

Lake Simcoe health and a land-lake phosphorus disconnect

Township of Brock, Mayor and Council
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Lake Simcoe Region
conservation authority



Member of Conservation Ontario



Our Role in Lake Research

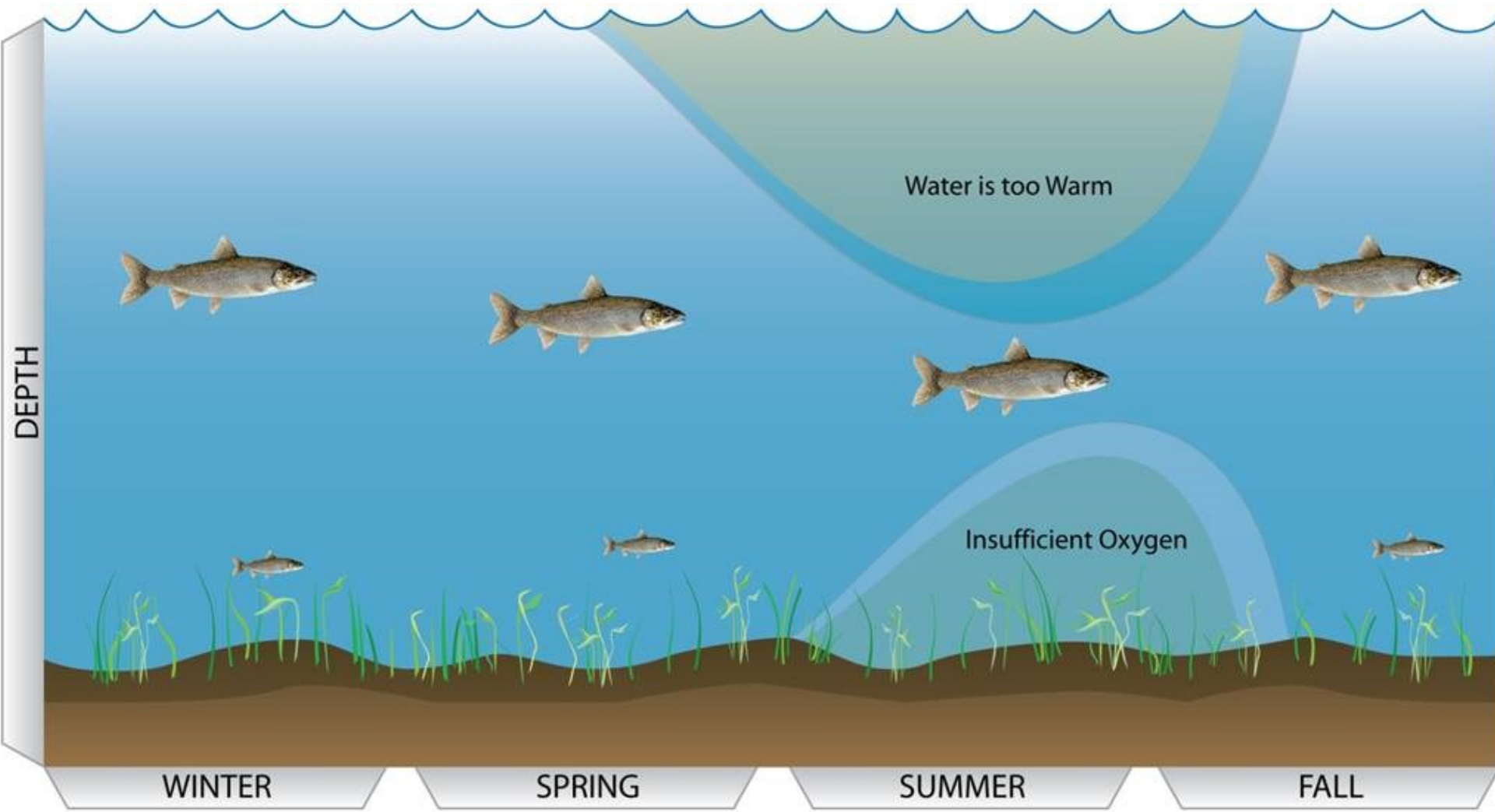
- **Work with MECP and MNRF**
- **Fill data gaps (nearshore zone)**
- **Address residents' concerns**
- **Investigate new / emerging issues**

