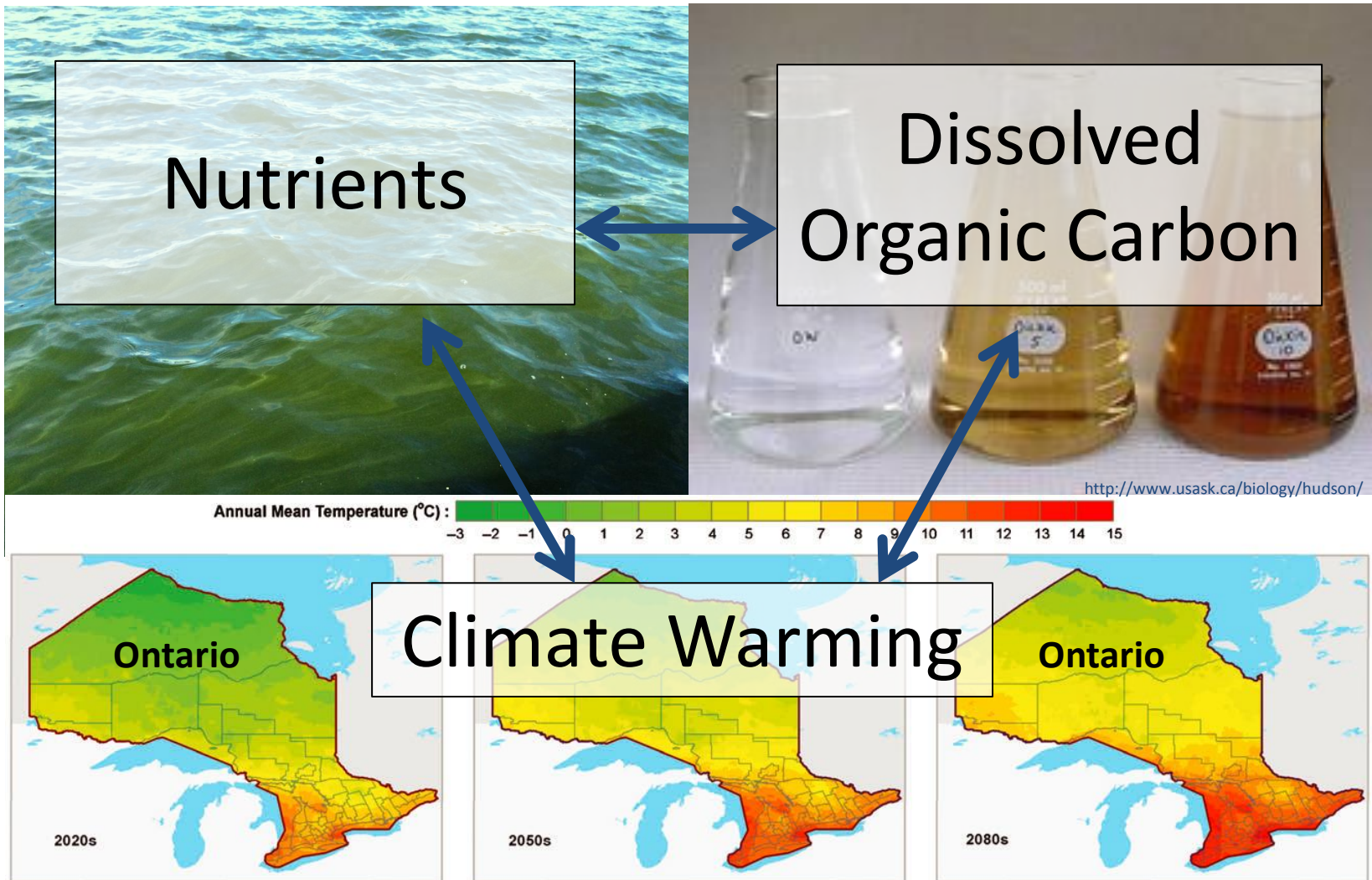
Volume Weighted Hypolimnetic Oxygen



$$VWHO = \frac{\text{Sum of (Oxygen x Volume of Water at each 1 m strata)}}{\text{Total Volume of Hypolimnion}}$$

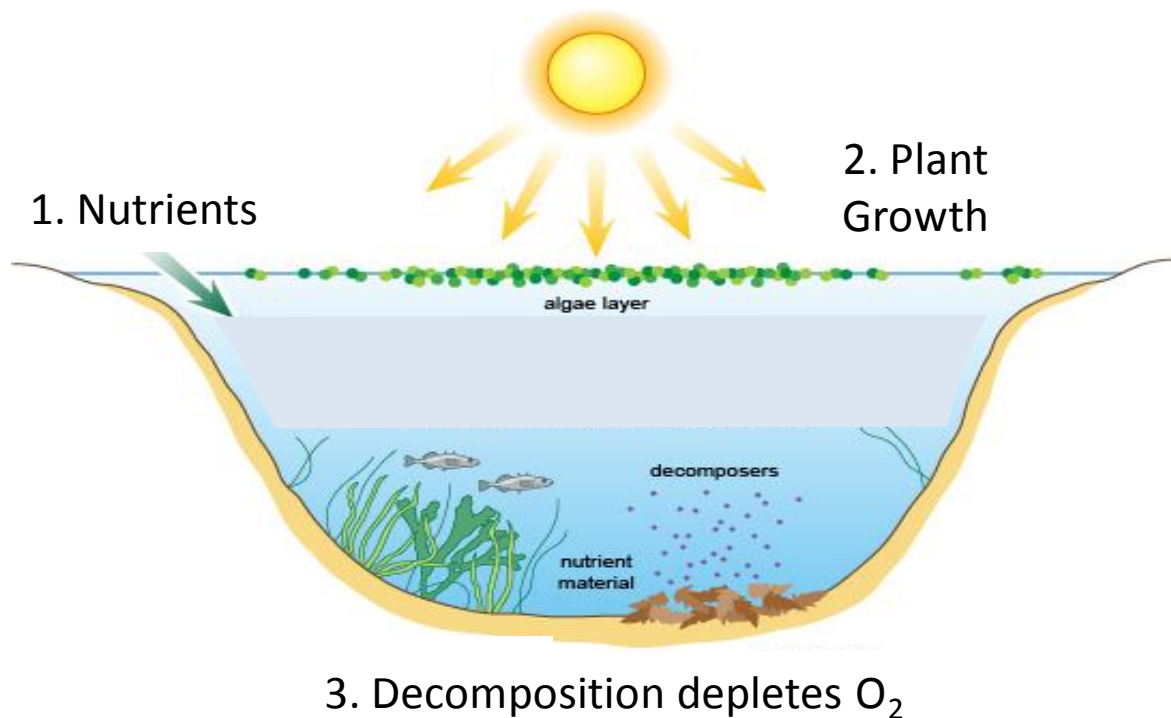
Provincial standard for end-of-summer VWHO in a Lake
Trout lake > 7 mg/L (Evans et al. 2007)

Variables that Influence Hypolimnetic Dissolved Oxygen (DO)



(Figure: Wang et al. 2014)

