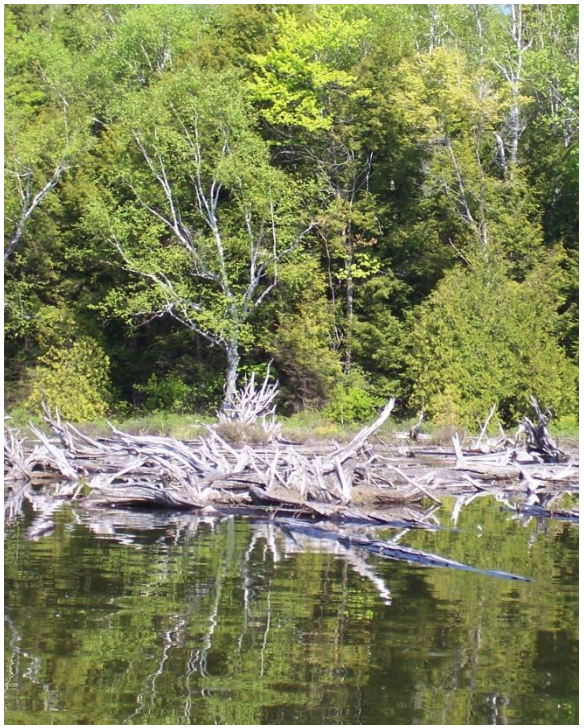
Our Lakes:
How Have They Changed Over the Last 25 Years?



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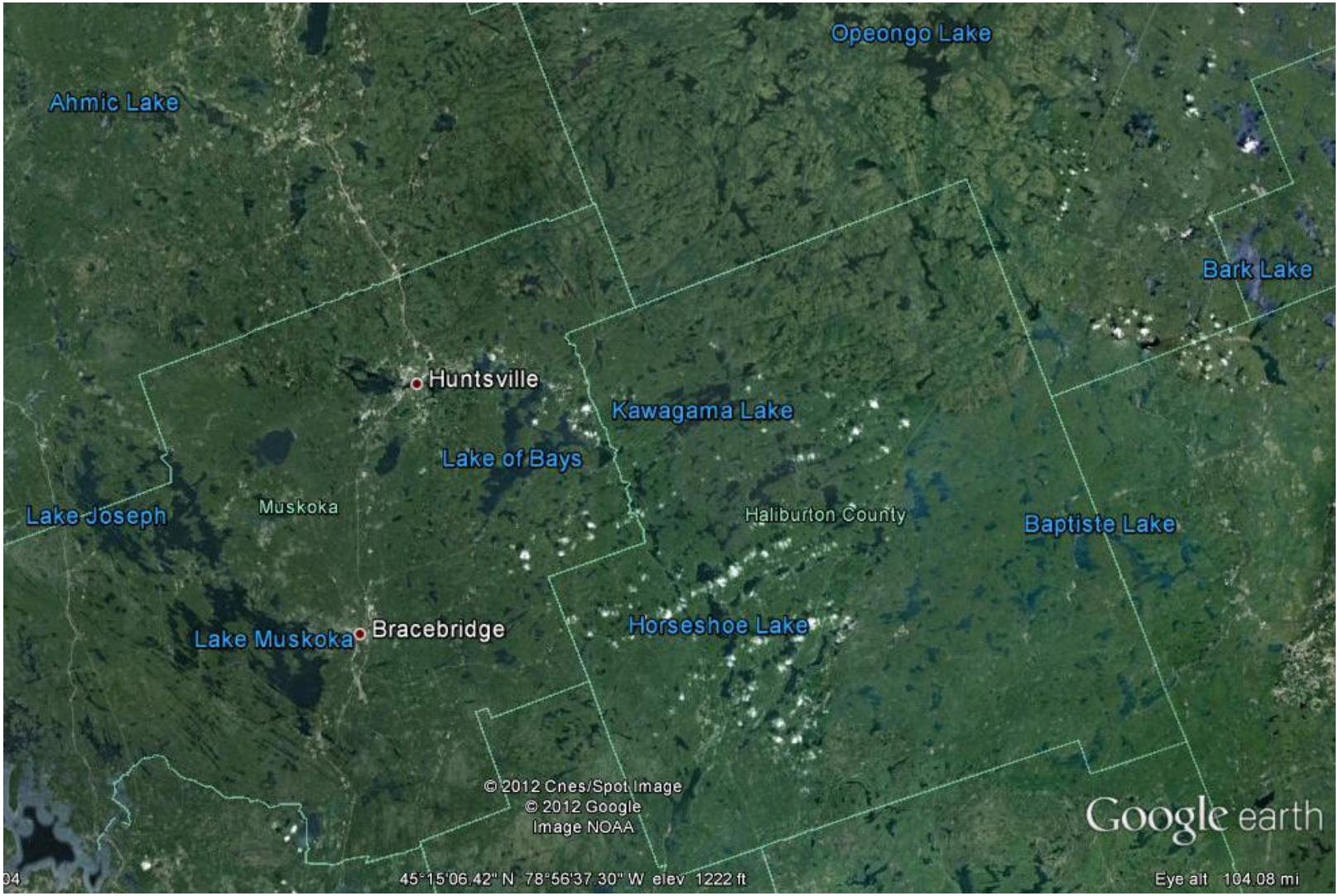
Muskoka – Land of Lakes

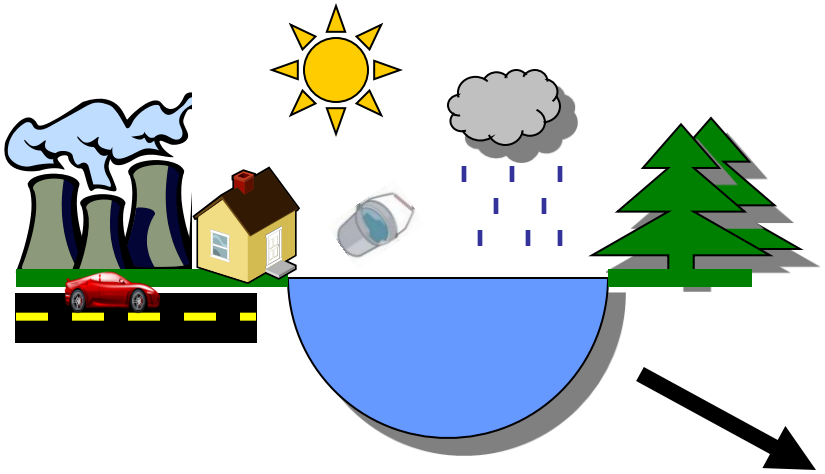


Lakes are a valuable resource

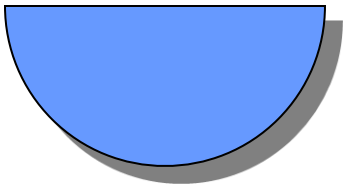
Lakes provide numerous benefits

- drinking water
- tourism
- recreational activities
- fisheries
- property values
- healthy communities
- cottage life

