
Nearshore Waters
Murray Charlton

Nearshore Waters

*Why are we so interested in the **Nearshore**?*

- Source of drinking water
- Utilities (power, industry)
- Front line pollution receiver
- Recreation
- Habitat
- Property values
- Aesthetics
- Inter-jurisdictional pollution transfer

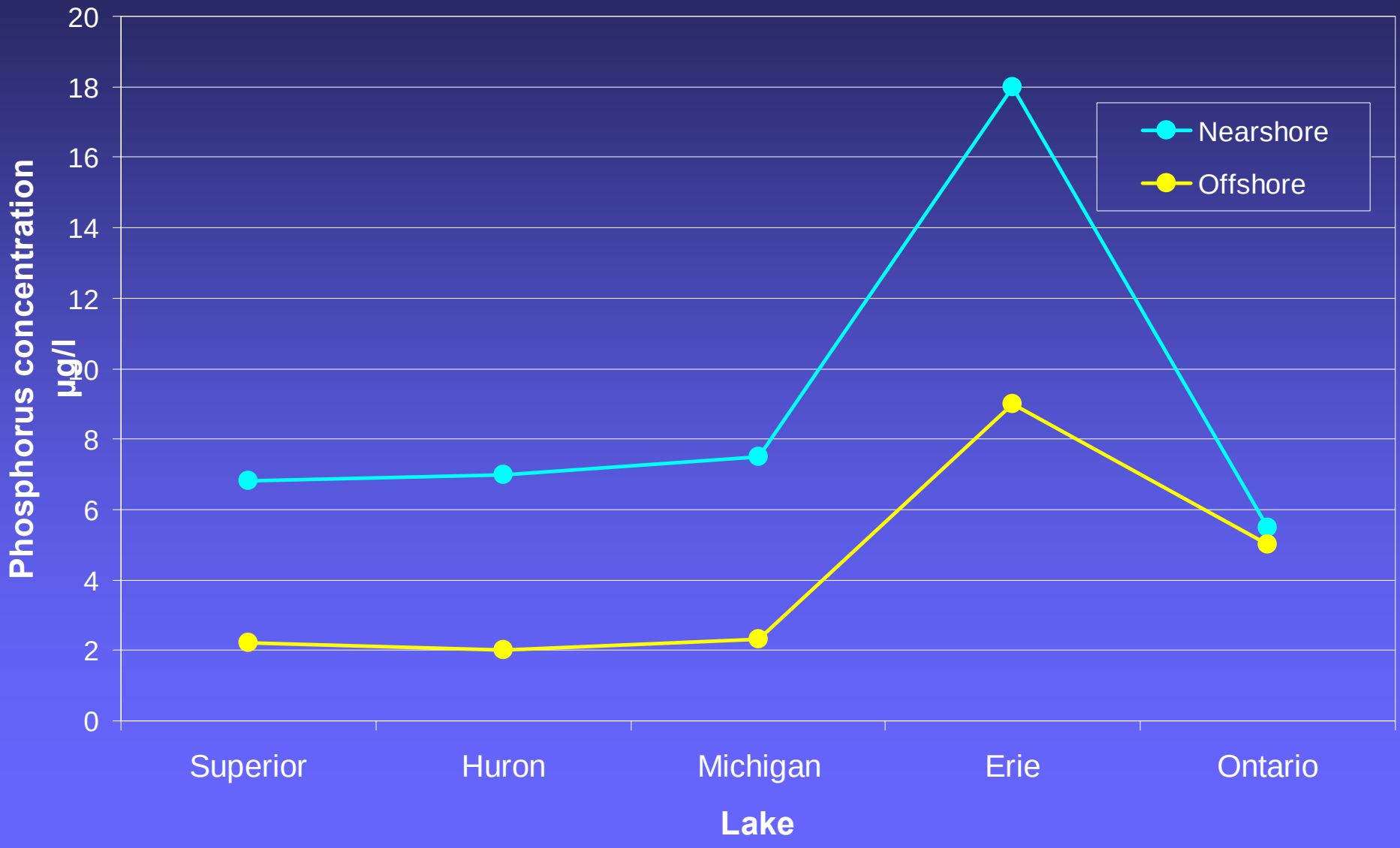
Nearshore Waters

- Nutrients
- Non-native species
- Viral Hemorrhagic Septicemia (VHS)
- *Cladophora*
- Harmful Algal Blooms
- Human health
- Botulism
- Physical processes and Nearshore habitat