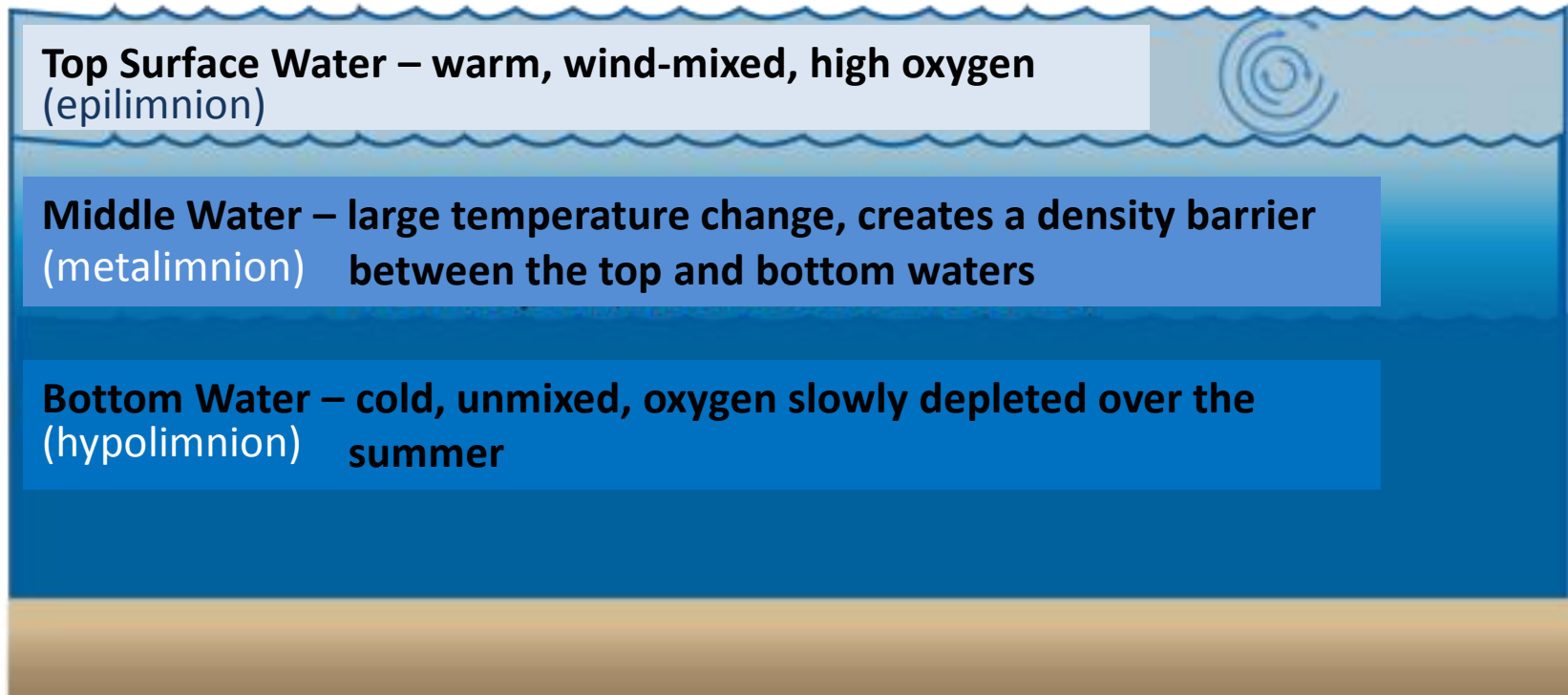
Increased Nutrient = Decreased Oxygen



Sources: Runoff from agricultural and urban areas, atmospheric deposition, septic systems, decaying organic matter, soil erosion