3 Key Stressors to Lake Simcoe

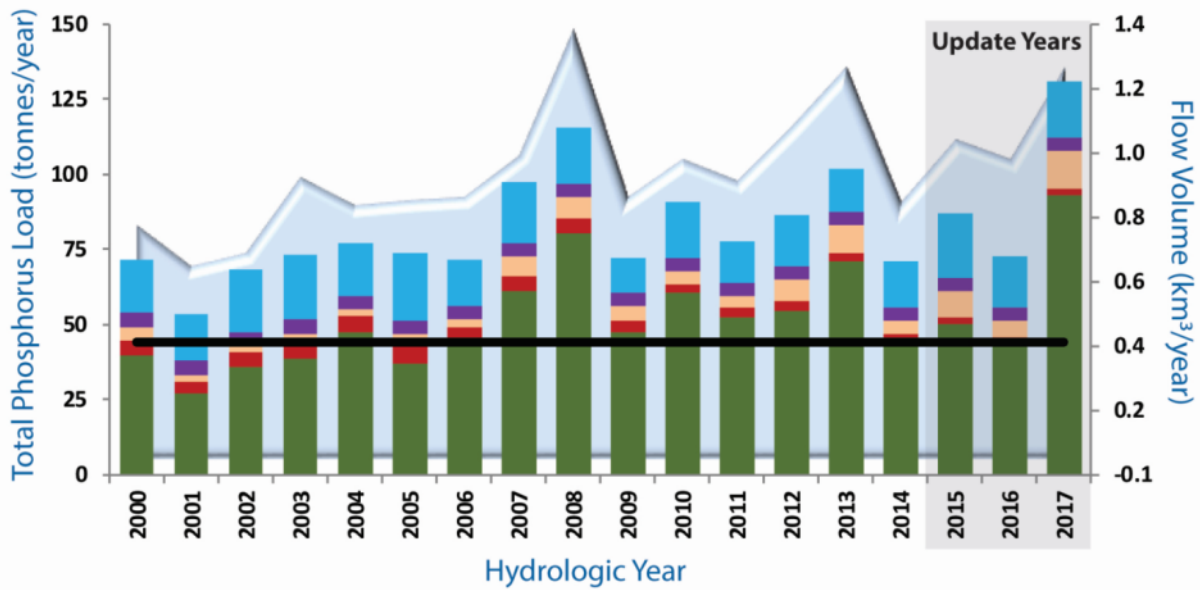
- Phosphorus
- Invasive Species
- Climate Change

Lake Simcoe Protection Plan

- Target for dissolved oxygen = 7 mg/L
- Estimated load = 44 tonnes of phosphorus per year

