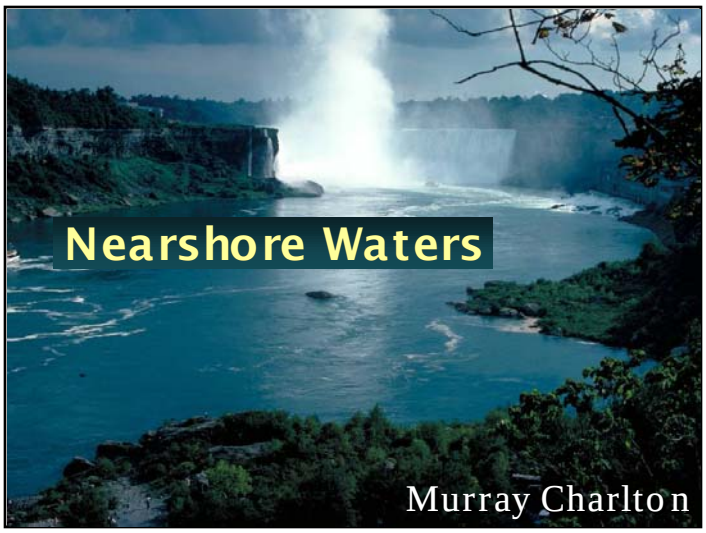

Good Afternoon

Since the SOLEC Nearshore report of 1996 many problems have stayed the same or become worse. During the same time some new issues have appeared and our understanding of some has increased dramatically.

CLICK

The nearshore is where we experience the water first hand. We drink it and at the same time discharge urban runoff and treated sewage into it.
Recreation and property values are affected by the condition of the nearshore.
Fish habitat is an important feature.
Due to alongshore currents there is the possibility of inter-jurisdictional transfers of pollution. And lets not forget our industries depend on good quality for process and cooling water flows.

CLICK

Nearshore Waters

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

The Nearshore Waters report has 8 chapters. I'll try to give the flavour of some of the highlights in this presentation.

CLICK

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 is usually the nutrient we are most concerned about where we have excessive algae problems.

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

A phosphorus concentration of 10 ug/L would be consistent with good water quality.

Offshore Total phosphorus is greater than 10 ug/L in 7% of samples, but only in Lake Erie – **So** offshore waters are generally in good condition.

In contrast, 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 consistent with mixing in of sources there
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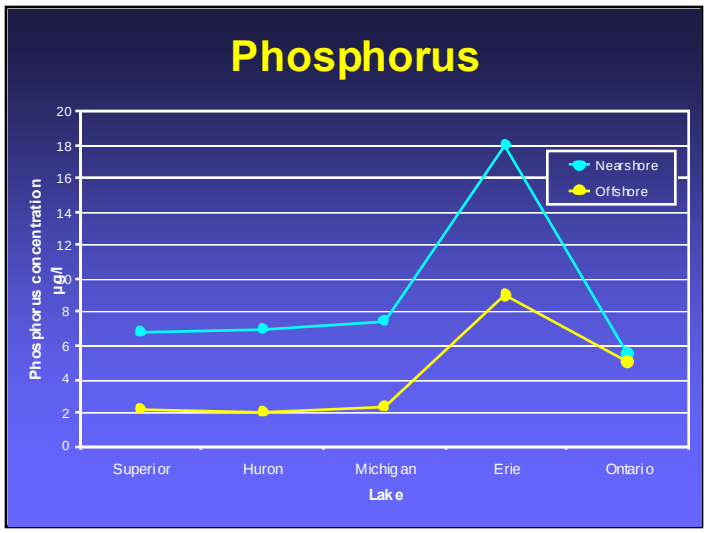

This graph shows total phosphorus nearshore and offshore in the Great Lakes – there is some doubt about the Lake Ontario data.

Phosphorus comes into the lakes in the nearshore and indeed is higher in nearshore zones and is high enough to help cause problems such as excessive Cladophora and blue green algae blooms in some places.