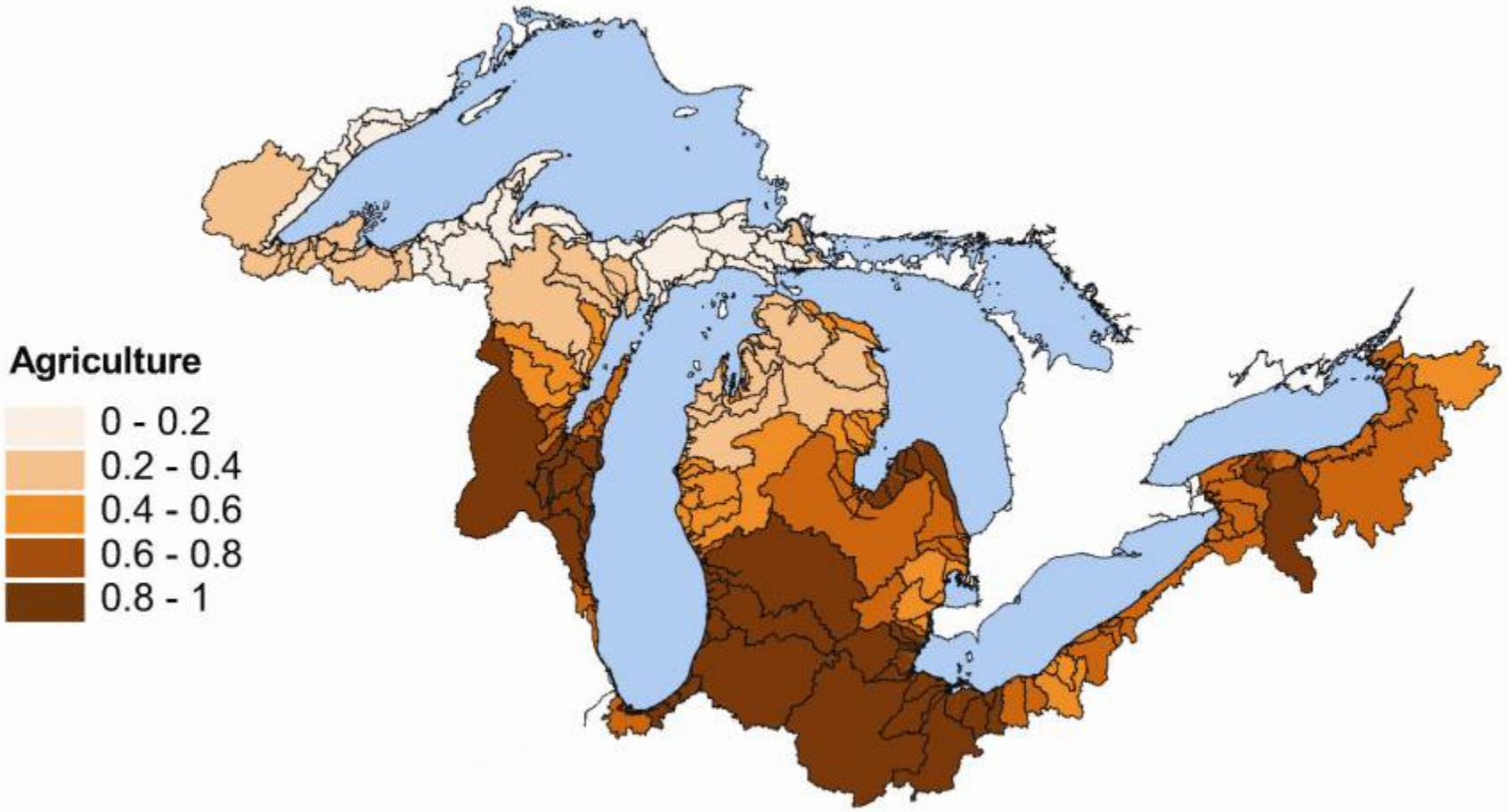
Nutrients

- Average concentrations of phosphorus and algae tend to be higher in the nearshore
- Nitrate is much higher in Erie and Ontario nearshore, perhaps consistent with agricultural and sewage sources
- Offshore Total Phosphorus is greater than 10 **u**g/L in 7% of samples, but only in Lake Erie
- Nearshore Total Phosphorus is greater than 10 ug/L in 18% of nearshore samples in all the Great Lakes
- Variability tends to be greater in the nearshore

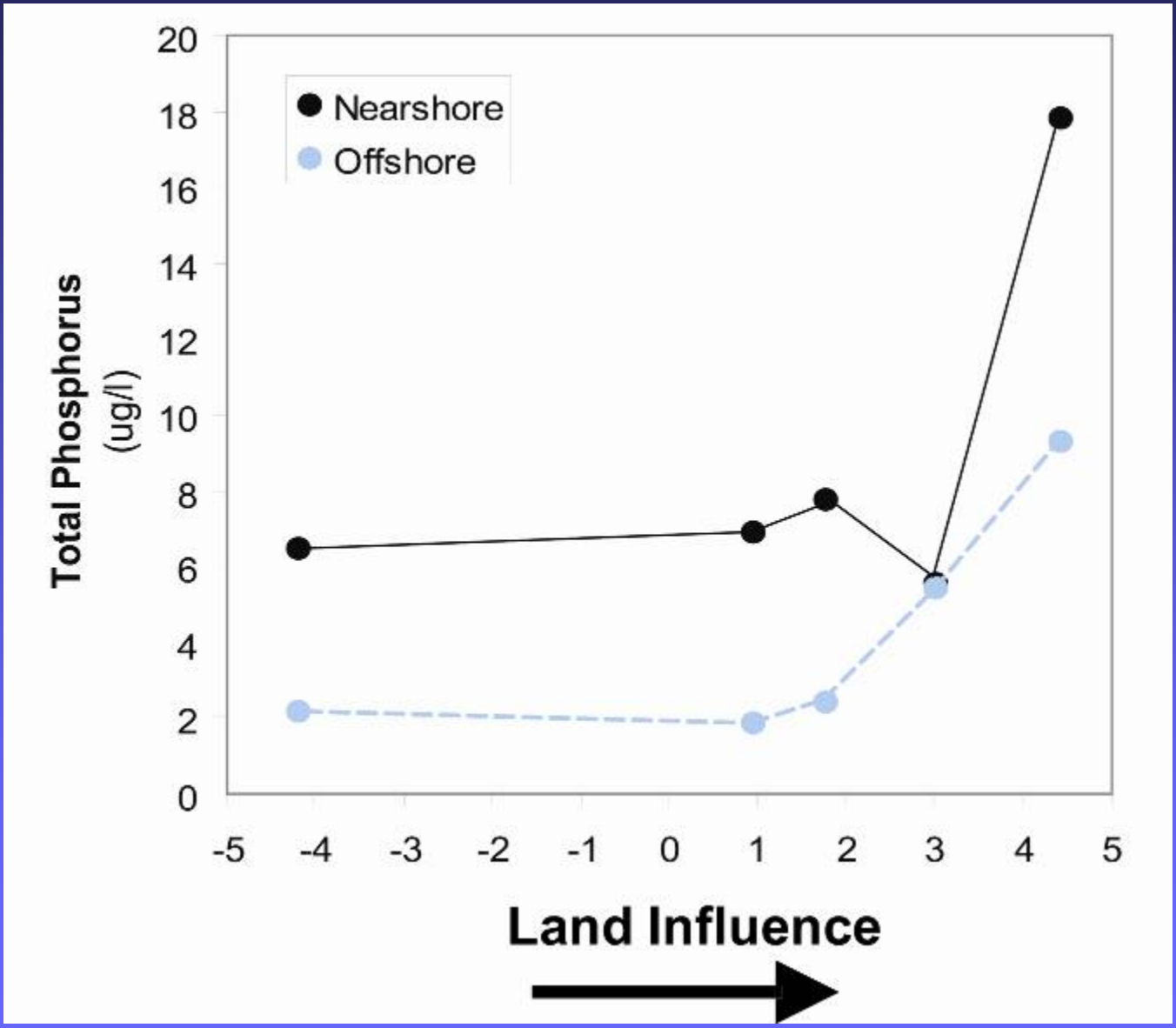
Phosphorus


Phosphorus concentration µg/l
20
18
16
14
12
10
8
6
4
2
0
Nearshore
Offshore
Superior
Huron
Michigan
Erie
Ontario
Lake

