Protecting our Lakes Forever:
Moving from rehabilitation to prevention during a time of climate change

Norman Yan
Friends of the Muskoka Watershed

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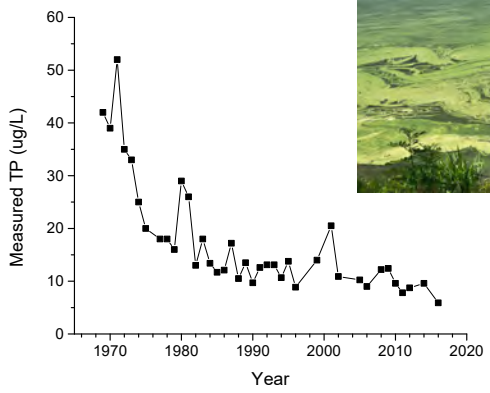
Ecological damage reversed
e.g. recovery from algal blooms in Muskoka Bay



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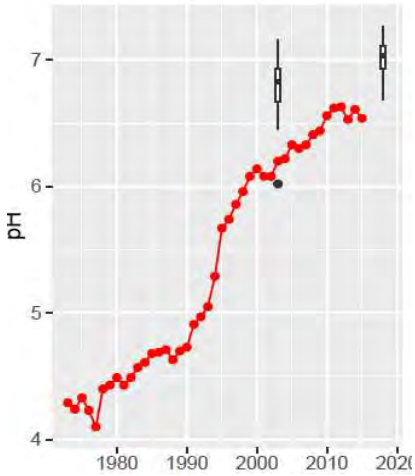
Recovery from acid rain in Sudbury
1st fish in Clearwater Lake in 50 years



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What are the steps we took?

- Realize something was wrong
- Identify what to do
- Generate the will to use that knowledge
- Act on that knowledge
- Ensure the action worked

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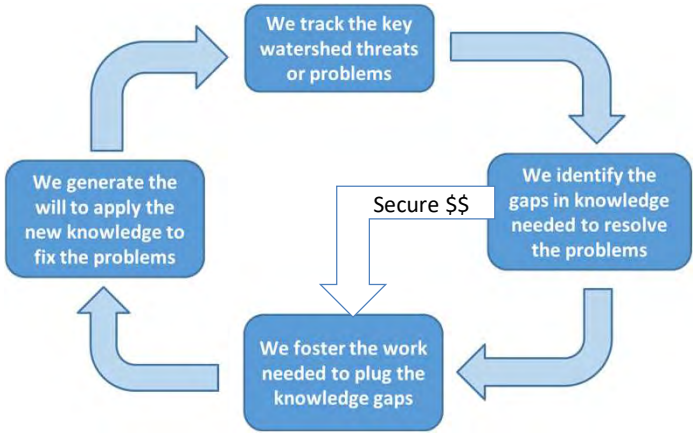
The FMW approach



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What are the emerging threats to clean healthy freshwaters*

- Climate change
- Invasions
- Infectious diseases
- Hazardous Algal Blooms (HABs)
- Hydropower expansion
- Emerging contaminants
- Engineered nanomaterials
- Micro-plastic pollution
- Light and noise
- Rising salinity
- Declining calcium
- Cumulative stressors

Andrea Reid et al. 2019. Emerging threats and persistent conservation challenges for freshwater biodiversity. Biol. Rev. 94: 849

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Which of these threaten our lakes now?

- Algal blooms (HABs) despite low and falling phosphorus
- Calcium decline
- Invading species
- Rising salinity from road salt
- Climate change
- And likely their interactions

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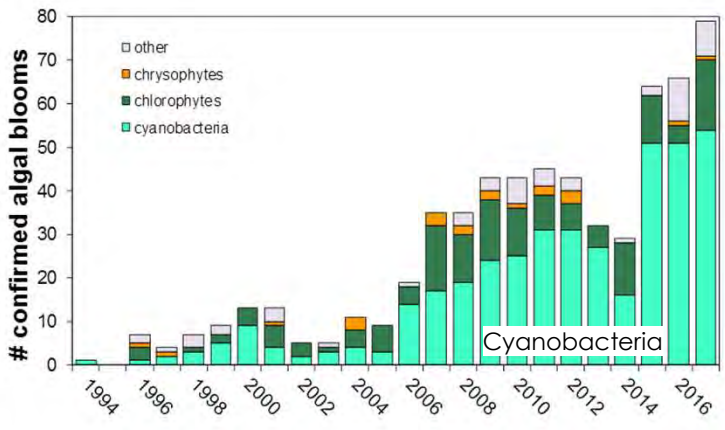
Algal blooms are on the rise in Ontario



