Good morning.

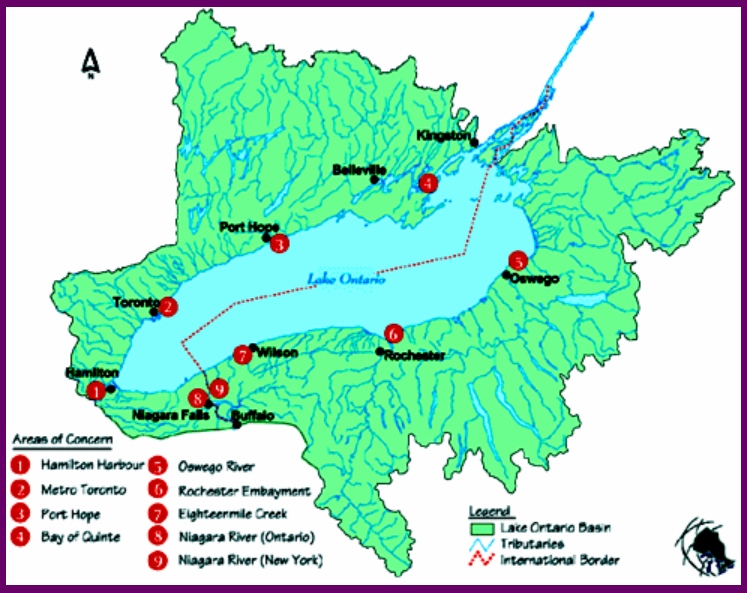
On behalf of the Lake Ontario LaMP, I will providing a brief overview of the State of the Lake Ontario ecosystem with respect to physical integrity.

Overview

- Introduction
  - Lake Ontario Basin
  - Physical characteristics and Lake processes
- Key factors affecting physical integrity
  - Lake level regulation
  - Zebra and quagga mussels
  - Urbanization
- Implications
- Summary

•In the time allotted, I will: provide a brief overview of the Lake, its drainage basin and physical processes and then focus on what we feel to be the key factors affecting the physical integrity of the Lake- lake level regulation; the impact of zebra and quagga mussels; and rapid urbanization - and the implications of these factors on the Lake and its ecosystem.

Lake Ontario drainage basin



•First some context- physical setting

•Lake Ontario is the last in the chain of Great Lakes.

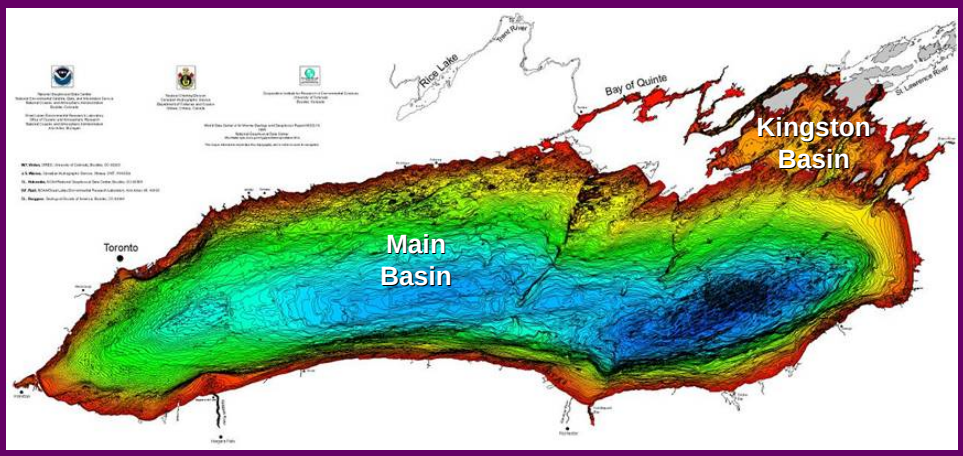
•More than eight million people live in the Lake Ontario basin, concentrated in the northwest part of the Canadian shoreline. This region, commonly referred to as the “Golden Horseshoe”, is highly urbanized and industrialized. The U.S. side of the lake is not as heavily populated, although there are concentrated areas of urbanization at Rochester, Syracuse and Oswego. Outside of these areas, agriculture and forests dominate the land uses within the basin.

