

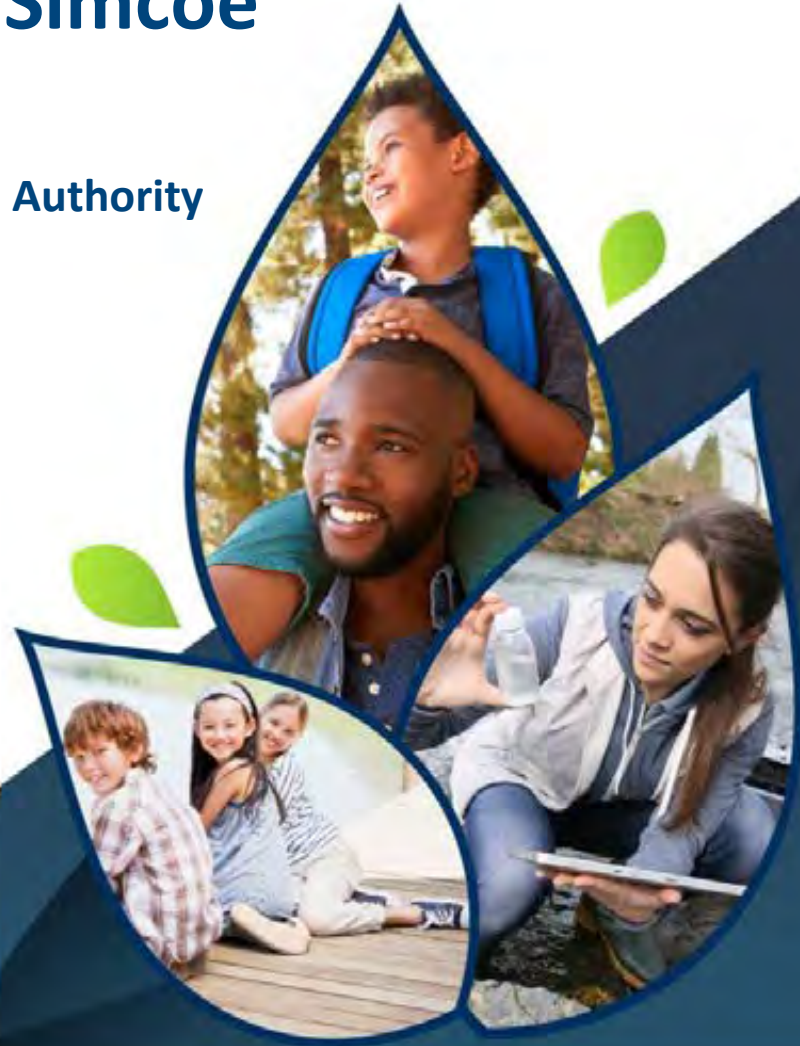
The Health of Lake Simcoe

Lake Simcoe Region Conservation Authority
Board of Directors
February 24, 2023

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Limnologist
Certified Lake Manager
(North American Lake
Management Society)



Lake Simcoe Region
conservation authority



Member of Conservation Ontario



Source: National Aeronautics and Space Administration Visible Earth; September 3, 2010



Source: Google Earth



Conservation Authority Lake Science Program



- Scientific approach to concerns of watershed residents; fill data gaps (nearshore zone); investigate new and emerging issues
- With partners, develop and assess **sustainable** lake management solutions for Lake Simcoe (and the Great Lakes): Lake Simcoe Protection Plan - Ontario's Great Lakes Strategy

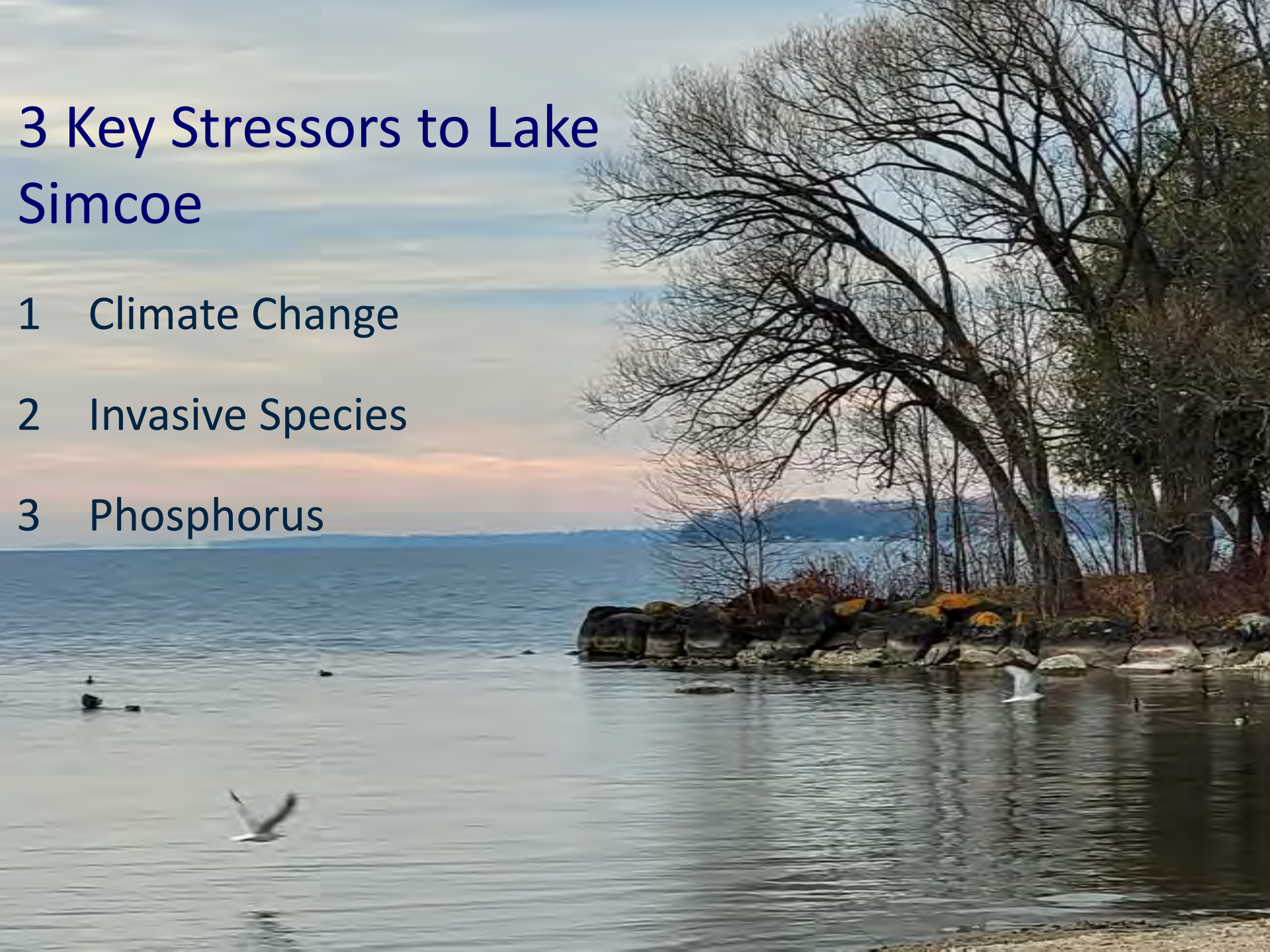
**Ministry of the Environment,
Conservation and Parks**
Offshore Water Quality
Algae
Zooplankton
Pollution

Conservation Authority
Nearshore Water Quality
Aquatic Plants
Benthic Invertebrates
Sediment Quality

**Ministry of Natural
Resources and Forestry**
Warmwater Fish
Coldwater Fish
Fish Stocking

3 Key Stressors to Lake Simcoe

- 1 Climate Change
- 2 Invasive Species
- 3 Phosphorus

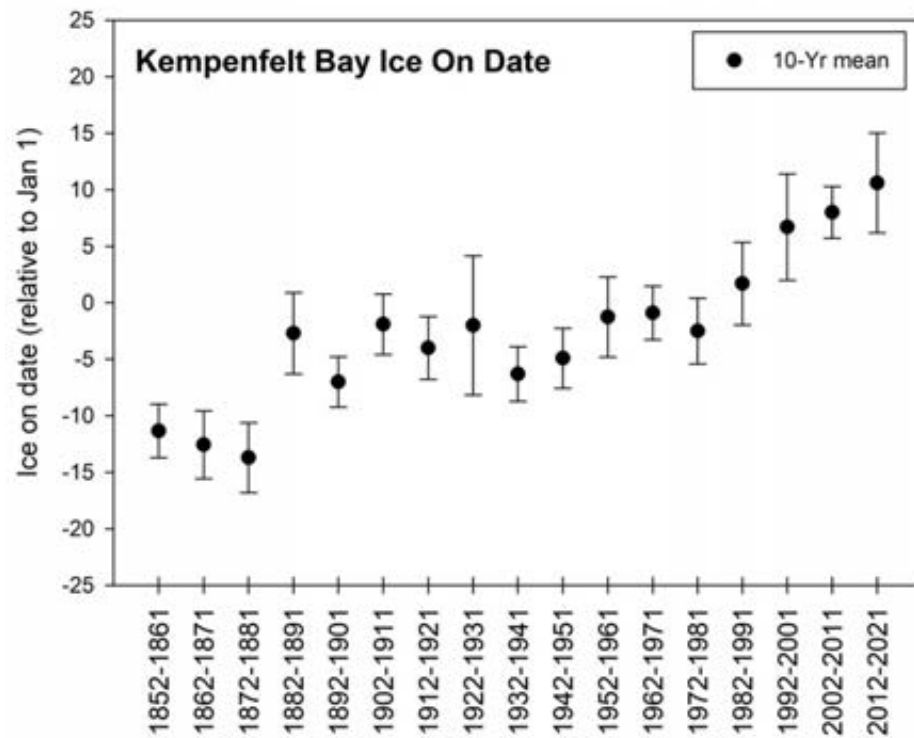
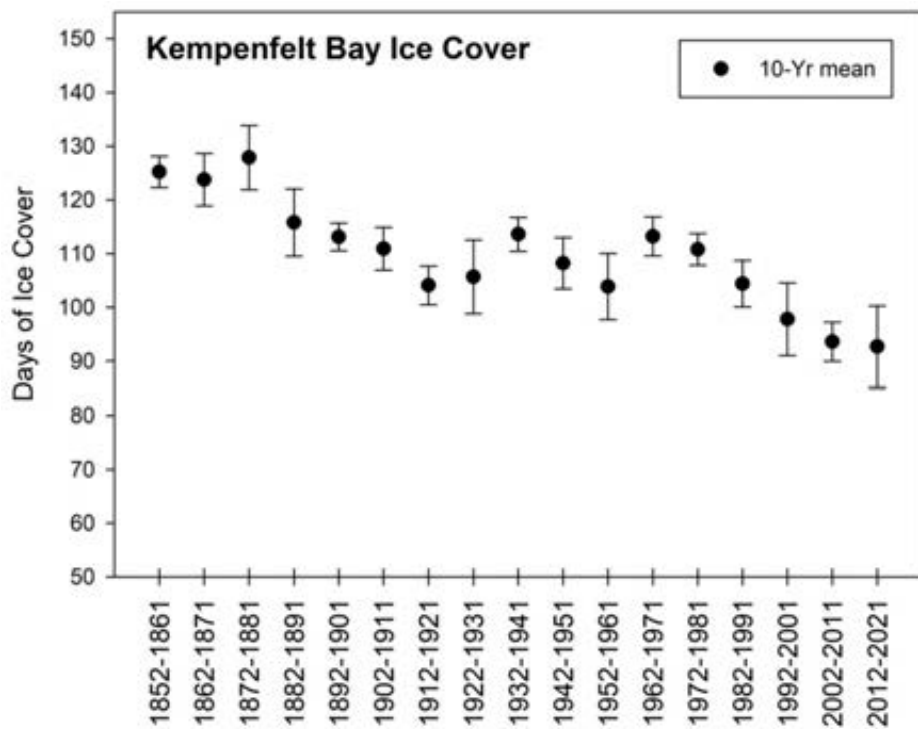