Source: Claire Holeton via A. Paterson, MECP)

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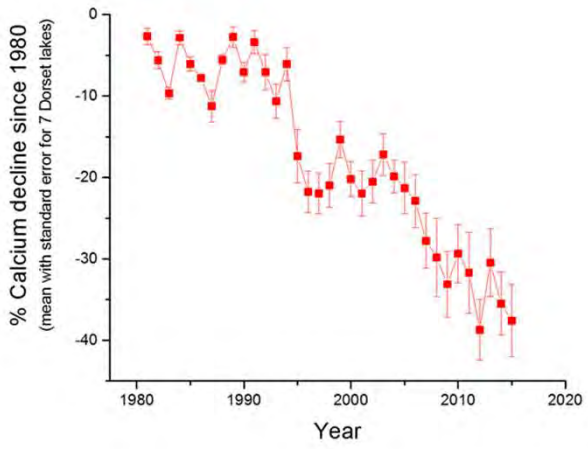
Calcium has fallen to damaging levels in 50% of Muskoka and 20% of Haliburton lakes*



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*From Paterson MECP DESC

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The invading spiny water flea has spread rapidly

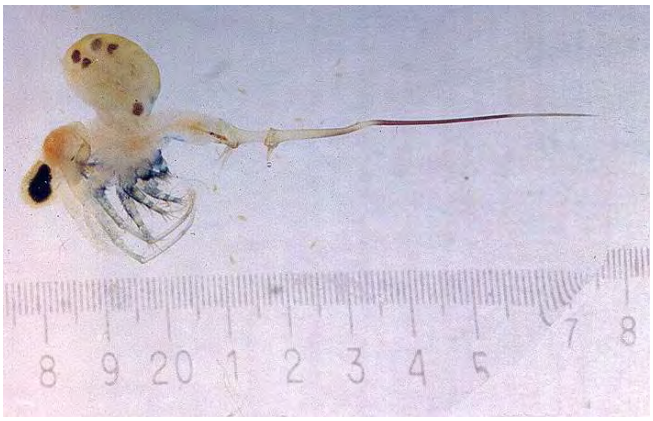

Photo from Harp Lake by Bill O'Neill

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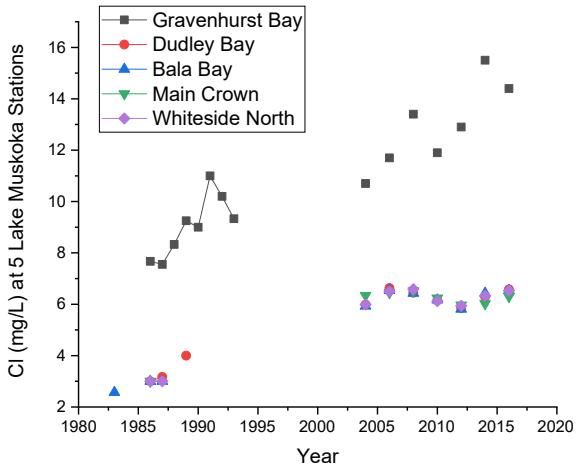
Salt levels are on the rise in many lakes e.g. in Lake Muskoka*



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* Data from MOE, MECP, DMM

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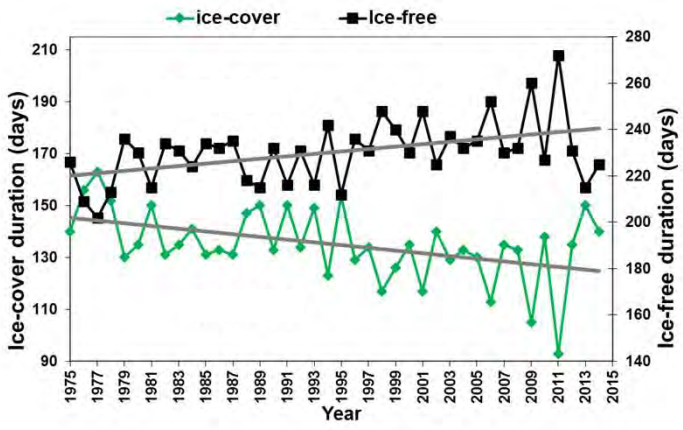
And the climate is changing* (e.g., ice-free seasons are now two weeks longer)