Increased Warming = Decreased Oxygen

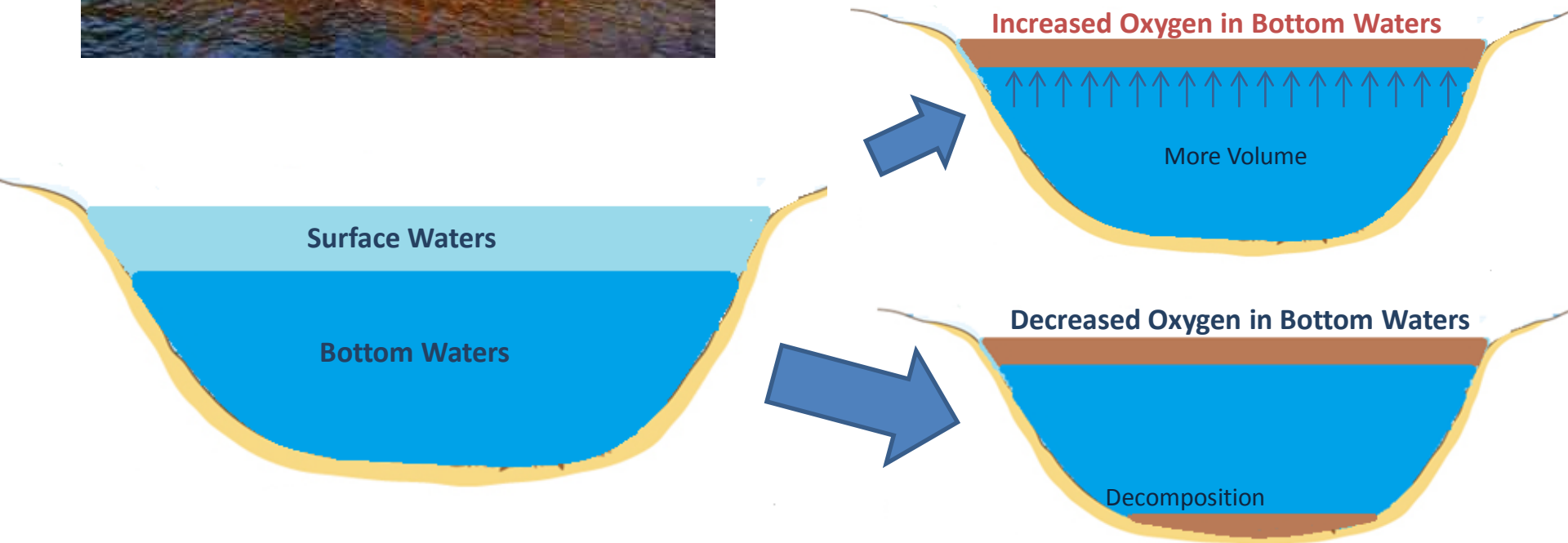


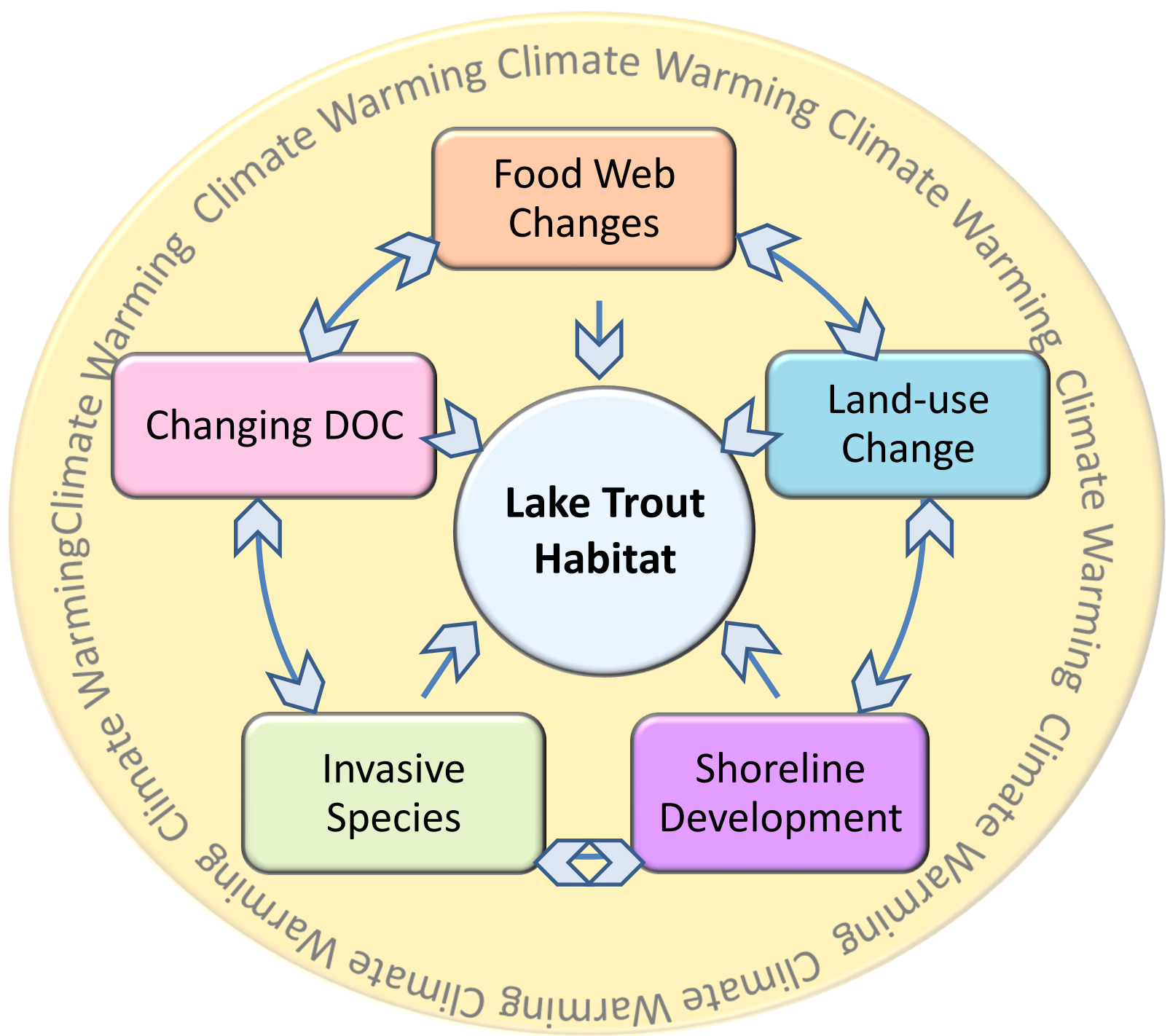
Climate warming can lead to longer and stronger periods of stratification
= greater depletion of DO

Increased DOC = Increased or Decreased Oxygen



- Dissolved Organic Carbon gives water brown colouring
- From the terrestrial environment, wetlands, groundwater, and living organisms in the lake





Research Questions

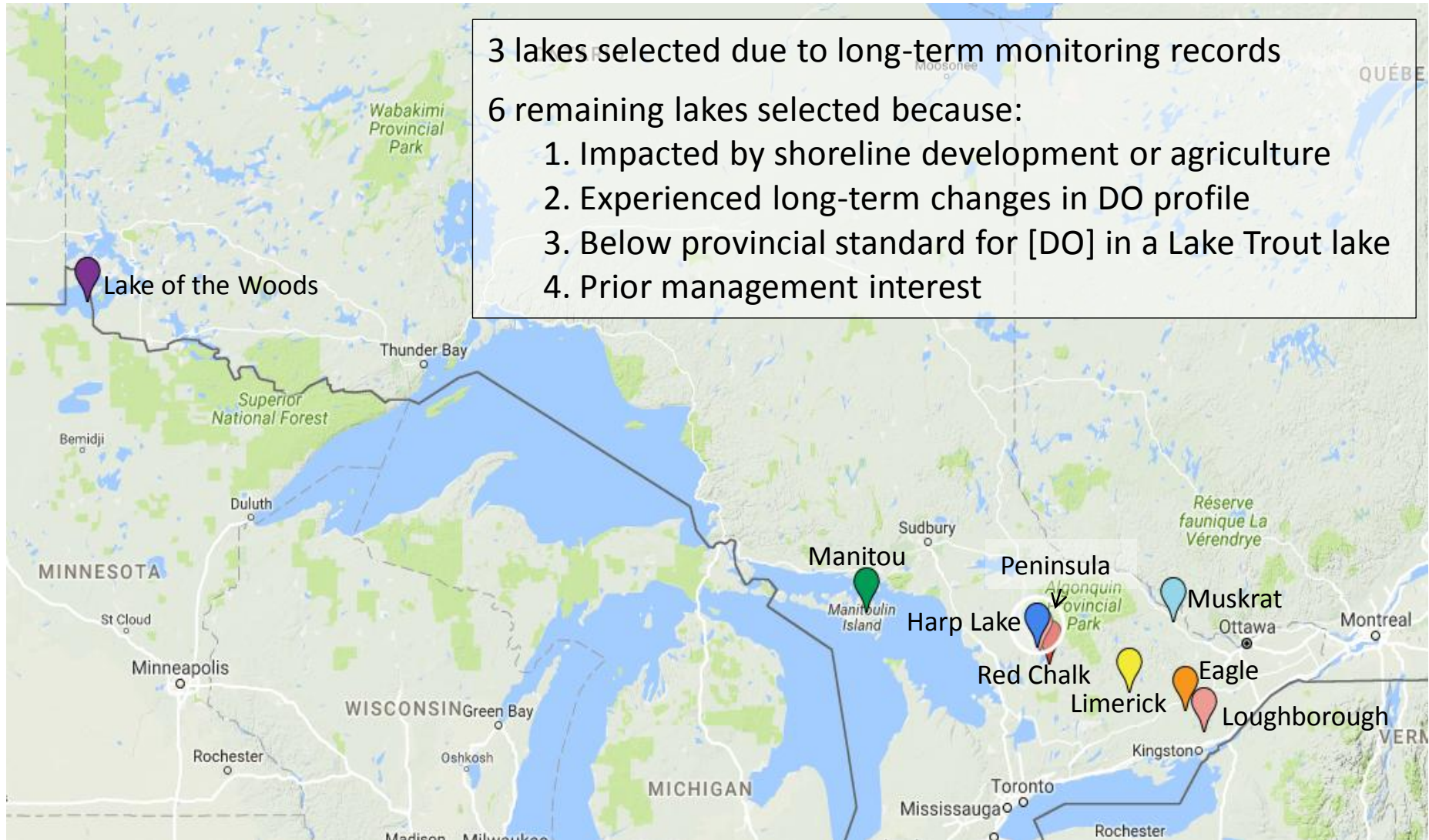
- How have Ontario Lake Trout lakes changed over time?
- Have end-of-summer DO concentrations changed?
- And if so, what stressors (warming, nutrients, DOC) are driving this change?