•The Forested areas are mainly in the northernmost and southernmost areas of the watershed. Nearer to the Lake, forest habitat is highly fragmented

•There are nine Areas of Concern (AOCs) in the Lake Ontario basin (including the Niagara River AOC).

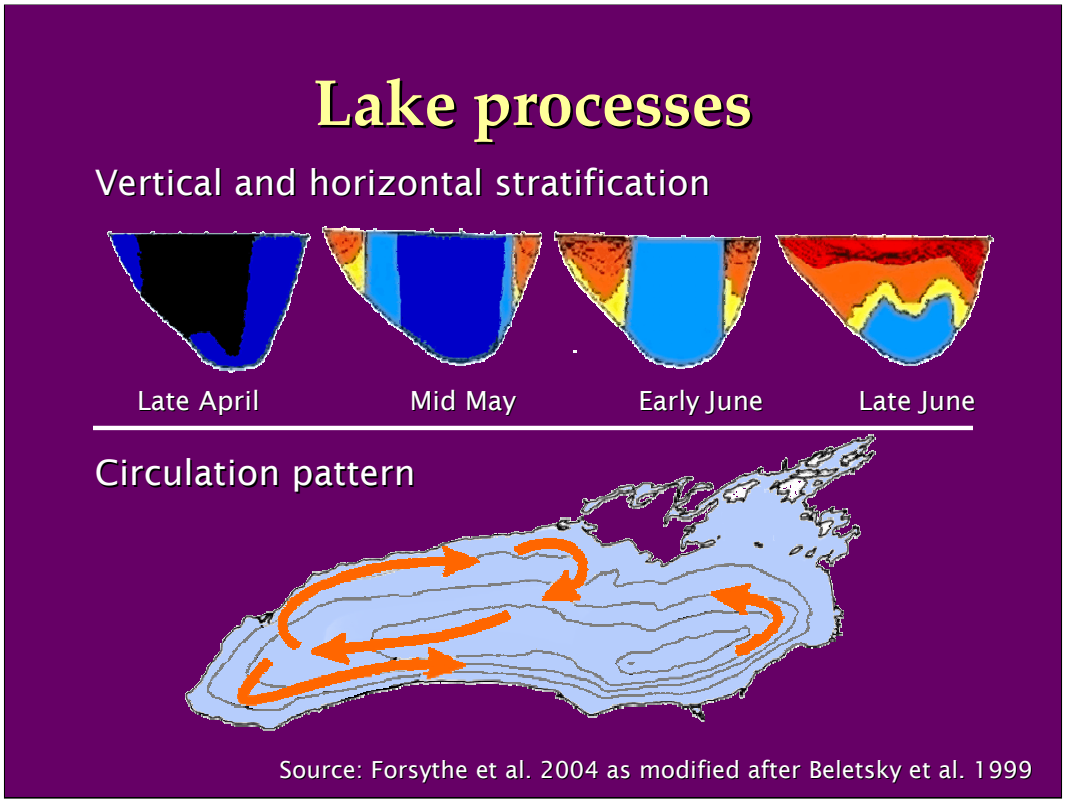
•Over 80% of the water flowing into Lake Ontario comes from the upper Great Lakes through the Niagara River.

Bathymetry



•In terms of the Lake itself- Lake Ontario is the smallest of the Great Lakes although it is relatively deep, with an average depth of 84 meters, and a water retention time estimated to be about seven years.

•There are two main sedimentary basins within Lake Ontario: 1) the Kingston Basin, which is a shallow basin located at the northeastern end of the Lake; and 2) a deeper main basin that covers the rest of the lake. Within the main basin there are three deep sub-basins: the Rochester, Mississauga, and Niagara Basins. These basins are bordered by a shallow inshore zone that extends along the perimeter of the main basin.

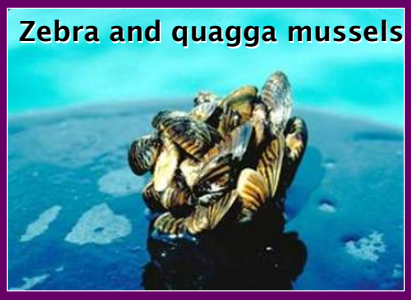


•Lake Ontario has a seasonally dependent pattern of both horizontal and vertical thermal stratification. What that means is that in the spring, the nearshore waters warm-up more quickly than the deep offshore waters. And since the density of water varies with temperature- the result is the Lake becomes stratified vertically between the nearshore and offshore zones- with very little mixing between the two. This thermal stratification lasts until about the middle of June when offshore waters finally warm and mixing occurs. (compared to other lakes)

•Then as the summer progresses the Lake experiences a a period of horizontal stratification- with very little mixing between the warm surface waters and the cool deeper waters. In the fall, when the surface waters cool, the waters mix again.