*Yao et al (MECP Dorset)

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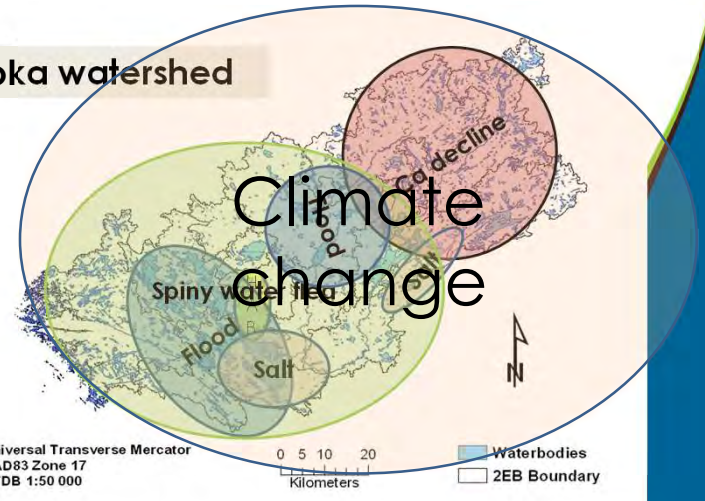
And these threats likely interact



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Might these stressors interact with climate change and lead to more HABs?

as in Dickson Lake, Algonquin Park

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How might stressor interactions increase the risk of algal blooms?

- Algal blooms are influenced by three main factors
  - species preferences and tolerances of lake chemistry, oxygen and temperature
  - Algal growth rates, linked to more key nutrients especially phosphorus
  - Algal death rates linked to more more grazing

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It's analogous to a good lawn

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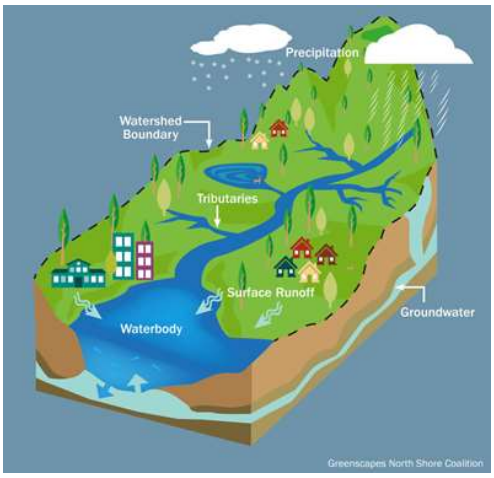
Where do lakes get their phosphorus?



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Images from Greenscapes North Shore Coalition

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And zooplankton are the "mowers"

Image from Utah State U

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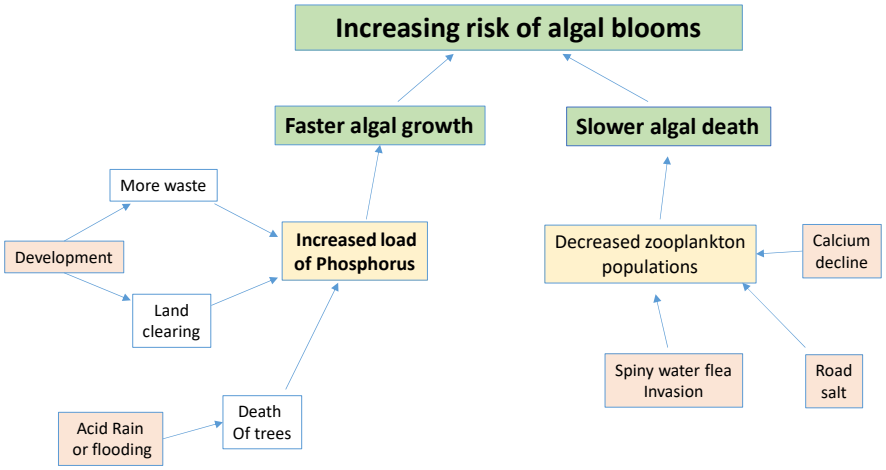