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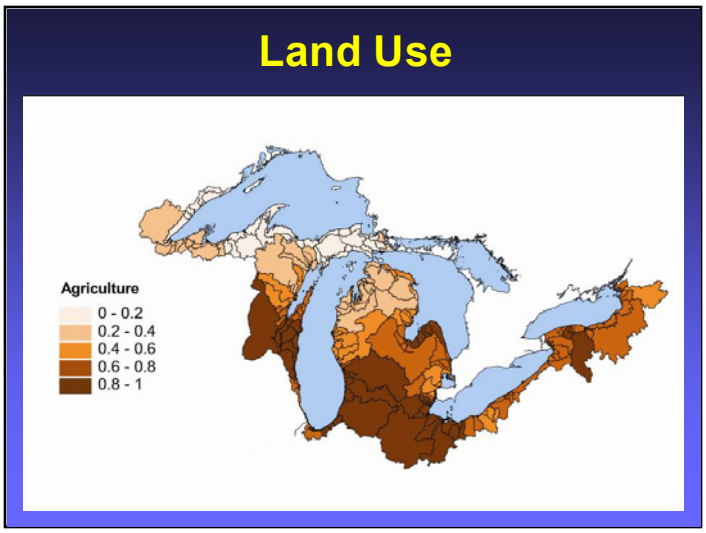

One pressure on water quality is increasing change in land use around the Great Lakes

The darker colours show the most development.

2.5% of U.S. land in drainage basin changed 1992 to 2001 – Half of this was non-developed to developed.

21% of development was within 10 km of the shoreline.

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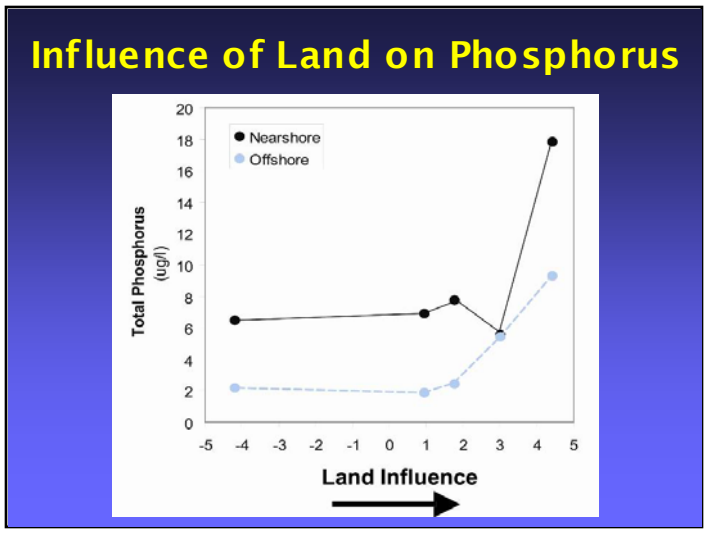

Here we have Total Phosphorus and the degree of agricultural development.

The degree of agricultural development is highest in the lower lakes and this correlates with potential to increase phosphorus in the nearshore and offshore.

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Harmful Algae Blooms can sometimes be spectacular such as this concentrated scum of toxic blue-green algae in Hamilton Harbour 2 weeks ago.

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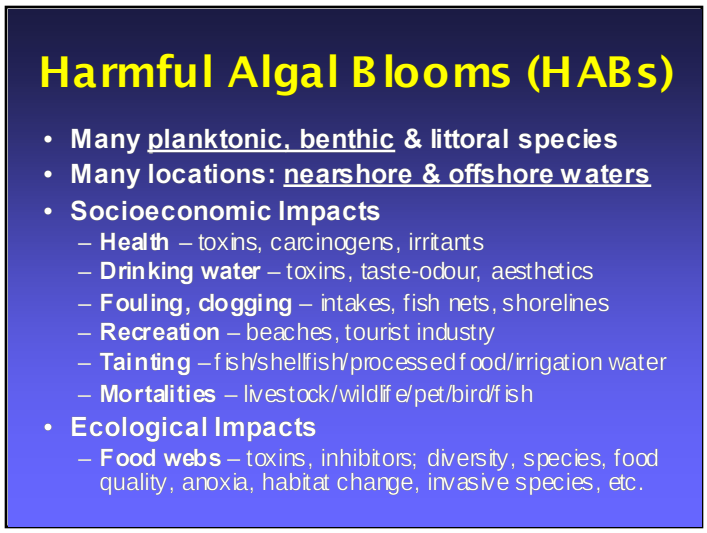