Our actions can impact lakes



Physical



Chemical

Biological

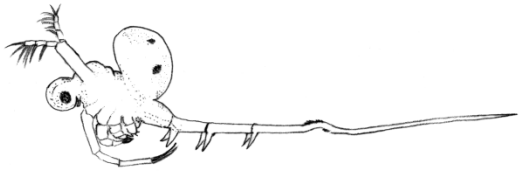
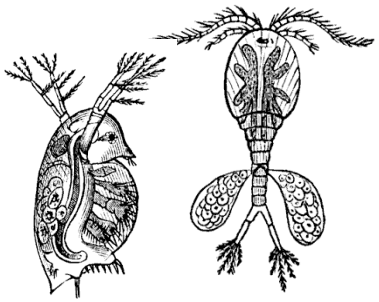
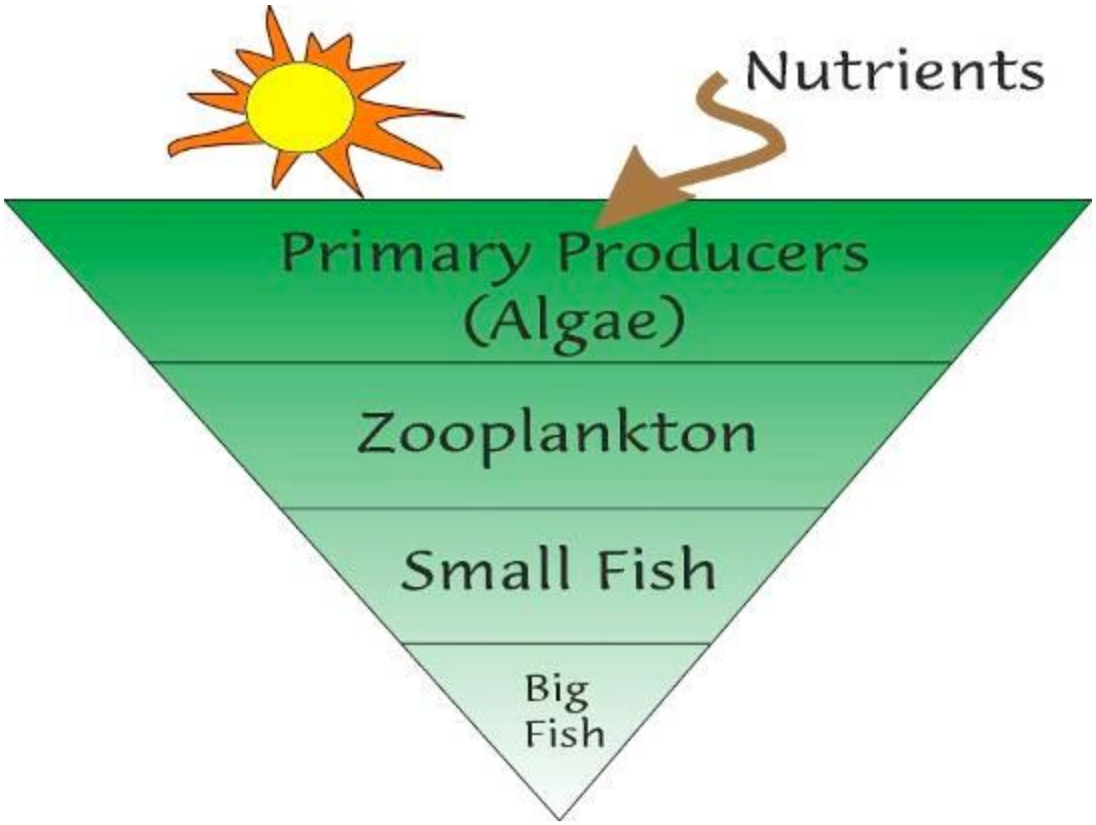


illustration: J.D. Young



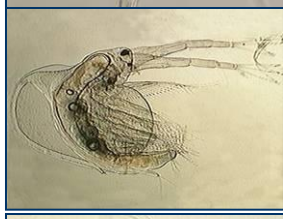
Why do we care about zooplankton?

Zooplankton are small, planktonic animals that play a key role in the transfer of nutrients through the food web










photos: UNH Center for Freshwater Biology

Lecture outline

Methods

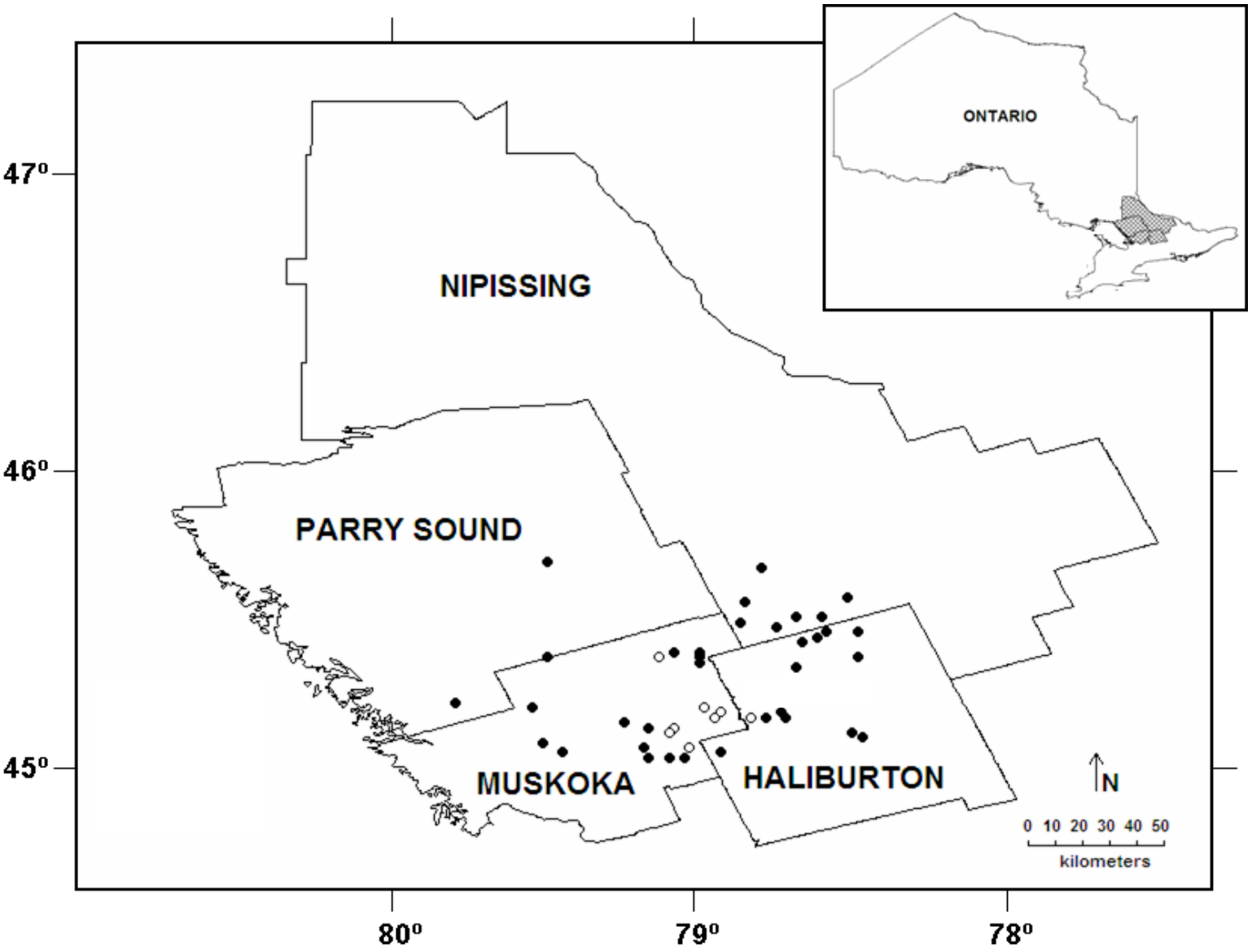
- What lakes I sampled
- What I measured

