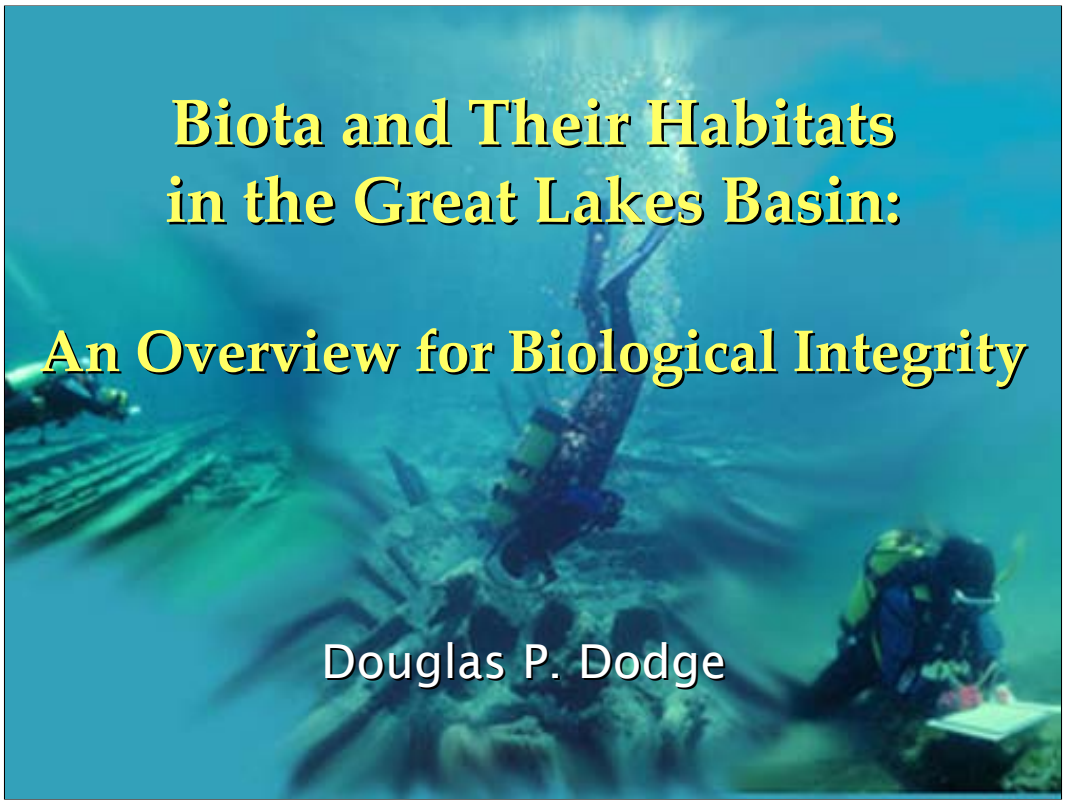


GOOD MORNING!! TODAY, I AM PRESENTING AN ASSESSMENT OF THE STATE OF THE BIOTA IN THE GREAT LAKES BASIN WITH AN OVERVIEW OF BIOLOGICAL INTEGRITY.

Overview

- What is Biological Integrity?
- Review indicator bundles for:
  - Biotic communities
  - Invasive species
  - Coastal zones
  - Aquatic habitats
- Review Biological Integrity from a Great Lakes perspective
- Consider persistent issues

THIS PRESENTATION IS DIVIDED INTO SEVERAL COMPONENTS,

FIRST A REVIEW OF EACH OF THE MAJOR 'BUNDLES' WHICH COMPRISE THE INDICATORS ASSOCIATED WITH GREAT LAKES BIOTA,

THEN, SOME COMMENTS ON BIOLOGICAL INTEGRITY,

AND FINALLY A DISCUSSION ABOUT PERSISTANT ISSUES AFFECTING GREAT LAKES BASIN BIOTA AND THE OUTLOOK FOR THEIR SUSTAINABILITY

What is Biological Integrity?

"Biological Integrity is the capacity to support and maintain a balanced, integrated & adaptive biological system having the full range of elements (the form) & processes (the function) expected in a region's natural habitat"

James R Karr, 1991 (modified)

WE USE THE DEFINITION MODIFIED FROM WORK BY DR KARR FROM HIS PUBLICATIONS ABOUT 'INDICES FOR BIOLOGICAL INTEGRITY'

THIS IS THE DEFINITION INTRODUCED AT SOLEC 2002

"Biological integrity is the capacity to support and maintain a balanced, integrated & adaptive biological system having the full range of elements [the form] & processes [the function] expected in a region's natural habitat"

Form and function

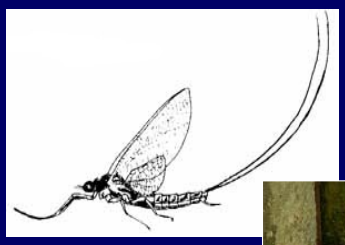
- Form
  - The structure of the system
- Function
  - The transfer of energy through a system

