State of the Lakes Ecosystem Conference 2008

DRAFT

Highlights Report: Assessments, Indicators and Nearshore Issues

State of the Lakes Ecosystem Conference 2008

Highlights from Indicator Reports and Nearshore Issues

Overview

As parties to the Great Lakes Water Quality Agreement, the governments of Canada and the United States are responsible for accurate reporting on the state of the Great Lakes. The State of the Lakes Ecosystem Conference (SOLEC) is a result of this commitment for reporting. With the establishment of a consistent suite of ecosystem indicators, the health of the Great Lakes basin can be objectively assessed. Regular reporting using a core set of indicators will promote more efficient and successful management, as well as create more accessible information for policy makers and the public.

SOLEC 2008 will continue to update and assess the state of the Great Lakes using the suite of indicators. Indicator reports were prepared for 63 of the 80+ indicators presently in the Great Lakes suite. To accommodate the increasing number of reports, the indicators have been assembled into 9 groups: Contamination, Biotic Communities, Invasive Species, Coastal Zones, Aquatic Habitats, Human Health, Land Use – Land Cover, Resource Utilization, and Climate Change. Several sub-groupings are also contained within the major categories, and several indicators are included in more than one group or sub-group.

Assessments

Authors of the indicator and nearshore reports were requested to assess, in his or her best professional judgment, the overall status of the ecosystem component in relation to established endpoints or ecosystem objectives, when available. Five status categories were used, designated here by color:

Good. The state of the ecosystem component is presently meeting ecosystem objectives or otherwise is in acceptable condition.

Fair. The ecosystem component is currently exhibiting minimally acceptable conditions, but it is not meeting established ecosystem objectives, criteria, or other characteristics of fully acceptable conditions.

Poor. The ecosystem component is severely negatively impacted and it does not display even minimally acceptable conditions.

Mixed. The ecosystem component displays both good and degraded features.

Undetermined. Data are not available to assess the ecosystem component over time, so no status can be identified.

Four categories were also used to denote “trajectory” or current trends over time of the ecosystem component that the indicator addresses, designated here by shape:

Improving. Information provided by the report shows the ecosystem component to be changing toward more acceptable conditions.

Unchanging. Information provided by the report shows the ecosystem component is neither getting better nor worse.

Deteriorating. Information provided by the report shows the ecosystem component to be changing away from acceptable conditions.

Undetermined. Data are not available to assess the ecosystem component over time, so no trend can be identified.

Assessing Status and Trends of the Great Lakes Ecosystem

OVERALL ASSESSMENT

GREAT LAKES ECOSYSTEM

Status: Mixed
Trend: Unchanging

In 2008, the overall status of the Great Lakes ecosystem was assessed as mixed because some conditions or areas were good while others were poor. The trends of Great Lakes ecosystem conditions varied: some conditions were improving and some were worsening.

INDICATOR CATEGORY ASSESSMENTS

CONTAMINATION

Status: Mixed
Trend: Improving

The transfer of natural and human-made substances from air, sediments, groundwater, wastewater, and runoff from non-point sources is constantly changing the chemical composition of the Great Lakes. Over the last 30 years, concentrations of some chemicals or chemical groups have declined significantly. There is a marked reduction in the levels of toxic chemicals in air, water, biota, and sediments. Many remaining problems are associated with local regions such as Areas of Concern. However, concentrations of several other chemicals that have been recently detected in Great Lakes have been identified as chemicals of emerging concern.

HUMAN HEALTH

Status: Mixed
Trend: Undetermined

Levels of PCBs in sportfish continue to decline, progress is being made to reduce air pollution, beaches are better assessed and more frequently monitored for pathogens, and treated drinking water quality continues to be assessed as good. Although concentrations of many organochlorine chemicals in the Great Lakes have declined since the 1970s, sportfish consumption advisories persist for all of the Great Lakes.