Results

- How have our lakes changed
- What is causing these changes

Summary

Study lakes


ONTARIO
NIPISSING
PARRY SOUND
MUSKOKA
HALIBURTON
47°
46°
45°
80°
79°
78°
N
0 10 20 30 40 50
kilometers

Study period & lake sampling

Study period

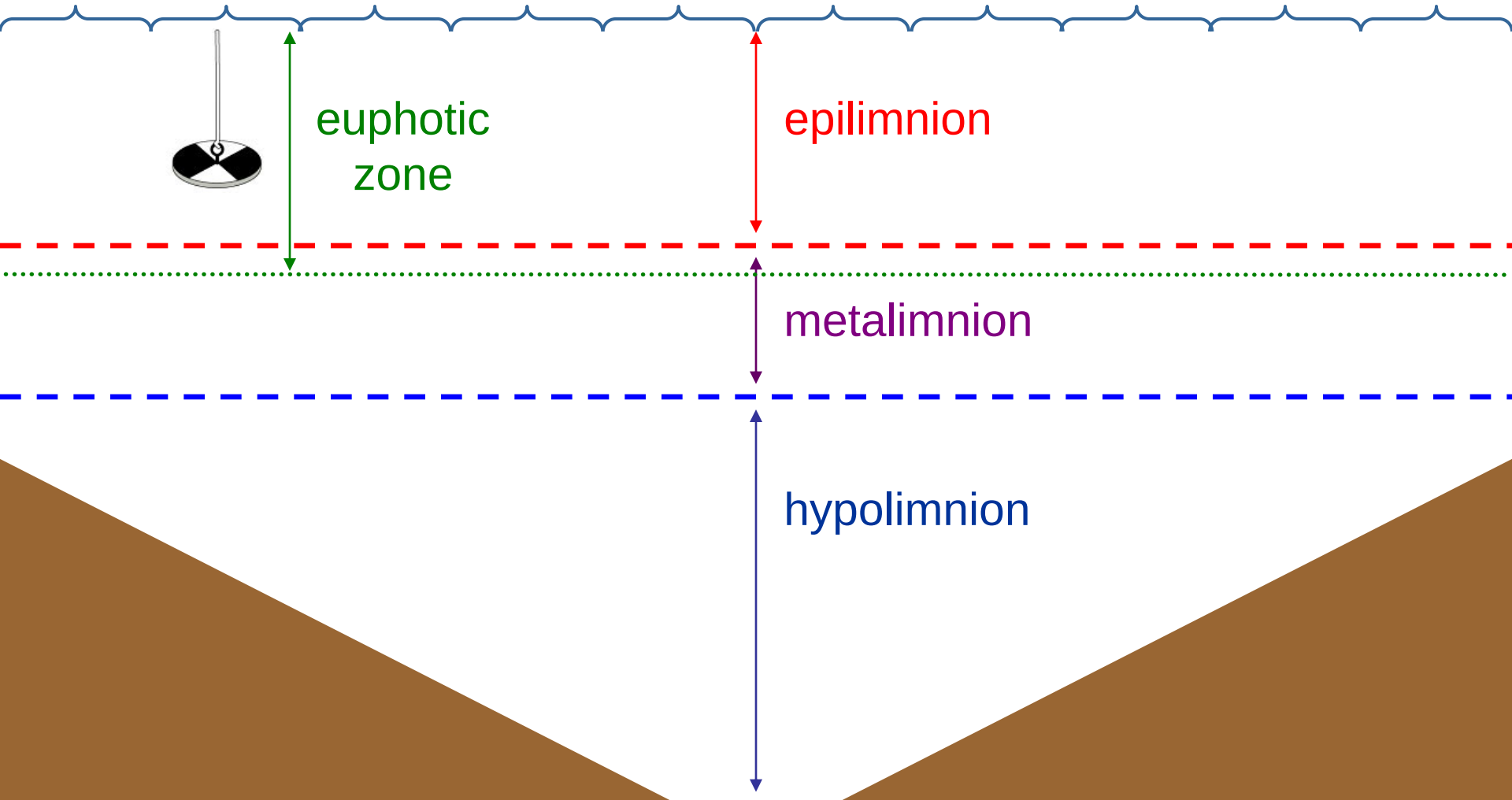
- 1981-2005
- ice-free season
  - May to October

Sampling

- lake access
  - road
  - portage
  - floatplane
- deepest point of the lake

Water temperature & chemistry

- monthly May to October
- from deepest point of lake



Zooplankton samples

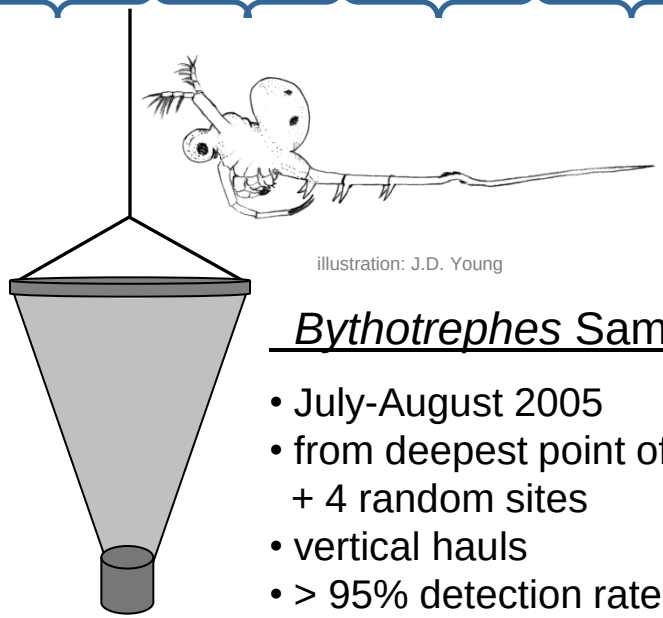
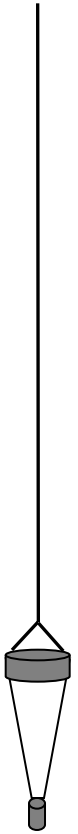
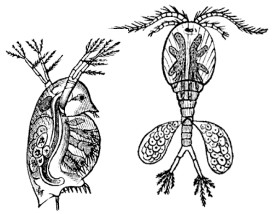


illustration: J.D. Young

Bythotrephes Samples

- July-August 2005
- from deepest point of lake + 4 random sites
- vertical hauls
- > 95% detection rate





Zooplankton Samples

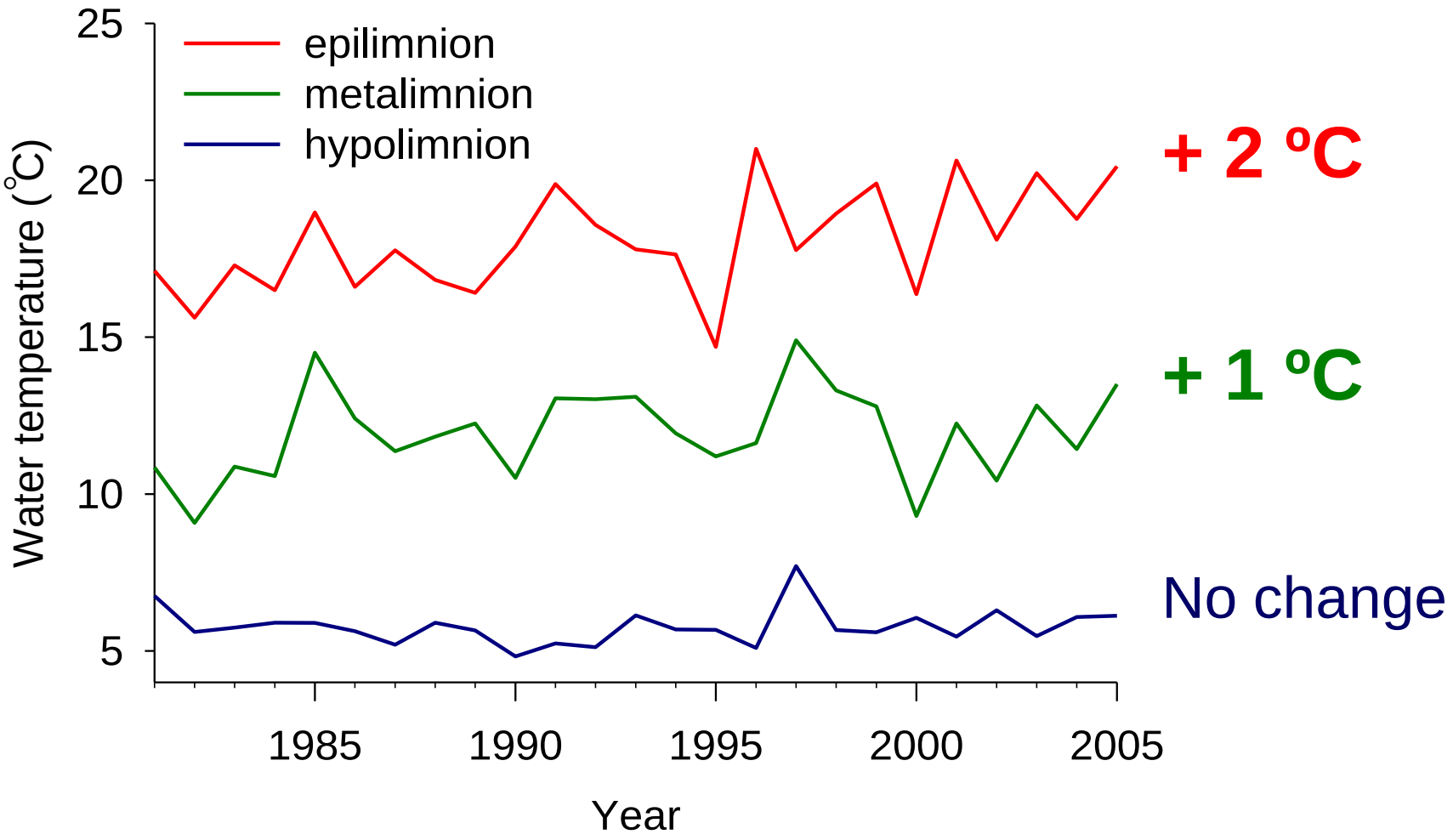
- monthly May to October
- from deepest point of lake
- 4-7 vertical hauls