Harmful Algal Blooms (HABs)

•Many planktonic, benthic & littoral species

•Many locations: nearshore & offshore waters with many impacts…

•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.

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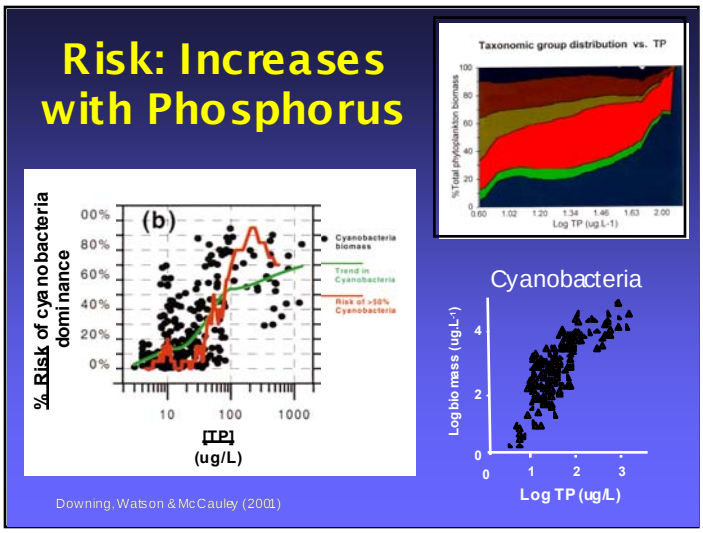

The average % risk of cyanobacterial or Blue-green algae dominance on the Y axis increases with TP levels on the X axis of the left hand graph. This is extreme above 50-60ug/L. note however the high variance around the "mesotrophic range" of 10 to 30 ugP/L – i.e. outbreaks, although erratic, can be severe sometimes with relatively low phosphorus.. Some rivers in Lake Erie have phosphorus higher than 60 ug/L.

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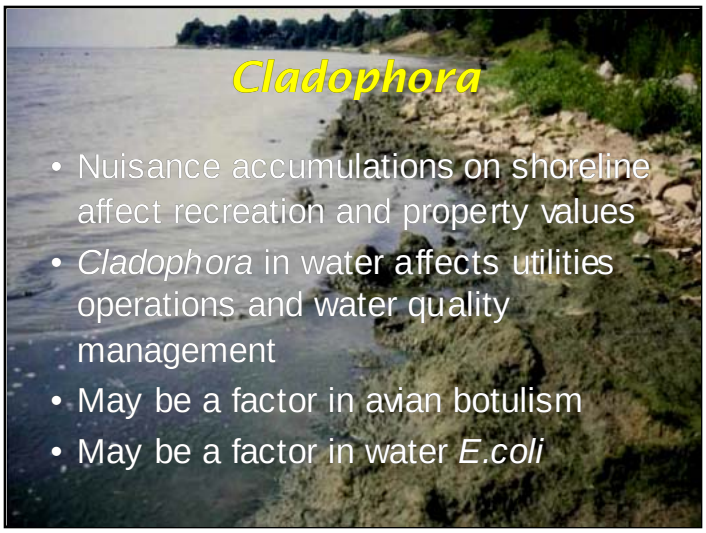

Cladophora grows as hair like filaments attached to rocky lake bottoms. Nuisance accumulations on shorelines, as in this slide, affect recreation and property values.