1. Climate change

- Stratified period **increased 28 days** (2012 versus 1980)
 - Deepwater: increased 4 degrees Celsius since 1980
- Since 2009:
 - Nearshore and offshore surface temperatures +2 degrees Celsius (mean July to October)
 - Highest recorded offshore: 27.4 degrees Celsius (July 9, 2020, mean approximately 22 degrees Celsius)

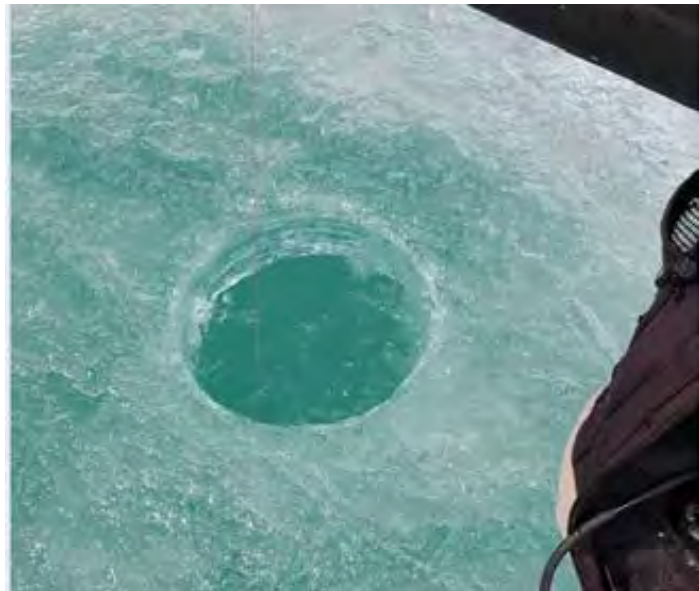


Climate change: ice cover

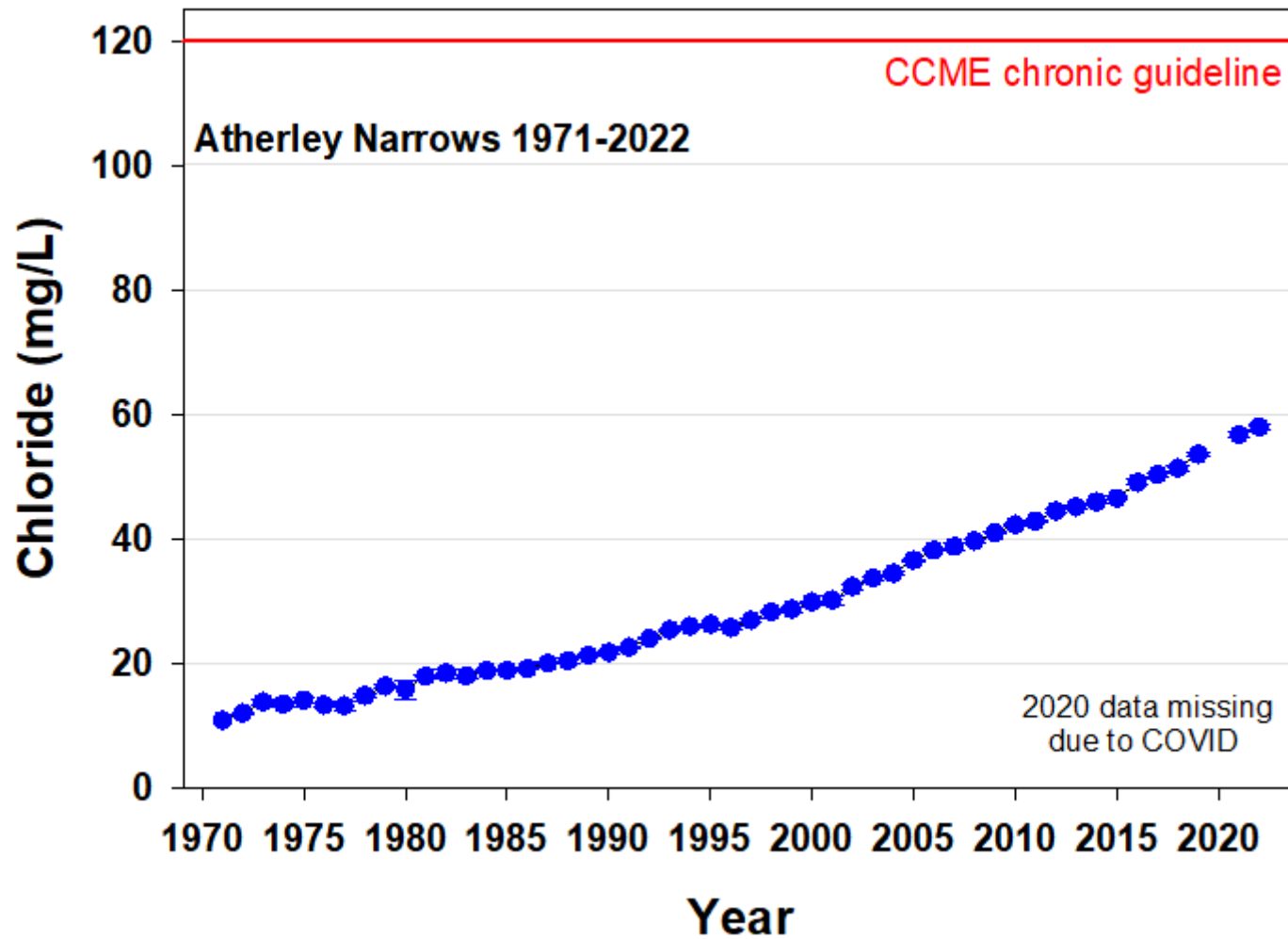


Source: Ice Watch Canada; Alex Mills, personal communication;
Lake Simcoe Region Conservation Authority unpublished

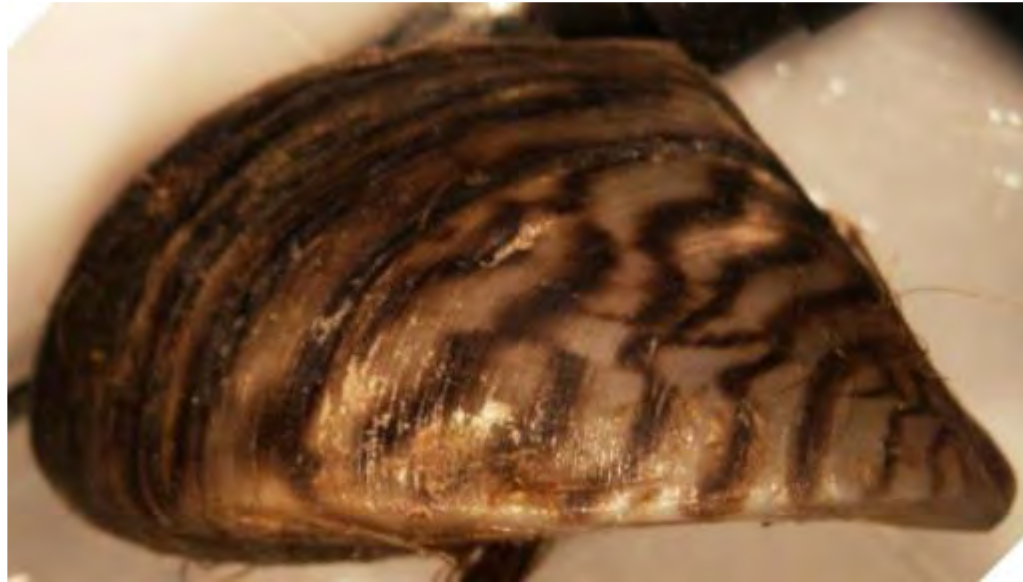
...and ice thickness



Winter Salt - Chloride



2. Invasive Mussels



Two species!