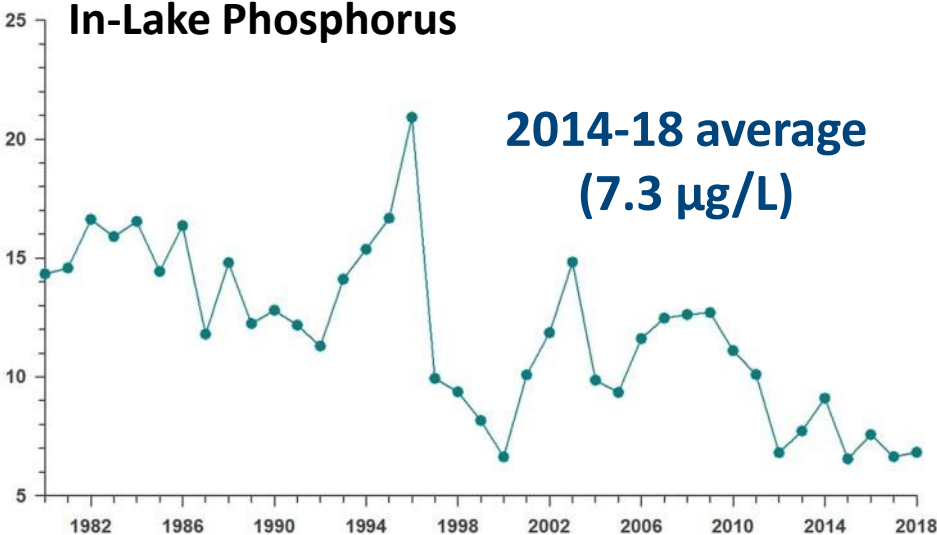


Phosphorus Loads and Tributary Flow Volume

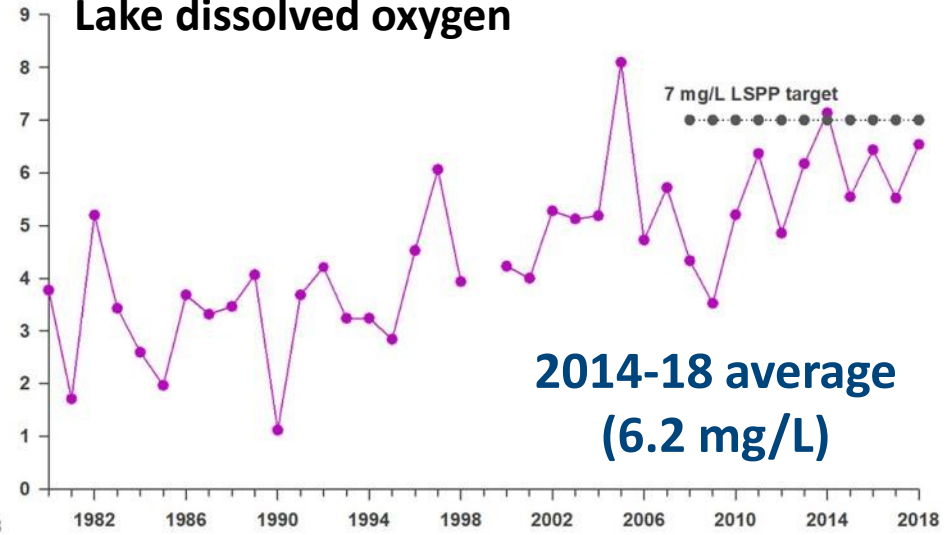


High tributary flows
= high loads

In-Lake Phosphorus



Lake dissolved oxygen



Loads Change, Lake Stays the Same?

Limnological Theory

Increased P Loading

Increased P Concentration

Lower Oxygen

• Lake Simcoe:

- Theory: P load 131 tonnes \rightarrow P concentration $\sim 13-18 \mu\text{g/L}$ \rightarrow oxygen 1-3 mg/L
- Actual : P load 131 tonnes \rightarrow P concentration = $6.8 \mu\text{g/L}$ \rightarrow oxygen = 6.5 mg/L





What's Going On?

1

Climate change & hydrology?

2

Invasive mussels?

3

Invasive plants?



Climate / Hydrology

- Climate is changing!
- Not just warmer temperatures
- Precipitation is changing
- More intense summer storms:
 - June 2017: 12.6 tonnes in 2 days
- More rain in winter:
 - Rain on frozen ground
- Fast storms = deliver P differently
- 70-80% of load from tributaries / polders
- **Extreme events are driving up loads**