BIOTIC COMMUNITIES

Status: Mixed
Trend: Undetermined

Despite improvements in levels of contaminants in the Great Lakes, many biological components of the ecosystem are severely stressed. Populations of the native species near the base of the food web, such as Diporeia and species of zooplankton, are in decline in some of the Great Lakes. Native preyfish populations have declined in all lakes except Lake Superior. Significant natural reproduction of lake trout is occurring in Lake Huron and Lake Superior only. Walleye harvests have improved but are still below fishery target levels. Lake sturgeon are locally extinct in many tributaries and waters where they once spawned and flourished. Habitat loss and deterioration remain the predominant threat to Great Lakes amphibian and wetland-dependent bird populations.

COASTAL ZONES AND AQUATIC HABITATS

Status: Mixed
Trend: Undetermined

Coastal habitats are degraded due to development, shoreline hardening and establishment of local populations of non-native invasive species. Wetlands continue to be lost and degraded. In addition to providing habitat and feeding areas for many species of birds, amphibians and fish, wetlands also serve as a refuge for native mussels and fish that are threatened by non-native invasive species.

RESOURCE UTILIZATION

Status: Mixed
Trend: Undetermined

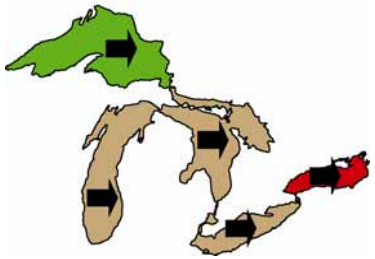
Although water withdrawals have decreased, overall energy consumption is increasing as population and urban sprawl increase throughout the Great Lakes basin. Human population growth will lead to an increase in the use of natural resources.

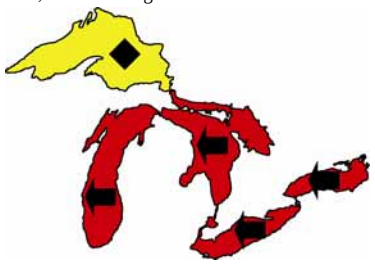
CLIMATE CHANGE

Status: Undetermined
Trend: Undetermined

A qualitative assessment of the indicator category Climate Change could not be supported for this report because the indicators are incomplete at this time.
Some observed effects in the Great Lakes region, however, have been attributed to changes in climate. Winters are getting shorter; annual average temperatures are growing warmer; extreme heat events are occurring more frequently; duration of lake ice cover is decreasing as air and water temperatures are increasing; and heavy precipitation events, both rain and snow, are becoming more common.