Results

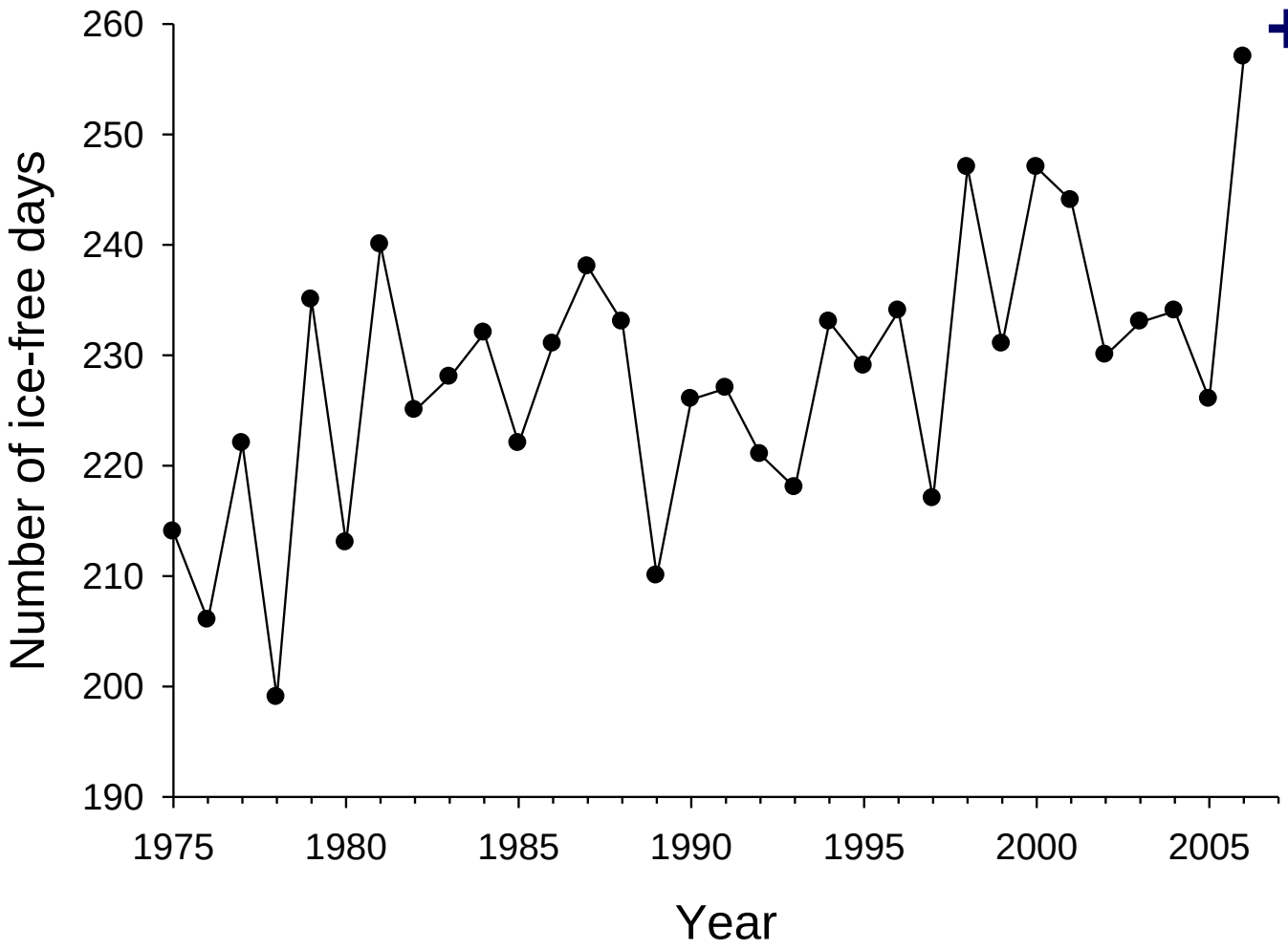
Our lakes have changed since the 1980s

- lake temperature
- water quality
- zooplankton communities

Lakes have gotten warmer

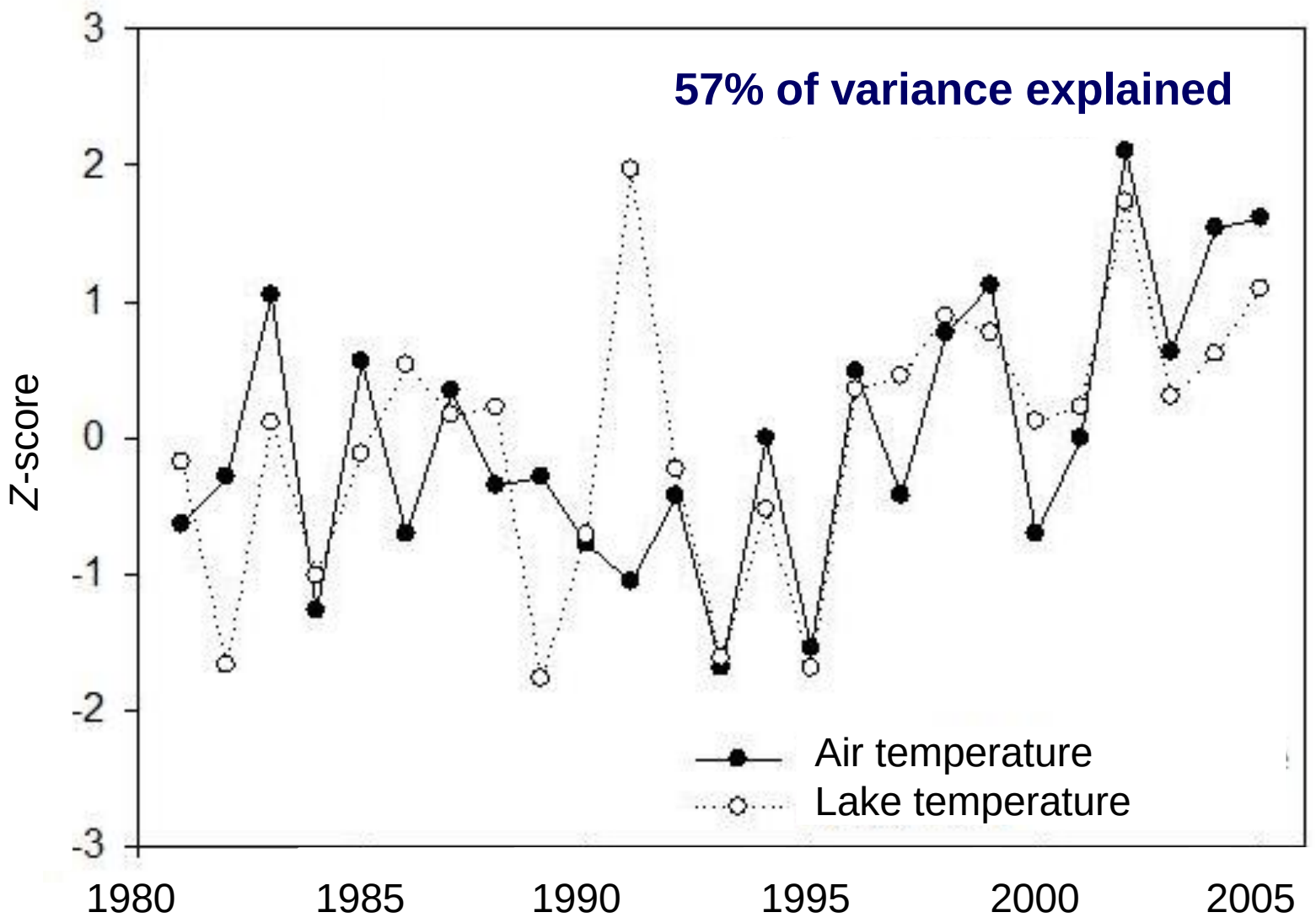


Fall mixing may be delayed

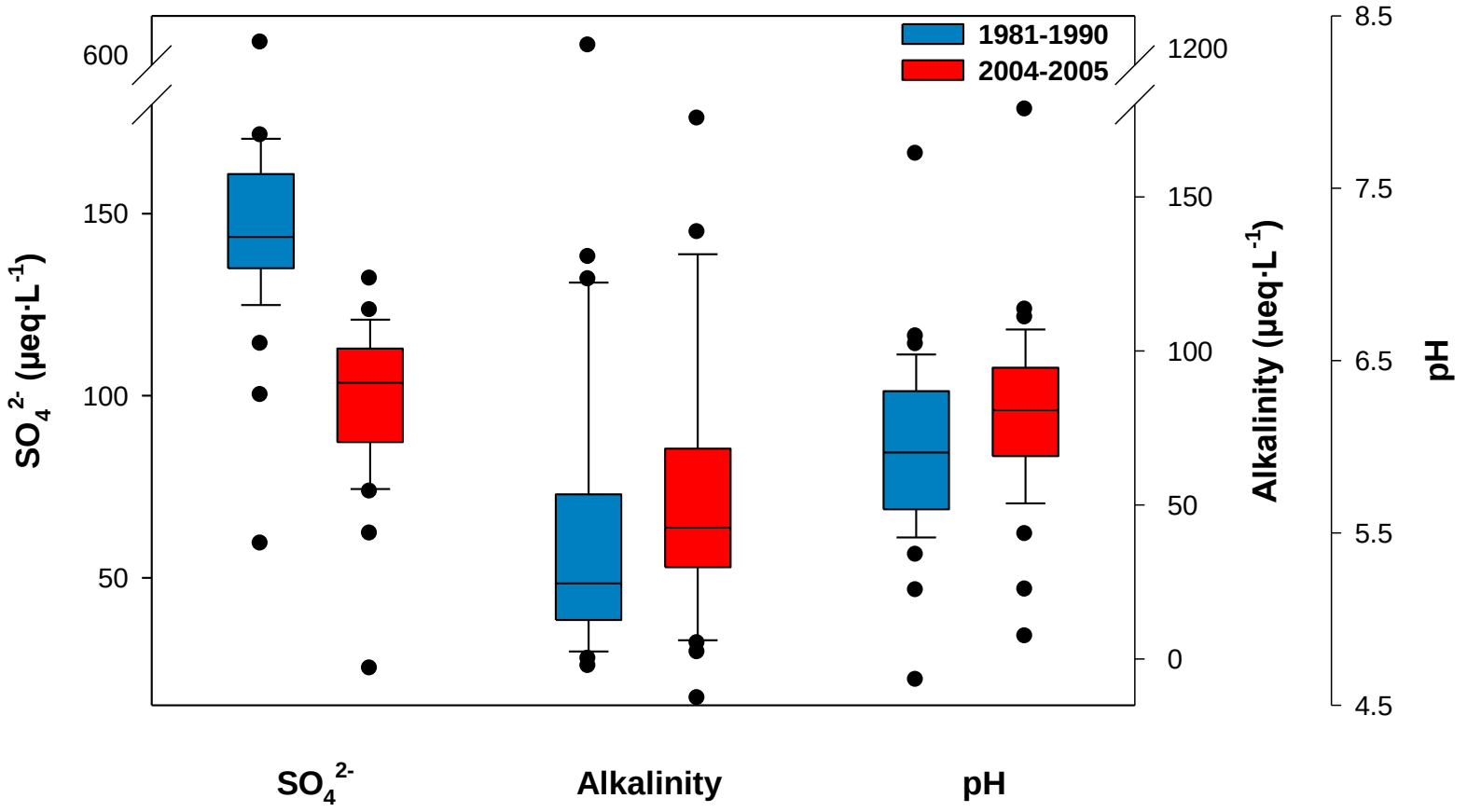


+ 3 weeks