Before June Storm

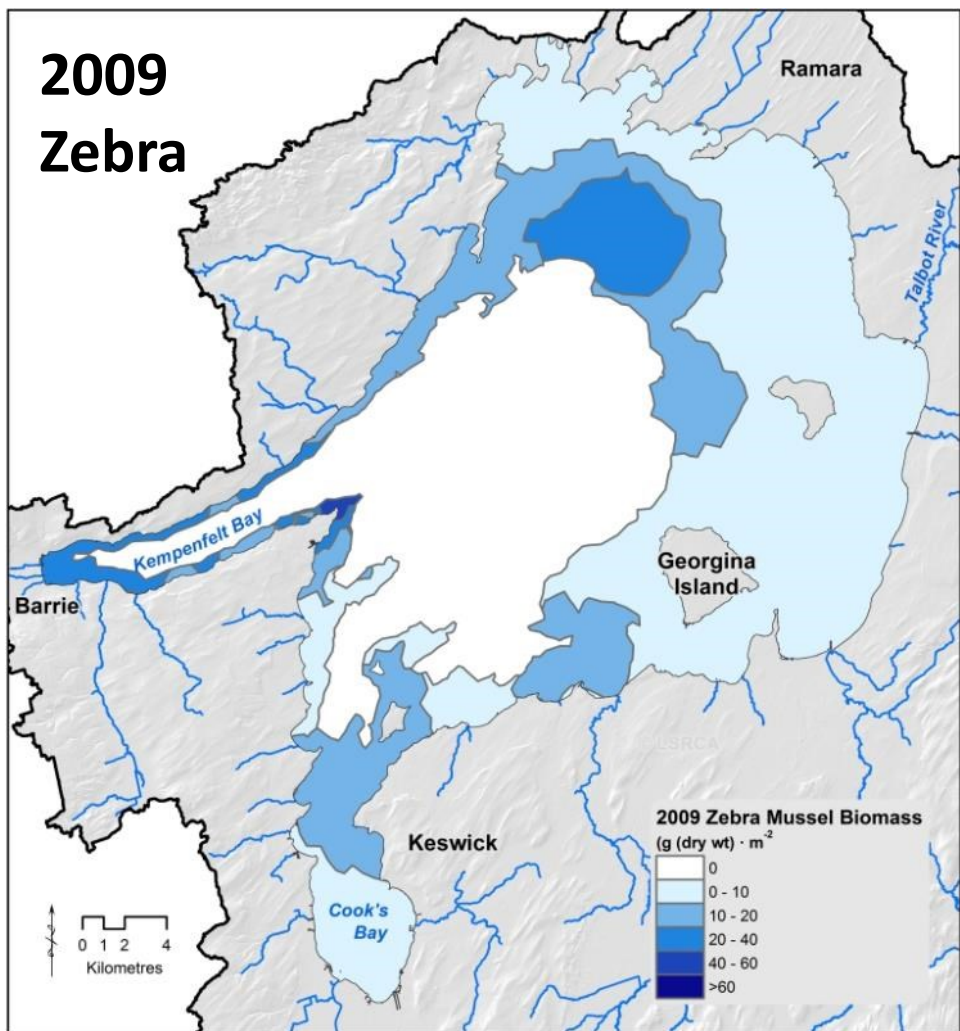


After June storm