•The prevailing west-northwest winds combined with the eastward flow of water from the Niagara River are the most important influences on lake circulation- resulting in a counter-clockwise motion. Circulation of water generally occurs along the eastern shore and within the sub-basins of the main lake. There is very little net flow along the north, inshore zone.

Key factors affecting Physical Integrity

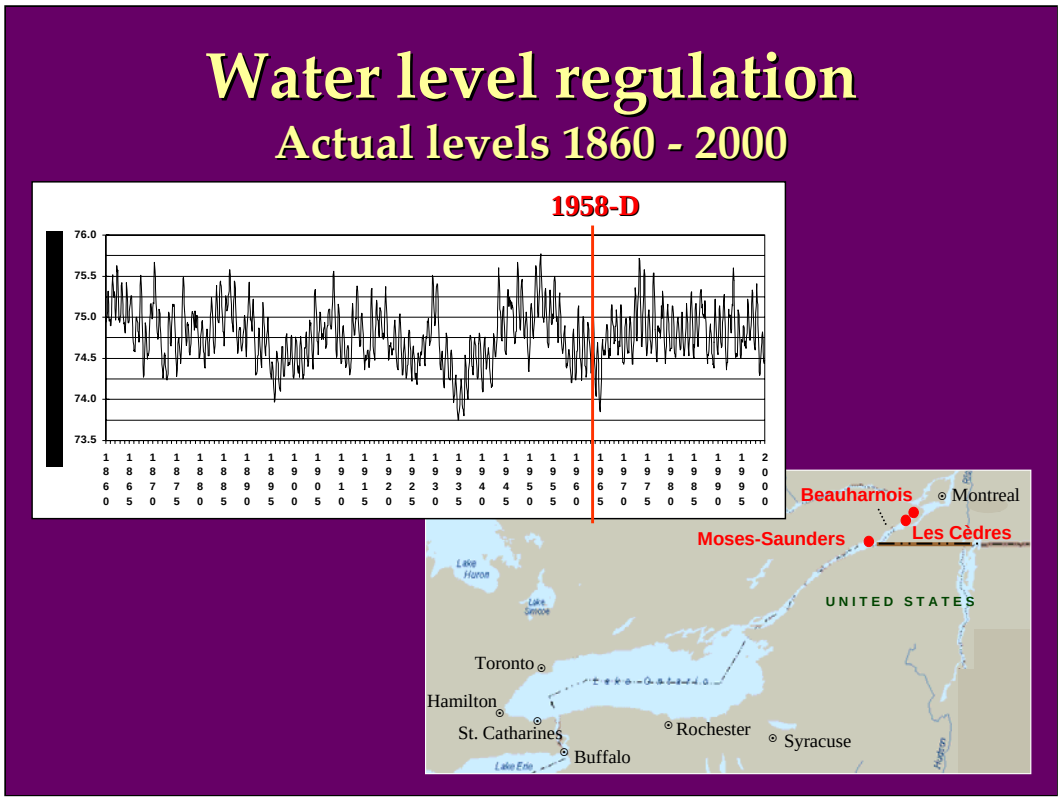


•Lake Ontario is an “ecosystem in transition”.

•Over the last hundred years the Lake has been subjected to a number of stresses including: overfishing, nutrient enrichment, contaminant discharges, the introduction of non-native species (eg. alewife, sea lamprey), and water level regulation, - which have lead to the degradation of water quality, the loss of fish and wildlife habitat and the decline of native fish communities.

•Currently, it is the collective opinion of the LaMP that: water level regulation; zebra and quagga mussels; and urbanization.are the most important issues impacting the physical integrity of the Lake.

•And these will be the focus of the presentation.



•First of all- water level regulation.

•Since 1960, Lake Ontario's water levels have been regulated by a series of dams on the St. Lawrence River.