Zebra mussels:

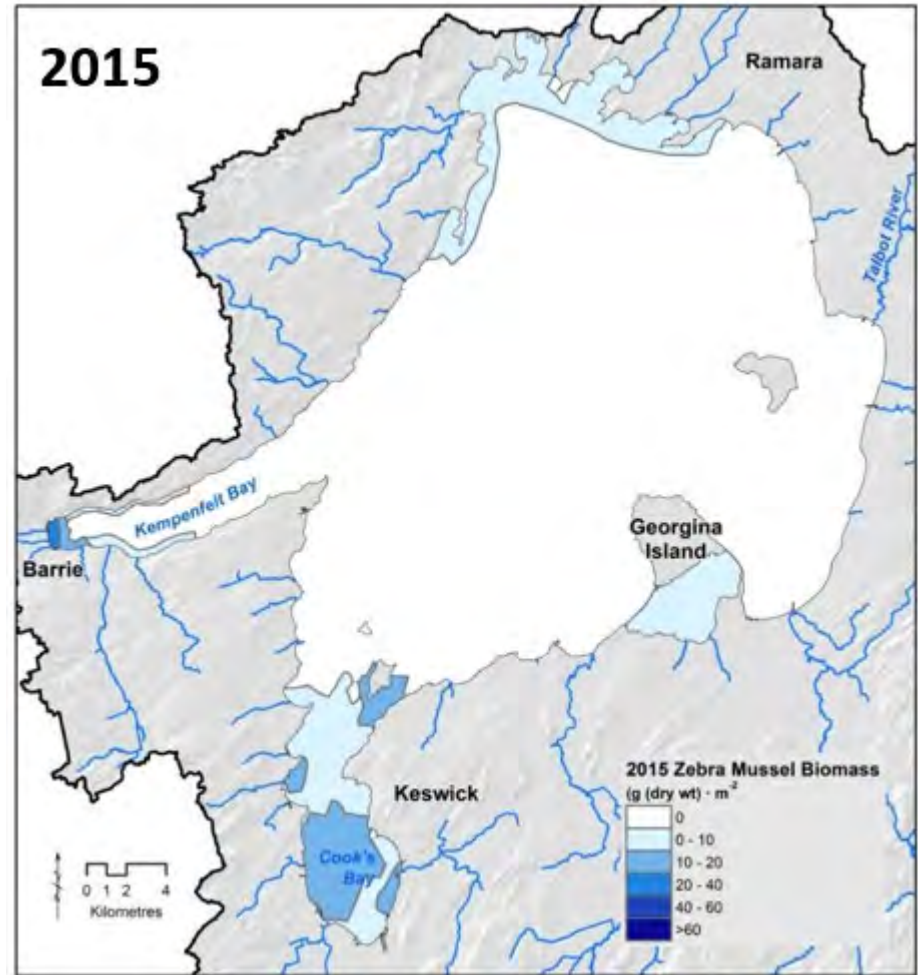
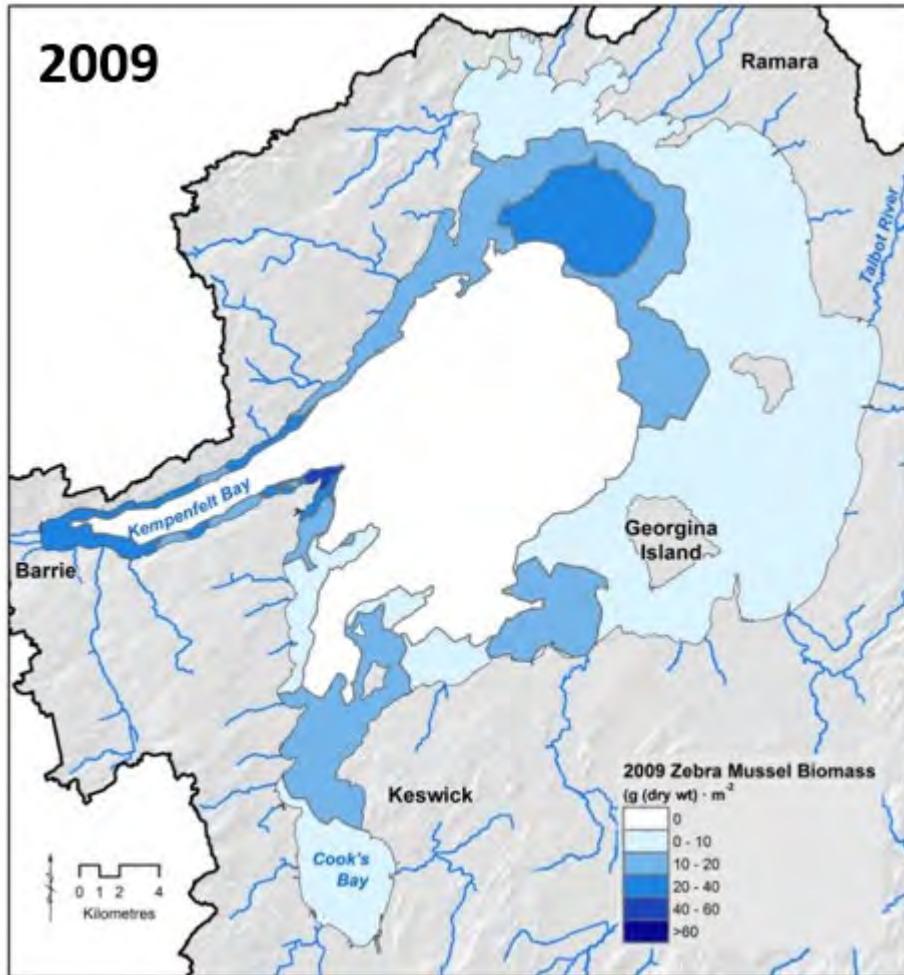
- arrived first
- “*Live fast, die young!*”
- Need warm water, lots of food, harder substrates

Quagga mussels:

- Survive cold and low food
- Can live on silt
- Replace zebras in approximately 7 to 9 years

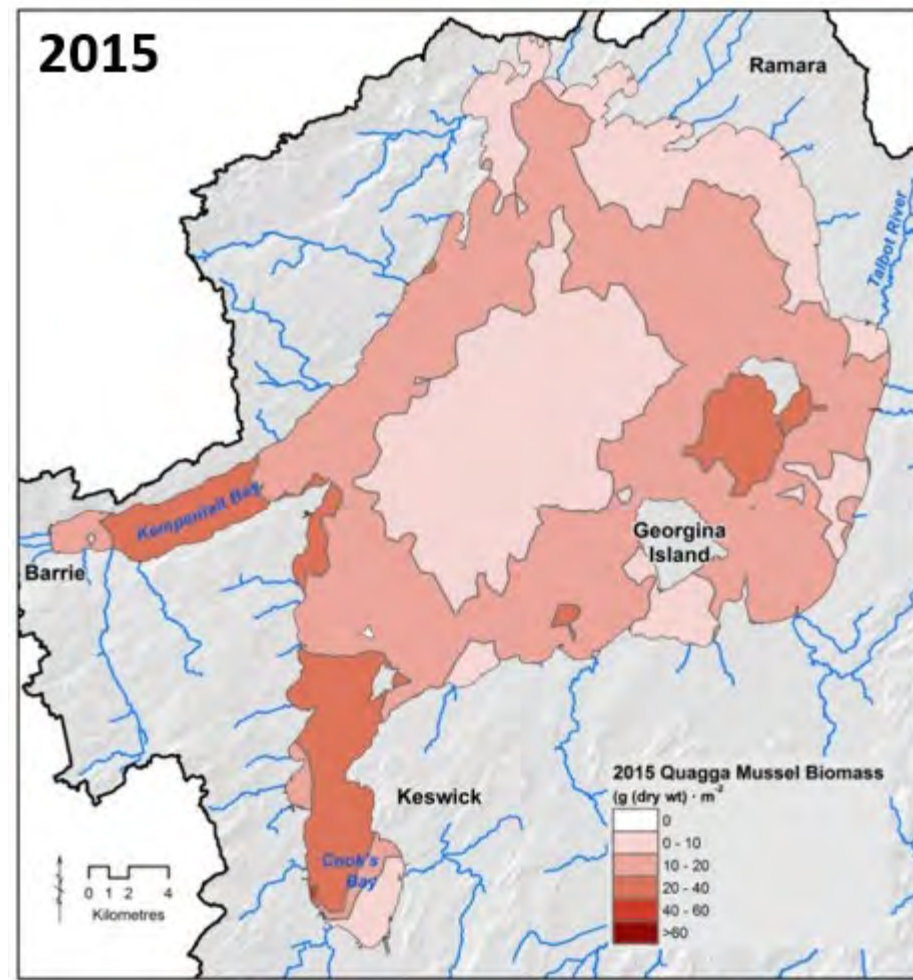
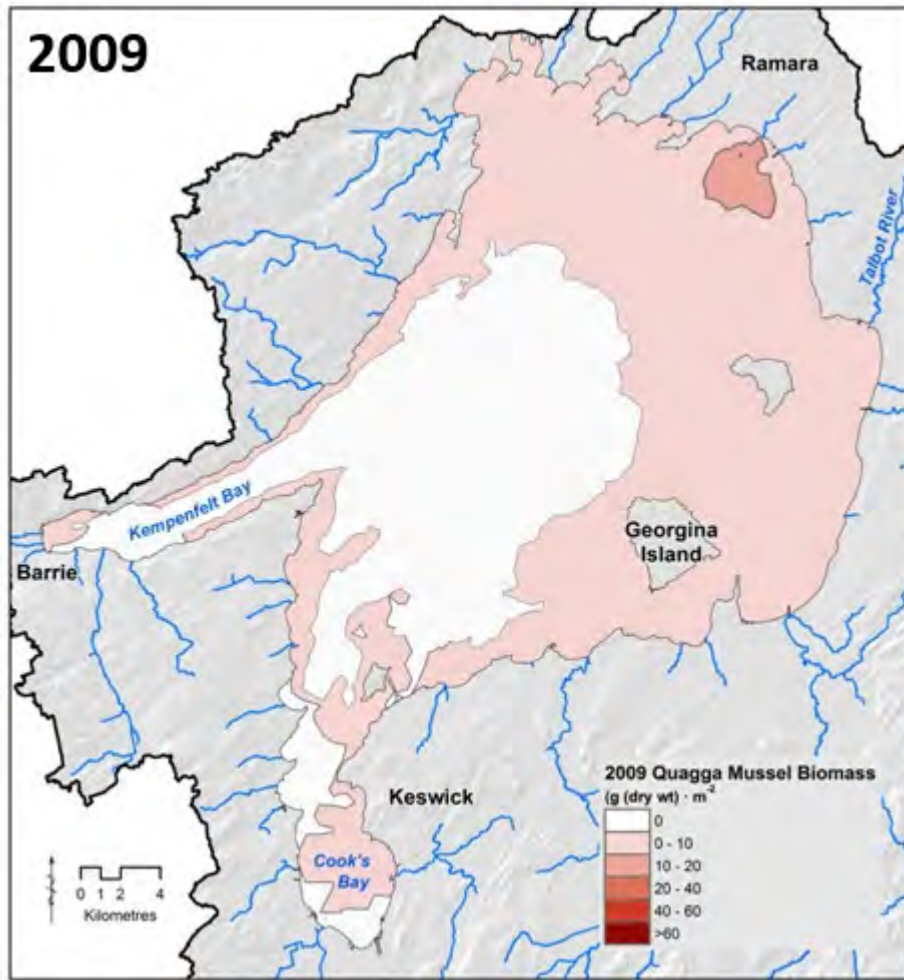