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*
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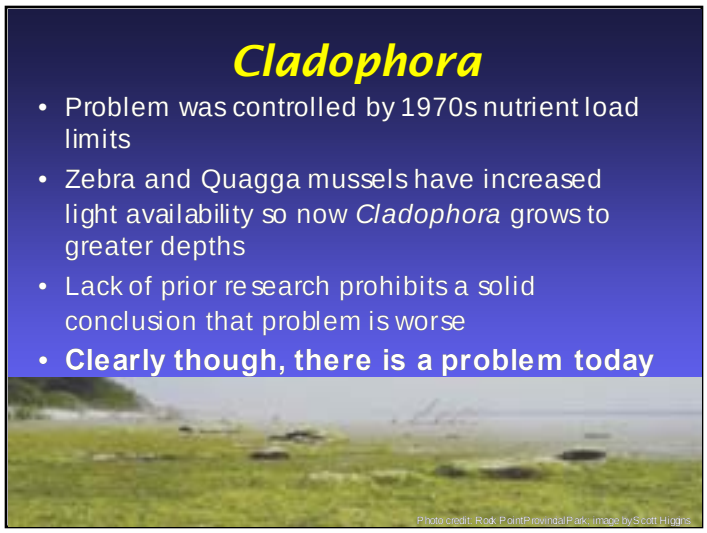

The Cladophora Problem was controlled by 1970s nutrient load limits.

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

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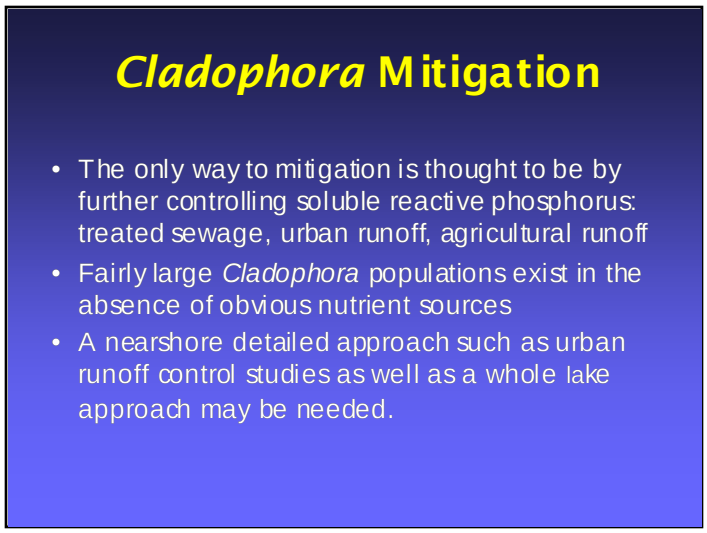

The only way to mitigation is thought to be by further controlling soluble reactive phosphorus: treated sewage, urban runoff, agricultural runoff

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.