Linking emerging threats to algal blooms **without** climate change

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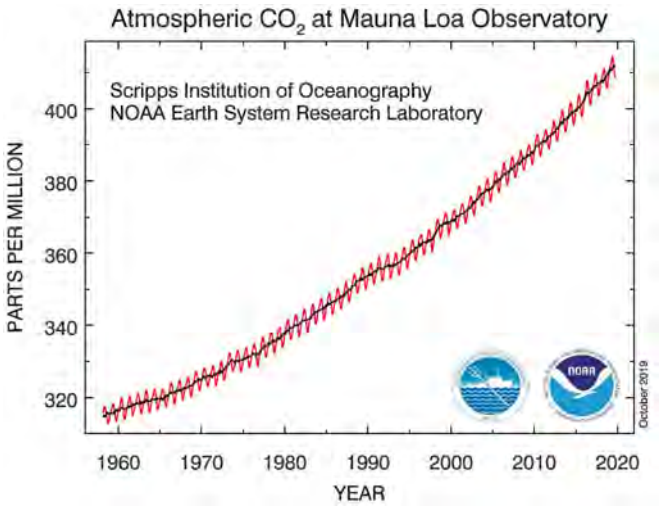
But atmospheric CO_2 levels are rising



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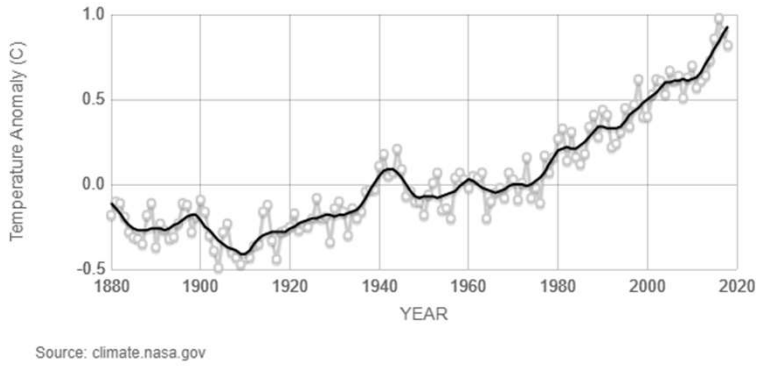
Raising global air temperatures*
(compared to 1950 to 1980 mean)



*Source: climate.nasa.gov

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Might the climate be a threat multiplier?
More lake-effect snow