FORM IS THE STRUCTURE OF THE SYSTEM, THAT IS THE TREE, THE ROCK, THE DEEP OR SHALLOW WATER, THE VALLEY OR THE HILL WITH ALL THE ASSOCIATED BIOTA.IN FRESHWATER,FORM IS THE PROVISION OF NICHES THAT MEET THE NEEDS OF THE ASSOCIATED BIOTA FOR REPRODUCTION, GROWTH AND SELF SUSTAINABILITY

FUNCTION IS ABOUT THE TRANSFER OF ENERGY THROUGH A SYSTEM

Review of biotic communities

Forests
Invertebrates
Fish
Amphibians
Birds
Mammals

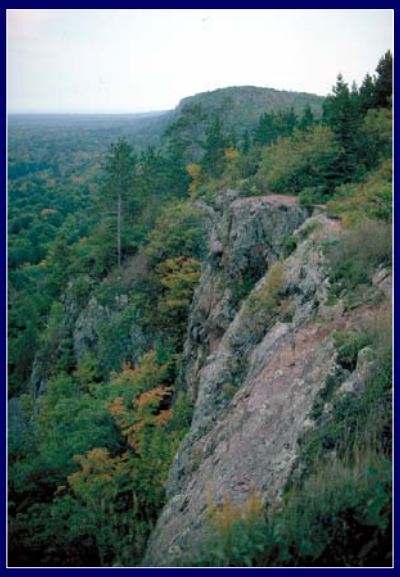


THIS PRESENTATION IS SUB-DIVIDED SOMEWHAT ARTIFICIALLY INTO SIX COMPONENTS SHOWN ON THE SCREEN.

The divisions were chosen on the basis of the different trophic levels represented in the basin, and represented in the list of Great Lakes Indicators.

Forest cover

- Water quality and quantity
- Restoration of terrestrial, aquatic, and groundwater resources
- Land/water interfaces



Status: Mixed Trend: Improving

Total forested areas increased in the Great Lakes Basin in recent decades, a signal that water quality from non-point sources should improve at least for some watersheds, along with a return to more normal patterns of run-off.

Total forest cover for Southern Ontario streams of at least 60% by area are calculated to advance the restoration of terrestrial, aquatic and groundwater resources in urban catchments presently with little forest-cover.

At a watershed scale, the restoration and protection of forested areas can reduce the need for costly infrastructure and show major cost-savings by prevention rather than remediation at “end-of-pipe”.

Increases in total area of riparian vegetation will also improve the quality and quantity of land-water interfaces in lakes and streams, a zone frequently neglected, especially along lake shores and, in land-planning submissions where riparian corridors are often written-off as expendable.

As well, improved land/water interfaces assist in the recovery of many fish & amphibian species and associated mammalian species like mink and otter.

Forested streams will provide transport corridors for wildlife and the basis for trail systems for people.

STATUS: MIXED ***TREND: IMPROVING***

Native invertebrates are losing ground

- Benthos
  - *Hexagenia*
  - *Diporeia*
- Wetland species

Native benthos are in trouble

Lakes Erie and St Clair have lost 99% of their native benthic organisms, and the remaining Great Lakes populations are dispersed and fragmented.

The **Dreissenids**, zebra & quagga mussels, are major threats to native benthos; other non-native species [eg spiney waterflea] are detrimentally affecting populations of native zooplankton.

Hexagenia populations MAY be improving, a welcomed sign because this genus is the agent for major energy transfers at sediment surfaces in mesotrophic waters [e g L. Erie] as larvae feed on organic material settling in the water column. However the genus is still susceptible to untreated sewage, and the effects from quagga mussels and zebra mussels are unknown.

Native invertebrates are losing ground

- Benthos
  - *Hexagenia*
  - *Diporeia*
- Wetland species

The benthic amphipod, ***Diporeia***, is an excellent bio-indicator of offshore waters [>30 m], and a preferred food for salmonids and lake whitefish.

Unfortunately, ***Diporeia*** numbers are decreasing rapidly in Lake Michigan. In Lake Superior, significant reductions in populations of lake whitefish are associated with declining numbers of ***Diporeia*.**

In Lake Huron, there has been a sequential decline in nearly all benthic invertebrates, with ***Diporeia*** now absent or declining at even deep [73 m] stations, while populations of the quagga mussel have increased.

In Lake Ontario, **Diporeia** numbers are falling and ranges are shrinking.

In wetlands, physical changes in habitat, alterations to natural hydrographs, and eutrophication continue to threaten invertebrates by providing conditions more suitable to the production and range-expansion of non-native species.

The indicator for salmon & trout reports a mixed/improving assessment across the Basin.

Lake trout stocking in Lake Huron has re-established a significant biomass as stocking effectiveness remains high. But adequate spawning stocks [>age 6] are not yet established because predation by sea lamprey in upper and mid-lake regions may be limiting recovery.

In Lake Superior in 2003, sea lamprey consumed as much biomass of lake trout as was taken by all fishing activities.

In Lake Ontario, despite lower rates of stocking, chinook salmon abundance is stable, possibly because natural reproduction is contributing to higher survival rates of young fish, although the condition of individuals of spawning chinook has deteriorated.