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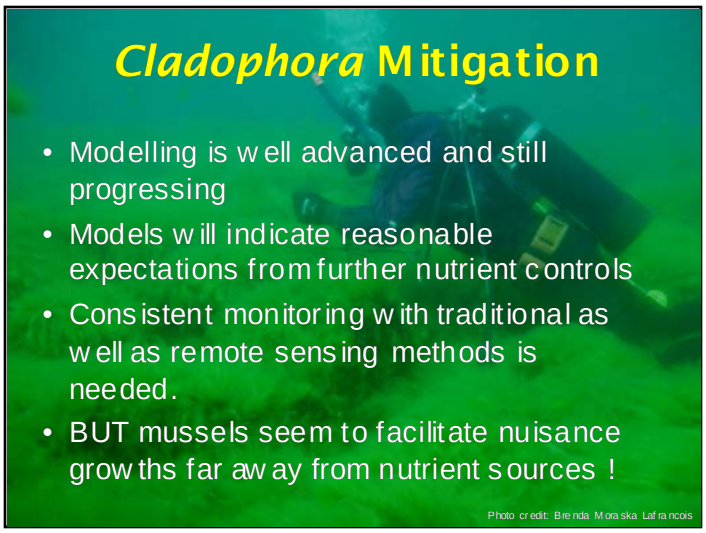
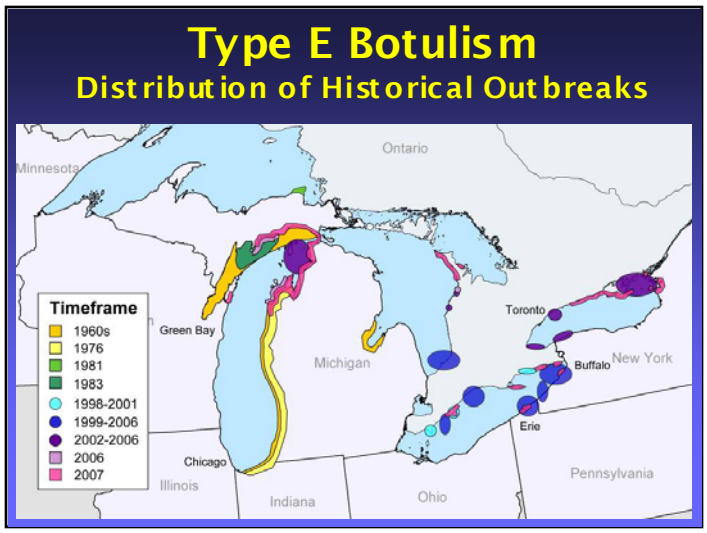


Modelling is well advanced and still progressing

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 so we may be stuck with this problem!



Type E botulism has been blamed as the cause for die-offs of fish and tens of thousands of birds around the Great Lakes, reaching as far back as the 1960s.

While mostly limited to the Northern and Eastern shores of Lake Michigan and Saginaw Bay several decades ago, in the past ten years, outbreaks shifted east and began occurring annually along other regions of Lake Huron in 1998, in Lake Erie in 1999, and in Lake Ontario after 2002.

Over the past few years, the location of outbreaks has shifted again to include areas in northern Lake Michigan, as Ken Hyde will elaborate on during the Lake Michigan presentation tomorrow.

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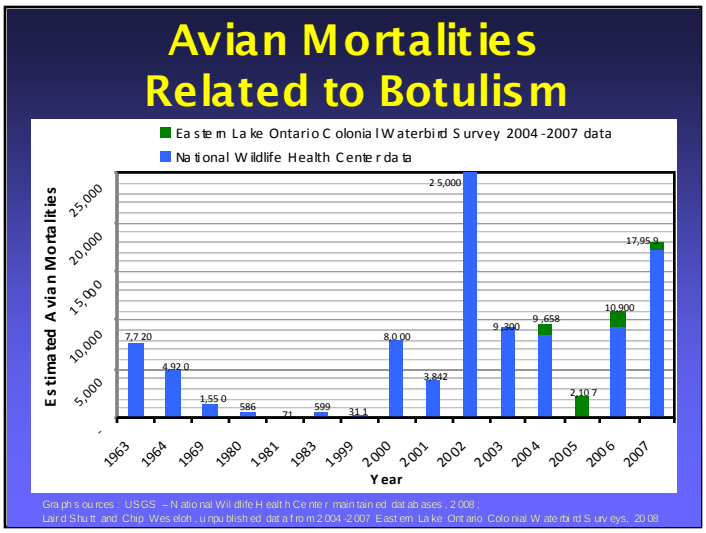


Avian deaths have been quite variable and data are incomplete but still some episodes have large numbers of mortalities.

There are several opportunities for additional research and mitigative actions that would help us begin to respond.