Land Use



Influence of Land on Phosphorus



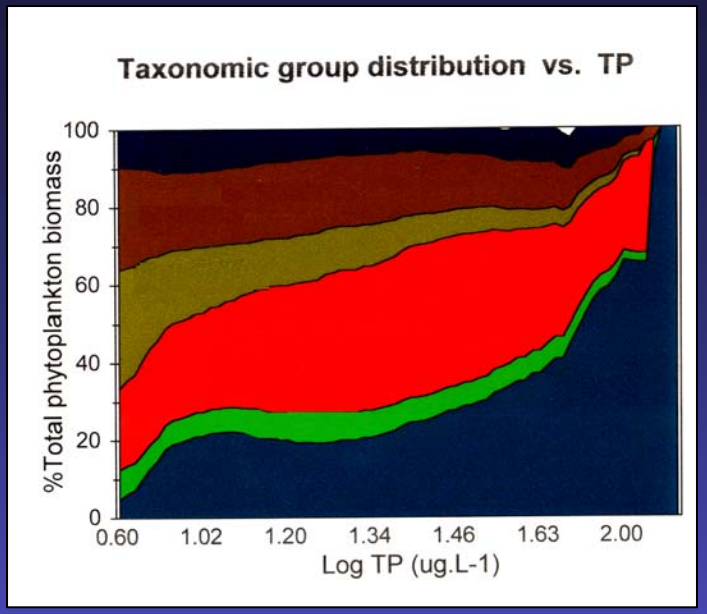
Harmful Algae Blooms (HABS)

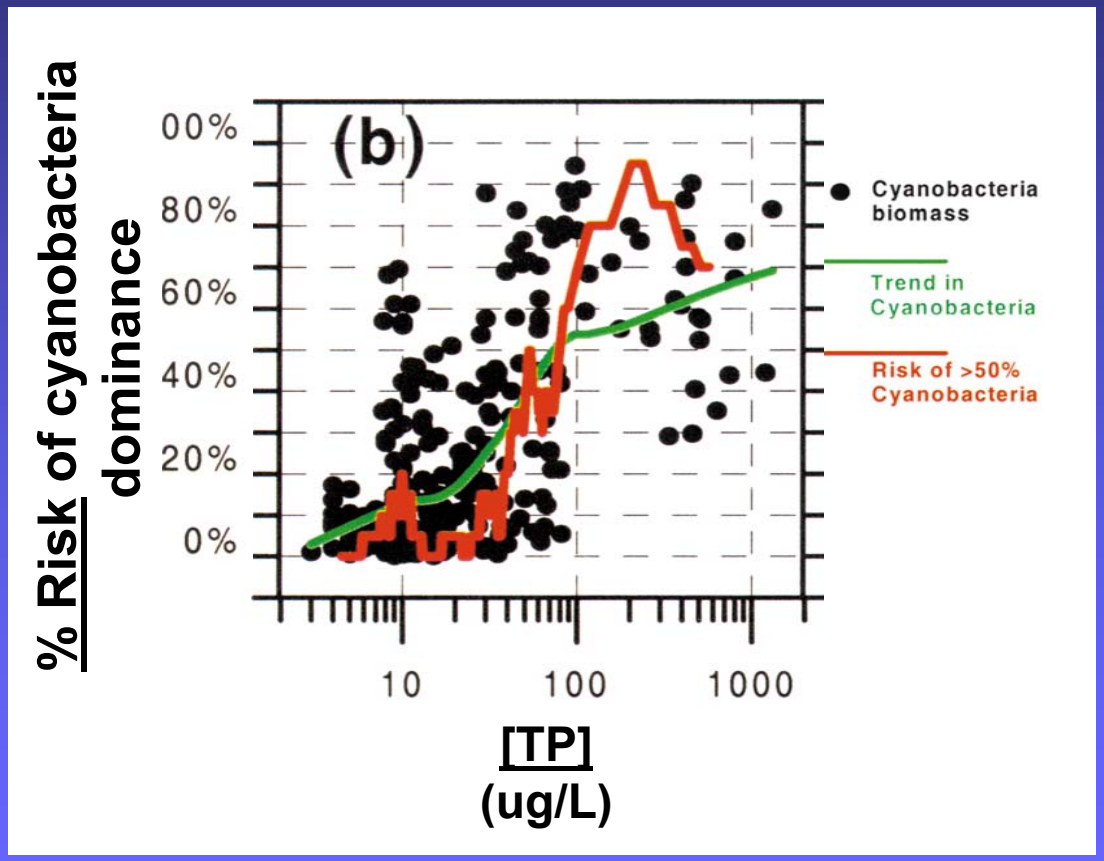
Hamilton Harbour 2 weeks ago (Hamilton Spectator)