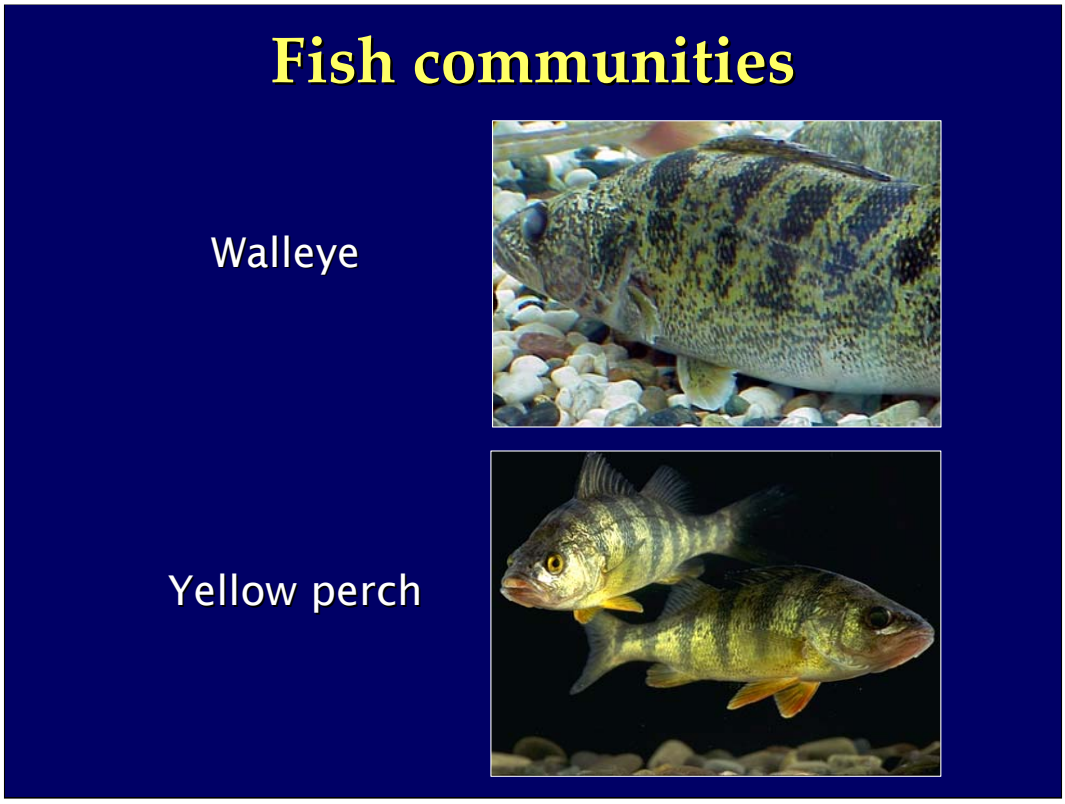
As well, thiamine-deficiency in salmonids caused by feeding on alewife remains problematic preventing some salmonids from full recovery.

Lake trout, the keystone species for Great Lakes in infertile waters is having a variable success of recovery, but the trajectory is improving. In Lake Superior, lake trout stocks are at or near a state of self-sustainability. However, in Lake Ontario, lake trout reproduction is yet to support self-sustaining populations, Two new spawning sites were found in Lake Huron, and, in the Erie Eastern Basin, 2003 was the third consecutive year with increased catches of lake trout in assessment gear, likely because of high survival of 1999 to 2002 fish-stockings.

However, abundance of some mature lake trout stocks continues to decline because smaller prey-fish biomasses may be limiting, and because *Zebra and quagga mussels* are adversely impacting spawning shoals.

The goal to re-establish Lake Trout in Lake Michigan remains elusive.

Brook trout will gain from renewed attention being given to the basin-wide management of quantity and quality of groundwater.



Walleye populations are threatened by losses of habitat for spawning and early life-stages,-- losses related to changes in land-use--, and shifts in energy-transfers caused by non-native species, especially changes in watersheds draining into Areas of Concern.

For example, in Lake Huron, the lake-wide valued walleye of Saginaw Bay continue to be under pressure from sedimentation and urbanization such that some historic walleye-spawning reefs are now covered in silt.

Despite these negative pressures, sport catch-per-unit-of-effort [CUE] for walleye in Lake Erie increased in 2003, with a concomitant increase in mean age of fish in both angling and commercial fisheries.

In Lake Ontario,-where populations are relatively stable but much reduced from the numbers in the 1980s-, younger year-class numbers improved slightly, so that numbers of age 3 and older fish populations should remain steady at least for the next several years. Walleye may now be spawning again in inshore and tributary waters in the Toronto area.

Yellow perch populations remain high in Lake Erie.

The plight of American eel populations in the lower Great Lakes and St. Lawrence River is indicative of changes in animal populations of the Great Lakes that occur when humans make major alterations which detrimentally affect physical integrity .

Dams and canals have all but eliminated upstream migrations of juvenile eels.

The downstream journey of the resultant survivors now grown into maturing adults is further complicated by having to run the gauntlet of intakes and high dams in their quest to return to the Atlantic Ocean.