Study Lake Selection

3 lakes selected due to long-term monitoring records

6 remaining lakes selected because:

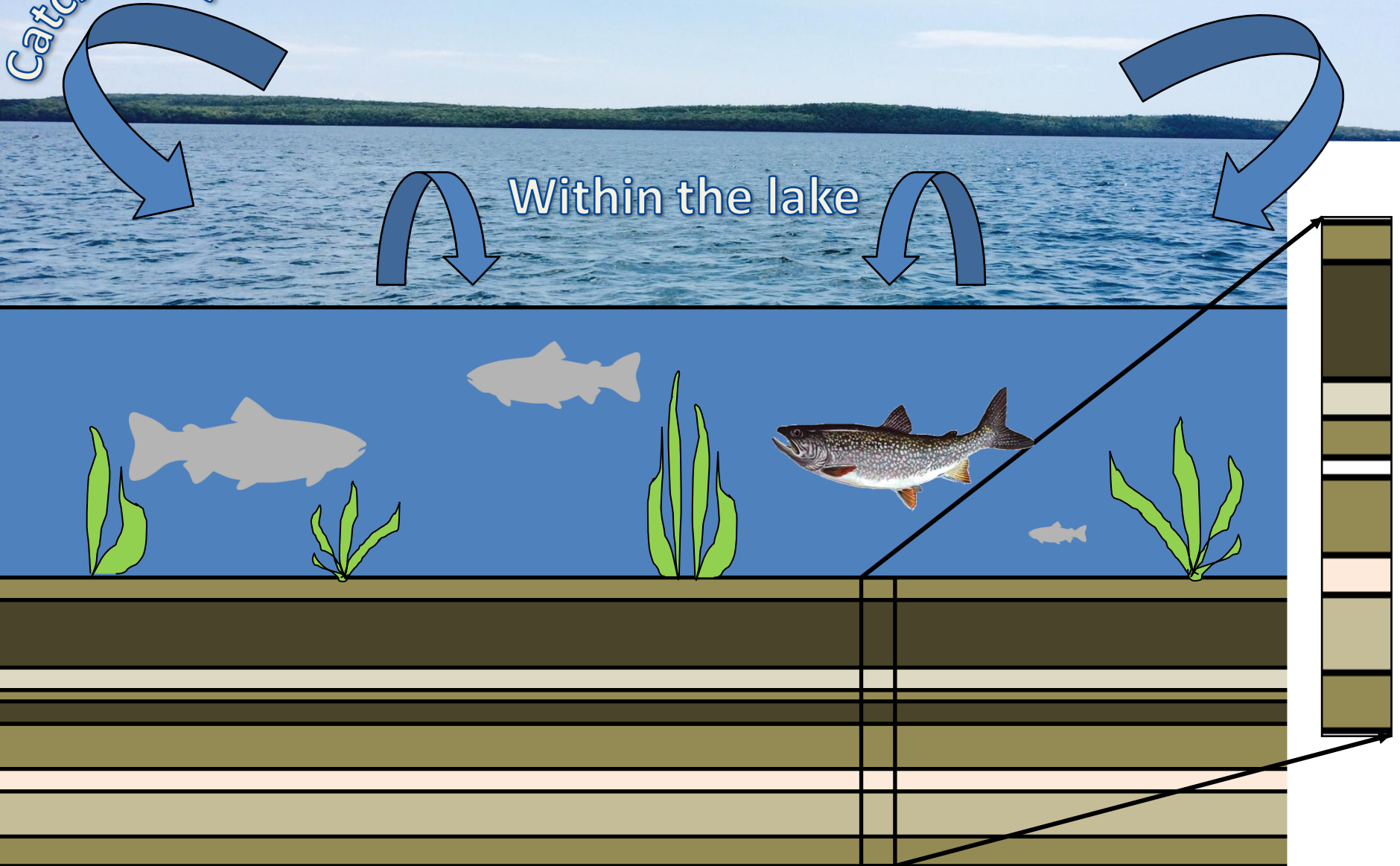
1. Impacted by shoreline development or agriculture
2. Experienced long-term changes in DO profile
3. Below provincial standard for [DO] in a Lake Trout lake
4. Prior management interest