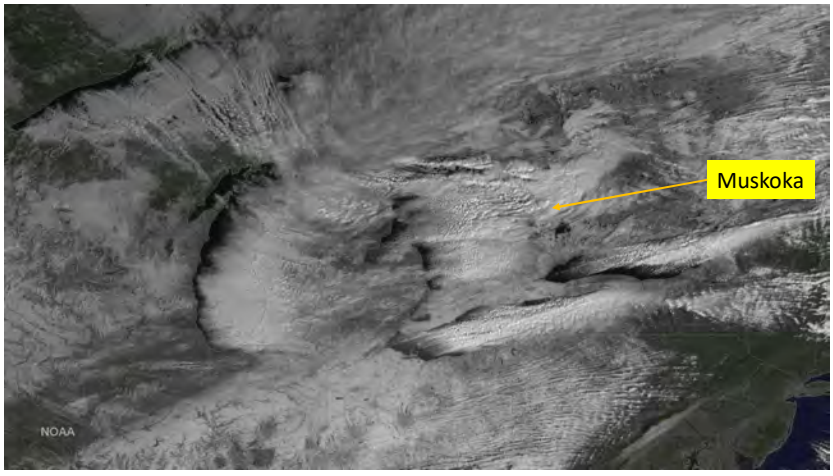

Image from NOAA

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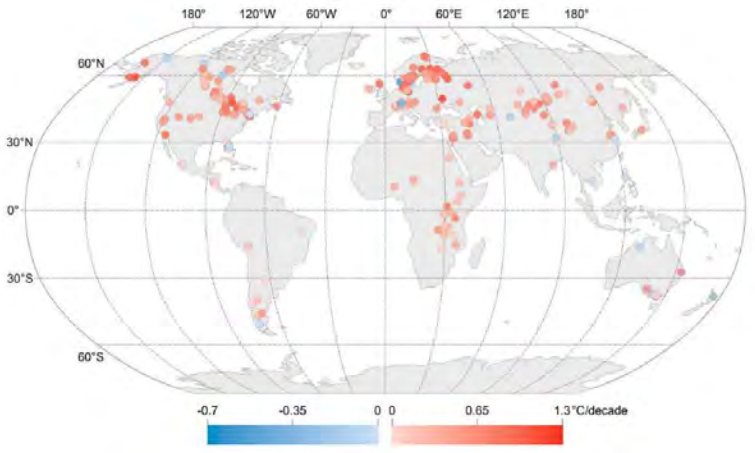
And lake surface waters are warming (warming trend 1985-2009 for 240 lakes)



*O'Reilly et al. 2015 Geophys. Res Let.

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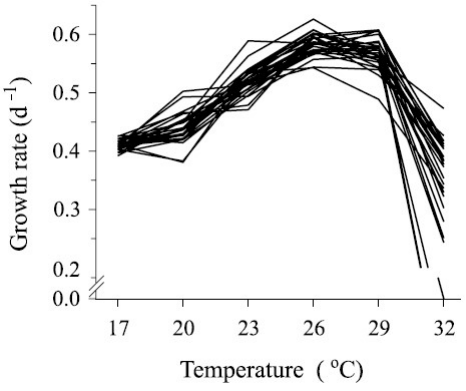
If too hot, zooplankton suffer

growth vs. temperature for *Daphnia magna**



*Lampert 2006 Pol. J. Ecol

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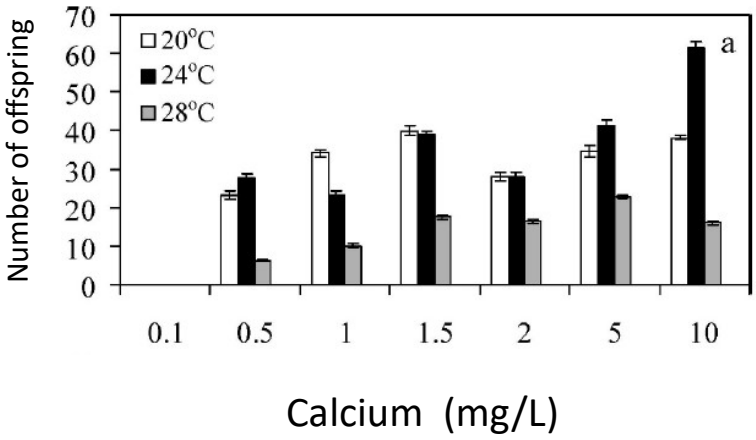
High temperatures interact with other stressors, e.g. increasing low Ca damage to *Daphnia**



*Ashforth and Yan 2008 Limnol. Oceanogr.

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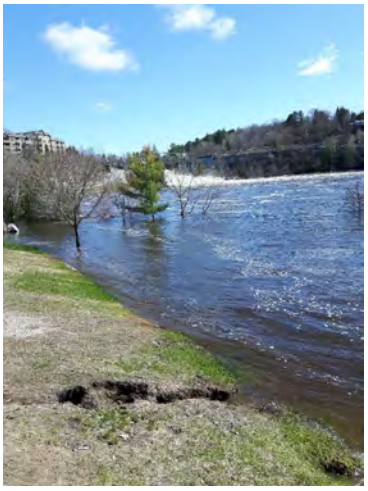
Flooding can increase erosion and perhaps nutrient supply



