



LAKE PROFILES

What makes each of the Great Lakes unique?

GREAT LAKES FACT SHEET



2

Lake Profiles

The Great Lakes were formed nearly 20,000 years ago, at the end of the last ice age. Glacial meltwater from the retreating continental ice sheet filled the region and carved out fresh water basins, forming the lakes. The Great Lakes are the largest freshwater system in the world and, taken together, account for about one-fifth of the world's surface fresh water. With the exception of Lake Michigan, which lies entirely within the United States, the border between Canada and the U.S. runs through the middle of the lakes, making Great Lakes issues a key focus of binational relations. The lakes have inspired their own wannabes over the years. In 1998, the U.S. federal government declared Lake Champlain the sixth Great Lake, but the designation was widely ridiculed because the lake is so small in comparison to the real Great Lakes.

The Great Lakes region faces a variety of challenges, and many of them are broad-reaching concerns common to all the lakes — invasive species, loss of wildlife habitat and populations, harmful pollutants and climate change. However, each lake also has its own unique ecological characteristics and, as a result, faces its own specific challenges for management and remediation.

LAKE SUPERIOR

Canadian singer-songwriter Gordon Lightfoot brought the grandeur and power of Lake Superior to life with his song "The Wreck of the Edmund Fitzgerald." The SS Edmund Fitzgerald was once the largest freighter to travel the Great Lakes. During a massive winter storm, with near hurricane-force winds and waves more than 10 metres high, the ship went down in Lake Superior not far from shore on November 10, 1975.



Lake Superior is the largest of the five Great Lakes as well as the deepest, the most northerly and the coldest. By surface area, it is the world's largest freshwater lake, covering approximately 82,100 square kilometres. The lake's average depth is 147 metres, and it contains approximately 10 per cent of the Earth's fresh water — more water than all of the other Great Lakes combined.

Of the Great Lakes, Lake Superior is least affected by human development. The population density in the region is low, and most of the surrounding land remains forested because of shallow, rocky soils that are unsuitable for agricultural use. The area around the lake is rich in natural resources. Mining and forestry have been important to the region's economy, but they have also presented challenges to the lake's environmental health.

Both its size and its cold temperature have profound effects on the ecology of Lake Superior. Its large surface area means that it is the recipient of significant quantities of contaminants from airborne deposition. It is particularly vulnerable to the "grasshopper effect" — a process in which harmful pollutants evaporate, are transported from warmer to colder climates by wind currents and eventually redeposit on water or soil as the air encounters cooler temperatures, condenses and forms precipitation. This effect brings the pollutants generated far to the south, in the urban, industrial heartland, into Lake Superior, the most remote of the Great Lakes. Because of its size, the lake has a retention time — the measure of time that water stays in a lake — of nearly 200 years. Long retention times keep harmful pollutants in the lake longer, available for uptake in the aquatic food chain. For this reason, fish in Lake Superior have been found to have higher concentrations of some harmful pollutants than similar fish in other lakes.

The lake's cold climate is essential to maintaining its unique plant and wildlife habitats and populations, such as lynx and woodland caribou. The warmer temperatures predicted as a result of climate change may force cold-dwelling wildlife to find more suitable habitat further north, and a rise in water temperature could threaten the ability of some native fish species to reproduce and survive, allowing invasive non-native species to outcompete them in the warmer water. A considerable number of invasive species, such as sea lamprey, round goby and Eurasian watermilfoil, have established themselves in Lake Superior and continue to present a serious threat to its health.

LAKE MICHIGAN

In its early years, Chicago flushed its sewage directly into the Chicago River, which flowed into Lake Michigan. Because the lake was also the source of drinking water for the citizens of Chicago, the dumping of sewage into the river and lake resulted in outbreaks of cholera and typhoid in the city. By 1887, concerns about sanitation prompted a decision to reverse the flow of the river so that it emptied into the Mississippi River Basin and away from Lake Michigan. The Chicago Sanitary and Ship Canal was built to accomplish this and has been described as one of the greatest public works projects in history. Many towns downriver, however, were not so happy about being the recipients of Chicago's sewage.



Lake Michigan is the second largest of the lakes by volume and the third largest by area. The lake has a surface area of approximately 57,800 square kilometres and an average depth of 85 metres. The Lake Michigan area is the only place on Earth where you can find the Petoskey stone, a pebble-shaped fossilized coral dating from 350 million years ago and marked by an unusual hexagonal pattern.