Invasive zebra mussels



Source: Ginn and others 2018. Journal of Great Lakes Research

Invasive quagga mussels



Source: Ginn and others 2018. Journal of Great Lakes Research

Invasive mussels

- Filter feeders: remove algae and particles:
 - Filter volume = Lake Simcoe (11 cubic kilometres) approximately 2.75 days!
 - These particles have phosphorus.
- Quagga mussels are the dominant controllers of phosphorus in the Lower Great Lakes!
- Increase water clarity + dissolved phosphorus.
- Higher water clarity = more aquatic plants.

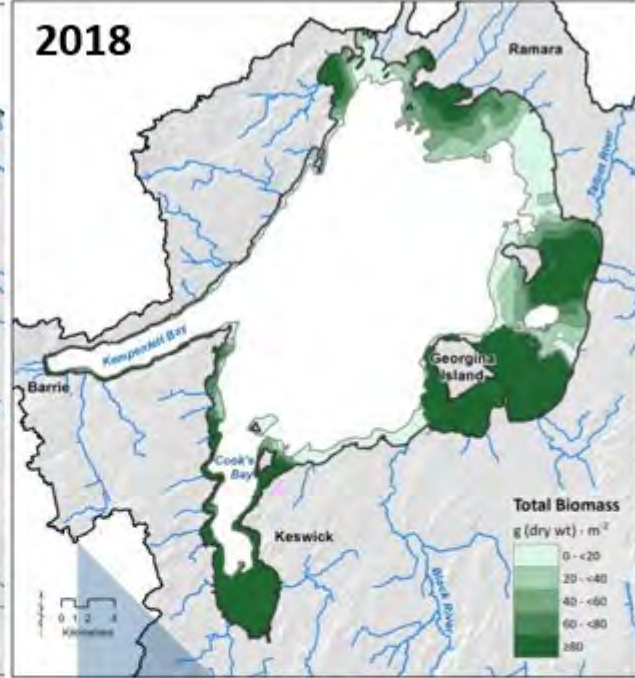
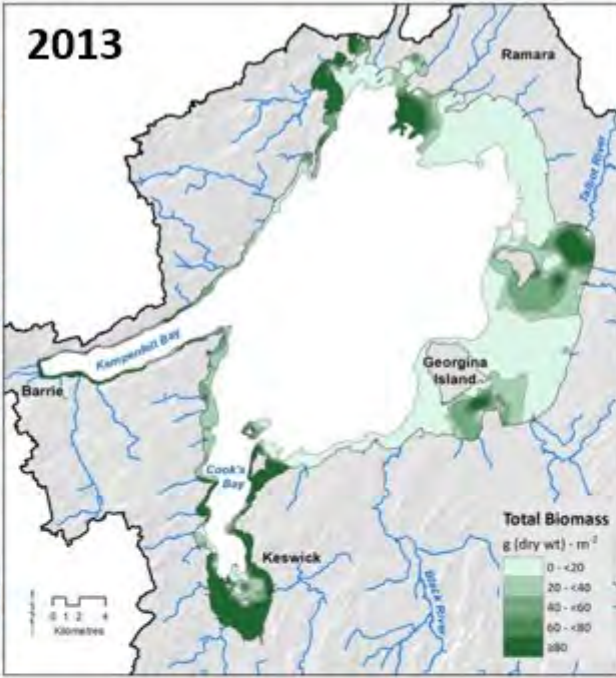
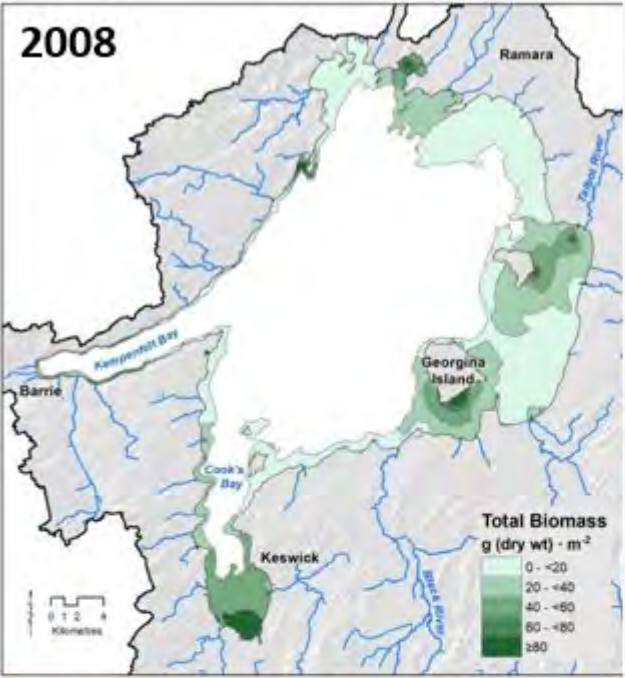


Aquatic Plants

- **The public's #1 lake concern!**
 - 53% of inquiries.
- **Legally protected in Ontario:**
 - Important fish habitat and nursery;
 - Buffer wave action and reduce erosion.
- Naturally present in “healthy” lakes.
- **But...** amount increases with:
 - Surplus nutrients;
 - Increased water clarity;
 - Invasive species.