(click) Lake sturgeon has potential for a spectacular recovery after many years of decline and extirpation in part of its range; although many dams on high-gradient streams continue to prevent access to spawning habitats.

Any recovery will result from re-introductions, more restrictive fishing, habitat repair, lower concentrations of bio-accumulating chemicals in sediment, and removal of dams on tributaries, the latter being a mixed blessing because more open streams may also increase sea lamprey spawning habitat.

(click) Prey fish populations are in various stages of deterioration especially where the bulk of the biomass has been smelt and alewife, As well, stocks of herring, whitefish, and two species of sculpins are in danger.

The re-establishment of the species bloaters and lake herring as major components in the aquatic food web would assist in the recovery of more-self-sufficiency in lake trout populations.

Yellow perch is a important fish species for both commercial and sport-fishing enterprises, but this species is also an essential food item for many Great Lakes piscivores, including walleye, pike and several species of birds.

In Lake Michigan, yellow perch populations remain low.

As was noted earlier, yellow perch populations remain high, especially in Lake Erie.

THE ASSESSMENT OF THE OPEN WATER BIOTA SUGGESTS A MIXED SITUATION,

THE UNCERTAINTY OF WHICH WAY NATIVE INVERTEBRATE POPULATIONS WILL SHIFT PREVENTS PROJECTING ANY TRAJECTORY FOR FUTURE CHANGES.

HAVING MORE NATIVE FISH IN SPECIES MIXES IN FORAGE FISH POPULATIONS IS A POSITIVE SIGN FOR SOME NATIVE PREDATORY FISH.

THE LACK OF OLDER AND BIGGER LAKE TROUT IN FOUR OF FIVE LAKES INDICATES THAT MORE IMPROVEMENT IS REQUIRED BEFORE THIS SPECIES IS SELF-RELIANT. SEA LAMPREY REMAIN A CONSTANT THREAT TO SALMONIDS AND ARE PREVENTING THE ACHIEVEMENT OF SELF-SUSTAINABLE LAKE TROUT POPULATIONS IN ALL OF THE LAKES

THERE HAVE BEEN IMPROVEMENTS CHANCES FOR SOME COMMUNITIES, WALLEYE, YELLOW PERCH, AND STURGEON.

Amphibians and birds

John Mitchell

John Mitchell

Status: Mixed Trend: Deteriorating

Amphibians, Reptiles and Birds are combined into one slide for this presentation.

Amphibians

There has been a general decline in populations of American toad and the frogs, Chorus, Green & Northern likely because of continuing losses of suitable habitats.

Reptiles

Contaminants in turtle eggs are still above guidelines; high levels will slow development of turtle embryos

Birds

General decreases in wetland-dependant birds (especially 7 sensitive species), and increases in numbers of three tolerant species, along with downward trends in amphibian communities suggest that quality and quantity of wetlands continue to deteriorate.

Some birds are also detrimentally affected by regulated water-levels. Loss of quality wetlands habitats combined with chemical levels that are potentially limiting indicates more stress and limits-to-growth for wetland bird communities.

Bald eagle populations continue expansion into new territories even when deformities related to toxic substances still occur.

STATUS: MIXED TREND: DETERIORATING

Non-native species

Sea lamprey control:

Status: Fair-Good Trend: Improving

The rest of the mess:
Poor and Deteriorating

NUMBERS OF SEA LAMPREY IN THE GREAT LAKES ARE ARE CONSIDERABLY LOWER THAN LEVELS MEASURED DURING THE 1950s BEFORE THE GREAT LAKES FISHERY COMMISSION BEGAN CONTROL PROGRAMS IN THE 1960s.

LAKE ONTARIO: DECLINING NUMBERS SINCE EARLY 1980s, WITH ABUNDANCES WELL WITHIN THE TARGET RANGE OF FISH COMMUNITY OBJECTIVES.

LAKE ERIE: AFTER INITIAL CONTROL MEASURES IN THE 1980s, POPULATIONS COLLAPSED. HOWEVER, IN THE MID-1990s, POPULATIONS INCREASED TO LEVELS THAT THREATENED REHABILITATION OF LAKE TROUT IN THE EASTERN BASIN. FURTHER TREATMENTS CAUSED REDUCTIONS TO NUMBER BELOW TARGETS, WHILE WOUNDING RATES ON LAKE TROUT ALSO DECLINED.

LAKE SUPERIOR: POPULATIONS FLUCTUATED OVER LAST 20 YEARS,BUT LEVELS REMAIN LESS THAN 10% OF PEAK ABUNDANCE.

LAKE MICHIGAN: HAS SHOWN A SLOW BUT CONTINUING UPWARD TREND IN SEA LAMPREY NUMBERS SINCE 1980. INCREASES ARE ATTRIBUTED TO PRODUCTION FROM THE ST MARYS RIVER AND FROM THE MANISTIQUE RIVER. – POSSIBLE REASONS WHY LAKE TROUT ARE NOT YET REPRODUCING IN LAKE MICHIGAN

LAKE HURON: IN THIS LAKE, THE PRODUCTION OF SEA LAMPREY FROM THE ST MARYS RIVER HAD SO NEGATIVELY AFFECTED LAKE TROUT POPULATIONS THAT RESTORATION PROGRAMS FOR THIS SPECIES WERE ABANDONED IN 1995. A SOPHISITICATED AND INTEGRATED APPROACH TO CONTROL HAS LOWERED WOUNDING AND MORTALITY RATES FOR LAKE TROUT.