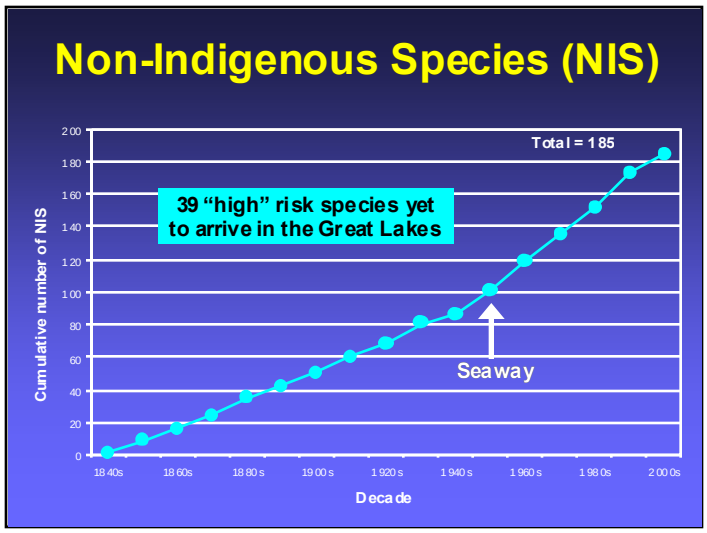
Such as,

•The development of an inexpensive and reliable field testing kit would enable more efficient monitoring

•Additional research investigating transfer mechanisms and environmental triggers would help focus potential responses

•Support of ongoing efforts in carcass clean-up during outbreaks may help to limit the extent of botulism outbreaks.

•Coordination of existing efforts and database improvement would also aid in focusing future research and response projects



Invasive non-indigenous species or alien species have become an increasing problem in the Great Lakes.

The graph shows the cumulative number of plants and animals that have invaded. We now have 184 species in the lakes; the rate of invasion increased with the St. Lawrence Seaway but may be decreasing lately.

Studies show that 39 species with a high risk of damaging invasion are yet to appear if introduction pathways are not closed.

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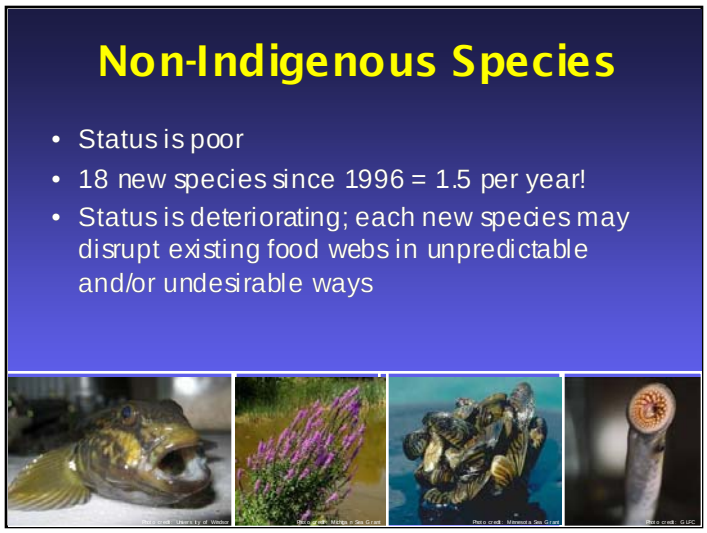

The status of the Non-indigenous species problem is poor

18 new species have invaded since 1996 = 1.5 per year!

The situation is deteriorating as each new species may disrupt existing food webs in unpredictable and/or undesirable ways

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Some bad examples of recent invaders are:

Cercopagis (fish hook waterflea)