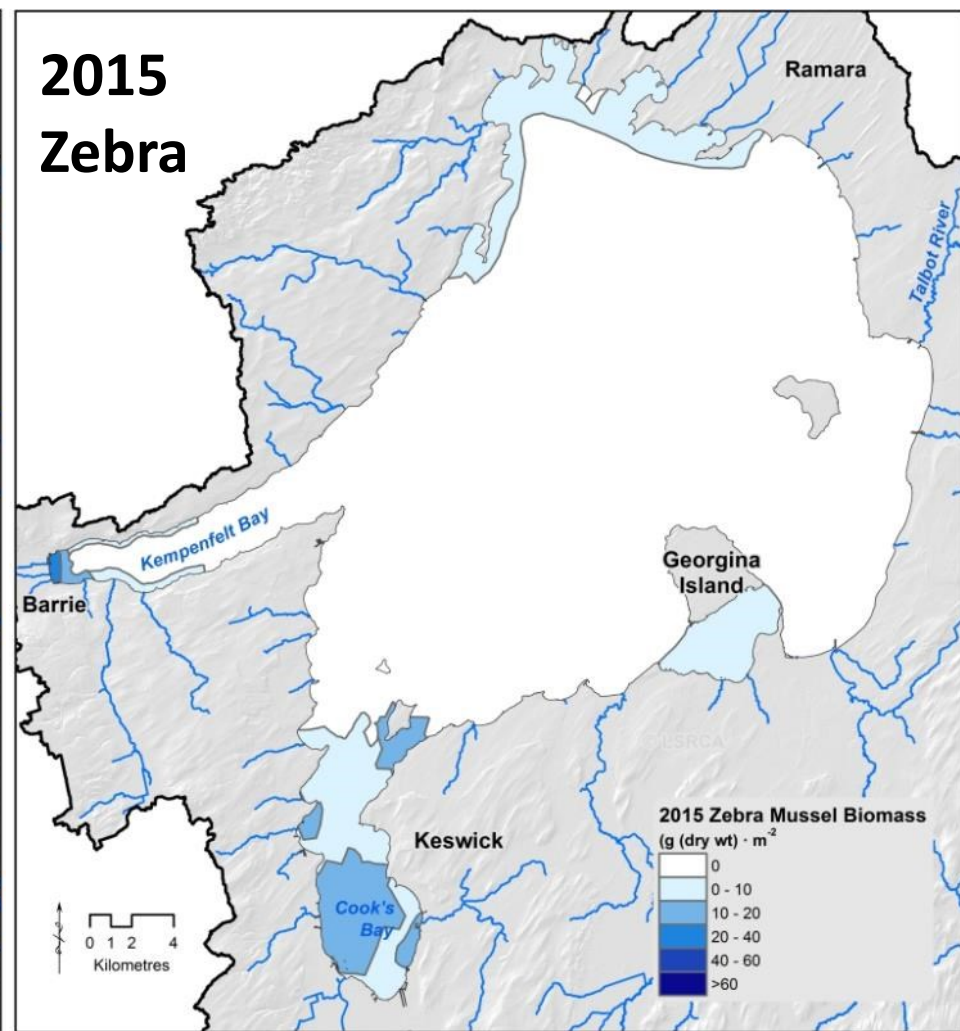
Invasive mussels

- 2009: 84% zebra mussels
- Shallow water “ring” around lake