2008 INDICATOR ASSESSMENTS

Category	Indicator	Assessment (Status, Trend)	State of the Ecosystem	Current and Future Pressures
Contamination	Contaminants in Colonial Nesting Waterbirds	Mixed, improving 	• Most contaminants in herring gull eggs have declined substantially (>90%) since first measured in 1974. Spatially, some sites in Lakes Michigan, Huron and Ontario were much more contaminated than others. More than 50% of all contaminant concentrations at all colonies (N=120) are declining as fast or faster than previously measured. The exceptions are concentrations of fire-retardant brominated diphenyl ethers (BDEs). • In terms of ecological effects on colonial waterbirds from contaminants (e.g. eggshell thinning, failed reproduction, population declines) most bird species have increased in numbers over the last 20-30 years.	• Contaminant levels in herring gull eggs are continuing to decline at a constant rate, though in 2007 there has been the noted slow down in the rate of decline. However, even at current contaminant levels, more physiological abnormalities in herring gulls occur at Great Lakes sites than at cleaner, reference sites away from the Great Lakes basin. • Although almost all contaminants are decreasing and many biological impacts have lessened, we do not yet know the full health implications of the subtle effects of these contaminants and of newly monitored contaminants such as PBDEs.
	Atmospheric Deposition of Toxic Chemicals	Mixed, improving for PCBs, banned organochlorine pesticides, dioxins, furans Mixed, unchanging or slightly improving for polycyclic aromatic hydrocarbons (PAHs) and mercury 	• While concentrations of some substances are very low at rural sites, they may be much higher in "hotspots" such as urban areas. • Levels of persistent bioaccumulative toxic (PBT) chemicals in air tend to be lower over Lake Superior and Lake Huron than over the other three Great Lakes (which are more impacted by human activity), but their surface area is larger, resulting in atmospheric inputs being of greater importance to these lakes. • Connecting channels inputs dominate over atmospheric inputs for Lake Erie and Lake Ontario, which have smaller surface areas. • Lakes Michigan, Erie and Ontario have greater PBT inputs from urban areas.	• Residual sources of PCBs remain in the United States and Canada and throughout the world; therefore, atmospheric deposition will still be significant at least decades into the future. • PAHs and metals continue to be emitted and therefore concentrations of these substances may not decrease or will decrease very slowly depending on further pollution reduction efforts or regulatory requirements. • Even though emissions from many sources of mercury and dioxin have been reduced over the past decade, both pollutants are still detected at elevated levels in the environment. • Atmospheric deposition of chemicals of emerging concern, such as brominated flame retardants and other compounds, could also serve as a future stressor on the Great Lakes.
Biotic Communities	Benthic amphipod, *Diporeia*	Mixed, deteriorating 	• Populations of *Diporeia* spp. continue to decline in Lakes Michigan, Huron, and Ontario. • While presently gone or rare in shallow waters in each of these Lakes, numbers have also declined in deeper, offshore waters. • *Diporeia* in Lake Erie are likely close to extirpation. • Decline coincides with introduction of non-native zebra and quagga mussels.	• Declines may be more extensive as populations of non-native mussels expand. • The continuing decline of *Diporeia* has strong implications to the Great Lakes food web. Many species rely on *Diporeia* as a major prey item, and the loss of *Diporeia* will likely have an impact on these species. Recent evidence suggests that fish are already being affected. For instance, growth and condition of an important commercial species, lake whitefish, has declined significantly in areas where *Diporeia* abundances are low in Lake Michigan, Lake Huron, and Lake Ontario.
	Walleye	Mixed, variable 	• Walleye status is considered "fair" in Lakes Michigan, Huron, Erie, and Ontario. • Reductions in phosphorus loadings during the 1970s substantially improved spawning and nursery habitat. Concerns about food web disruption, pathogens (such as botulism and viruses), noxious algae, and watershed management practices persist.	• Reproductive success of walleye is affected by changes in nutrient concentrations, by weather, water-levels, and from predation and competition by non-natives.

Category	Indicator	Assessment (Status, Trend)	State of the Ecosystem	Current and Future Pressures
	Lake Sturgeon	Mixed, improving 	• There are remnant populations in each basin of the Great Lakes, but few of these populations are large. • Lake sturgeon are now extirpated from many tributaries and waters where they once spawned and flourished. • Confirmed observations and captures of lake sturgeon are increasing. • Stocking has contributed to increased abundance in some areas.	• There is a need for more information about some remnant spawning populations. Little is known about juvenile life stages. • Habitat restoration is needed as spawning and rearing habitat has been destroyed, altered or access to it is blocked. • An additional concern for lake sturgeon in many of the Great Lakes is the ecosystem changes that are resulting from high densities of invasive species such as Dreissenid mussels and round gobies and the presumed related spread of Botulism Type E which has produced die-offs of lake sturgeon in most years since 2001.
	Contaminants Affecting Productivity of Bald Eagles	Mixed, improving 	• Concentrations of organochlorine chemicals are decreasing or stable but still above No Observable Adverse Effect Concentrations for the primary organic contaminants DDE and PCBs. • The percentage of nesting pairs producing one or more fledglings and the number of young produced per territory have risen, indicating that the population is healthy and capable of growing. • In August 2007, the bald eagle was removed from the federal list of threatened and endangered species. The two main factors that led to the recovery were the banning of DDT and habitat protection afforded by the Endangered Species Act for nesting sites and important feeding and roost sites. • In Ontario, the northern population of bald eagles has been downlisted to species of concern whereas the southern population remains listed as endangered. The southern population continues to increase steadily on Lake Erie.	• Relatively large habitat units (territories) are necessary to support eagles, and continued development pressures along the shorelines of the Great Lakes constitutes a concern. • Eagles are relatively rare and contaminant effects on individuals can be important to the well-being of local populations. • Contaminant levels in nestling eagles are considered low, however, post-breeding eagles may be at substantial risk to metal poisoning (specifically mercury and lead).
Invasive Species	Aquatic Non-native Species	Poor, deteriorating 	• The total number of aquatic non-native species introduced and established in the Great Lakes has increased steadily since the 1830s. There are currently at least 184 species of non-native algae, fish, invertebrates, and plants that have become established in the Great Lakes. • The number of ship-introduced species has increased exponentially.	• An effort to establish and strictly enforce laws and regulations regarding the introduction and management strategies of aquatic non-native species is needed in order to maintain the integrity of the Great Lakes ecosystem. • The unauthorized release, transfer, and escape of introduced aquatic non-native species and private sector activities related to aquaria, garden ponds, baitfish, and live food fish markets are of particular concern.
	Terrestrial Non-native Species	Undetermined 	• The total number of terrestrial non-native species has increased steadily since the 1800s. • The most adaptable non-native terrestrial species are often able to reproduce at a rapid rate. • Information provided by the World Wildlife Fund of Canada indicates that there are 157 non-native terrestrial species located within the Great Lakes basin, including: 95 vascular plants, 11 insects, 6 plant diseases, 4 mammals, 2 birds, 2 animal diseases, 1 reptile, and 1 amphibian. • The World Wildlife Fund of Canada has listed 29 species, 19 of which are vascular plants, as having a “severe impact” on native biodiversity.	• Further research needs to be undertaken in order to obtain a better understanding of the biology and current distribution of terrestrial non-native species throughout the Great Lakes basin. • An increased understanding of the link between vectors and donor regions is needed, in addition to a continuous monitoring effort of these routes of entry. • The growing transboundary movement of goods and people has heightened the need to prevent and manage terrestrial NIS. Most invasive species introductions can be linked to the intended or unintended consequences of economic activities. For this reason, the Great Lakes basin has been, and will continue to be, a hot bed of introductions unless preventive measures are enforced.