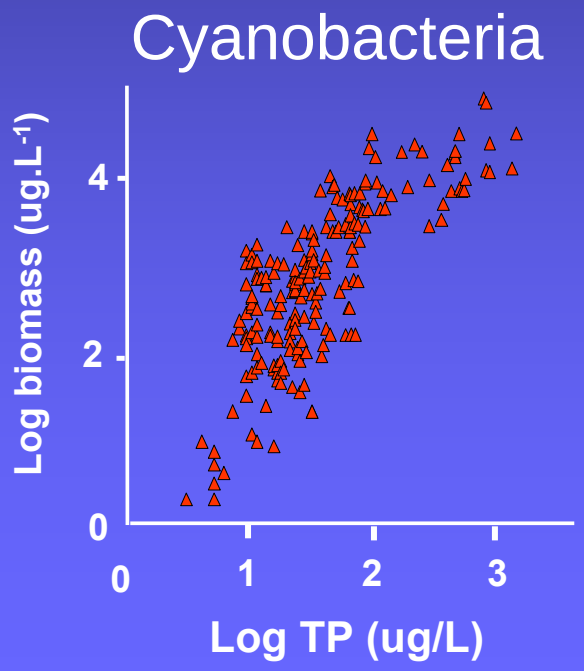
Harmful Algal Blooms (HABs)

- **Many planktonic, benthic & littoral species**
- **Many locations: nearshore & offshore waters**
- **Socioeconomic Impacts**
  - **Health** – toxins, carcinogens, irritants
  - **Drinking water** – toxins, taste-odour, aesthetics
  - **Fouling, clogging** – intakes, fish nets, shorelines
  - **Recreation** – beaches, tourist industry
  - **Tainting** – fish/shellfish/processed food/irrigation water
  - **Mortalities** – livestock/wildlife/pet/bird/fish
- **Ecological Impacts**
  - **Food webs** – toxins, inhibitors; diversity, species, food quality, anoxia, habitat change, invasive species, etc.

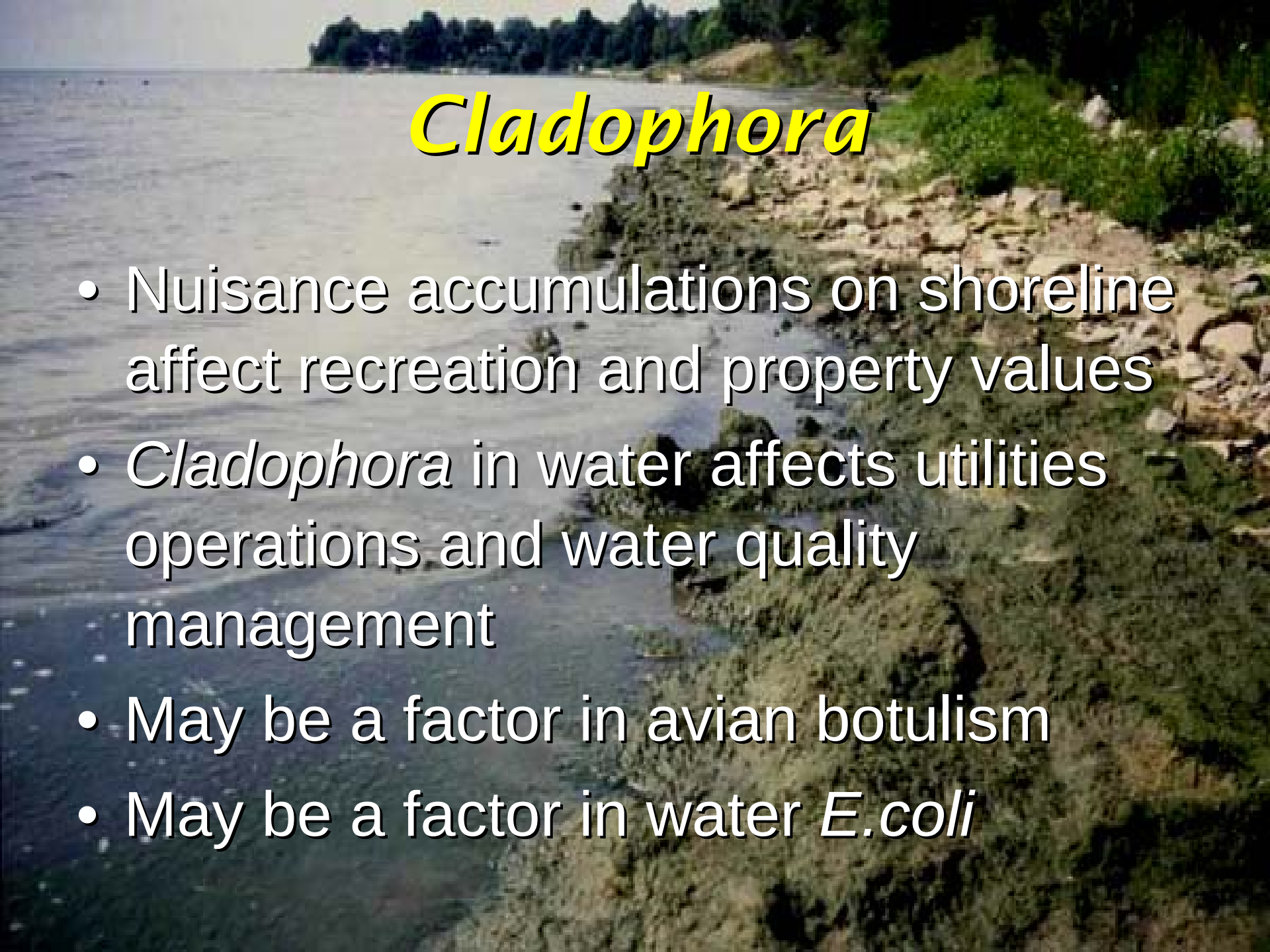
Risk: Increases with Phosphorus







Downing, Watson & McCauley (2001)



Cladophora

- Nuisance accumulations on shoreline affect recreation and property values
- *Cladophora* in water affects utilities operations and water quality management
- May be a factor in avian botulism
- May be a factor in water *E.coli*

Cladophora

- Problem was controlled by 1970s nutrient load limits
- Zebra and Quagga mussels have increased light availability so now *Cladophora* grows to greater depths
- Lack of prior research prohibits a solid conclusion that problem is worse
- **Clearly though, there is a problem today**