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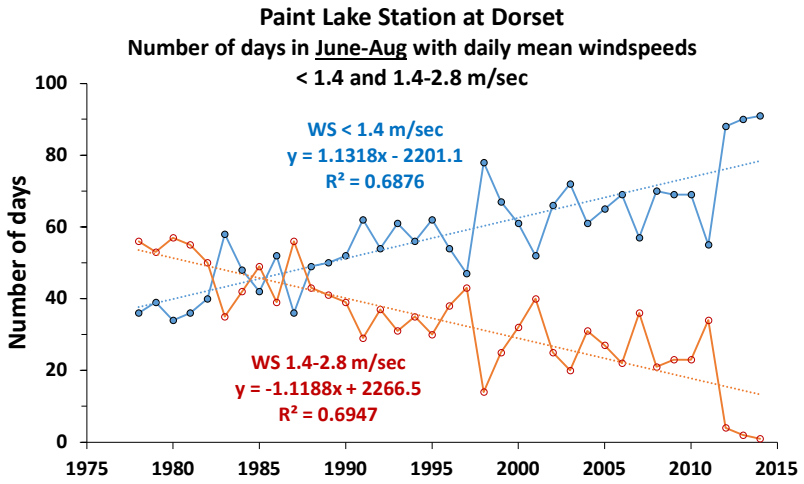
Summer wind speeds are falling, favouring blue-greens



From Yao MECP DESC

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Climate change is likely a threat multiplier for HABs

By damaging animal plankton, that eat algae via

- more salt
- warmer water
- increasing damage from low calcium

Increasing nutrient supply

- more erosion via floods

Improving habitat for blue-green algae

- Warmer water
- Lower wind speeds
- Lower bottom water oxygen in late summer and fall

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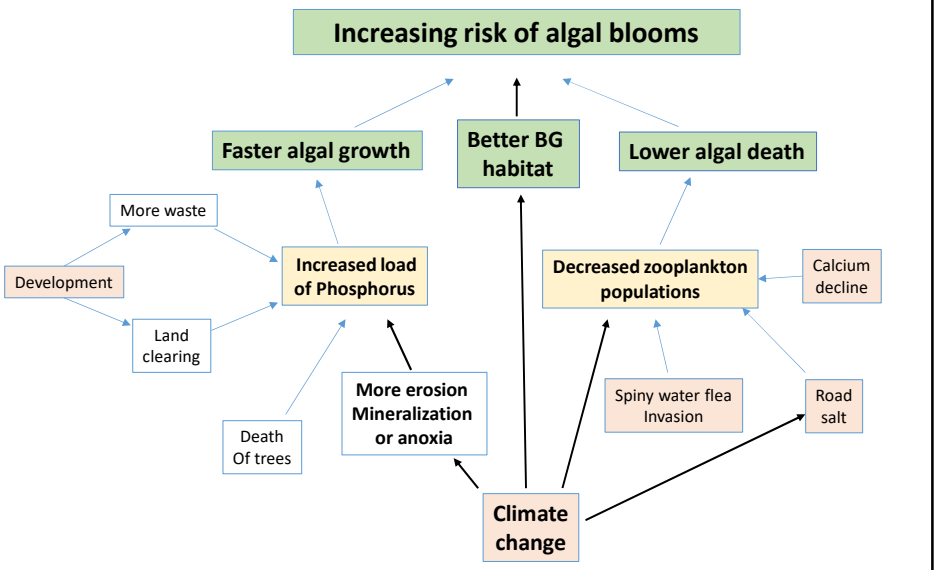

Linking emerging threats to algal blooms **with Climate Change**

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So shouldn't we…

- Work to reduce GHG emissions
- Protect the forests
- Protect the animal plankton
- Plug the key knowledge gaps so we know what actions might help the most

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Improve early warning indicators

- Modify lake partner programs to include and report emerging threats, e.g. salt, calcium, ice duration, air and water temperature
- Implement real-time monitoring of conditions that lead to algal blooms

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Identify the key knowledge gaps for HABs

- Why are there more fall blooms?
- What are the critical habitat thresholds that induce HABs?
- Do zooplankton losses linked to calcium decline, fall warming, road salt or the spiny water flea increase the HAB risk?
- Does calcium decline limit retention of phosphorus in forests?
- How does climate change alter all of the above?

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Implement real-time lake monitoring in blue-green nursery areas

More platforms like THELMA – on Harp Lake (DESC)

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Finally, when we know what to do, let's foster the will to act

- For decreases in calcium

ASH MUSKOKA

- For increases in salt, begin with

smart about salt
Winter Salt Management Program

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Our vision

Healthy Muskoka Watersheds forever

Our mission

To foster the understanding, choices, actions and wise management needed to protect our freshwater ecosystems forever

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Please join us in this work
https://fotmw.org

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