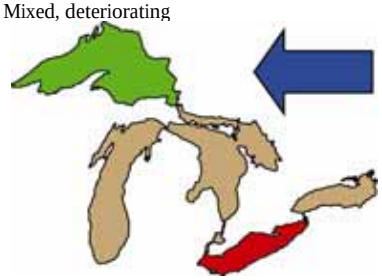
Category	Indicator	Assessment (Status, Trend)	State of the Ecosystem	Current and Future Pressures
Coastal Zones	Coastal Wetland Area by Type	Mixed, deteriorating 	• Coastal wetlands totaling 216,743 hectares have been identified within the Great Lakes and connecting rivers up to Cornwall, Ontario. • Wetlands serve as a refuge for native mussels and fish that are threatened by nearby non-native invasive species. • Despite significant loss of coastal wetland habitat in some regions of the Great Lakes, the lakes and connecting rivers still support a diversity of wetland types. • The St. Clair River delta, where the St. Clair River outlets into Lake St. Clair, is the most prominent single wetland feature accounting for over 13,000 hectares.	• Reductions in wetland area are continuing from filling, dredging and draining for conversion, to other uses such as urban, agricultural, cottage development, shoreline modification, water level regulation, adjacent land use, non-native species invasions, and sediment and nutrient loading from watersheds. • Estimates of coastal wetland extent, particularly for the upper Great Lakes, are acknowledged to be incomplete due to existing data limitations. • Because of growing concerns around water quality and supply and the role of wetlands in flood attenuation, nutrient cycling and sediment trapping, wetland changes need to be monitored closely.
	Islands	Mixed, undetermined 	• Great Lakes islands total 31,407 in number, make up the world's largest freshwater island system; and are globally significant in terms of biological diversity. • By their very nature, islands are vulnerable and sensitive to change. • New research indicates that nearshore island areas in the Ontario waters of Lake Huron account for 58% of the fish spawning and nursery habitat. • Many of Ontario's provincially rare species and vegetation communities can be found on islands in the Great Lakes. • More information is needed to evaluate, prioritize, and make appropriate natural resource decisions on islands.	• Proposals to develop islands are increasing. • The Binational Collaborative for the Conservation of Great Lakes Islands will soon recommend management strategies for Great Lakes islands to preserve the unique ecological features that make islands so important and recommend management strategies to reduce the pressures on a set of priority island areas. • The *Framework for Binational Conservation of Great Lakes Islands* will be completed in 2009
Aquatic Habitats	Phosphorus Concentrations and Loadings	Open Lake: Mixed, improving or unchanging Nearshore: Poor, undetermined 	• Strong efforts begun in the 1970s to reduce phosphorus loadings have been successful in maintaining or reducing nutrient concentrations in the lakes. • Average concentrations in the open waters of Lake Superior, Lake Michigan, Lake Huron, and Lake Ontario are at or below expected levels. Concentrations in the three basins of Lake Erie fluctuate from year to year. • Researchers involved with phosphorus load estimation from tributaries to Lake Erie and Lake Michigan have noted that 1) phosphorus loads may be increasing after a long period of decrease and 2) an increasing proportion of the phosphorus is an available, dissolved form. Both these observations have important implications, particularly to the nearshore. More phosphorus entering the nearshore, in a form easily used by algae, could lead to more algal blooms in the lakes.	• Enhanced monitoring of nearshore and embayment sites and tributaries is needed. • Even if current phosphorus concentration discharge limits are maintained, increased populations may result in increased loads. • Continued improvements in agricultural practices and sewage treatment and sewer systems, and continued promotion of phosphorus-free detergents will reduce nutrient concentrations in the lakes. • Recent research indicates that climate change may be influencing the phosphorus loads to the Great Lakes through changes in snowmelt and storm patterns.
Human Health	Beach Advisories, Posting and Closures	Mixed, unchanging 	• The percentage of beaches open the entire season remained nearly constant in the U.S. (73% average) during the period 1998-2007 and in Canada (49% average) from 1998-2007. The percentage of beaches posted more than 10% of the season averaged 9% in the U.S. and 42% in Canada during 2006-2007. Differences in the percentage of open and posted beaches between the U.S. and Canada may reflect differing posting criteria.	• Recreational water may become contaminated with animal and human feces from sources such as combined sewer overflows and sanitary sewer overflow, malfunctioning septic systems, or poor livestock practices. • Additional point and non-point source pollution at coastal areas due to population growth and increased land use may result in additional beach postings, particularly during wet weather conditions. • To ensure accurate and timely posting of Great Lakes beaches, methods must be developed to deliver quicker results that focus not just on indicator organism levels but on water quality in general.