Photo credit: Rock Point Provincial Park; image by Scott Higgins

Cladophora Mitigation

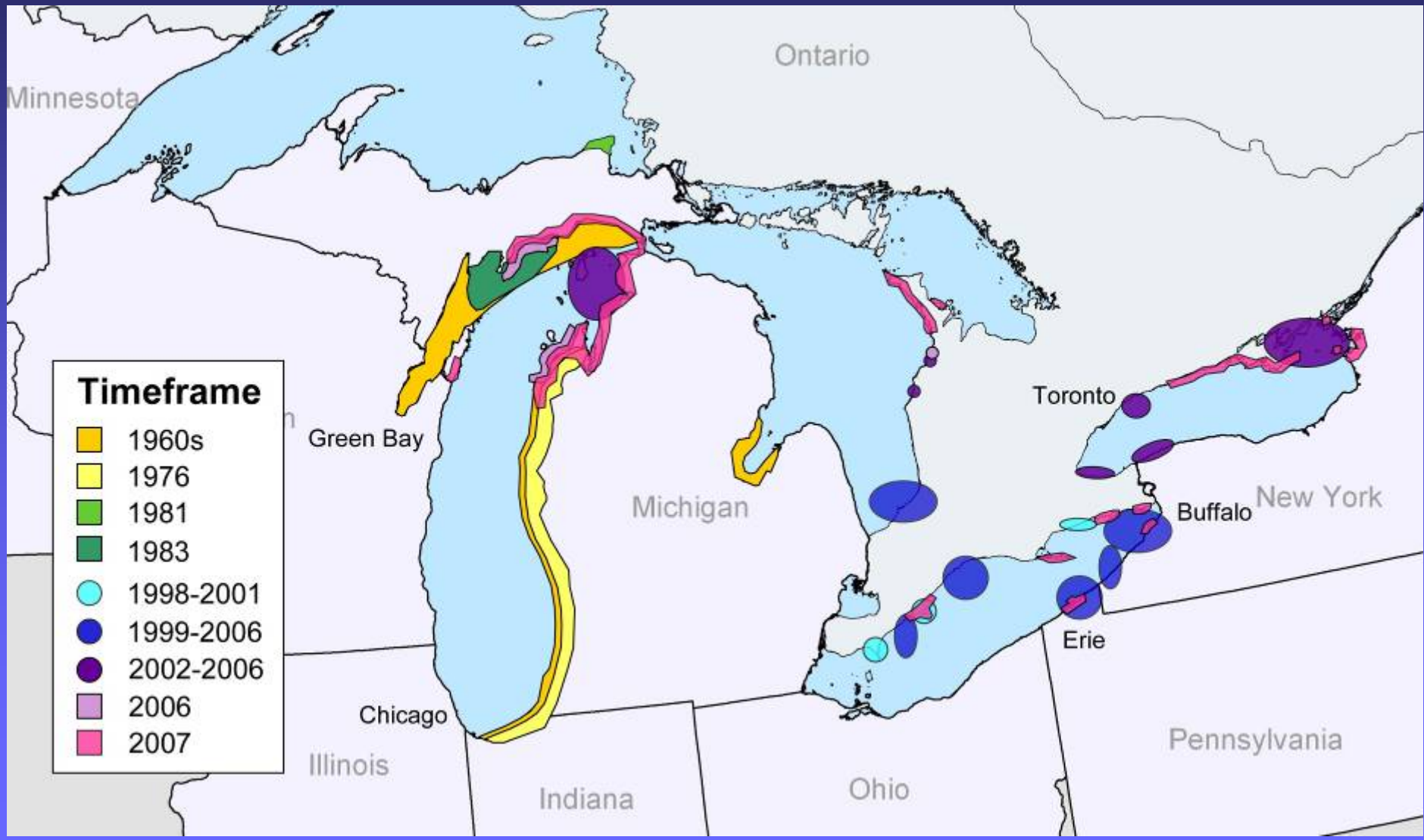
- The only way to mitigation is thought to be by further controlling soluble reactive phosphorus: treated sewage, urban runoff, agricultural runoff
- Fairly large *Cladophora* populations exist in the absence of obvious nutrient sources
- A nearshore detailed approach such as urban runoff control studies as well as a whole lake approach may be needed.