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

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

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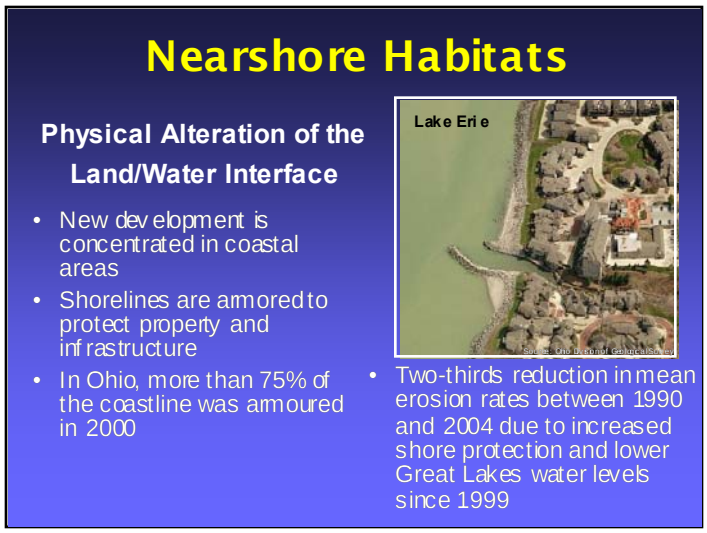

Physical alteration of the land-water interface is affecting nearshore habitats.

New development is concentrated along shorelines that are then armoured to protect property and infrastructure.

For example 75% of the Ohio shoreline is armoured.

Armouring has been successful in causing a two thirds reduction in erosion rates. BUT there is a downside to this.

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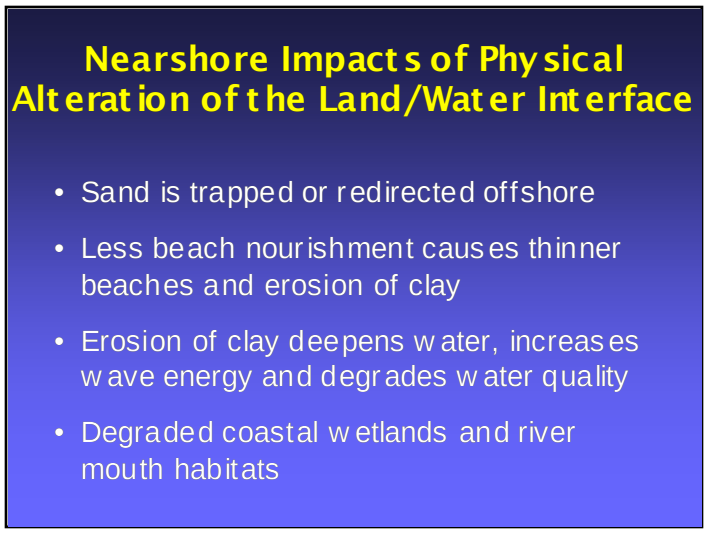

Sand is trapped or redirected offshore

Less beach nourishment causes thinner beaches and erosion of clay

Erosion of clay deepens water, increases wave energy and degrades water quality

This also causes degraded coastal wetlands and river mouth habitats .

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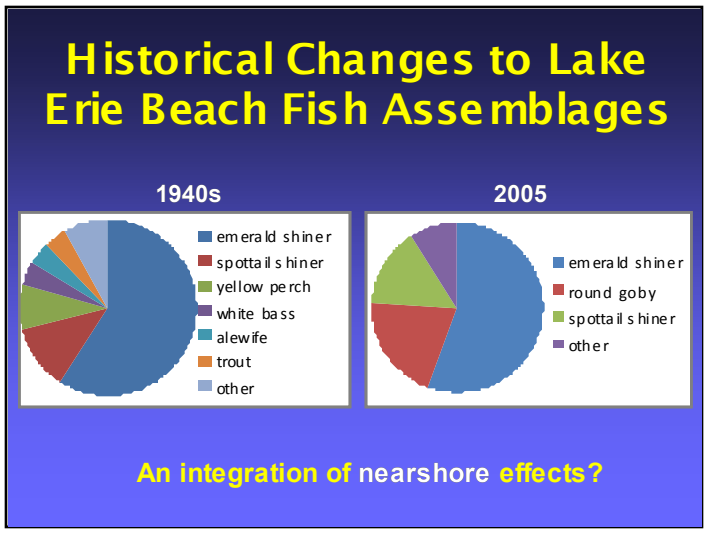

In a comparison of seining done off of Lake Erie beaches in the 1940s by Dr. Scott of the Royal Ontario Museum and recent seining done in 2005 and 2006:

-Using similar effort, more species were collected in the 1940s (40 species vs. 29 species)

-There was a greater diversity of species dominant in the 1940s

-Only emerald shiner and spottail shiner, two pelagic species, had similar relative abundances between the two time periods.