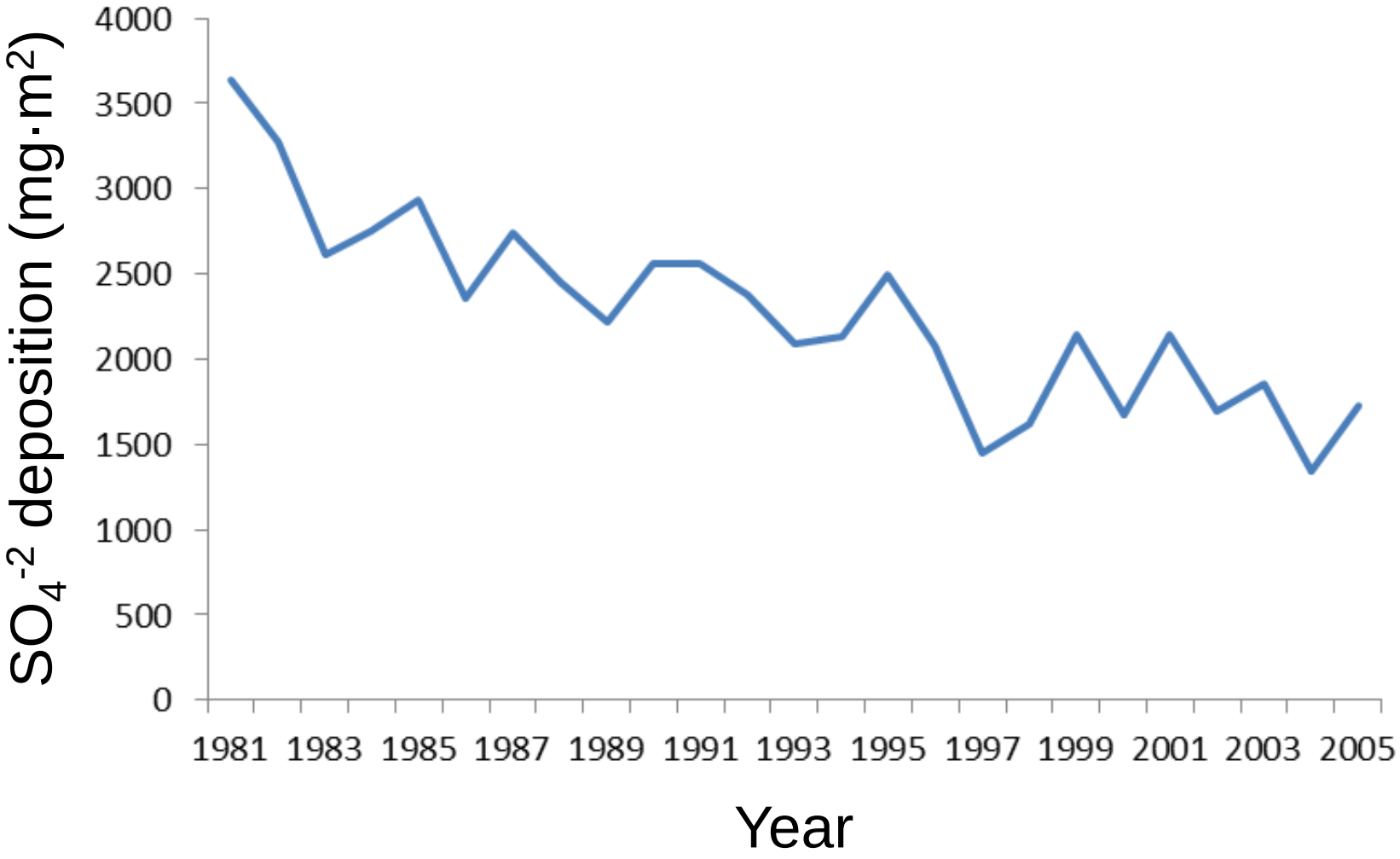
Cause: air temperature



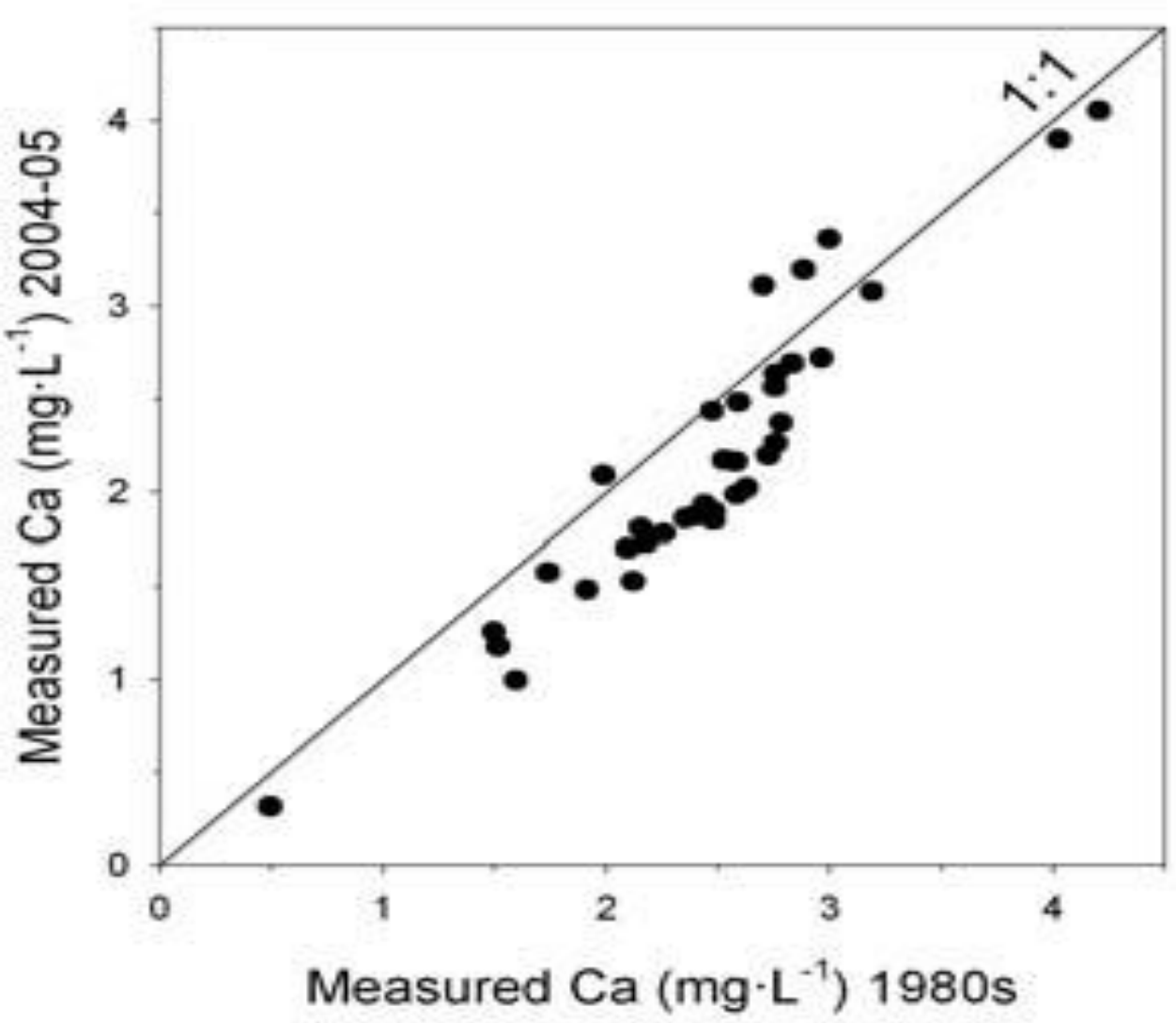
Lake acidity has decreased



Cause: less acid rain



Calcium has decreased

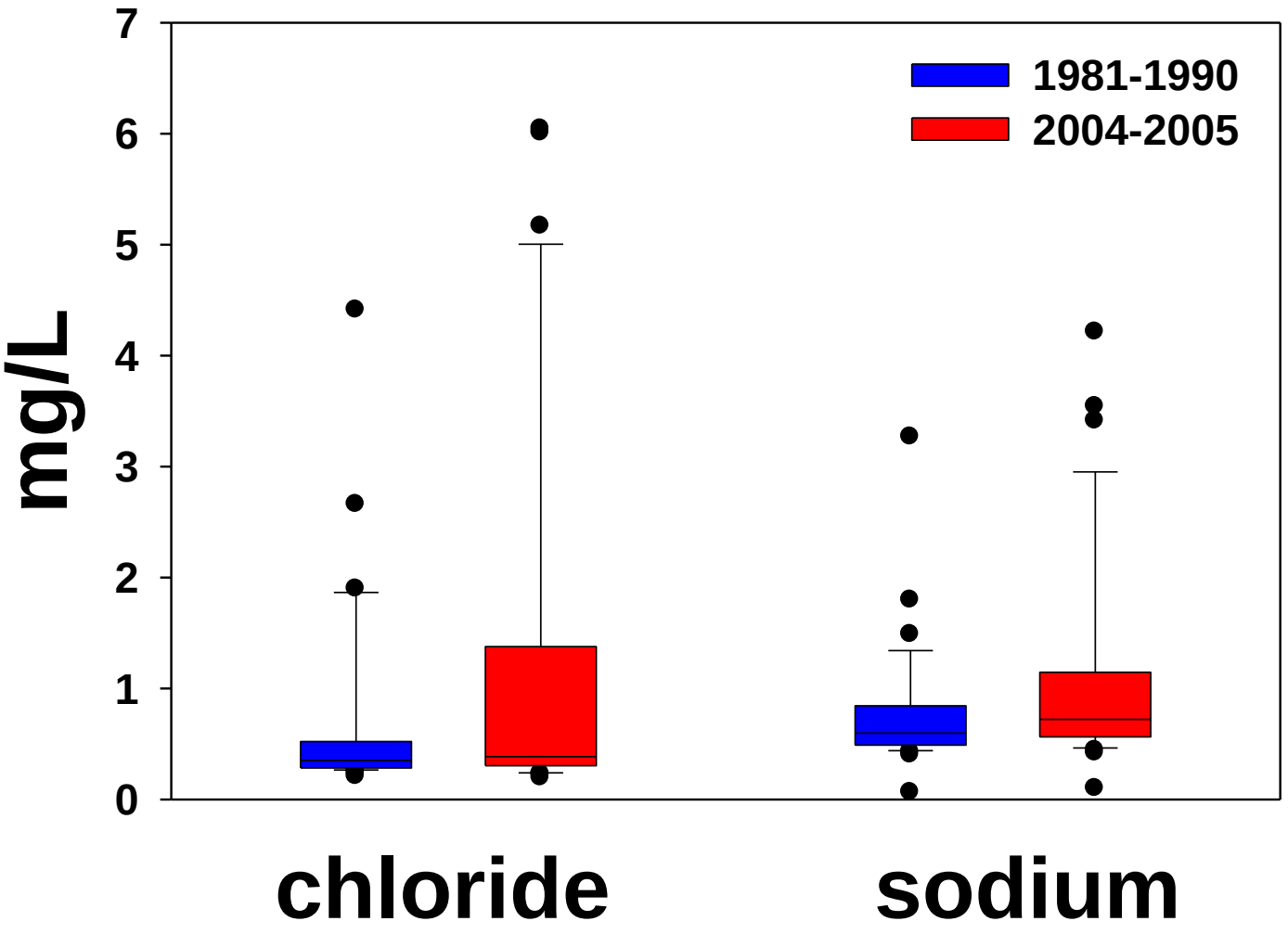


Cause: acid rain & logging

- thin soils with low mineral content
- long-term acidic leaching of soils
- reductions in acid rain
- multiple logging cycles

Photo credit: MNR

Lakes are saltier



Cause: road salt

- salt, particularly NaCl, is used as a de-icer in winter
- ~370 km of roads are salted in Muskoka
- sources include road applications, storage facilities & disposal of waste snow