Category	Indicator	Assessment (Status, Trend)	State of the Ecosystem	Current and Future Pressures
	Contaminants in Sport Fish	Mixed, improving 	• Organochlorine contaminants in Great Lakes sportfish are generally decreasing. • While these contaminants continue to decline, monitoring for other contaminants such as mercury and PBDEs has increased in the Great Lakes. • In the U.S., PCBs still drive advisories for limiting consumption of Great Lakes sport fish. • In Ontario, most of the consumption advisories are driven by PCBs, mercury, dioxins and furans. Toxaphene also contributes to a small proportion of consumption advisories for sport fish from Lake Superior and Lake Huron (Ontario). • Health Canada recently revised its total daily intake levels for PCBs and dioxins, which increased the frequency of consumption restrictions caused by PCBs and dioxins and decreased the frequency of consumption restrictions for toxaphene and mirex/photomirex.	• Each state or province is responsible for developing fish advisories for protecting the public from pollutants in fish and tailoring this advice to meet the health needs of its citizens. • All Great Lakes have consumption advisories based on PCBs, dioxin and mercury. Toxaphene, chlordane and mirex trigger advisories in some lakes. • Regular monitoring must continue in the Great Lakes basin to maintain trend data. • Monitoring for PBT contaminants of emerging concern, such as brominated flame retardants, should be undertaken before their concentrations in sportfish reach levels that may affect human health. • Additional information about the toxicity of a larger suite of chemicals is needed. The health effects of multiple contaminants, including endocrine disruptors, also need to be addressed.
Land Use – Land Cover	Land Cover – Land Conversion	Mixed, undetermined 	• The U.S. portion of the Great Lakes watershed has undergone substantial change in many key land use categories from 1992-2001. • Approximately 2.5% or 798,755 hectares of the U.S. portion of the Great Lakes basin experienced some type of land use change between 1992 and 2001 Low-intensity development increased by 33.5%, high-intensity development increased by 19.6%, and transportation (road) area increased by 7.5%. The continued rapid expansion and growth of urban and suburban areas and associated infrastructure is the single most significant land use/land cover change (~60%) within the U.S. portion of the Great Lakes basin. Much of the newly developed land was converted from agricultural or early successional vegetation (ESV) lands.	• The Lake Michigan watershed had the greatest total area of change between 1992 and 2001. The Lake St. Clair watershed had the highest rates of change into development from wetland, early successional, vegetation agriculture, and forest sources. The Lake Erie watershed had the greatest proportion of land conversion to development, while the Lake Superior watershed had the lowest. The Lake Ontario watershed had the greatest proportion of forest conversion to development. The Lake Huron watershed had the highest proportion of wetlands being converted to development, followed closely by Lakes Michigan and Erie. • In addition to population growth and economic development, recent increases in the price of diesel fuel and gasoline in combination with Federal (U.S.) subsidies for biofuel production have made crop and/or land use conversion to row-crop agriculture (e.g. corn, soybeans) economically attractive. Currently available land use/land cover change mapping does not adequately capture these potential changes in land use.
	Urban Density	Mixed, undetermined 	• The population in both the U.S. and Canada has been increasing in recent decades. According to Statistics Canada, between 1996 - 2006, the population of the Great Lakes basin Census Metropolitan Areas grew from 7,041,985 to 8,187,945, an increase of 1,145,960 or 16.27%. The 2000 U.S. census reports that from 1990 - 2000 the population contained in the Metropolitan Statistical Areas of the Great Lakes basin grew from 26,069,654 to 28,048,813, an increase of 1,979,159 or 7.6%. • The growth characteristics of five large Canadian cities indicate that from 1986-2000 the areal extents of these communities have grown at a faster rate than their populations and thus sprawl continues to be a major problem.	• Under the pressure of rapid population growth in the Great Lakes region, mostly in the metropolitan cities, urban development has been undergoing unprecedented growth. • Sprawl is increasingly becoming a problem in rural and urban fringe areas of the Great Lakes basin, placing a strain on infrastructure and consuming habitat in areas that tend to have healthier environments than those that remain in urban areas. This trend is expected to continue, which will exacerbate other problems, such as increased consumption of fossil fuels, longer commute times from residential to work areas, and fragmentation of habitat. • There are insufficient data on urban centers across the basin. A major challenge remains generation of consistent binational, multi-temporal statistics.