**2009
Zebra**

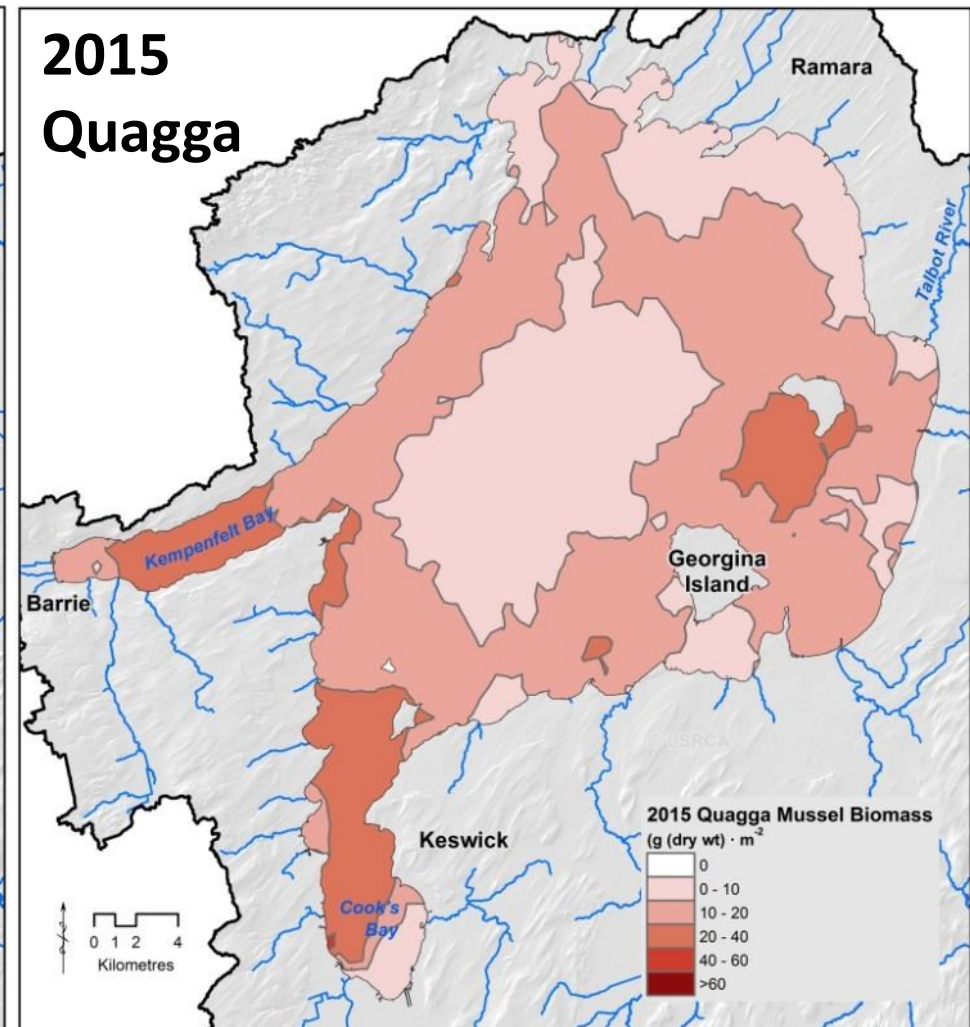
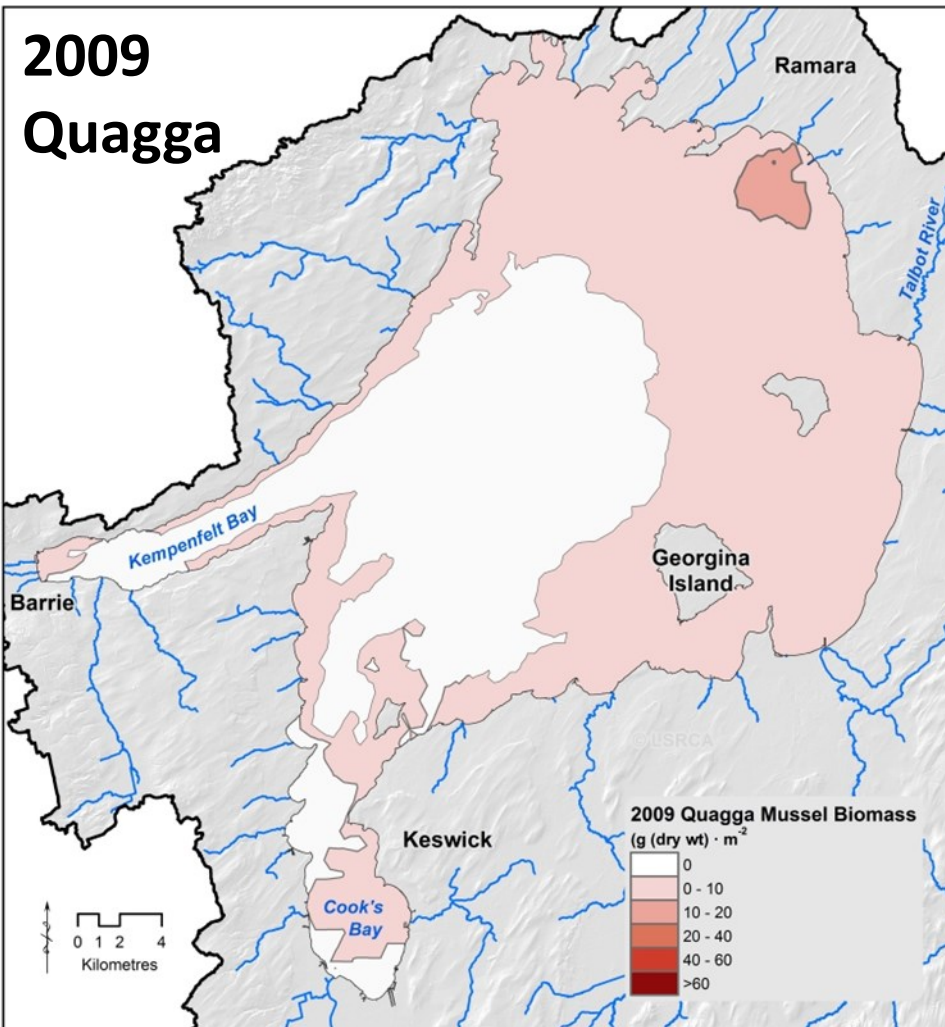