5 times increase in aquatic plants



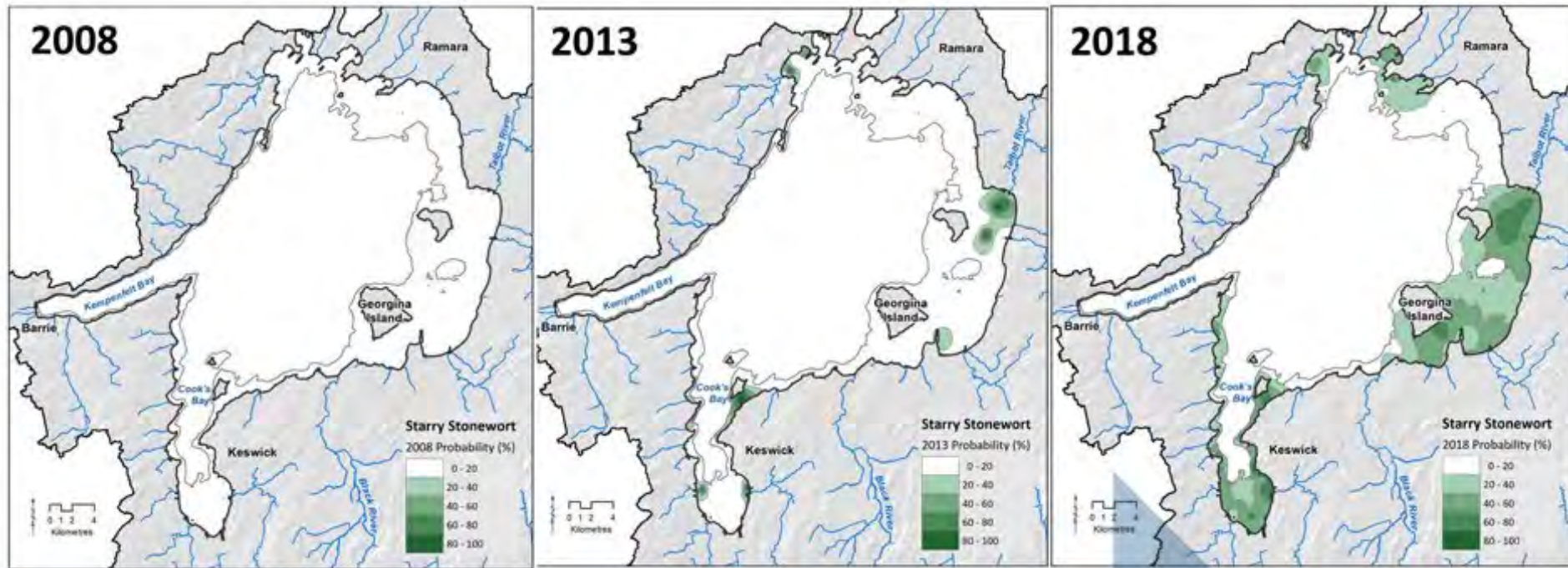
29.9 g/m²

80.3 g/m²

153.9 g/m²

Source: Ginn and others 2021. The Lake and Reservoir Management Journal

Starry stonewort trends



0 %

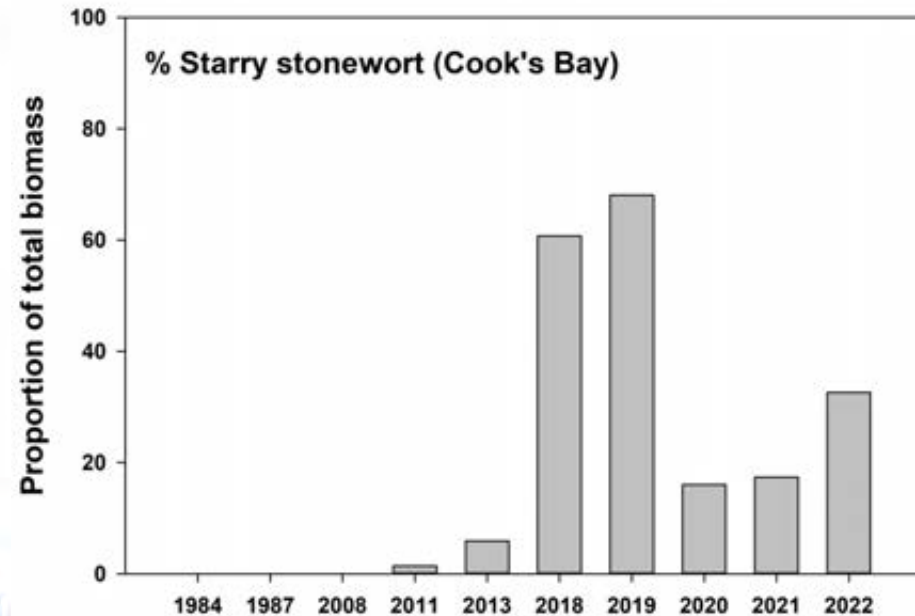
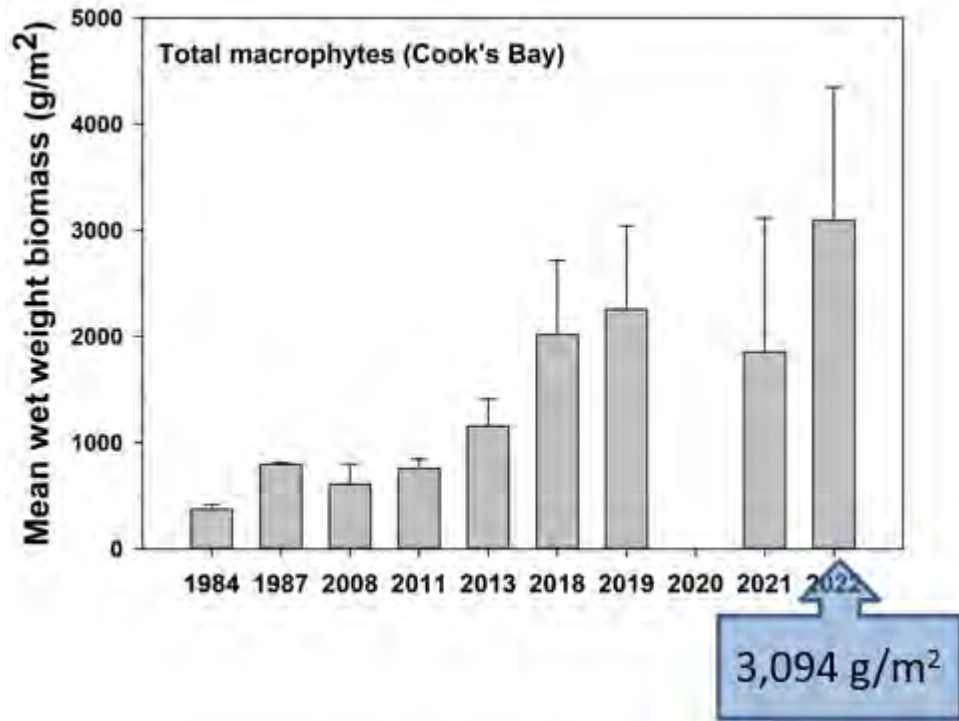
31.4 %

67.6 %

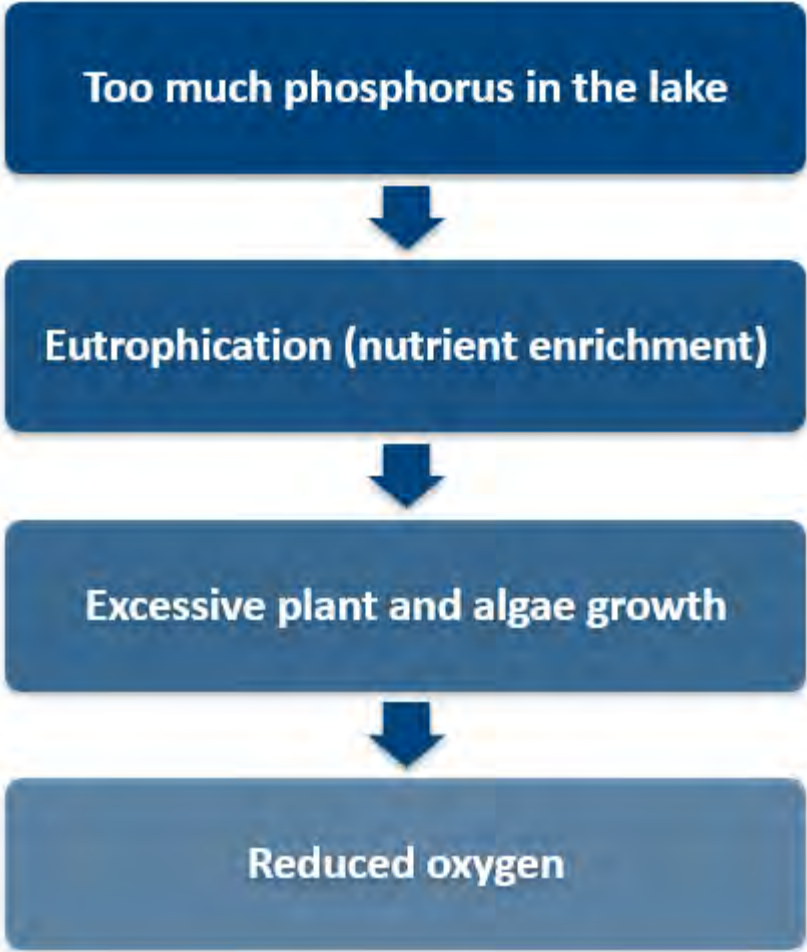
Source: Ginn and others 2021. The Lake and Reservoir Management Journal

Aquatic plants

- Increase since 1980s: water clarity, habitat space, starry stonewort (since 2011)
- 2020 to 2021: large (79%) starry stonewort decline, recovery in 2022

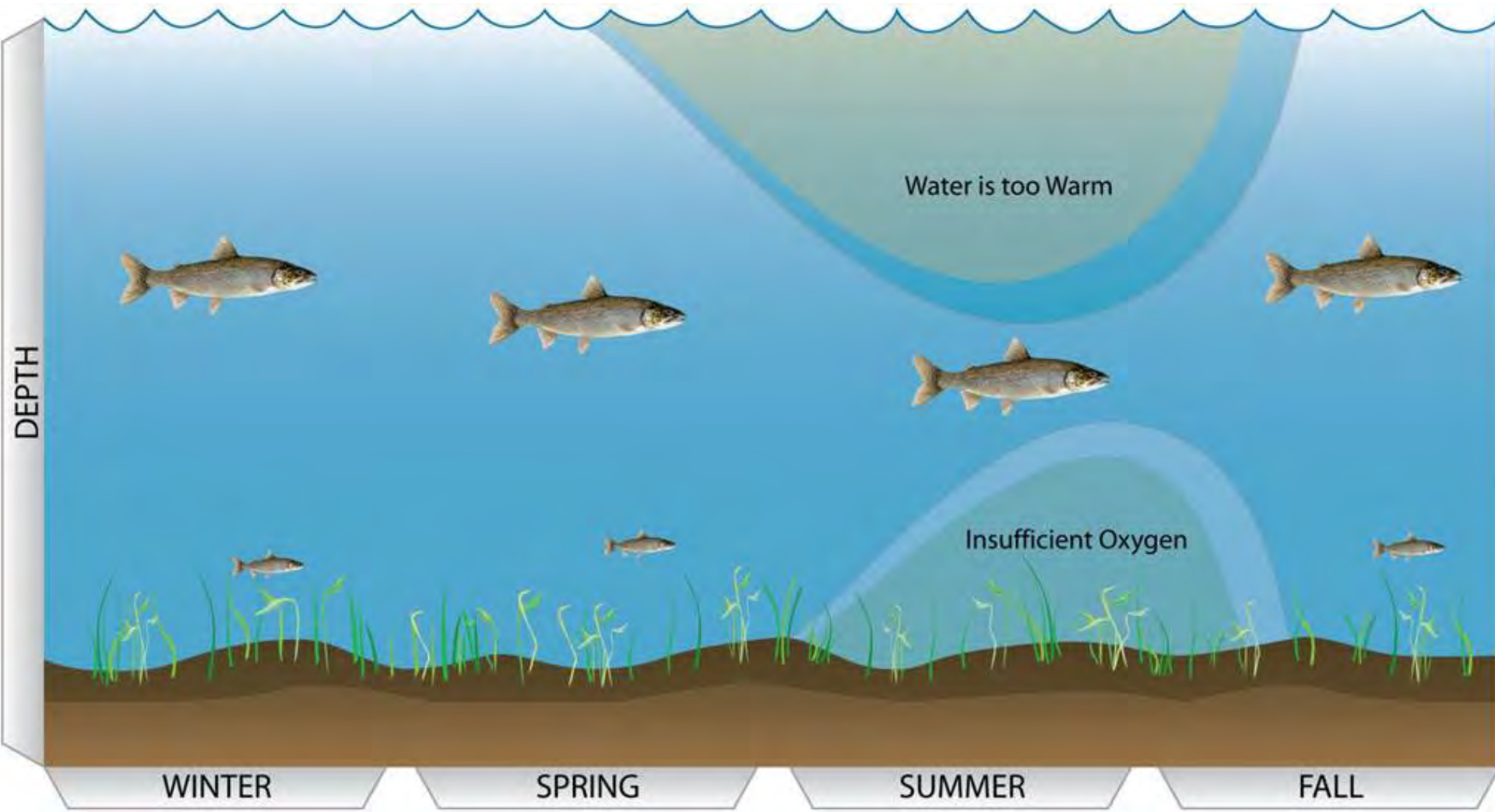


Why all the Fuss over Phosphorus?