Category	Indicator	Assessment (Status, Trend)	State of the Ecosystem	Current and Future Pressures
Resource Utilization	Water Withdrawal	Mixed, unchanging 	• Withdrawal rates in the late 1990s were below their historical peaks and do not appear to be increasing at present. • Self-supplying (directly withdrawn) thermoelectric and industrial users account for over 80% of the total withdrawal. • Decreases in water withdrawal in both the United States and Canada are a result of the shutdown of nuclear power facilities, advances in water efficiency in the industrial sector, and growing public awareness of resource conservation.	• In the immediate future, the greatest pressure will come from communities where existing water supplies are scarce or of poor quality. • The Great Lakes-St. Lawrence River Basin Water Resources Compact was signed into law on October 3, 2008 by U.S. President Bush. The deal was negotiated by the governors and ratified by legislatures in all eight states. Congress recently gave its approval. The pact bans new diversions of water, with limited exceptions for communities near the basin boundary that meet rigorous requirements. It also requires the states to adopt policies for managing water use, giving them considerable flexibility while requiring them to meet common standards. The plans could be mandatory or voluntary. Regional goals will be reviewed every five years. • The Canadian provinces of Ontario and Quebec adopted similar policies. In 2005, Ontario, Quebec and the eight Great Lakes states signed the Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement intended to protect and conserve the waters of the basin.