Cladophora Mitigation

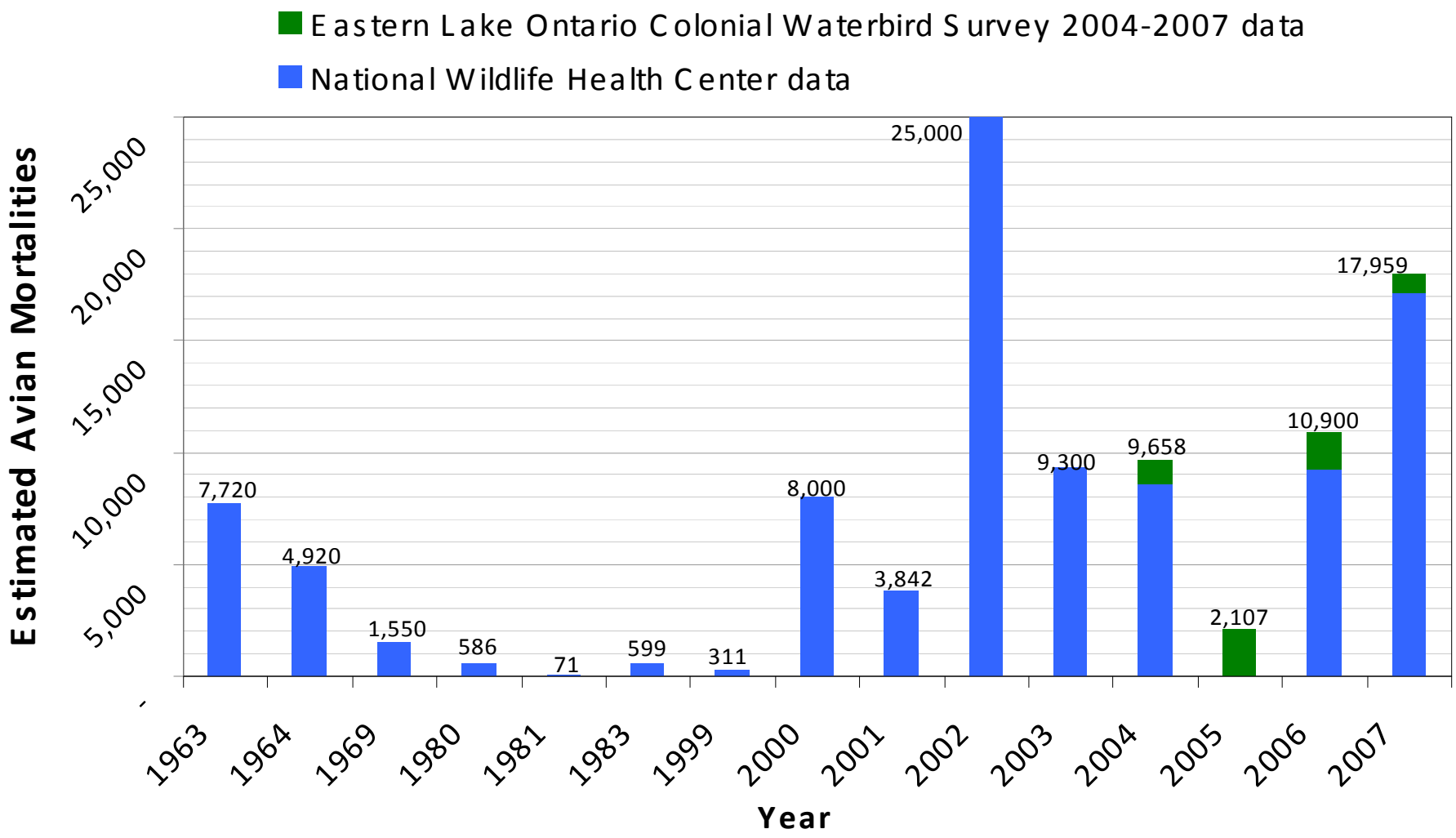
- Modelling is well advanced and still progressing
- Models will indicate reasonable expectations from further nutrient controls
- Consistent monitoring with traditional as well as remote sensing methods is needed.
- BUT mussels seem to facilitate nuisance growths far away from nutrient sources !

Photo credit: Brenda Moraska Lafrancois

Type E Botulism
Distribution of Historical Outbreaks

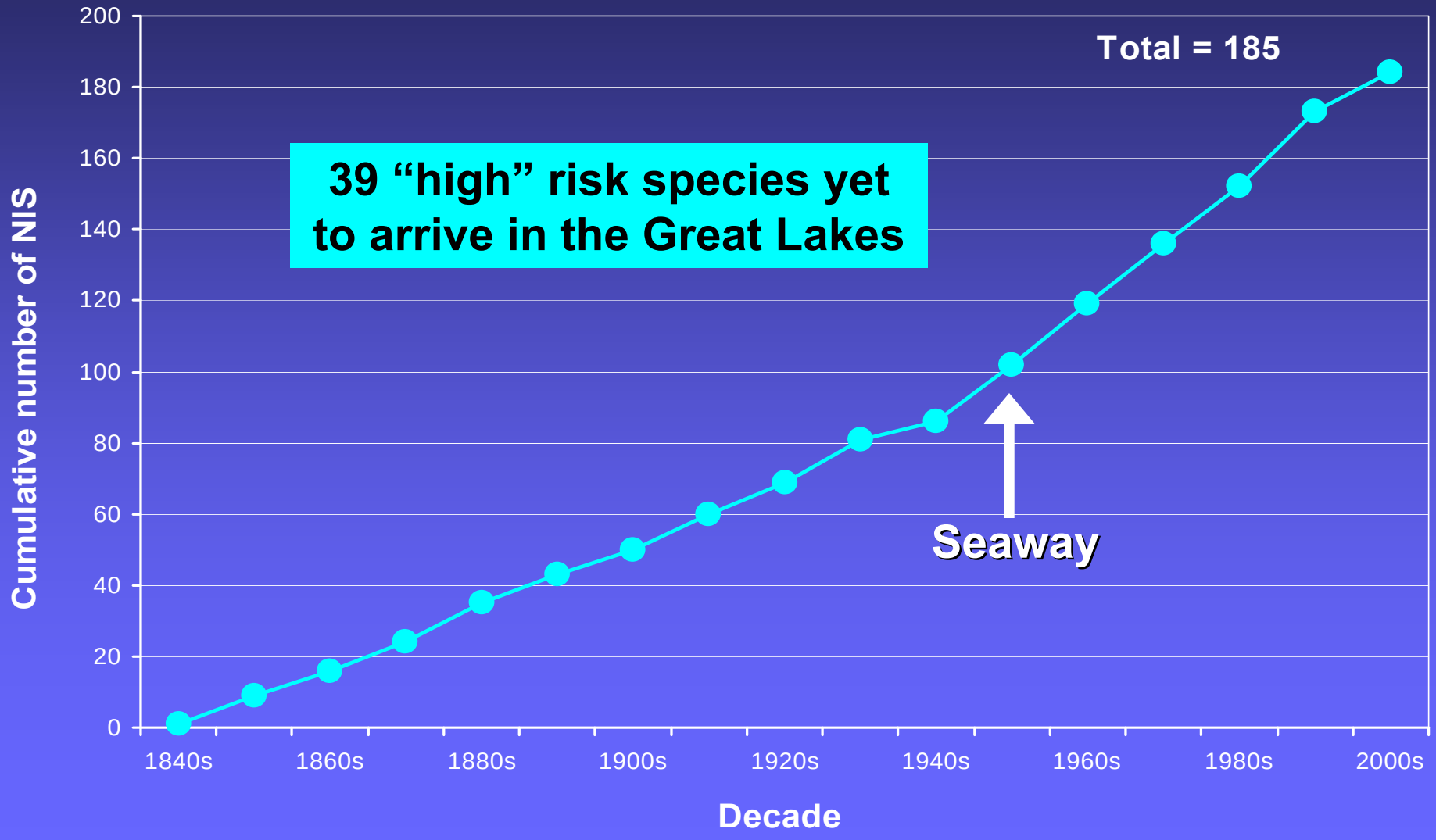


Avian Mortalities Related to Botulism



Graph sources: USGS – National Wildlife Health Center maintained databases, 2008;
Laird Shutt and Chip Weseloh, unpublished data from 2004-2007 Eastern Lake Ontario Colonial Waterbird Surveys, 2008