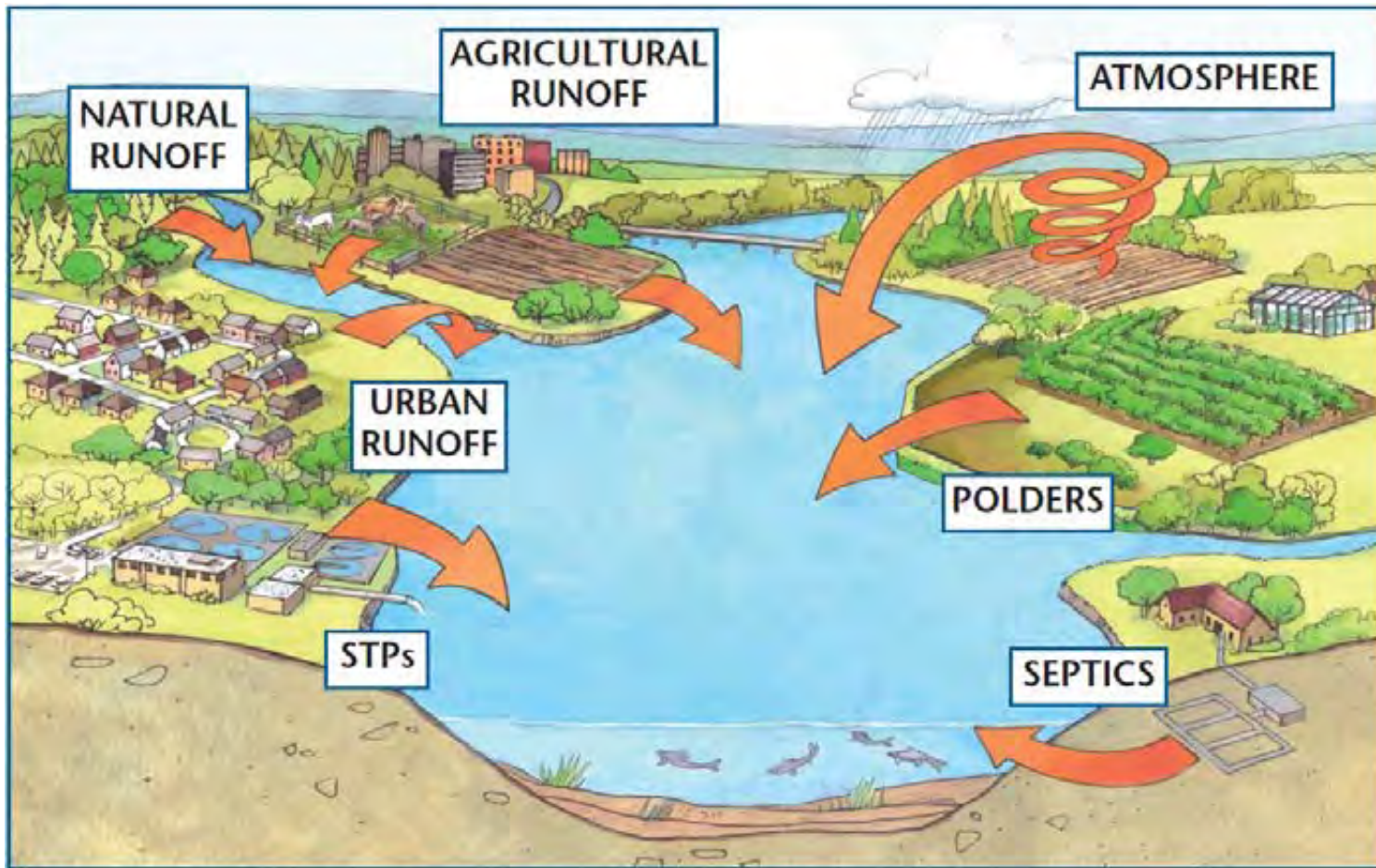


Lake Simcoe Protection Plan

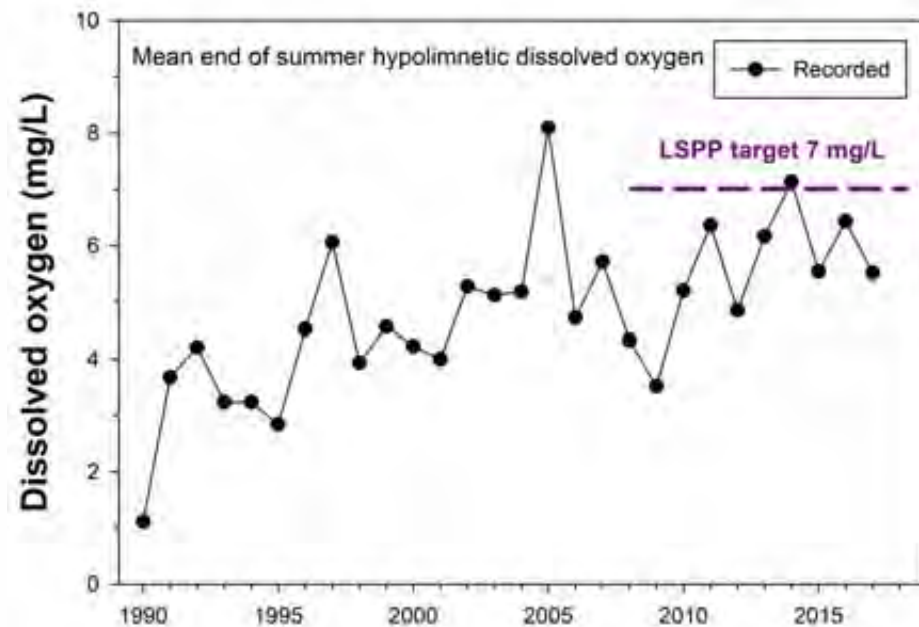
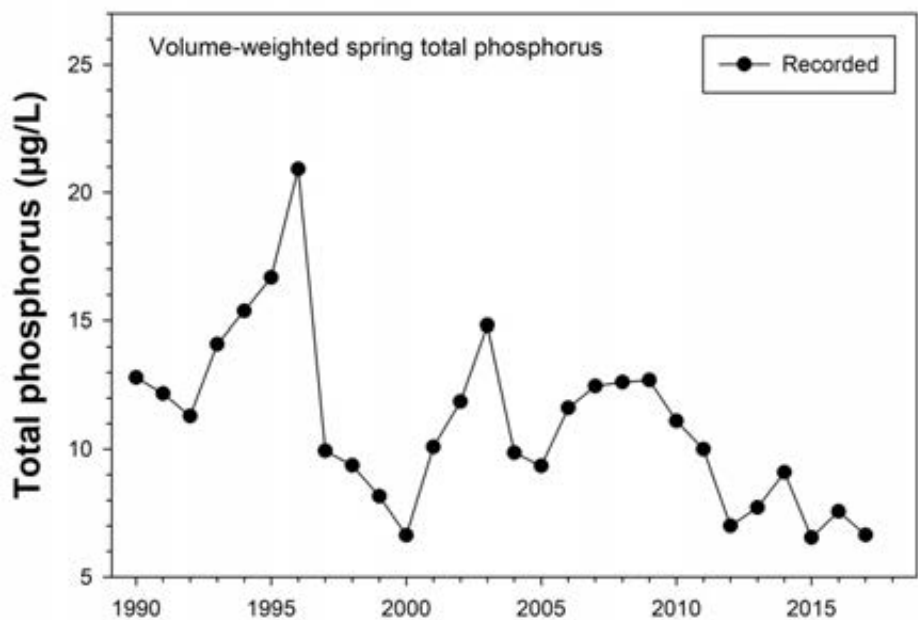
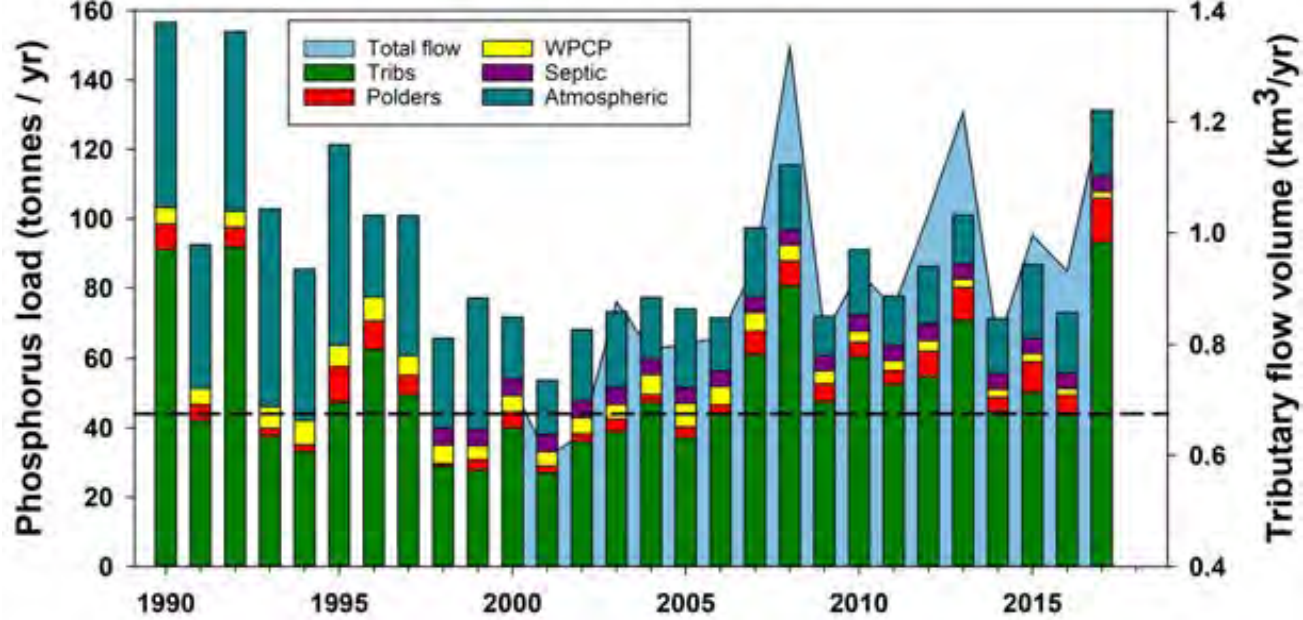
- Target for dissolved oxygen = 7 milligrams per litre
- Estimated load = 44 tonnes of phosphorus per year