•The Water levels are determined by the International Joint Commission (IJC) under a plan- known as 1958D- that seeks to balance a number of interests including hydropower, commercial navigation, and shoreline property owners downstream. It is important to note, however, that during the development of the plan, environmental and recreational factors were not considered.

•By managing lake levels, the range in water level fluctuations has been reduced- as you can see from this slide. During periods of sustained high or low water supplies, regulation of outflows has helped to make water levels more stable. During the extreme low water supply period of the mid-1960s, for example, Lake Ontario levels were maintained higher than they would have been. During the high water supply periods of the early and mid-1970s, mid-1980s, and 1993, water levels were held well below pre-project levels.

•Bottom line is - regulation has worked to reduce the range in fluctuations.

Water level regulation
Impacts on Biological Integrity

•Many scientists believe that water level regulation has had serious and lasting impacts on Lake Ontario's natural resources, including fish and wildlife, shoreline habitat and dune barrier systems, and the numerous wetland complexes that line the shoreline.

•For example, there is considerable evidence to suggest that the management of lake levels has inadvertently reduced the area, quality and functioning of Lake Ontario nearshore wetlands.

•As a result of lake level management, Lake Ontario wetlands are no longer experiencing the same range of periodic high and low water levels.

•Regulated water levels have affected the natural range, frequency, timing and duration of water level changes in coastal wetlands, and in turn reduced the extent and diversity of wetland communities and altered habitat quality for wetland fauna.

•The low levels of variations in water levels are thought to have lead to cattail dominance and reduced species diversity in coastal wetlands.

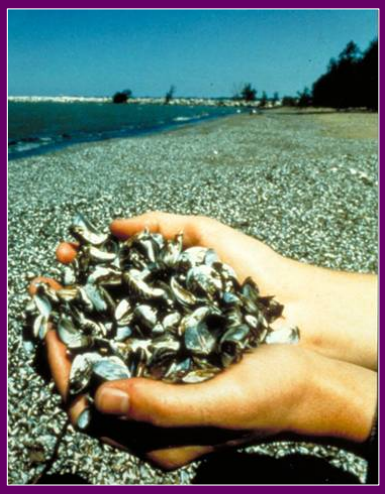
•The full range of the impacts of these changes, however, has never been documented- until now.

•The International Lake Ontario-St. Lawrence River Water Level Study is currently in year 4 of a major 5 year study evaluating the potential impacts of changing water levels on all affected interests including the environment. If you are interested in learning more ….suggest you attend the break-out session this afternoon.

Non-native species
Impacts on Physical Integrity

- Increased light penetration
- Major modifications to habitats - on shore and nearshore

"Changes are forever"



•The 2nd factor

•in Lake Ontario, zebra and quagga mussels have changed many aspects of the physical habitat of the Lake. Their filtering activities have greatly reduced the amounts of material in the water column, thereby increasing light penetration.

• Increased light penetration has, in turn, has allowed re-growth of extensive macrophyte beds in many littoral areas.

•The innumerable shells released as the mussels die have modified onshore and nearshore habitats, creating shell beaches, like the one pictured here, that in many cases have smothered shoreline boulder complexes.

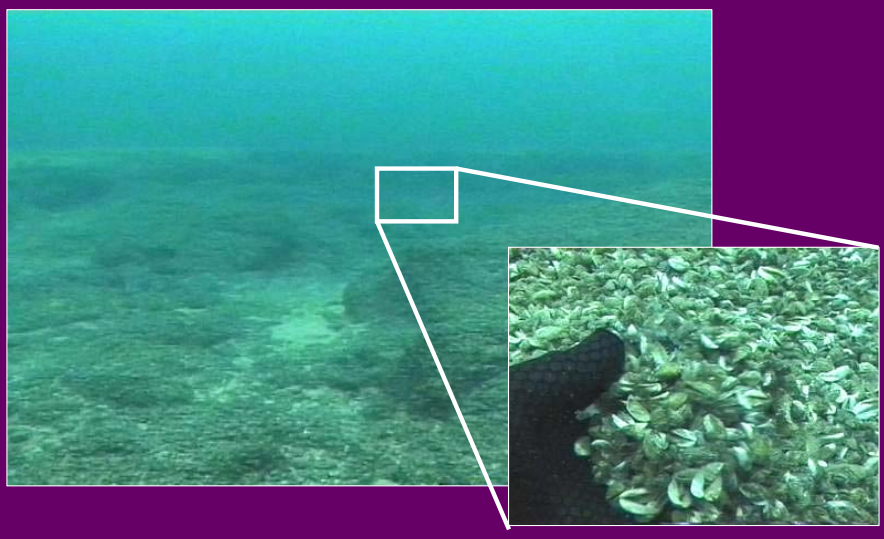
•Colonies have coated many harder substances as well, encrusting many manmade features.