Non-Indigenous Species (NIS)



Non-Indigenous Species

- Status is poor
- 18 new species since 1996 = 1.5 per year!
- Status is deteriorating; each new species may disrupt existing food webs in unpredictable and/or undesirable ways


Photo credit: University of Windsor


Photo credit: Michigan Sea Grant


Photo credit: Minnesota Sea Grant


Photo credit: GLFC

Non-Indigenous Species: 3 "Bad" Ones

Cercopagis (fish hook waterflea)

- Competes against baby fish and planktivorous fish
- Fouls fishing gear

Photo credit: U.S. Environmental Protection Agency

Disease

- Viral Hemorragic Septicemia (VHS)
- Largemouth Bass Virus (LMBV)
- Spring Viremia of Carp (SVC)

Hemimysis (mysid shrimp)

- Competes against young fish, but may be a source of food for older fish

Photo credit: NOAA, GLERL

Nearshore Habitats

Physical Alteration of the Land/Water Interface

- New development is concentrated in coastal areas
- Shorelines are armored to protect property and infrastructure
- In Ohio, more than 75% of the coastline was armoured in 2000

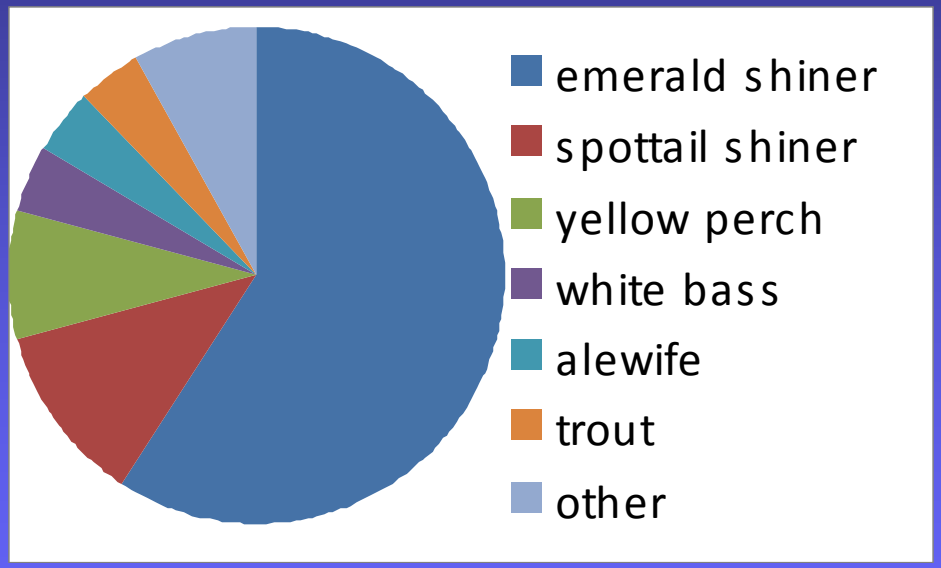
- Two-thirds reduction in mean erosion rates between 1990 and 2004 due to increased shore protection and lower Great Lakes water levels since 1999

Nearshore Impacts of Physical Alteration of the Land/Water Interface

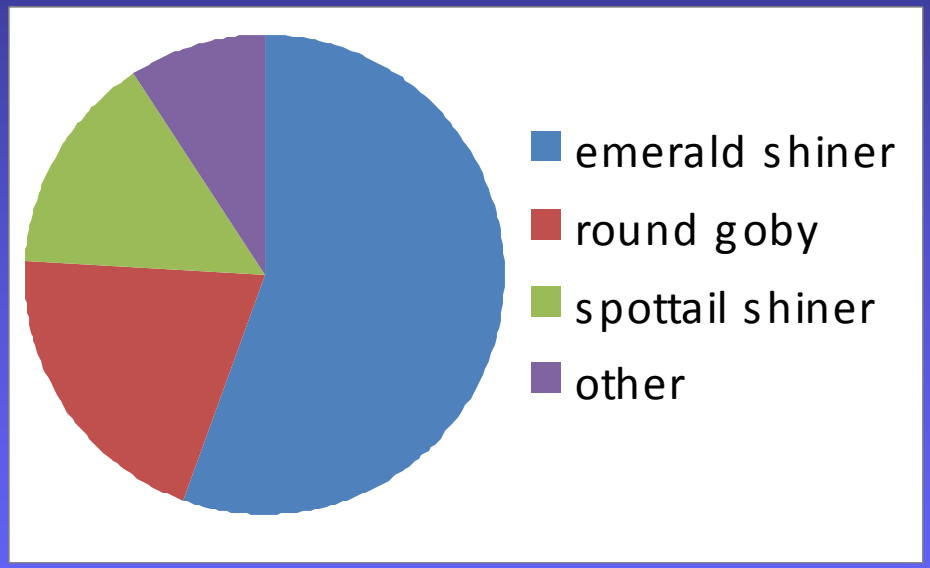
- Sand is trapped or redirected offshore
- Less beach nourishment causes thinner beaches and erosion of clay
- Erosion of clay deepens water, increases wave energy and degrades water quality
- Degraded coastal wetlands and river mouth habitats

Historical Changes to Lake Erie Beach Fish Assemblages

1940s



2005



An integration of nearshore effects?