**2015
Zebra**



Invasive mussels

- 2015: 88% quagga mussels
- Deep water invasion

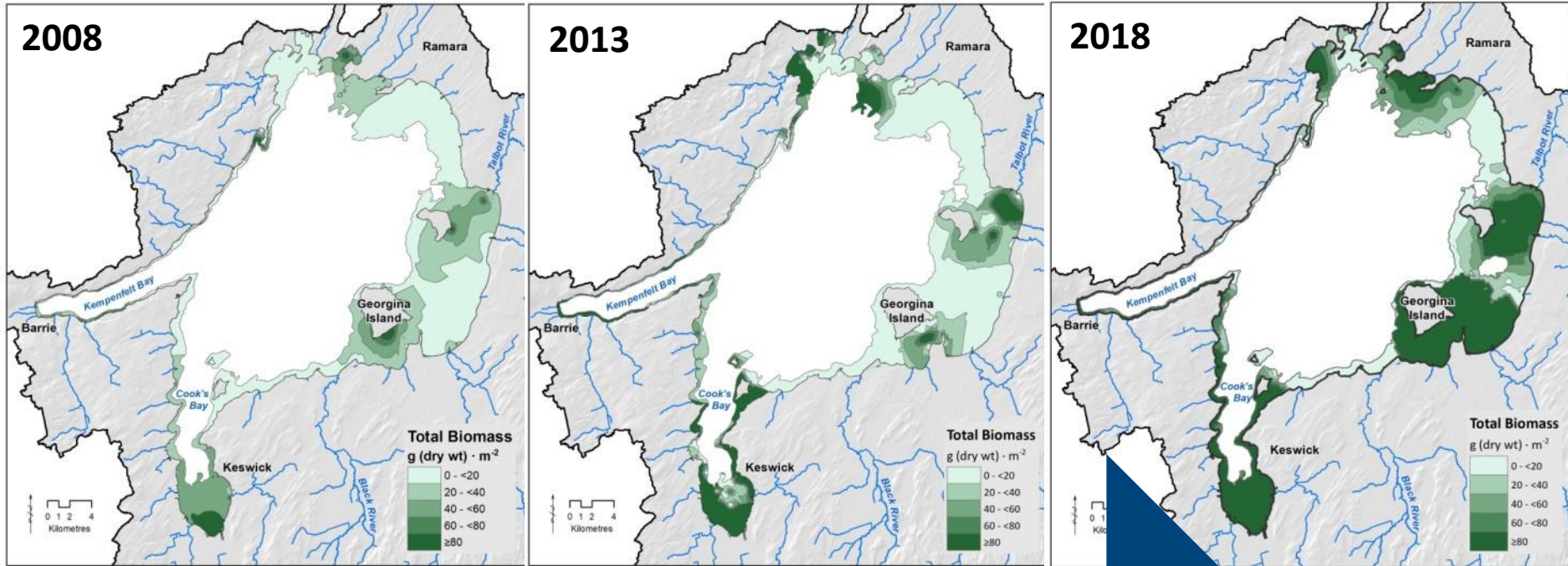


Invasive mussels

- Filter feeders: remove algae and particles
 - Filter volume = Lake Simcoe (11 km³) ~ 2.75 days!
 - These particles have phosphorus
- Quagga mussels are the dominant controllers of phosphorus in the Lower Great Lakes!
- Increase water clarity and dissolved phosphorus
- Higher water clarity = more aquatic plants