Major Components of the Phosphorus Load

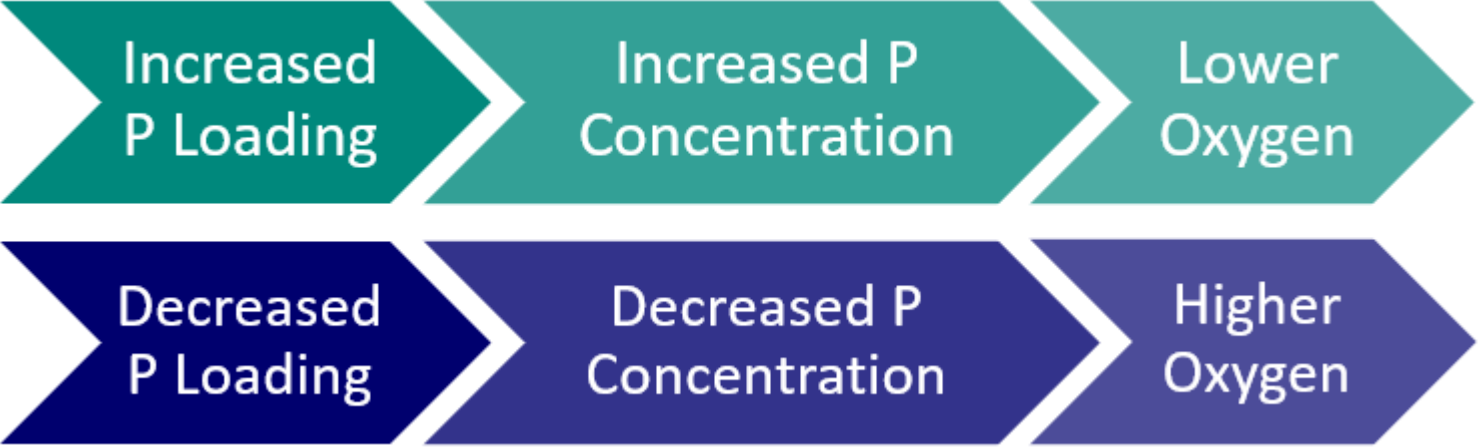


Interesting fact: More than 3,000,000 data points annually are used to calculate the load

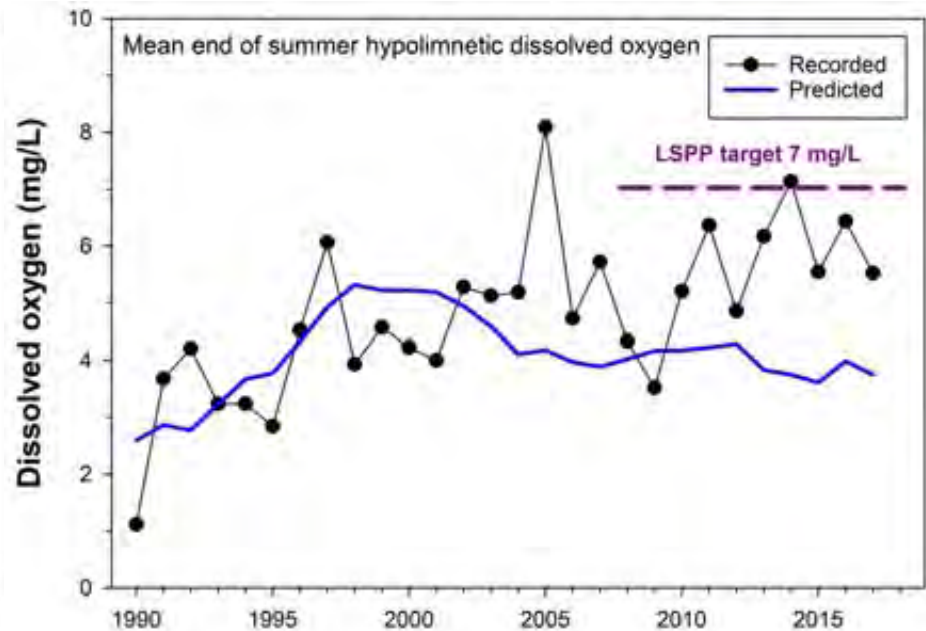
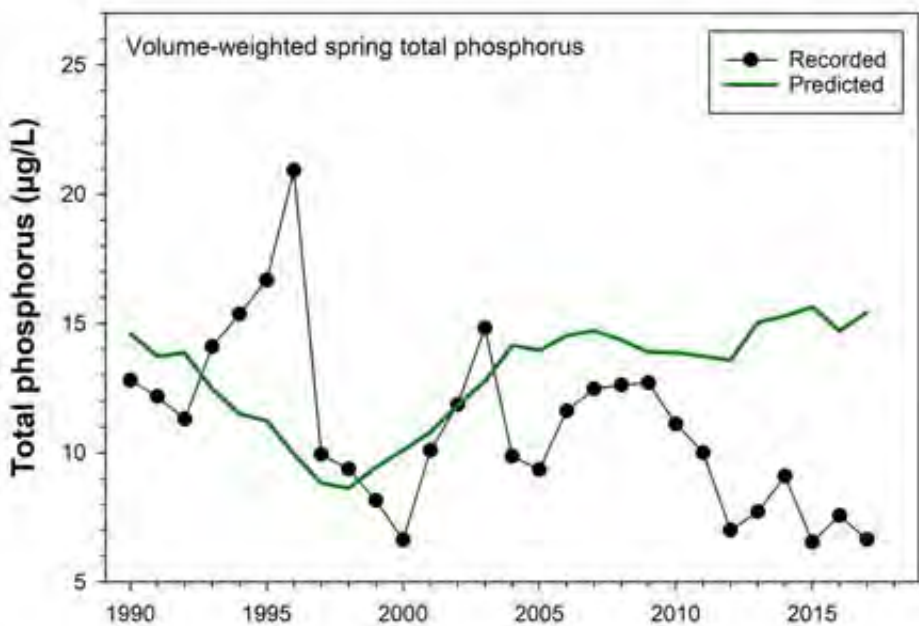
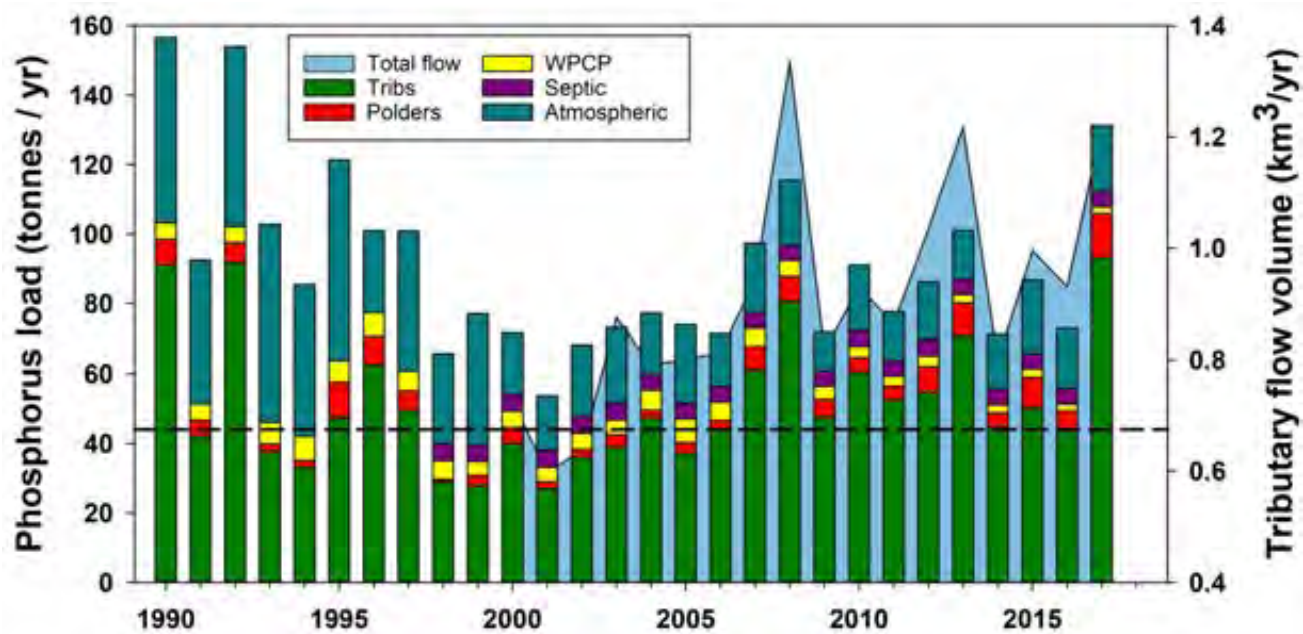