•In littoral and sublittoral areas, colonies have formed clumps and piles over soft substrates.

•Deeper still, the quaggas have formed colonies that sit on top of mud substrates.

Non-native species

Impacts on Biological and Chemical Integrity



•Not only have these non-native mussels affected the physical habitat of the Lake, they have also dramatically impacted the Lake's biological and chemivcal integrity.

•The zebra and quagga mussels filter water to feed on microscopic phytoplankton and other organic material, thereby reducing the amount of food available to other benthic organisms.

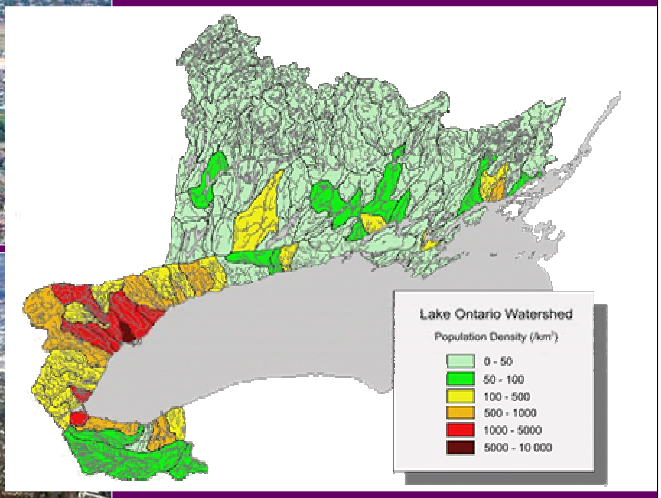
•As a result, populations of important native benthic organisms have generally declined, and this has created a ripple effect that has affected the health of the fisheries- which you will hear more about from Bruce Morrison in the next presentation..

•As new exotic species continue to be introduced from ballast water from overseas shipping and other sources, the potential for impacts from other non-native species is considerable. Some recently introduced species in Lake Ontario, such as the Round Goby and a zooplankton species called the Fish-Hook Water Flea, have taken advantage of the unstable conditions in Lake Ontario and have expanded rapidly as well.

•Another emerging issue is Type E Botulism. Interactions between zebra/quagga mussels and the round goby are thought to have created conditions in the Lake that favour the growth of Type E botulism which has now been detected at a few locations along the Lake Ontario shoreline- most recently this summer on the North East shore.

•From a management perspective, it is not clear what the future holds. Once a non-native species is introduced, it disrupts the food web and creates a ripple effect. You can never go back to what you had originally- the changes are irreversible- which is why prevention is the key.

Urbanization



•The 3rd factor I would like to discuss is urbanization.

•On the Canadian side, land use and population growth are also putting an enormous stress on the system and this stress is growing. It is projected that by 2030- 3.0 million more people will live in the Lake Ontario basin, concentrated at the western end of the Lake.

•It is important to note, however, that this same growth pressure is not being felt on the U.S. side- where only modest increases in population (3.7% over the next 20 years) are forecast.

•Most of the growth will be concentrated in the Golden Horseshoe, where low-density urban sprawl is spreading rapidly over the countryside, removing large areas of farmland and natural habitats. This rapid urban growth is projected to continue around Toronto and into the Hamilton-Niagara Area.

•Between 1996 and 2001 more than 90% of Ontario's population growth took place in this region (11).

•In fact, this is the third fastest growing area in North America and one of the top 10 most sprawling regions in the world (10).

•It is projected that the region's population will grow from 7.4 million in 2000 to 10.5 million in 2031- an increase of 43% (11).