Lake Sediment Archives

Catchment

Within the lake

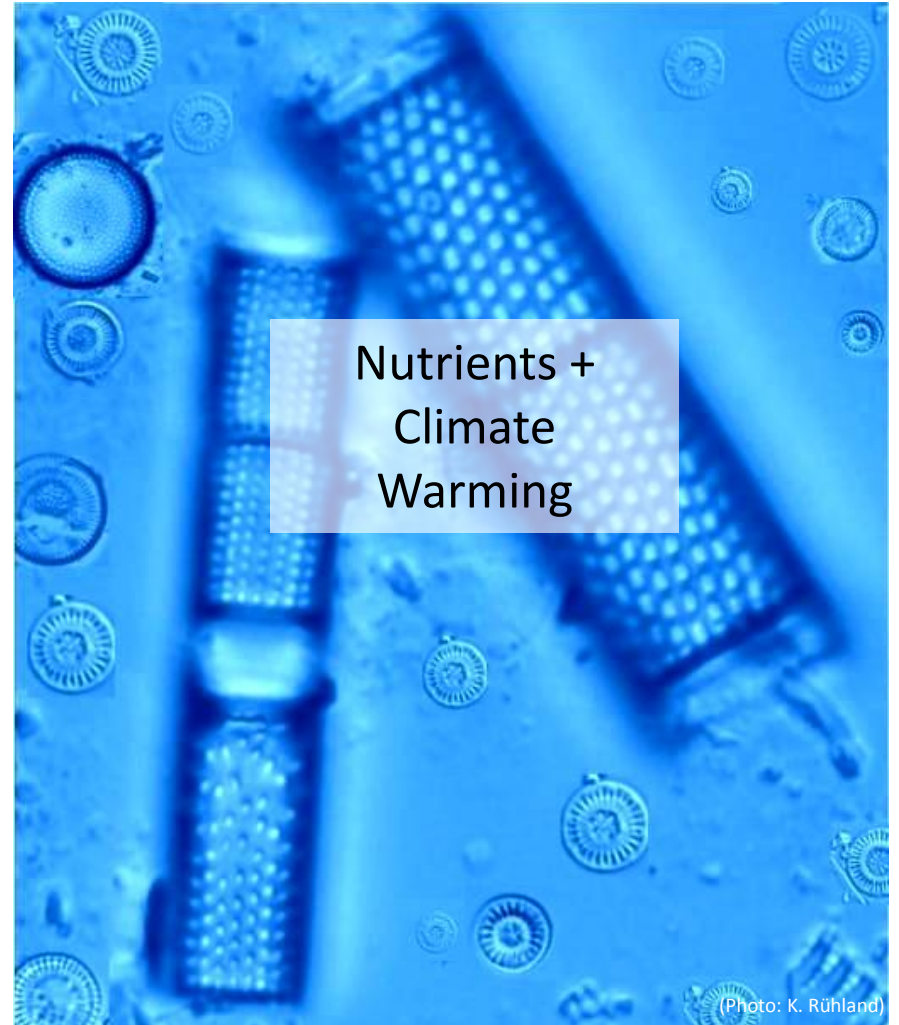


Indicators in Lake Sediments

CHIRONOMIDS



DIATOMS

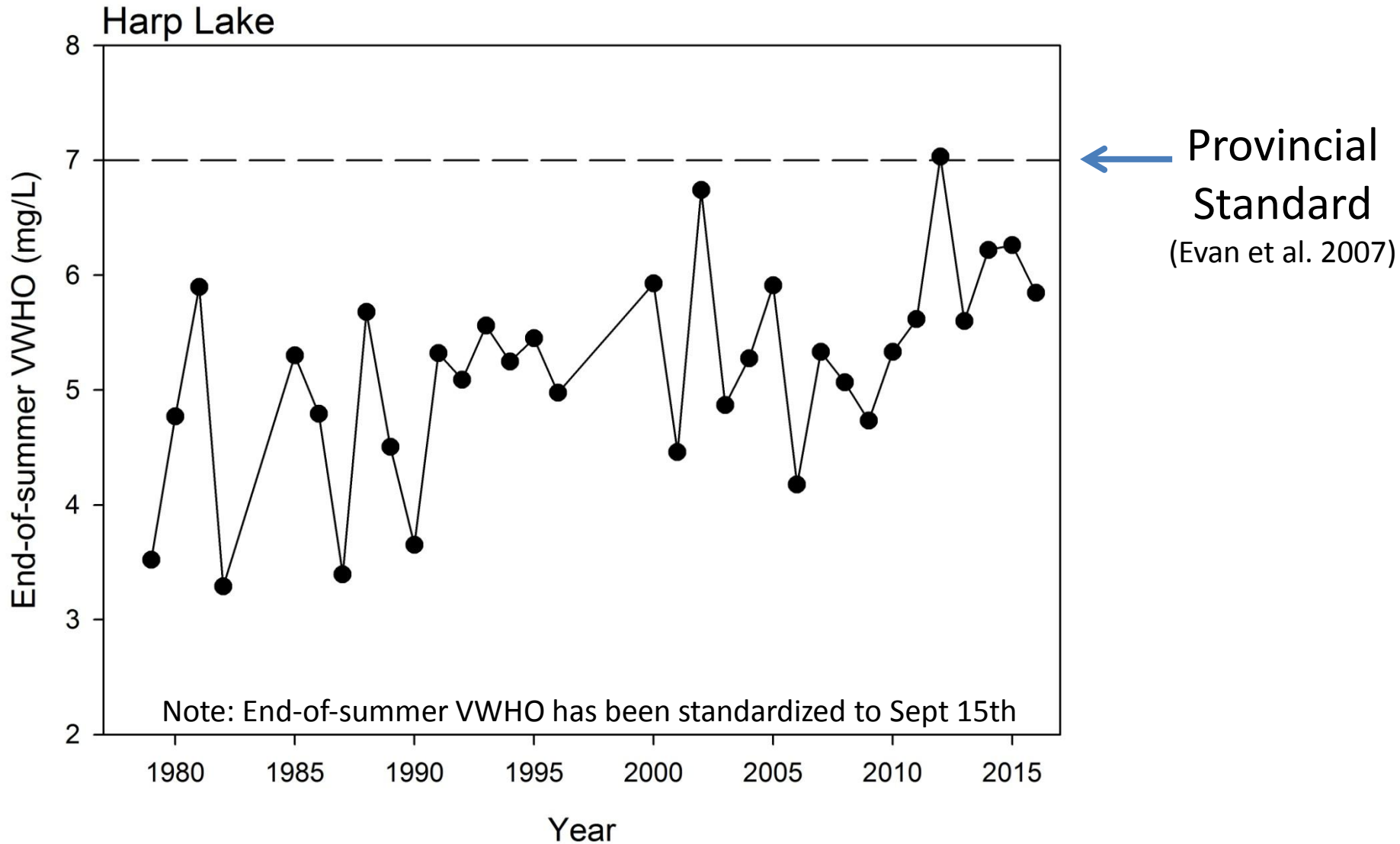


Harp Lake

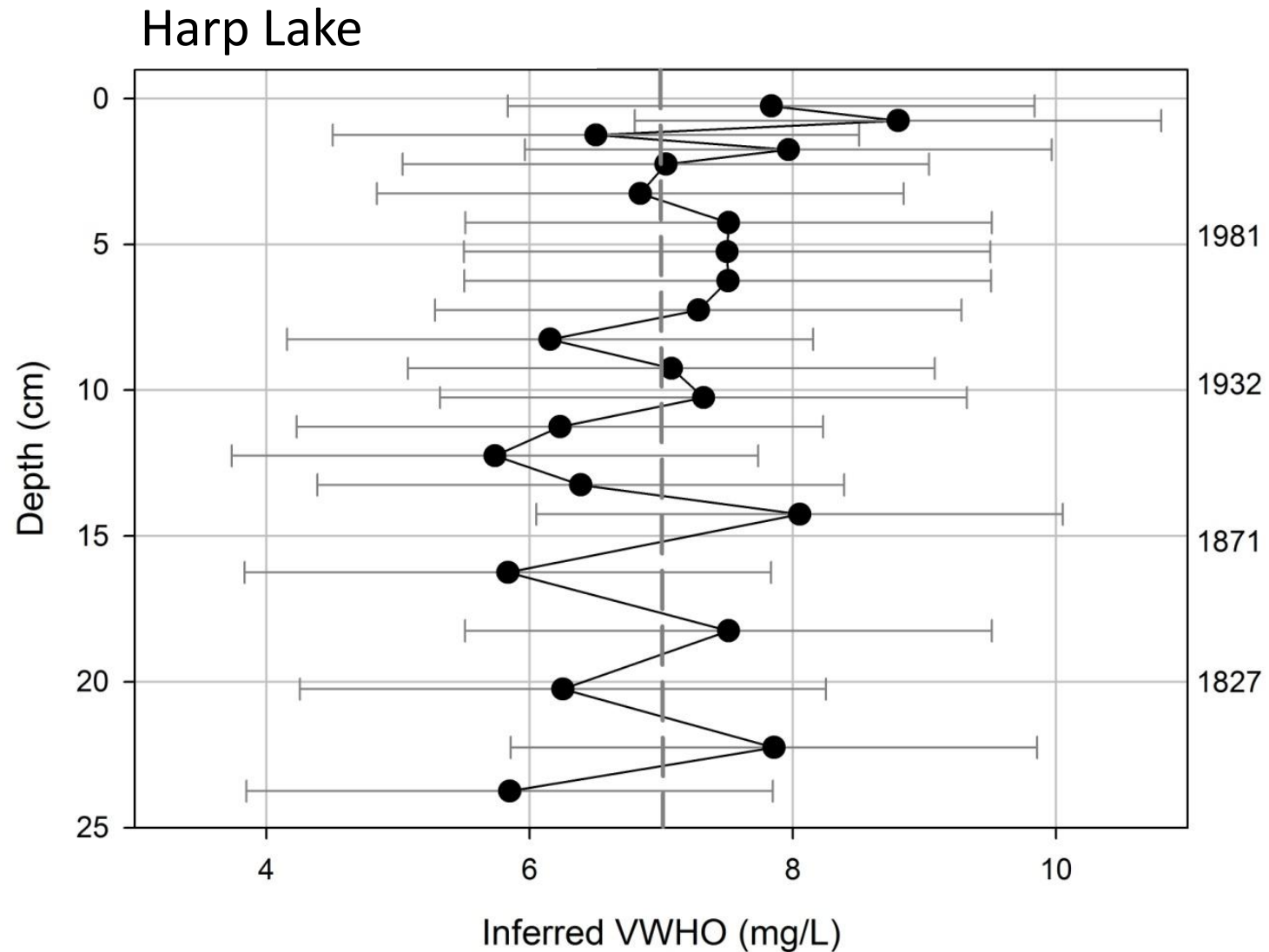
- Stocked to support the recreational Lake Trout fishery
- Monitored bi-weekly since the late-1970s
- Low nutrient, deep lake (max depth 37.5 m)