Phosphorus Loads, Concentration, and Oxygen

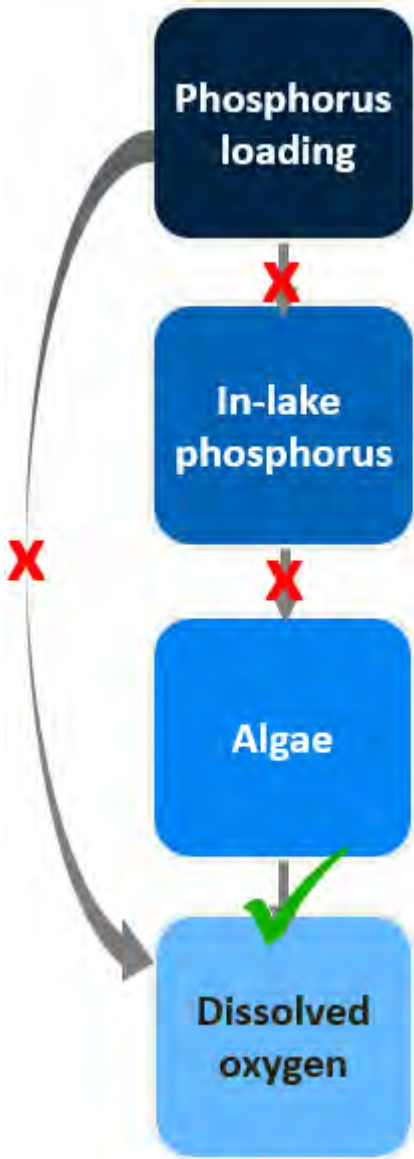
Limnological Theory



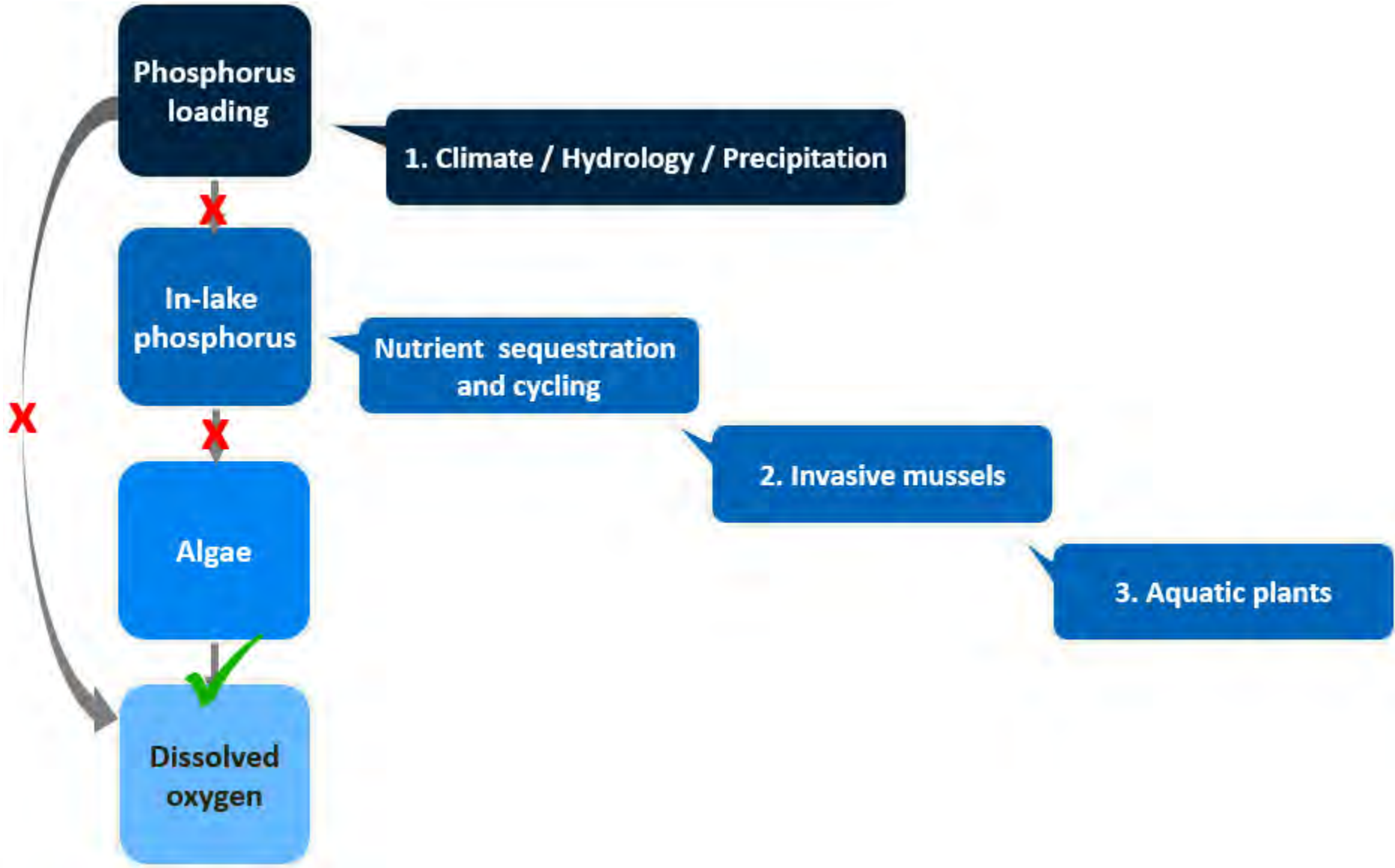
But what if it doesn't?



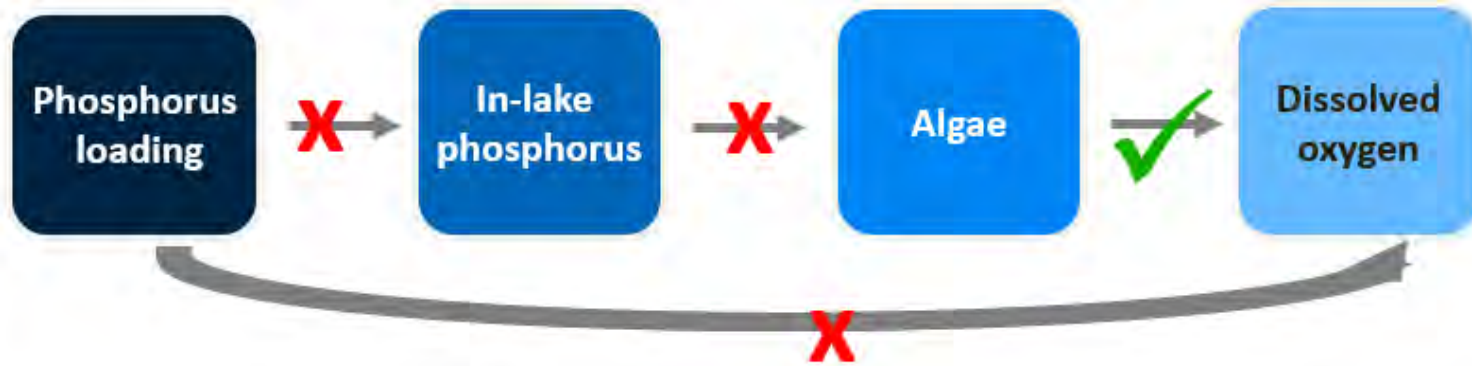
Phosphorus model



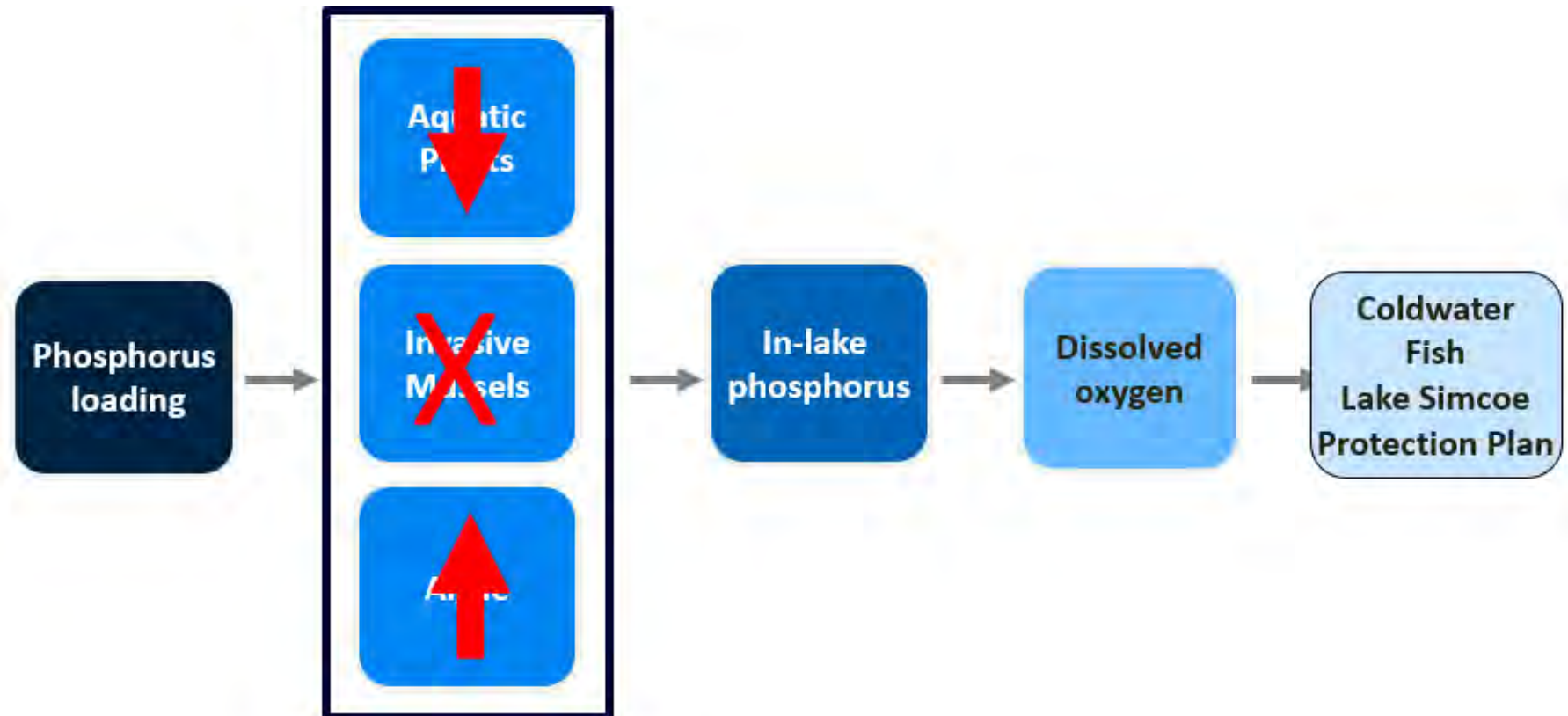
Phosphorus decoupling



Current Model:



Moving Forward:



Summary

- Lake Simcoe undergoing complex changes since approximately 2009 (climate, invasive species).
- Changes are also occurring, in part, across Great Lakes Region.
- Phosphorous decoupling is an ongoing ecological process in Lake Simcoe and elsewhere.
- We need on-going monitoring and better models for adaptive management.

Our existing strategy / targets were based on different environmental conditions!