2008 NEARSHORE ISSUES AND ASSESSMENTS

Issue	Assessment (Status, Trend)	State of the Ecosystem	Current and Future Pressures
Botulism	Mixed, deteriorating 	• The frequency and severity of Type E botulism outbreaks have cycled over the last several decades, with recent increases and expansion of affected areas and species. • Although outbreaks have been documented in the Great Lakes region as far back as 1963, annual die-offs of birds and fish on the shores of Lake Huron began again in 1998, in Lake Erie in 1999, and in Lake Ontario in 2002. Over the past few years, botulism outbreaks have been particularly severe in Lake Michigan. • In 2007, botulism outbreaks caused an estimated 17,000 avian mortalities for the entire Great Lakes region.	• The prolific growth of the native *Cladophora* algae believed to occur because of increased water clarity and subsequent increase in sunlight penetration resulting from the invasive Dreissenids' water filtration capabilities, may be linked with botulism outbreaks. • Other factors linked to the growth of *Cladophora*, such as nearshore nutrient loading and cycling, may potentially influence botulism outbreaks. • Invasive species may also play a key role in the recent outbreaks. Current hypotheses suggest that invasive quagga mussel beds create additional habitat for *C. botulinum* bacteria and accumulate the toxin. They may then facilitate transport of the toxin up the food chain as they are consumed by fish, and especially by the invasive round goby.
Viral Hemorrhagic Septicemia (VHS)	Mixed, deteriorating 	• VHS is a new introduction into the Great Lakes, probably introduced in 2001 or 2002. • VHS has been confirmed to be present in all of the Great Lakes except Lake Superior, and in inland lakes and streams in Michigan, New York, Ontario, Ohio, and Wisconsin. • It is unknown how VHS was introduced into the Great Lakes. Suspected vectors for the introduction and spread include ballast water, movement of live fish (including baitfish) into the Great Lakes, and the natural migration of fish. • VHS is responsible for significant fish kills in the Great Lakes.	• Movement of live fish, including baitfish, will contribute to the spread of the Great Lakes strain of VHS through the Great Lakes basin and other regions of the U.S. and Canada. • Significant fish kills are expected to occur as VHS spreads into these new areas. Additionally, immunologically naïve fish populations or year classes in areas where the virus has already occurred will be susceptible to periodic outbreaks of VHS in the future. • In response to the outbreaks, a Federal Order was passed in 2006 that places restrictions on interstate movement of warm and cool water fishes. The states of IL, IN, MI, NY, OH, PA, and WI, along with the Canadian provinces of Ontario and Quebec have also adopted VHS rules. Rules vary by state or province, but generally place limits on live fish (including baitfish) movements and require testing for VHS prior to intra or interstate transfer or release.