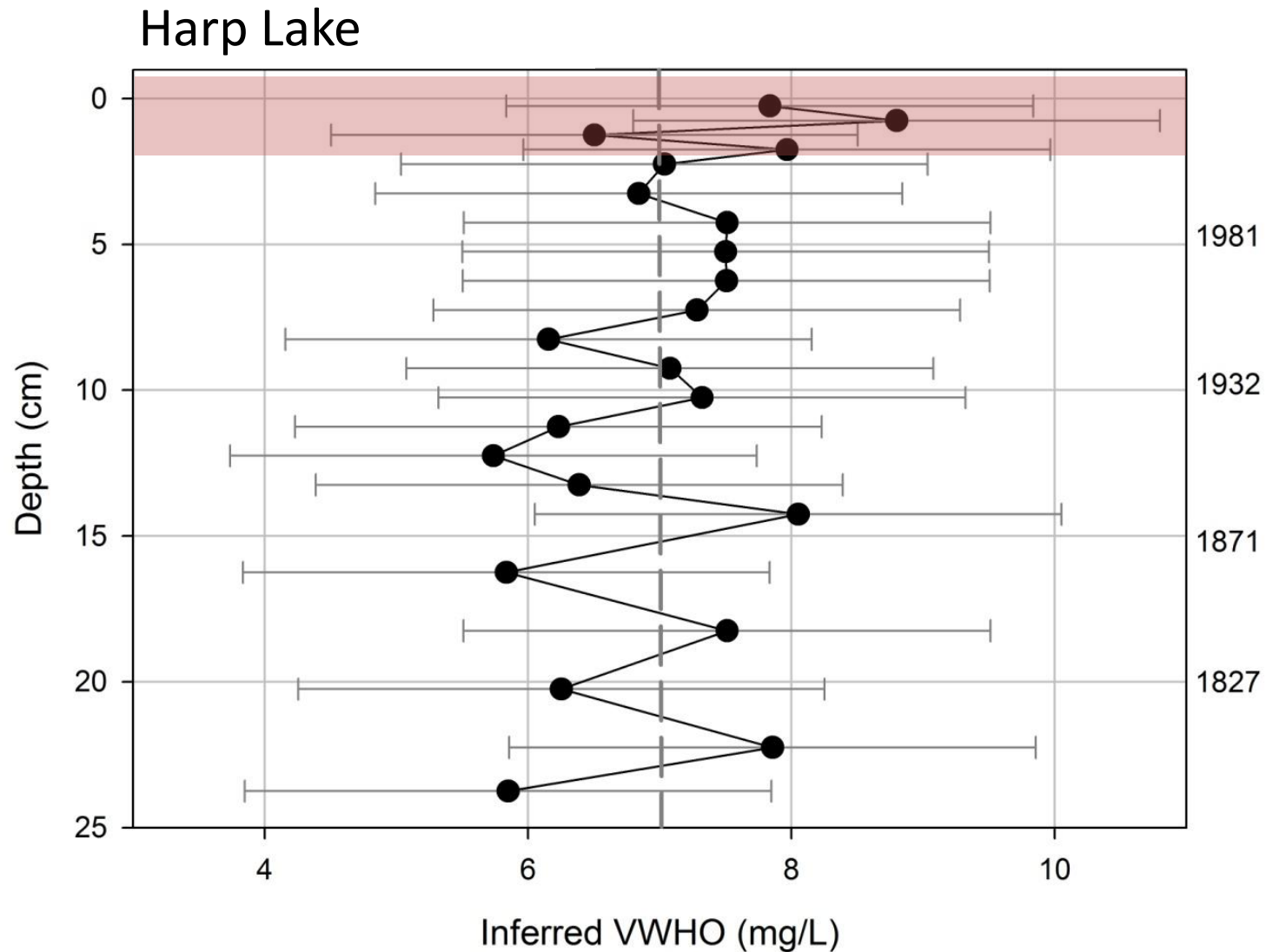
End-of-summer Bottom Water Oxygen



Chironomid Oxygen Reconstruction

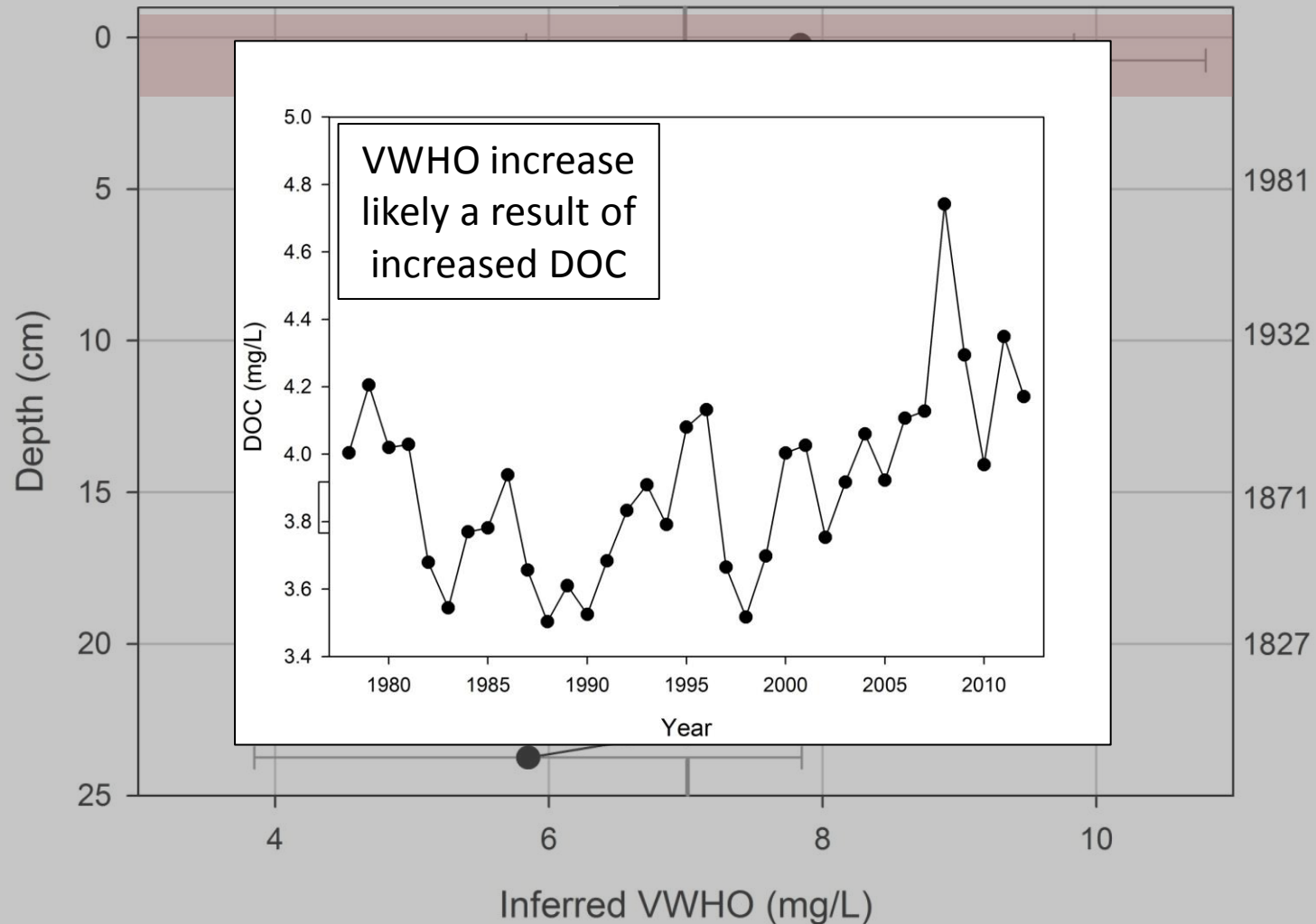


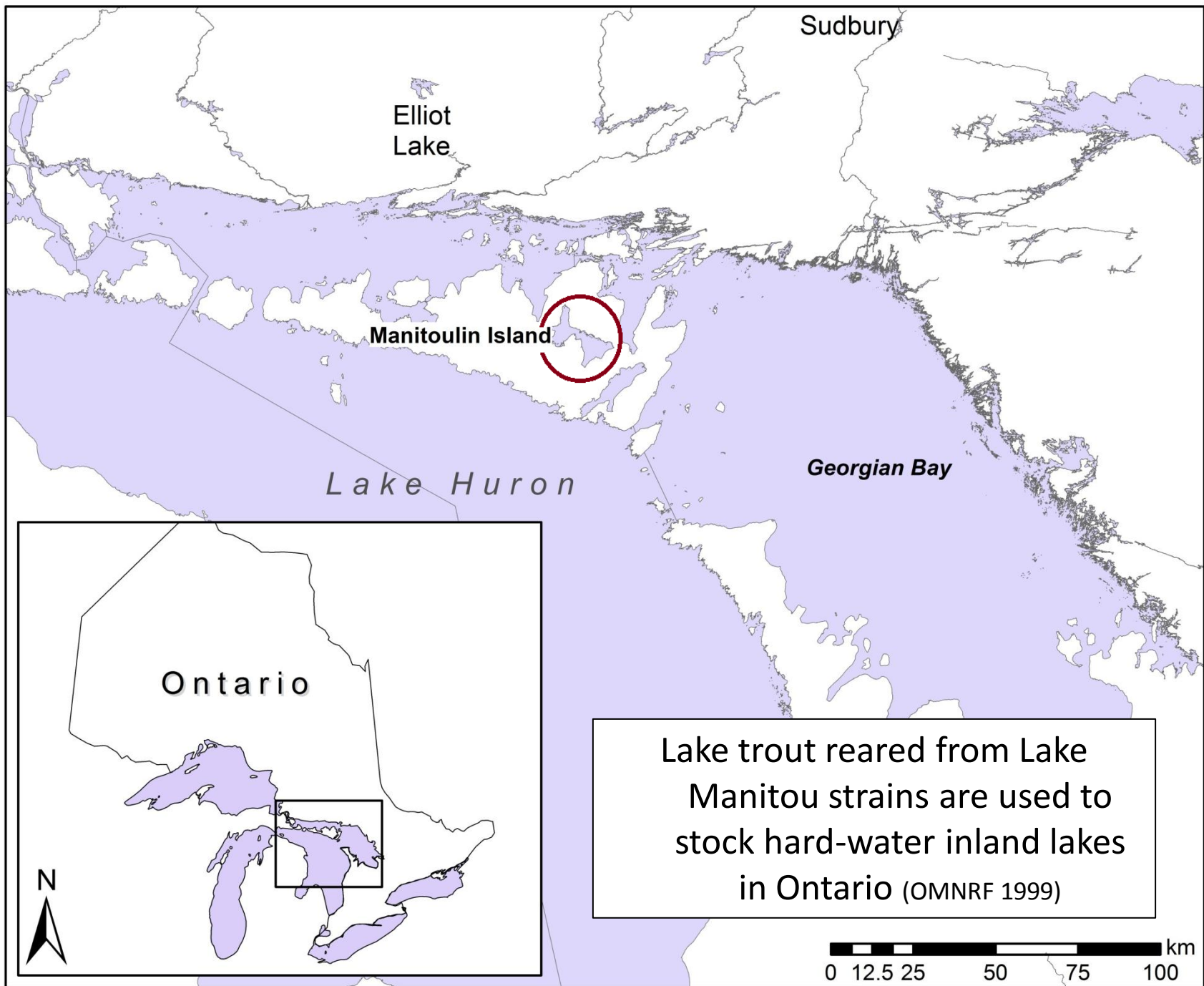
Chironomid Oxygen Reconstruction



Chironomid Oxygen Reconstruction

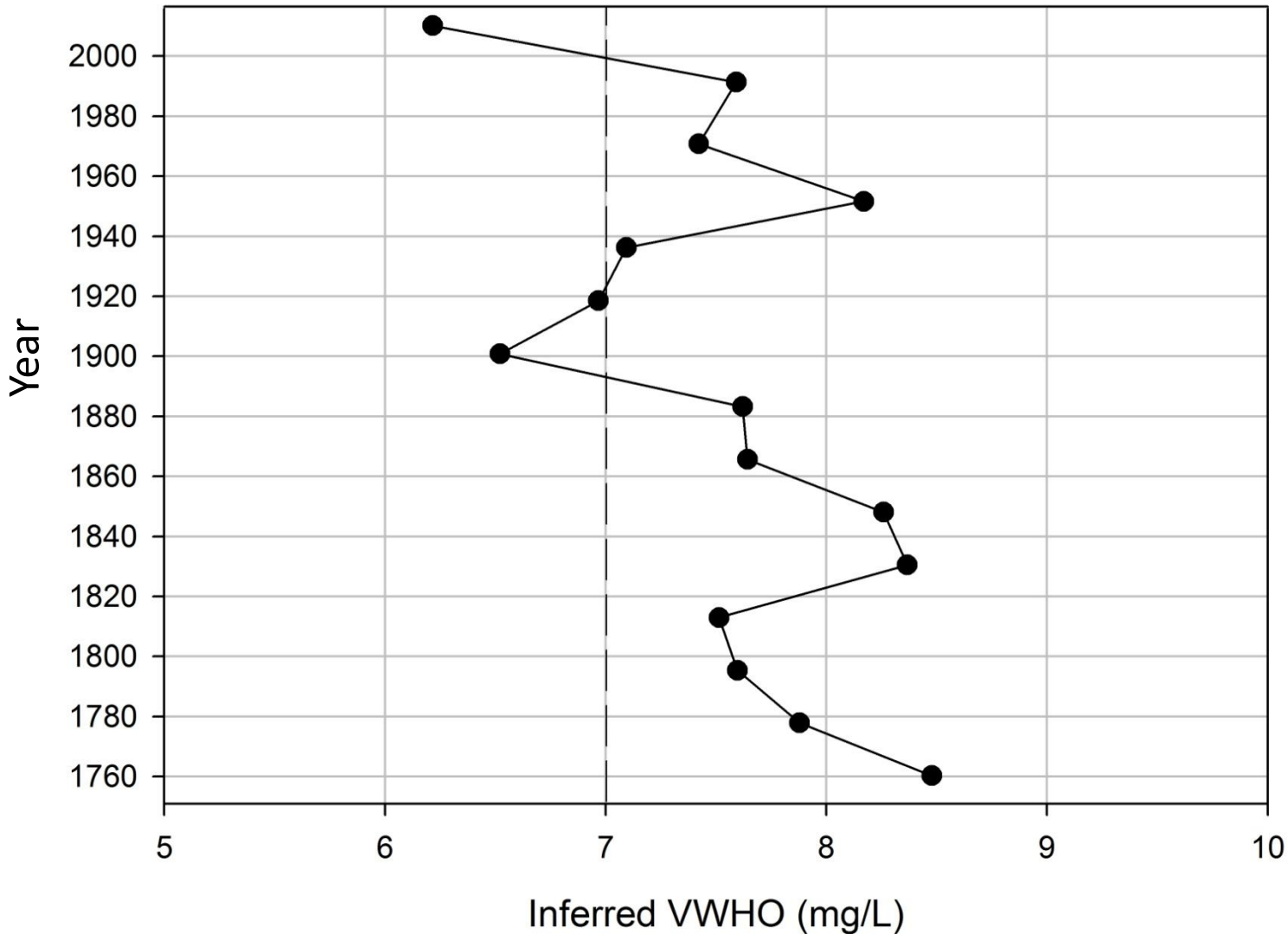