-Round goby was the second most dominant species in the recent sampling.

-CLICK

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

A number of nearshore effects mentioned in this presentation come together to cause problems for nearshore fish.

Eutrophication, Claodphora, Shoreline Protection, and, Invasive species all seem to contribute to loss of species richness in the nearshore fishery.

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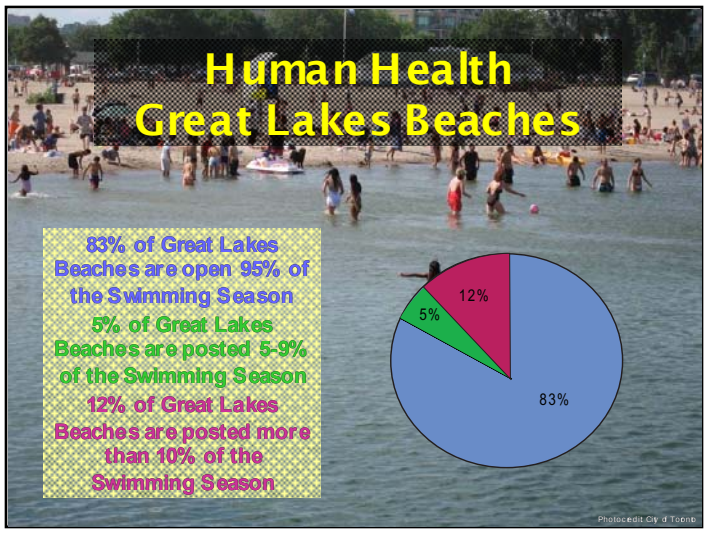

Conditions at Great Lakes beaches are generally quite good.

Posting criteria are quite stringent but still:

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

We now know bird faeces may be a factor in E.coli at beaches

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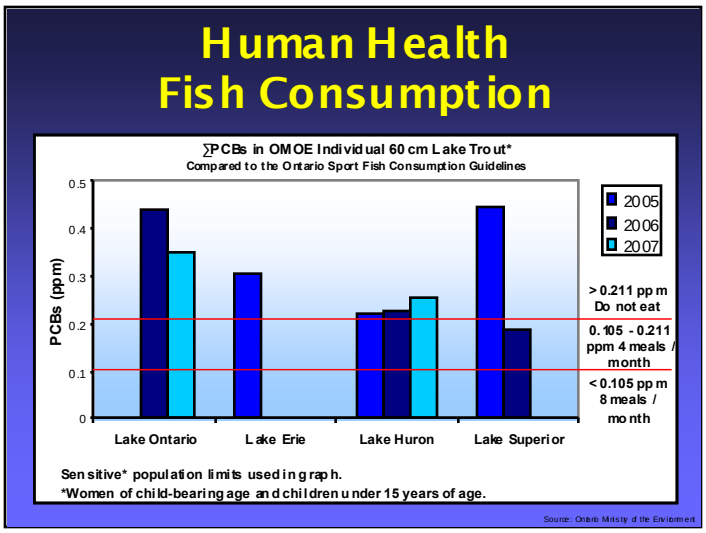

ΣPCBs in OMOE individual 60 cm lake trout compared to the Ontario Sport Fish Consumption Guidelines.

Advisory limits for sensitive populations (women of child-bearing age and children under 15 years of age) are used in graph.

Concentrations are generally declining but in many locations are above limits for the most sensitive people.

CLICK

Finally

Come to the breakout session this afternoon on..

Adaptive Management Implications for the Changing Aquatic Nearshore

"What really can be done?"

Acknowledgments

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