•In the region, more than 1000 square kilometers of land will be urbanized- most of it prime agricultural land (9). This is almost double the area of the City of Toronto and represents a 45% increase in the amount of urbanized land in the region.

•At issue is not only the absolute growth in population, but the nature of that growth. The fringe development is sprawling- consuming 2 to 3 times more land per person than neighborhoods in the old City of Toronto, which were built prior to World War 2 (7).

Urbanization
Impacts on integrity

- Hydrologic cycle altered
- Increase in impervious cover - more runoff, more/higher peak flows, lower baseflows
- Watersheds degraded and getting worse
- Increase in contaminants
- Vehicle emissions to increase 42%

•Urbanization radically alters an area's hydrologic regime. Increase in impervious cover- leads to increases in stormwater runoff, more and higher peak flows and lower baseflows.

•There is a strong negative relationship between urban stream quality and impervious cover- the more impervious the land area, the greater the level of stream impairment.

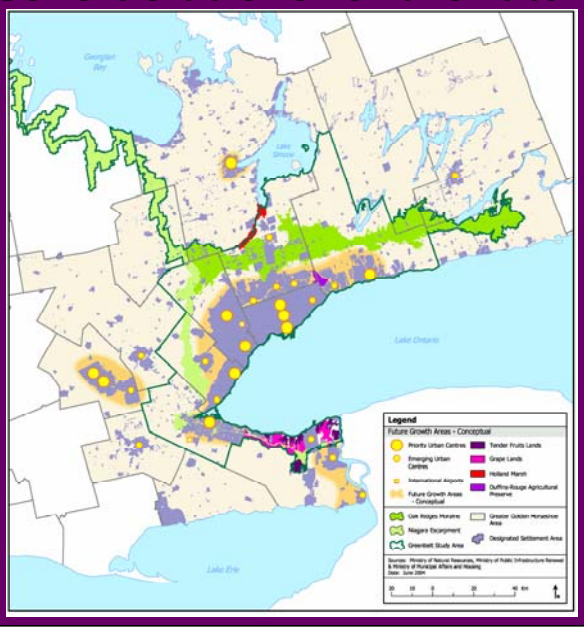
•A review of the literature has shown that less than 10% imperviousness in an urbanizing watershed is required to maintain stream water quality and quantity, and preserve aquatic species density and biodiversity. An upper limit of 30% has been found to be a threshold for degraded streams.

•Lower density development with less impervious surface cover yields greater rates of urban run-off on a per capita basis than dense urban development that consists mainly of impervious surface coverage. In other words, estimated per capita discharges in stormwater runoff decrease with higher density development (6,8).

•This effect is due to the fact that the infrastructure and house footprint requirements for low density development at the site level increase the rate at which land in the watershed is developed. As previously undeveloped land is converted to developed uses, pervious open space and naturally absorbent land is converted to roads, houses, shopping malls, businesses and other uses. The compacted lawns that typically accompany this style of development function much differently that natural green space(6).

•In addition such development requires greater amounts of transportation-related impervious infrastructure, such as roads, driveways, and parking lots. If development is entirely auto-dependent – which is the general case in low density development – it can increase vehicle miles traveled and associated air pollution, which also impacts water quality through air-to-water deposition (6).

Urbanization
Considerations for the future



•The IJC's 12th Beinnial report has posed a fundamental physical integrity question for all of us: "collectively are, our policy, program and management efforts sufficient to protect water quality from the effects of sustained expansion of major urban areas in the Great Lakes Basin and ensure ecosystem integrity?"

•Pictured here are the projected growth areas in Southern Ontario. The current settlement areas are pictured here in purple. The yellow dots represent areas targeted for intensification and the darker orange is proposed new development areas (9).

•It will be very difficult, if not impossible to maintain recommended 30% natural cover guidelines at the western end of Lake Ontario with these development pressures. Furthermore, our experience in watersheds such as the Don, suggest that natural heritage and source water protection systems will be severely stressed under development scenarios such as this.

•In terms of management considerations- can't stop more growth and development. The challenge will be to design our communities to accommodate more people- without rampant urban sprawl- and to protect nature for future generations.

Summary

Lake Ontario - an “ecosystem in transition”

•For more information on the State of Lake Ontario (from a broader perspective than physical integrity)- suggest you pick the handout available at the registration desk.

•Thank you