(click) ASSESSMENT OF SEA LAMPREY CONTROL IS FAIR-GOOD & IMPROVING

THE GREAT LAKES FISHERY COMMISSION HAS BEEN IN THE BUSINESS OF CONTROLLING SEA LAMPREY, ONE OF THE FIRST OF THE INFAMOUS NON-NATIVE INVADERS, SINCE THE LATE 1950s, YET CONTROL IS, AT BEST, A YEAR-BY-YEAR CHALLENGE THAT IS LIKELY TO BE NON-ENDING,

THERE IS A LESSON HERE,

ONCE A NON-NATIVE SPECIES BECOMES ESTABLISHED IN THE GREAT LAKES SYSTEM: it is a life-long member of the Great Lakes. AND ERADICATION IS THE IMPOSSIBLE DREAM.

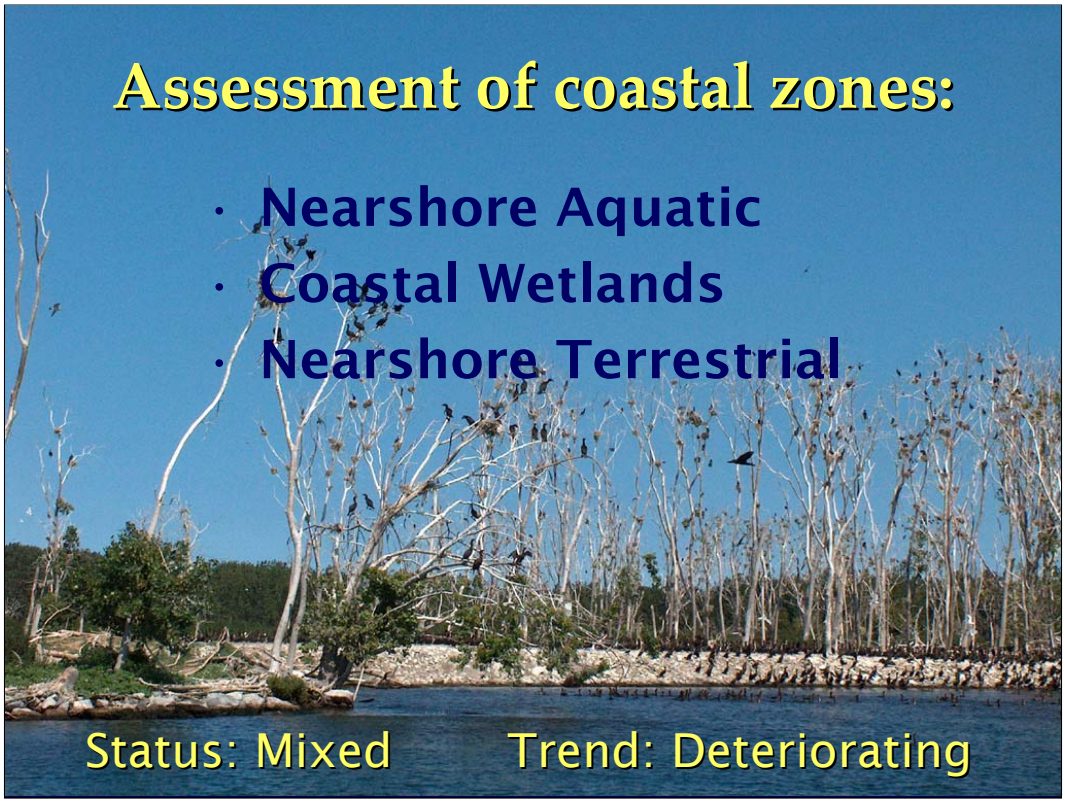
(click) THE REST:

NEARLY 10% OF NON-NATIVE SPECIES INTRODUCED INTO THE GREAT LAKES BASIN HAVE DETRIMENTALLY AFFECTED ECOSYSTEM INTEGRITY. HUMAN ACTIVITIES ASSOCIATED WITH SHIPPING ARE RESPONSIBLE FOR MORE THAN HALF OF ALL INTRODUCTIONS.

INTRODUCTIONS FROM OCEANGOING SHIPS ARE GROWING EXPONENTIALLY, AND ACCOUNT FOR MORE THAN 70% OF THE INTRODUCTION OF NON-NATIVE FAUNA INTO WATERS OF THE GREAT LAKES.

ASSESSMENT IS POOR & DETERIORATING

THE GREAT LAKES SYSTEM IS LIKELY NOW IN THE MIDDLE OF AN ‘INVASIONAL MELTDOWN’.