Aquatic plants have increased... a lot



29.9 g/m²

80.3 g/m²

153.9 g/m²

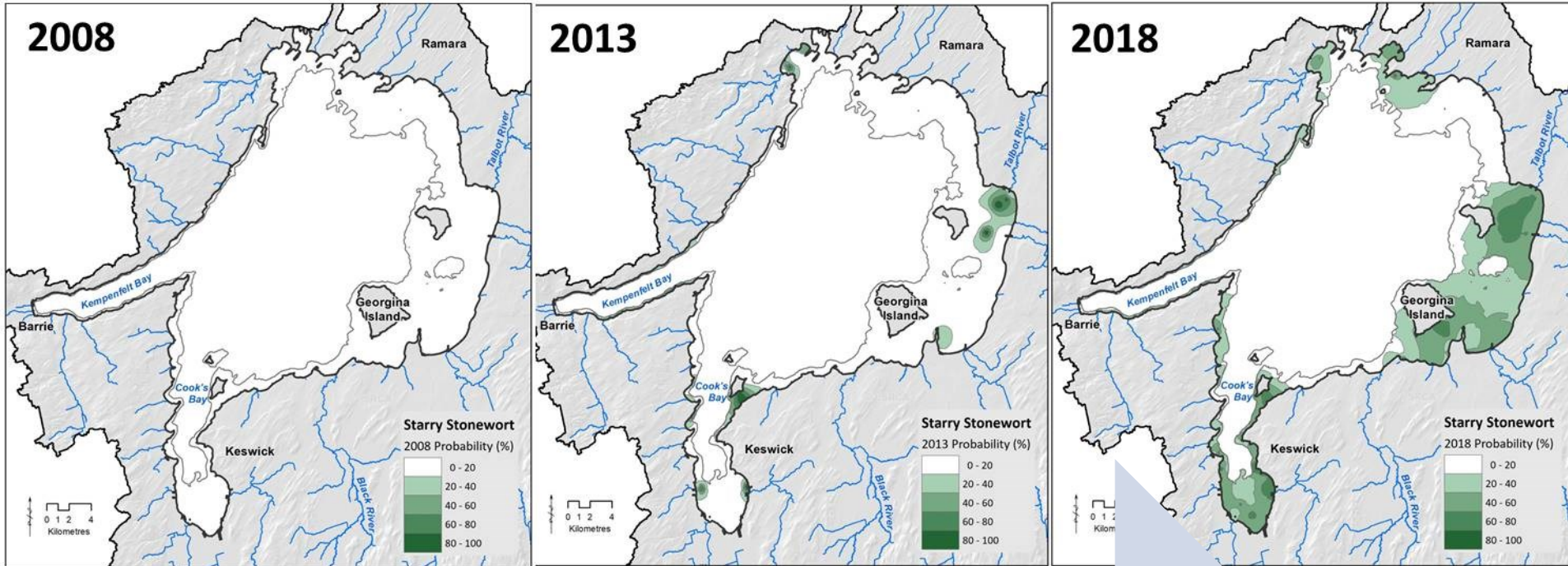
- Increase is mostly one invasive species (now 67% of total plants in lake)

Starry Stonewort

- St. Lawrence R. 1974; L. Simcoe 2009
- “Macro- algae” (plant-like algae)
- **No roots, all nutrients come from water**



Starry stonewort: trends



0%

31.4%

67.6%

Now: the dominant shallow water species in Lake Simcoe
Tissue phosphorus may be ~10x that of native plant species

Beach postings and bacteria

- Beaches monitored by regional health units
- Bacteria: *E. coli* and coliforms
- Usually correspond to rain events / wave action / suspended sediment
- Widespread issue in Great Lakes Region and globally
- More often with climate change conditions: hot, dry summers; intense downburst storms; warm shallow water; reduced water currents; organic sediments
- MECP / Western U study:
 - Bacteria higher sand vs water
 - Bacteria reservoir in foreshore (washed in)
 - Persistence: survive 2+ months
 - Source-tracking:
 - Postings not attributed to human / bovine
 - Likely source: naturally present or birds



Summary

- Lake Simcoe is doing well, but there are challenges:
 - Extreme rain events drive up loads
 - Why is the lake not responding?
- Invasive species: have they restructured the lake and its foodweb?
- “Lakes are complicated” - we need to consider physical, chemical, biological changes and their interactions
- We need targeted monitoring to find our answers



Moving forward

- Efforts to reduce phosphorus and improve ecological health need to be continued
- LSRCA, in collaboration and with support from MECP, are continuing to research this phosphorus-oxygen disconnect in order to understand what this may mean to future management

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