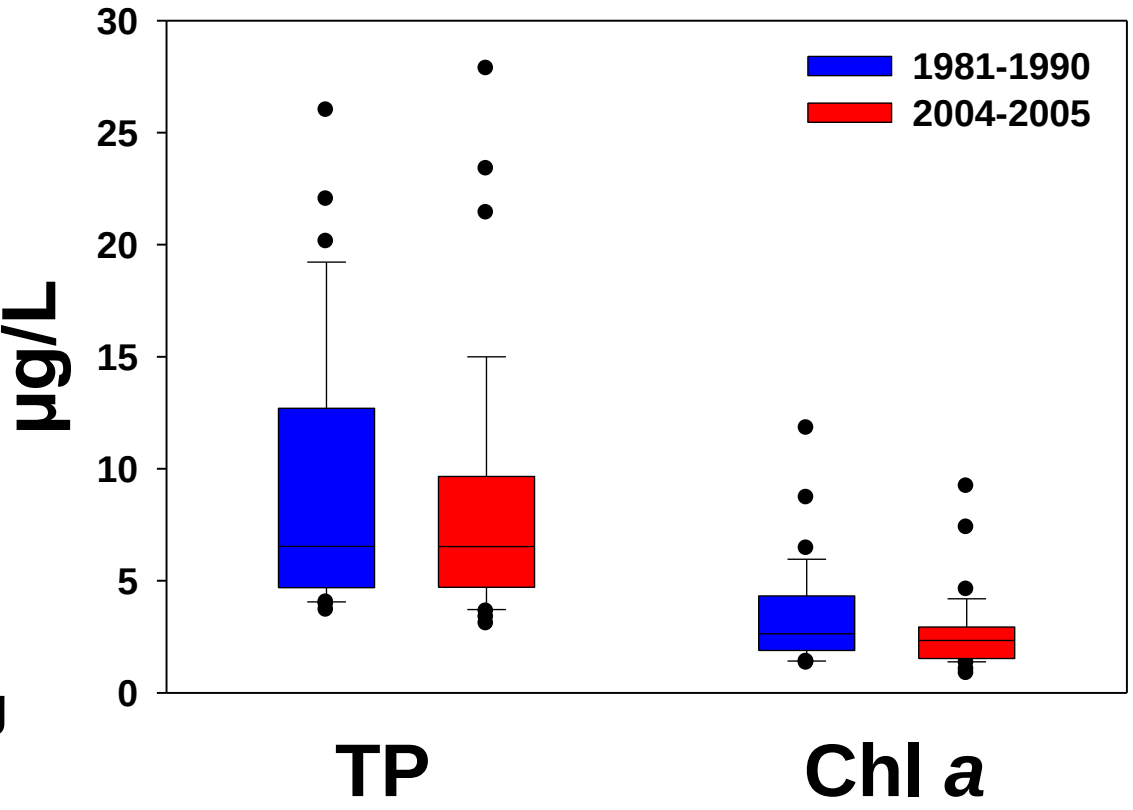
Photo credit: MTO

Phosphorus is decreasing

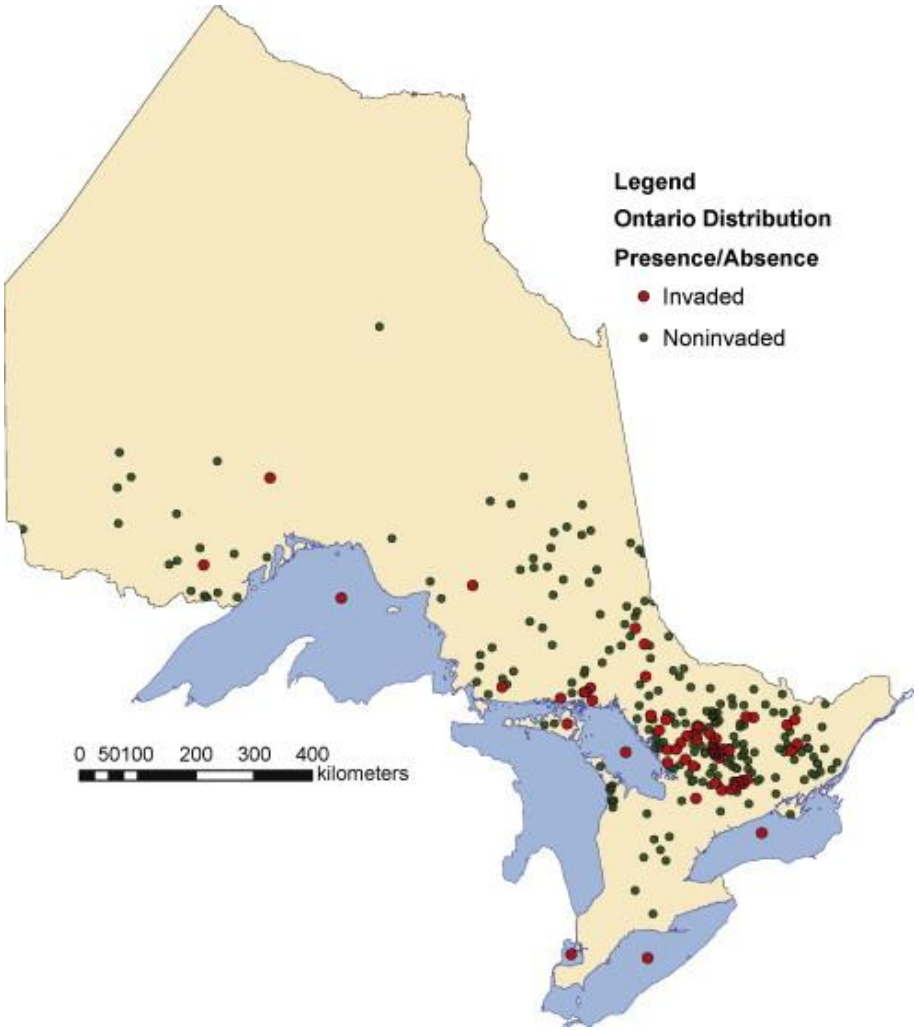
- average decrease of ~20%
- corresponding decrease in chl *a*

Cause?

- lower stream export during spring
  - lower concentrations
  - processes that control terrestrial release of TP during spring snowmelt may be important



Bythotrephes has spread



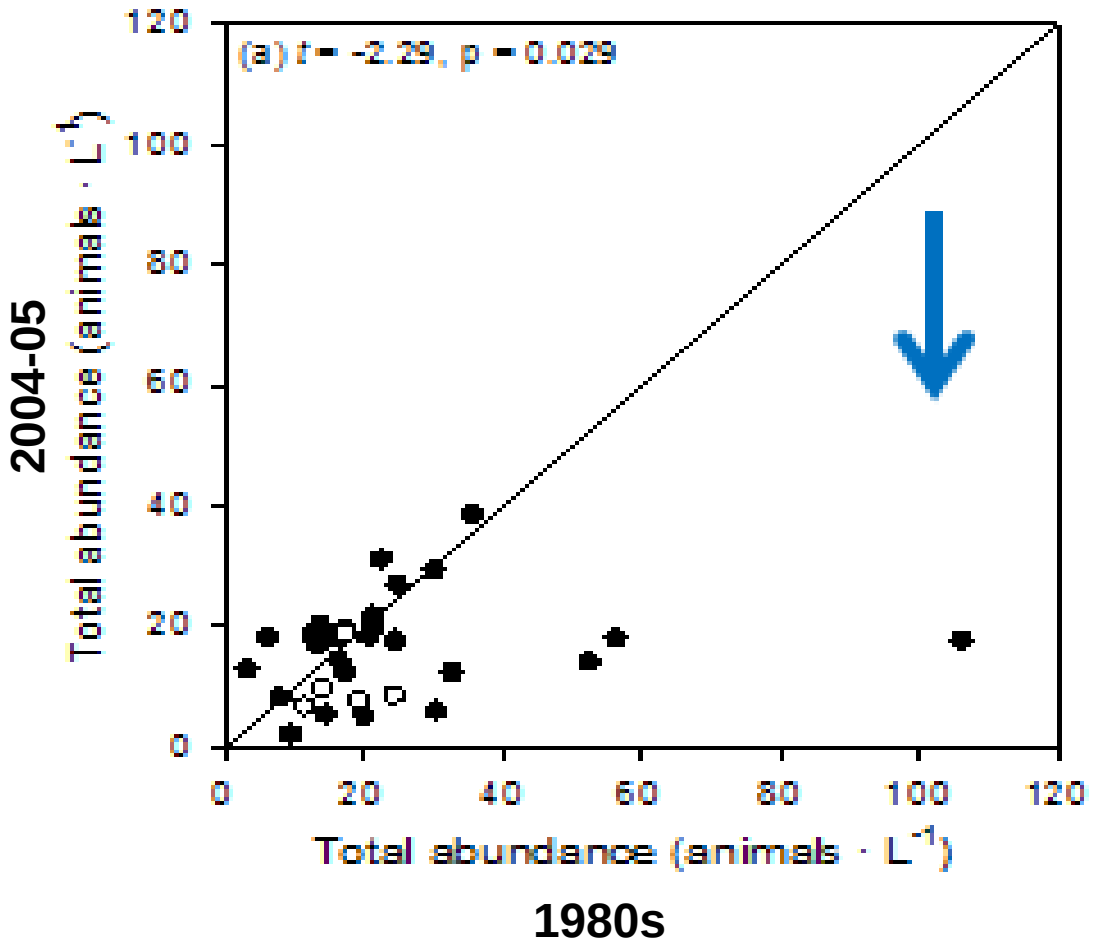
Source: Potapov et al. 2011

Photo credit: Dave Brenner, MSGCP

- first detected in inland lakes in Canada in 1989
- now found in over 50 Muskoka lakes
- present in 8 of the lakes I sampled
- spread via boating, fishing, fish, birds, hydrology