THESE THREE HABITAT TYPES ARE PART OF THE CONTINUUM THAT CONSITUTES THE LAND/WATER INTERFACE

THE NEARSHORE AQUATIC IS BEING DETRIMENTALLY AFFECTED BY CONTINUED HARDENING OF SHORELINE AND SHORELANDS, AFFECTING BOTH PHYSICAL AND BIOLOGICAL INTEGRITIES.IN LAKES HURON, ERIE, AND ONTARIO,

SOME NEARSHORE AREAS & EMBAYMENTS HAVE ELEVATED LEVELS OF PHOSPHOROUS, RESULTING IN NUISANCE ALGAE GROWTHS INCLUDING CLADOPHORA

Although not quantified as yet for Coastal Wetlands, WETLANDS in general, CONTINUE TO SHRINK IN SIZE AND NUMBER. IN LAKE HURON, FOR EXAMPLE, SIGNIFICANT LOSSES ARE ASSOCIATED WITH CONVERSION OF WETLANDS FOR AGRICULTURE AND WITH LOW WATER LEVELS WHICH CAUSE INLAND WETLAND TO DRY AND WHICH CREATE BARRIERS TO FISH MIGRATION

REMAINING WETLANDS ARE LOSING INTEGRITY, CAUSED BY WETLAND DESTRUCTION FROM LAND DEVELOPMENT AND LOSS OF HYDROLOGIC FUNCTION, LAKE LEVELS, STREAM-BANK EROSION AND SHORELINE CHANGES, NON-NATIVE SPECIES INVASIONS, AND BY CHEMICAL CONTAMINATION IN SEDIMENTS.

LOSSES OF HEALTHY FUNCTIONAL WETLANDS MEAN FEWER REFUGIA FOR NATIVE CLAMS, BIRDS AND FISH.

THE NEARSHORE TERRESTRIAL ZONE IS DETERIORATING BECAUSE OF DEGRADED CONDITIONS OF SAND DUNES AND BEACHES, ROCKY SHORES, AND ALVARS, AND AS THE RESULT OF CONTINUING SHORE- SURFACE HARDENING.

OPEN LAKE:

UNDERSTANDING PHOSPHORUS CONCENTRATIONS HELPS TO EVALUATE TROPHIC STATUS AND FOOD-WEB DYNAMICS IN THE GREAT LAKES.

AVERAGE CONCENTRATIONS IN LAKES SUPERIOR, MICHIGAN, HURON & ONTARIO ARE AT OR BELOW EXPECTED LEVELS

IN LAKE ERIE, LEVELS FLUCTUATE EACH YEAR IN ALL THREE BASINS, AND ARE SOMETIMES ABOVE TARGET-LEVELS.

ASSESSMENT: MIXED

TOXIC CHEMICALS:

THE STATUS OF TOXIC CHEMICALS IN OFFSHORE WATERS IS DIFFICULT TO SUMMARIZE BECAUSE OF MAJOR SPATIAL AND TEMPORAL DIFFERENCES.

HOWEVER, CONCENTRATIONS OF ORGANOCHLORINES CONTINUE TO DECLINE:

FOR EXAMPLE, DIELDRIN, WHICH IS UBIQUITOUS TO ALL OPEN WATERS AND ALSO IN THE NIAGARA RIVER, AND

HEXACHLOROBENZENE WHICH IS USUALLY FOUND IN LOCALIZED AREAS

Assessment: mixed/improving

TOXIC CHEMICALS IN SEDIMENTS:

CONCENTATIONS ARE DECLINING FOR SEVERAL HEAVY METALS, INDICATIVE OF A TREND FOR MOST TOXIC CHEMICALS IN THE GREAT LAKES BASIN.

SEDIMENT IN LAKES ERIE, ONTARIO AND MICHIGAN HAD THE POOREST QUALITY WHERE HISTORICAL URBAN AND INDUSTRIAL ACTIVITIES HAVE BEEN LOCATED.

Assessment: Mixed & Improving

Aquatic habitats: Groundwater

Status: Mixed Trend: Deteriorating

EXCEPT FOR COASTAL WETLANDS, NEARSHORE ENVIRONMENTS AND TRIBUTARIES HAVE NOT BEEN INCLUDED IN THIS ASSESSMENT OF AQUATIC HABITAT

THE VALUE OF GROUNDWATER AND ITS ECOLOGICAL ROLE IN THE STATE OF THE GREAT LAKES ECOSYSTEM HAS GENERALLY BEEN IGNORED, OR, AT BEST, INCOMPLETELY ASSESSED.

HOWEVER, OUR UNDERSTANDING INCLUDES KNOWING THAT:

1. Surface water and groundwater are components of a single water resource.

2. The discharge of groundwater to the rivers, lakes, and wetlands of the Basin is a significant portion of stream flow into most of the Great Lakes, and is a tangible indication of the importance of groundwater within the Basin.

3. Groundwater quantity and quality issues are closely linked and both have implications in terms of water quality for use by both humans and endemic biota within the Great Lakes Basin.