Factors Related to Simplification of Lake Erie Beach Fishes

- Degradation of spawning habitat
- Eutrophication
  - nuisance blooms of *Cladophora*
- Channel darter – intolerant of poor shoreline. Protection structures lead to loss of sand and reduction in beaches (Meadows et al. 2005)
  - past century > 3500 structures built
- Invasive species
  - round goby: dominant nearshore species

Human Health
Great Lakes Beaches

83% of Great Lakes Beaches are open 95% of the Swimming Season

5% of Great Lakes Beaches are posted 5-9% of the Swimming Season

12% of Great Lakes Beaches are posted more than 10% of the Swimming Season

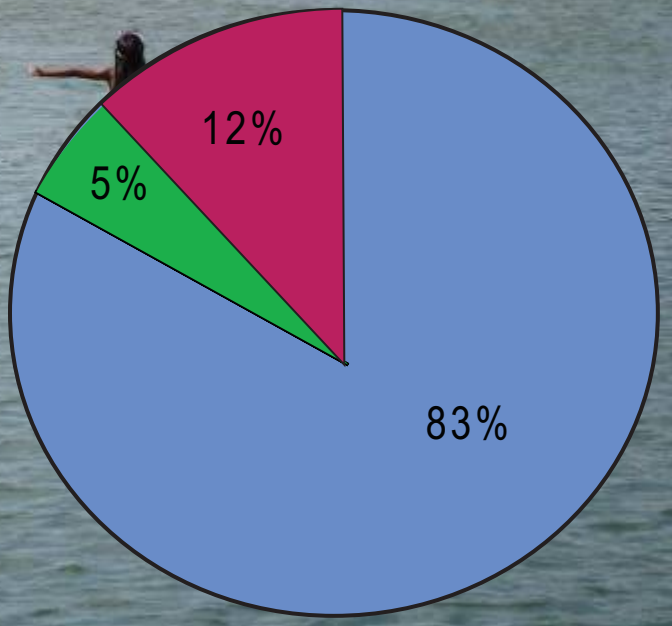
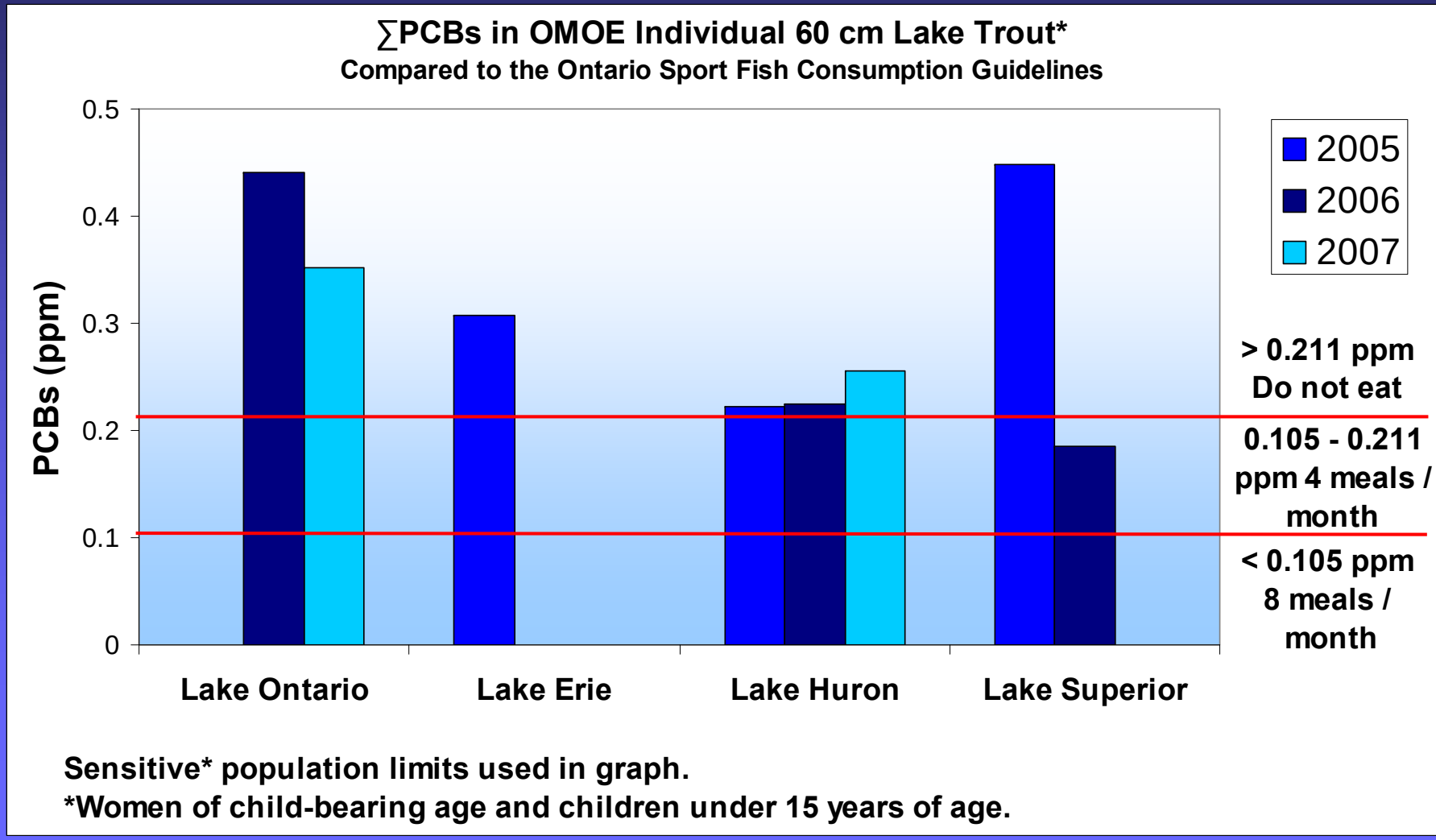


Photo credit: City of Toronto

Human Health
Fish Consumption



Sensitive* population limits used in graph.
***Women of child-bearing age and children under 15 years of age.**

Source: Ontario Ministry of the Environment

Nearshore Waters

Finally…

Afternoon Breakout Session

Adaptive Management Implications for the Changing Aquatic Nearshore

"What really can be done?"

Come to Plenary sessions tomorrow

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