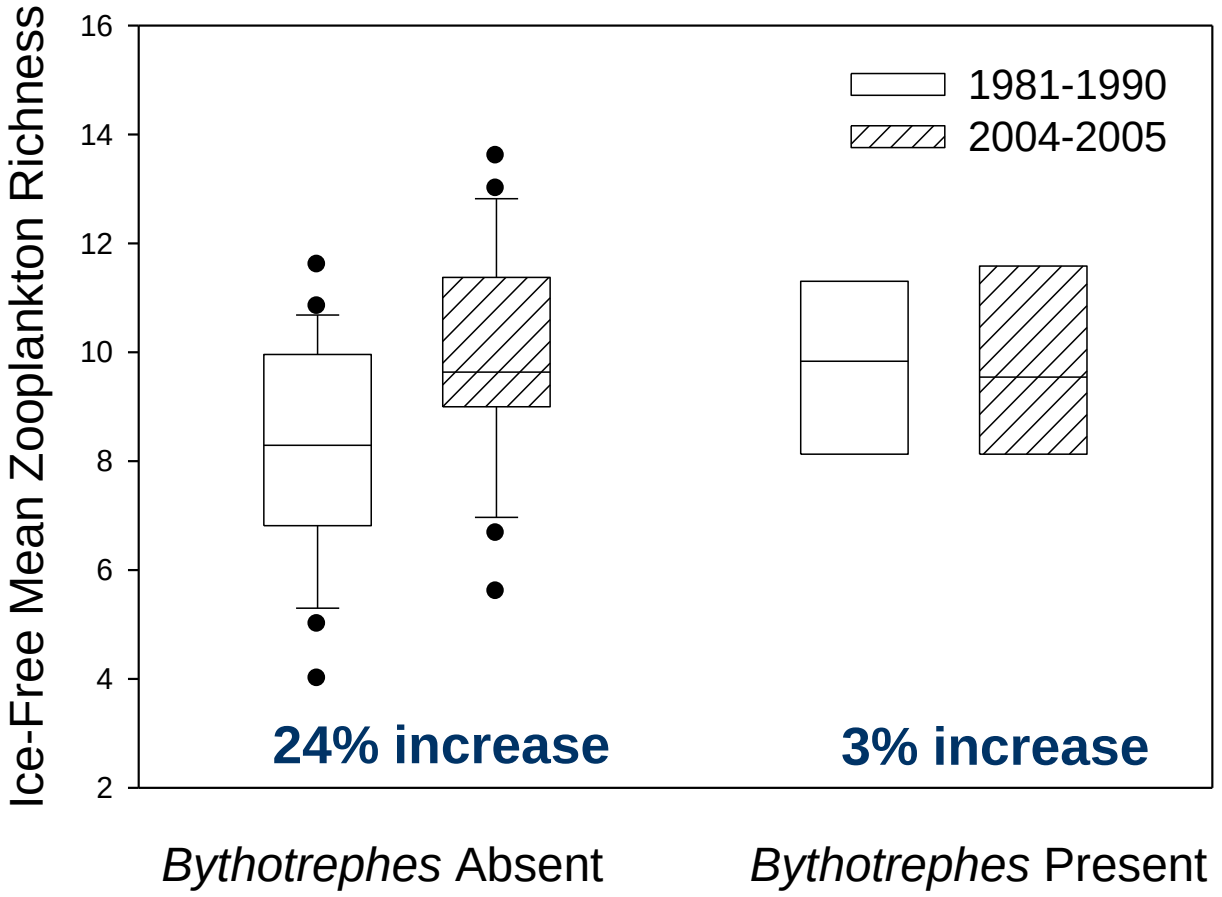
Impacts on zooplankton

- abundance ↓
  - ↓ TP
  - inferred ↓ in food availability

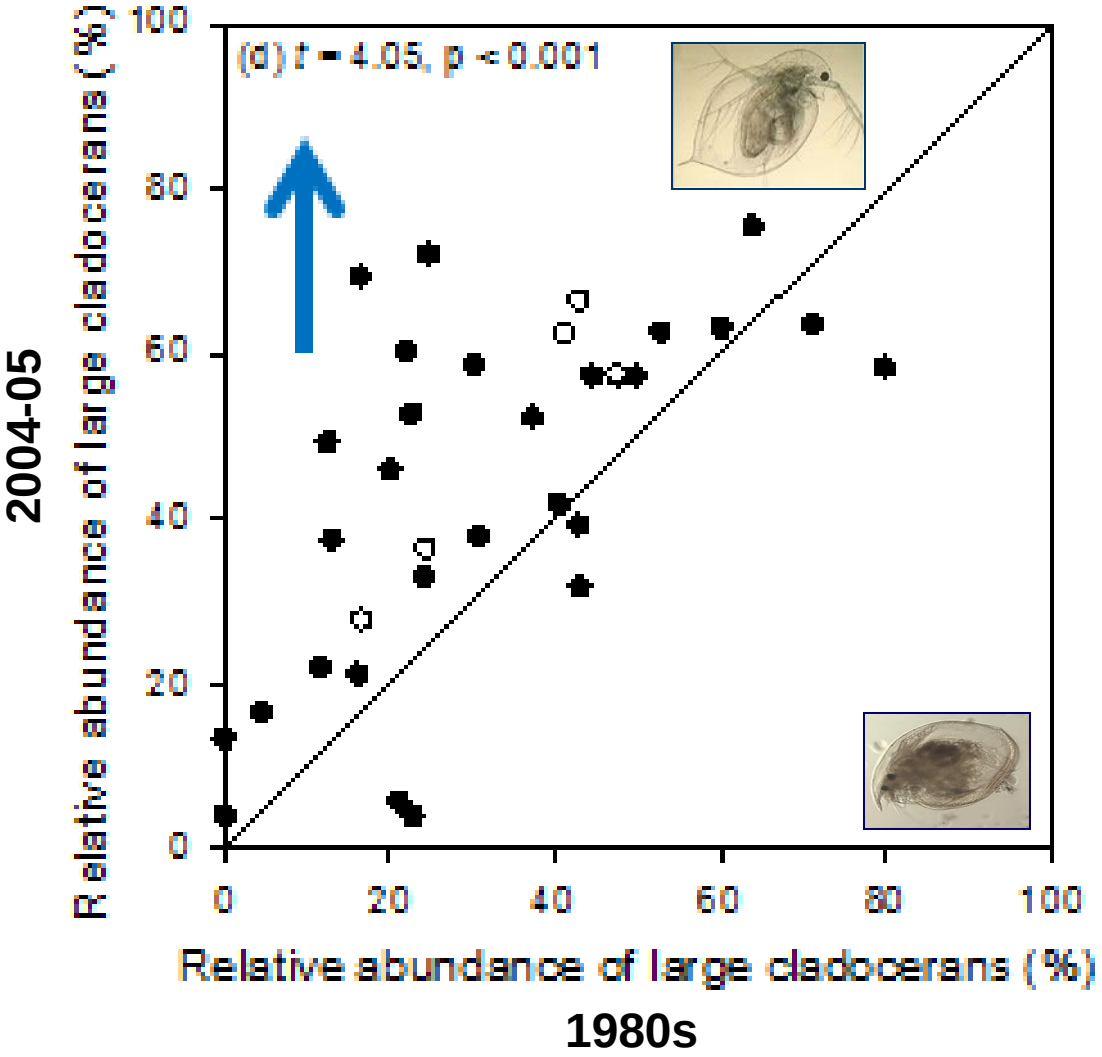


Impacts on zooplankton

- richness & diversity ↑
  - ↑ pH
  - ↑ temperature
  - ↑ TP
- *Bythotrephes* had a negative impact



Impacts on zooplankton



- large zooplankton ↑
  - ↓ TP
  - ↓ temperature
  - ↓ chloride

Summary

- Lakes in Muskoka have changed extensively since the 1980s, including changes in water temperature, water quality, & the spread of invaders.
- These changes have altered the zooplankton communities of the lakes.
- Changes occurred in a large number of lakes spread across the region, indicating that human activities are causing widespread ecological changes.
- We must continue to study these changes to support efforts to protect our lakes for future generations

Acknowledgements

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