Harp Lake





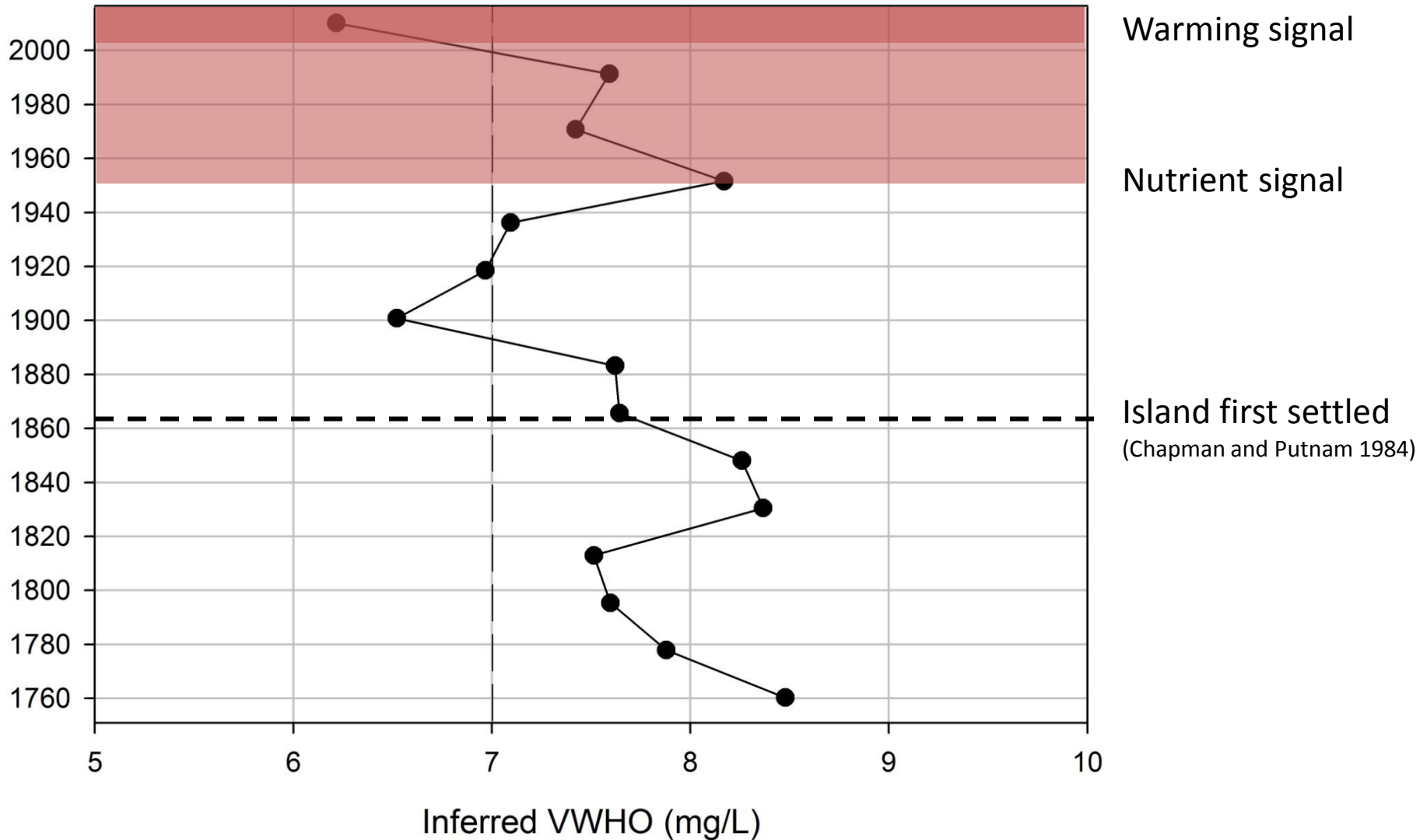
Chironomid Oxygen Reconstruction

Lake Manitou



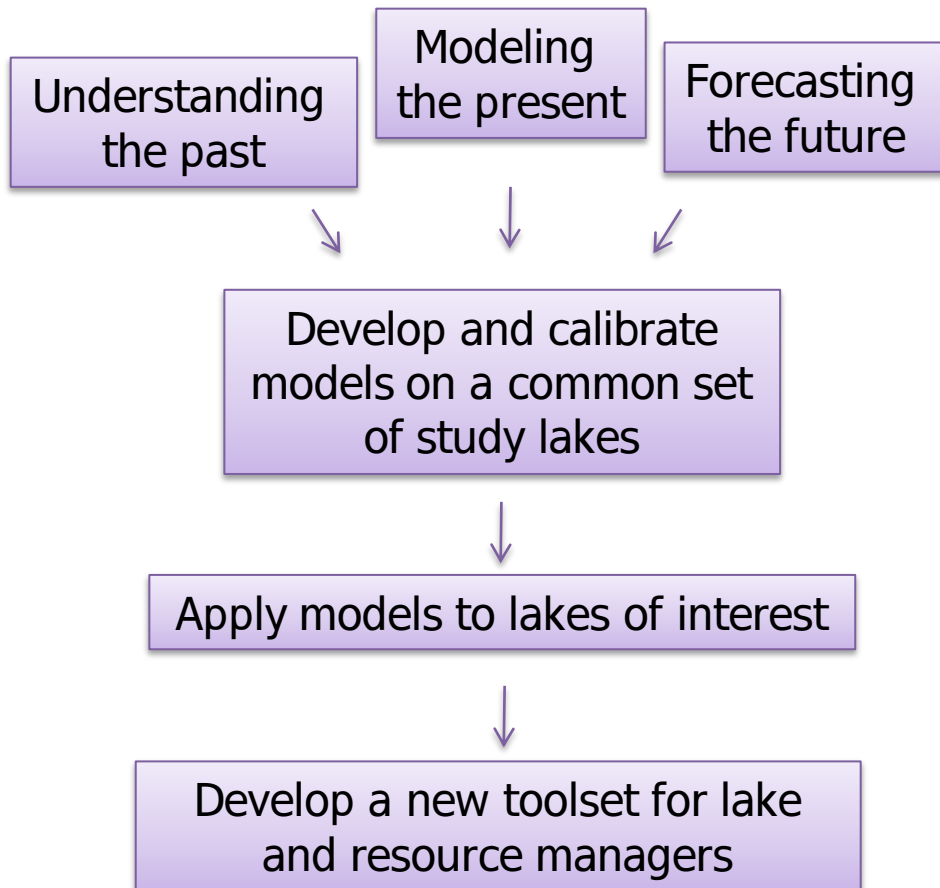
Chironomid Oxygen Reconstruction

Lake Manitou



Next Steps

Lake sediment archives can provide useful information about how and why Lake Trout lake are changing



Thank you!

- Liz Favot and the staff from the Blue Jay Creek Hatchery
- NSERC
- Environment Canada
- Ontario Ministry of the Environment and Climate Change
- Ontario Ministry of Natural Resources and Forestry
- Federation of Ontario Cottagers' Associations



NSERC
CRSNG