4. Reductions in both quality and quantity of groundwater will have drastic effects on dependant biota and their habitats in streams, lakes and wetlands, including threatened native birds, brook trout and several species of salamanders

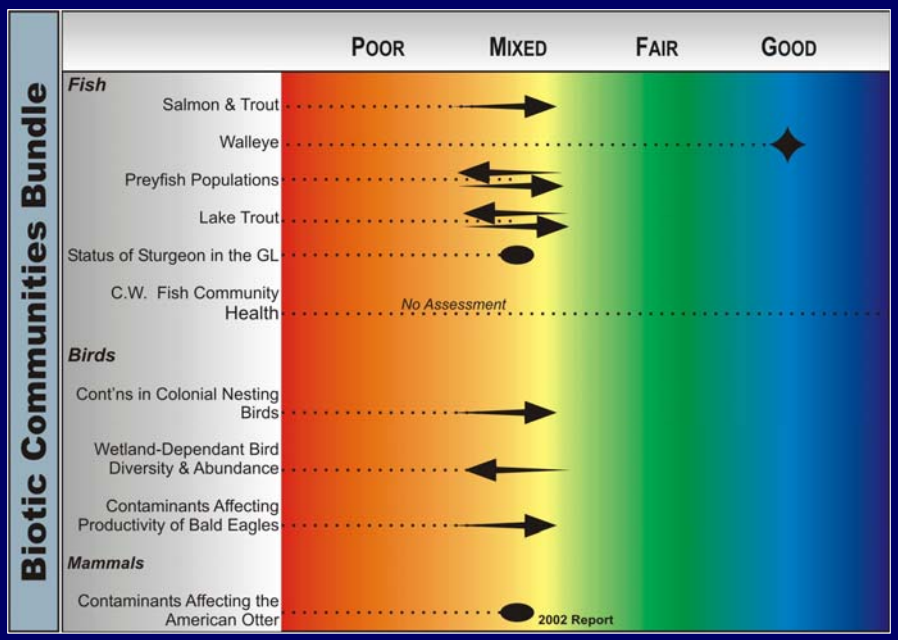
5. There is evidence that human activities related to land and water uses have impacted the quantity and quality of the resource.

6. Protection of groundwater resources is the feasible and cost-effective alternative to the remediation of degraded resources.

Assessment: MIXED & DETERIORATING

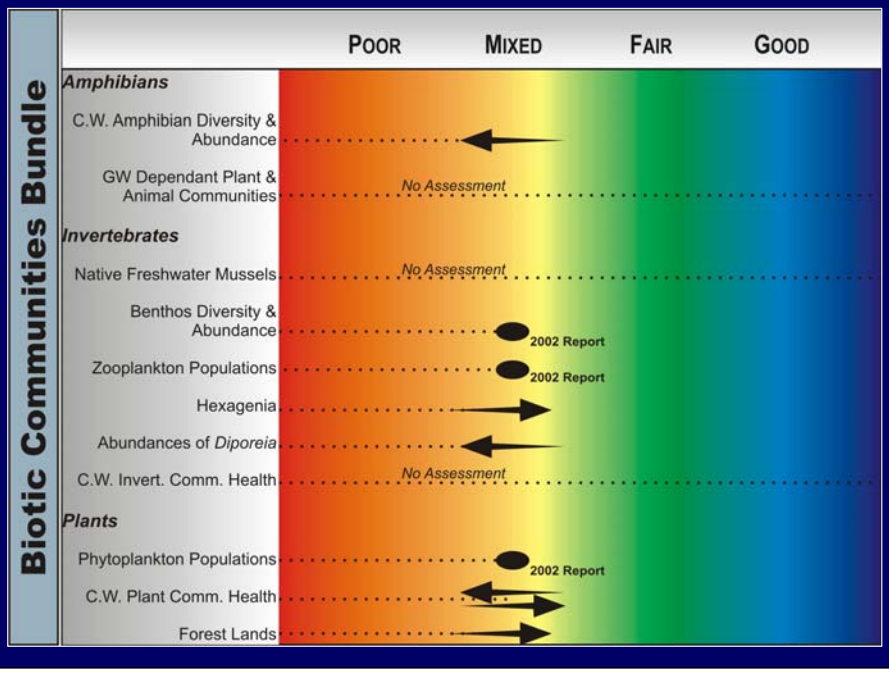
THERE IS A BREAKOUT SESSION THIS AFTERNOON TO DISCUSS FURTHER THE COLLECTIVE UNDERSTANDING OF THE QUALITY AND QUANTITY OF GROUNDATER IN THE BASIN

Summary of assessments



The summary of assessments presented here and in the following slide represent more indicators than have been summarized in this presentation and will be covered in this afternoon's breakout sessions.

Summary of assessments



Assessment of Biological Integrity

The Biological Integrity of the Great Lakes is Severely Compromised

AFTER CONSIDERING ALL OF THESE ASSESSMENTS, I CONSIDER The Biological Integrity of the Great Lakes TO BE severely compromised.

WHY??