The shores of Lake Michigan are home to one of the most extensive stretches of freshwater sand dunes in the world, providing habitat for rare species such as the dwarf lake iris. Climate change and development have had a significant effect on the dunes, and the Indiana Dunes National Lakeshore has even been identified as an endangered national park as a result.

Green Bay in Wisconsin is home to one of the most productive Great Lakes fisheries but is also the recipient of pollutants from a large concentration of pulp and paper mills. The more temperate, southern portion of the lake

is one of the most urbanized areas in the Great Lakes system. In addition to the pressures of urban and industrial development, invasive species such as quagga mussels have severely degraded the Lake Michigan ecosystem in recent decades. Conservation efforts in these areas have contributed to the recovery of previously threatened wildlife populations and a decrease in fish contamination levels, but these issues remain a challenge.

LAKE HURON

Lake Huron has a surface area of approximately 59,600 square kilometres and an average depth of 59 metres. The lake has the longest shoreline of any lake in the world and more than 30,000 islands, including Manitoulin Island, the world's largest freshwater island.



In the U.S., the Saginaw River region of the lake is highly developed, with intensive agriculture as well as a concentration of industrial activity. The St. Clair and Detroit River area is also heavily industrialized, particularly on the Canadian side. However, much of the region around Lake Huron has little heavy industrial or urban development. Its large watershed and relatively undisturbed nearshore areas support a wide diversity of species important to the Great Lakes region, including the massasauga rattlesnake and the piping plover (a small shorebird), both designated species at risk in Ontario. The compelling scenery and relatively easy access from several major urban centres have made Lake Huron a prime destination for tourists and cottagers.

Water quality issues, such as elevated levels of *E. coli* (potentially toxic bacteria found in gull droppings, sewage overflows, and urban and agricultural runoff), have been an issue in Lake Huron for many years, causing frequent beach closures. Outbreaks of Type E botulism, caused by the bacterium *Clostridium botulinum*, have occurred intermittently in the main basin of Lake Huron since 1998, killing thousands of fish and shorebirds. Invasive zebra and quagga mussels are believed to have contributed to these outbreaks by creating the anaerobic (oxygen-free) environments favoured by these bacteria.

Since the late 1960s, Lake Huron has been stocked with Chinook salmon and other non-native species of fish to create sport fisheries and to reduce huge populations of smaller non-native species, such as alewife and smelt. Predator fish native to Lake Huron, including lake trout, burbot, walleye and round whitefish, compete with these introduced species for food. Invasive species, such as zebra and quagga mussels, are also a significant threat to the food web. The ecosystem now contains more predator fish than prey species, resulting in unstable and unsustainable fish populations in some parts of the lake.

Falling water levels are increasingly altering the shoreline and wildlife habitat around Lake Huron. Dredging to create deeper shipping channels downstream from the lake has accelerated drainage, and the hotter, dryer weather associated with climate change has, at the same time, increased evaporation from the lake.

LAKE ERIE

Lake Erie has a surface area of approximately 25,700 square kilometres and is the shallowest of the Great Lakes, with an average depth of only 19 metres. It has the most biologically diverse ecosystem of all the lakes. Point Pelee,



the most southerly point of mainland Canada, is particularly noted for its abundance and diversity of plant and animal species as well as its importance on the migratory routes of monarch butterflies and a great many species of birds.

Lake Erie faces particularly intense pressures from development and urbanization. The concentration of urban population and intensive farming around Lake Erie exposes it to higher levels of agricultural and urban runoff than the other lakes. Because it is so shallow, Lake Erie has less capacity to dilute the harmful pollutants and overloads of nutrients, such as phosphorus, that enter the lake from runoff. In the 1970s, Lake Erie was said to be "dying" as a result of water quality issues, evidenced in fouled shorelines, rotting algae and dying fish. Concern over the conditions in Lake Erie contributed to the formulation of the Great Lakes Water Quality Agreement (GLWQA) in 1972. For some time, the lake showed signs of recovery, but more recently, water quality issues, particularly algal overgrowth, have again begun to cause concern.