Issue	Assessment (Status, Trend)	State of the Ecosystem	Current and Future Pressures
Cladophora	Mixed, deteriorating 	• *Cladophora* is a native, filamentous, green alga that is found attached to solid substrate in all of the Great Lakes. It grows sparsely in a few locations in Lake Superior, is typically associated with tributary and point source phosphorus inputs in Lake Huron, and occurs as widespread blooms in the comparatively phosphorus-rich waters of Lakes Erie, Michigan, and Ontario. • Where phosphorus resources are sufficient, the alga can grow to nuisance proportions, fouling beaches and clogging water intakes. • It is the nuisance growths of *Cladophora* observed in nearshore regions of Lakes Erie, Michigan and Ontario that have drawn the attention of those involved in public recreation, operation of utilities and water quality management.	• Phosphorus management efforts implemented in the latter decades of the 20th Century were generally believed to have been successful in reducing the frequency of nuisance algal conditions. Changes in the underwater light climate, occurring in response to colonization by Dreissenids, permitted *Cladophora* to expand its range and increase overall production to levels that resulted in significant beach accumulation and problems with water intake structures. • Emerging remote sensing technologies and on-site measurements of the stored phosphorus content of the alga hold promise as a means of assessing the response of *Cladophora* populations to management actions.
Harmful Algal Blooms (HABS)	Mixed, deteriorating 	• Recently there has been an apparent resurgence in algal blooms in the Lakes, and an additional new concern with their potential production of toxins or harmful metabolites. • HABs in the Great Lakes involve a variety of species and are particularly problematic in coastal areas. • Lake Erie has the most extensive nearshore region, so toxic HABs are a particular concern and the focus of several recent studies.	• Current and future pressures that could increase the productivity of HABS include: i) Continued introduction of invasive species. ii) Basin/shoreline development and expanding urbanization which will continue to affect timing, magnitude and bioavailability of point source and non-point source loadings. iii) Warming and increased storm events due to climate change that may favor more intense and widespread noxious blooms.
Nearshore Aquatic Habitats	Mixed, deteriorating 	• Anthropogenic activities have dramatically altered the Great Lakes basin through agricultural practices, urban development, industrial and commercial activities, and introduction of non-native species. The nearshore zone, in particular, has been heavily impacted by chemical pollution, nutrient enrichment, and physical alterations resulting from intense industrialization and urbanization. • The resulting habitat degradation is of great concern because Great Lakes littoral areas have high fish diversity and are important to the life histories of most native Great Lakes fishes. Coastal margin and nearshore areas also have diverse wetland, benthic, and planktonic communities that comprise the lower portion of food web. These organisms also provide other important ecosystem services.	• Recent nearshore habitat assessments and mapping work done in Lake Michigan and in Lake Erie suggest that many of the substrate and habitat changes are not new and are the long-term result of actions taken many decades earlier. In other words, with respect to nearshore coastal processes, we have passed through several major habitat "tipping" points decades ago and are now attempting to manage the remaining habitat in severely degraded systems. • Habitat degradation is expected to continue, necessitating implementation of strategies to ensure the future sustainability of remaining nearshore habitats critical to maintaining native biodiversity. • Ecological integrity is achieved by protecting and restoring water level regimes, nearshore coastal processes, and flow paths and connections that structure, organize, and regulate coastal margin systems and create regional-scale patterns that link coastal margin and open-lake areas within the basin.
Physical Processes	Mixed, deteriorating 	• The single most important anthropogenic factor disrupting nearshore coastal processes and pathways is increasing shoreline development and the physical alteration of the land-water interface. • Channel alterations due to dredging may alter tributary (river mouth), coastal margin, nearshore, and open lake flow patterns and connectivity. • Loss of protective nearshore sediment supplies has resulted in erosion and resuspension of fine-grained cohesive sediments increasing turbidity and reducing nearshore water quality.	• Within the Great Lakes, many natural processes have been impaired by anthropogenic activity. These impairments affect not only the ability of natural processes to convey energy, water, materials, and biota, but alter the benefits that water provides to the ecosystem as well. • Over the long term, altered flow regimes, diversions, and consumptive losses may lower water levels, changing open lake circulation patterns and connectivity; coastal processes; and connectivity between coastal margin and wetland/barrier systems within the Great Lakes.

Issue	Assessment (Status, Trend)	State of the Ecosystem	Current and Future Pressures
Nearshore Terrestrial Habitats	Mixed, deteriorating 	• The Great Lakes coast is over 28,300 km in length – a distance greater than half the equatorial circumference of the Earth - making it the longest freshwater coast in the world. • Coastal terrestrial ecosystems are some of the most threatened in the Great Lakes region because they occupy the same land-water interface where humans establish communities, industry and recreational facilities. This has resulted in the loss and degradation of many habitats that are of North American and global conservation concern, including endemic Great Lakes coastal habitats. • A large number of globally rare ecosystems have developed in response to the special conditions of the Great Lakes coast.	• An analysis of pressures on coastal terrestrial ecosystems was conducted through GIS based on general land cover and shoreline modification within each coastal eco-reach. Pressures were measured based on the percentage of urban cover and agricultural cover within 2 km of the coast, and the percentage of shoreline that was classified as "artificial." • Based on this analysis the areas under the greatest pressures (top 80th percentile) include the Duluth area in Lake Superior, southwestern portion of Lake Michigan, the western and northern coast of Lake Ontario, the southern shore of Lake Erie, the Niagara River in the U.S., the Detroit and St. Clair Rivers, western Lake Erie in the U.S. and Lake St. Clair in the U.S.