BECAUSE OF CERTAIN PERNICIOUS, PERSISTENT & ENTRENCHED ISSUES IN THE GREAT LAKES BASIN

Persistent and entrenched issues: Non-native species

Persistent & Entrenched Issues

Non-Native Species remain a wild card in any recovery program, AS THEY INVADE AND SPREAD ACROSS THE BASIN, ESPECIALLY IN HABITATS ALREADY STRESSED BY PHYISICAL AND CHEMICAL DAMAGES.

Untreated ballast water is an uncontrolled ecosystem threat to the Great Lakes such that investments in restoration may be lost because of interference from the ongoing introduction of non-native species by this vector.

Other actions are necessary to reduce non-native impacts, including preventing the transport and sale of non-native species, whether animal or plant. Commercial activities based on imports of live non-native species hold great threat to wetlands and forests. Restrictions need to be stronger and ecologically based and more than just for the prevention of disease for plants and animals.

Botulism:

Related directly to the non-native species issue is the potential problem OF Botulism. Botulism E in various fish species may cause mortality. Live fish, especially gobies, and perhaps other non-native species, could be the transfer-link to waterbirds; infected fish display loss-of-equilibrium and surface-breaching, becoming more susceptible to capture by avian predators. Botulism in avian communities means another link and vector into the biotic community of the Great Lakes.

Persistent and entrenched issues: Habitat quality and quantity

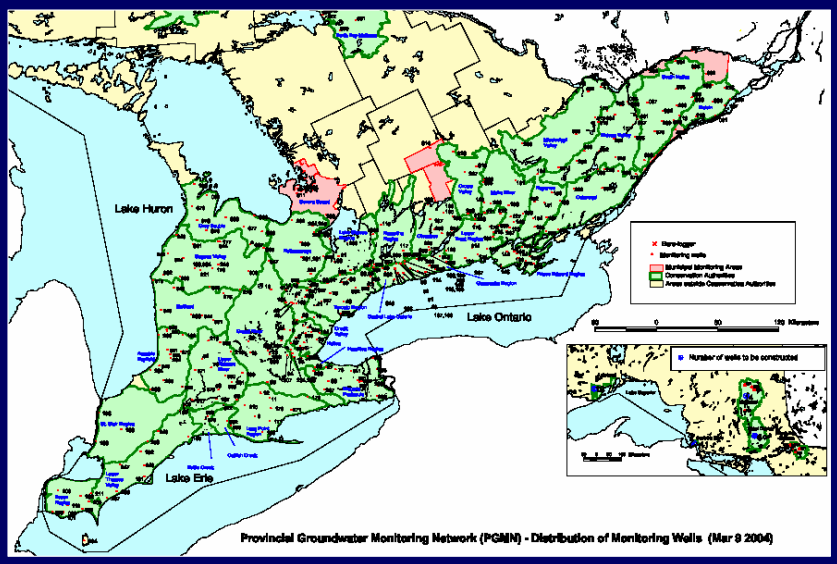
Habitat Quality & Quantity

Continue to deteriorate especially in nearshore terrestrial and aquatic environments; Urbanization is a constant threat to the quality and quantity of these resources.

UNIQUE STRUCTURES LIKE REEFS, COBBLE BEACHES, ALVARS, AND WETLANDS NEED MORE AND CONSISTENT PROTECTION, ESPECIALLY FROM ILL-ADVISED LAND-MANAGEMENT DECISIONS

LOSE THE QUANTITY AND QUALITY OF THESE NEARSHORE HABITATS MEANS LOSING THE BATTLE TO PROTECT AND REPAIR THE GREAT LAKES.

Persistent and entrenched issues: Water quality and quantity



Water Quality & Quantity

PHOSPHOROUS is significantly reduced in the Lakes in general, but may be too much in some areas. As populations increase so do loadings. (This is a problem not yet solved, especially in non-point source arena.

TOXIC CHEMICALS

Although PCB, Hg are decreasing, pharmaceuticals are continuing to cause problems for biota in the basin and are likely to do so for generations to come.

GROUNDWATER and its related resources need continued evaluation and protection, especially in land management decisions related to urban and industrial development. Groundwater is a renewed center of interest for more than just hydrogeologists and stream ecologists; in Ontario, the Walkerton tragedy and its fall-out have made governments and citizens pay more attention to this rich and sustainable resource. It is now more apparent that even Great Lakes extant, and not just its tributaries, need groundwater of high quality and quantity.

Persistent and entrenched issues: Native biota

- Sustainable natural reproduction
- Loss of condition in fish

Sustainable natural reproduction is a goal a long way from being achieved, especially for species directly dependent on the Great Lakes and it's tributaries. Loss of condition in fish even with adequate natural reproduction suggests a decline in both the quality and quantity of food sources for major predatory fish species.

Acknowledgments

- Staff and publications from:
  - Great Lakes Fishery Commission and its committees
  - U.S. Environmental Protection Agency
  - Environment Canada
  - Toronto and Region Conservation Authority

This presentation was very much a solo effort of my own composition for which I take full responsibility, but the orchestra that accompanied me was fabulous:

I acknowledge with gratitude the assistance of the following organizations and their staffs:

US Environmental Protection Agency;

Environment Canada;

Great Lakes Fishery Commission and its various committees;

Toronto and Region Conservation Authority