Lake Erie's commercial fishing industry accounts for the majority of the total value of Ontario's Great Lakes commercial fisheries. Top predator fish, such as walleye, have struggled to maintain their numbers in the face of changes to the food web that have been linked to invasive species, including zebra and quagga mussels. In addition, contaminant levels in fish continue to be a problem, resulting in fish consumption advisories for the lake and lost revenues for its commercial fisheries.

LAKE ONTARIO

At approximately 18,960 square kilometres, Lake Ontario is smaller in surface area than Lake Erie, but it is significantly deeper, with an average depth of 86 metres. The smallest of the lakes, Lake Ontario has the highest ratio of watershed area to lake surface area.



Lake Ontario is the last in the chain of the Great Lakes, and its downstream location means that it is the recipient of contaminants and waste that have been carried throughout the lake system. Contaminant levels within the lake are improving from what they were in the late 1960s and early 1970s, and some native wildlife species, such as the bald eagle and the osprey, have rebounded as a result.

The lake supports large urban populations both in southern Ontario and northern New York State. This area has traditionally been Canada's industrial heartland, and on both sides of the border, highly productive farmland has fostered extensive agricultural activity. The population increases predicted for this region over the next several decades, and the urban and infrastructure development associated with population growth, present the greatest challenge to the Lake Ontario environment.

AREAS OF CONCERN

In a 1987 amendment to the GLWQA, Canada and the U.S. agreed to develop Remedial Action Plans (RAPs) to restore forty-three Areas of Concern (AOCs) in the Great Lakes that were suffering from severe environmental degradation. AOCs were identified based on human activities (eating fish, drinking water and swimming) and ecological impacts (bird and animal deformities and loss of wildlife habitats).

Three Canadian AOCs (Collingwood Harbour, Severn Sound and Wheatley Harbour) and one U.S. AOC (Oswego River) have been delisted, meaning that remediation targets, such as contamination levels, have been met. Two other AOCs in Canada, Jackfish Bay and Spanish Harbour, are currently "in recovery," which means that all priority remedial actions in those AOCs have been completed, but the environment needs more time to recover naturally. In many other AOCs, progress is being made in upgrading sewage treatment, cleaning up contaminated sediment and revitalizing fish and wildlife habitat.

Jackfish Bay in Lake Superior was designated an AOC in 1987 due to the impacts from a local pulp and paper mill. In the 1990s, Canada and Ontario set new limits for pulp and paper mill wastewater, and both water quality and the health of the local fish population have improved greatly since remediation efforts began.

The Spanish Harbour Area in Recovery is located on the north shore of the North Channel of Lake Huron. It was designated an AOC in 1987 because of impaired communities of bottom-dwelling organisms, nutrient overloading and a tainted flavour in the area's fish, resulting from sewage discharges and contaminants associated with mining and forestry. Natural recovery is expected to mitigate the two remaining impairments in the area, fish consumption restrictions and issues related to elevated levels of metal in sediment.

LAKEWIDE MANAGEMENT PLANS

The 1987 amendment to the GLWQA also required the development of Lakewide Management Plans (LaMPs) for each of the five Great Lakes to support the agreement's commitment to "restore and maintain the chemical, physical and biological integrity of the Great Lakes." LaMPs identify actions that are necessary to help restore and protect each lake and to coordinate the work of the numerous stakeholders involved in the implementation of these actions. Some of the activities under the various LaMPs include remediation efforts for AOCs; the development of biodiversity strategies and aquatic invasive species prevention plans; monitoring of harmful pollutants and habitat loss; and efforts to reduce waste and prevent nutrient loading.

The 2012 amendment to the GLWQA reaffirms the commitment to restoring Areas of Concern and requires reports on LaMPs every five years.

SELECTED RESOURCES

For more information on the Great Lakes and what makes each of them unique, consult the following resources:

Environment Canada. Great Lakes Areas of Concern.
<http://www.ec.gc.ca/raps-pas/>

Environment Canada. Lakewide Management Plans.
<http://ec.gc.ca/grandslacs-greatlakes/default.asp?lang=En&nav=0CB6DFA3-1>

Ontario Ministry of the Environment. Lakewide Management Plans.
http://www.ene.gov.on.ca/environment/en/monitoring_and_reporting/lakewide_management_plans/index.htm

Ontario Ministry of Natural Resources. Great Lakes Portraits.
http://www.mnr.gov.on.ca/en/Business/GreatLakes/2ColumnSubPage/STEL02_173890.html

United States Environmental Protection Agency. Lakewide Management Plans. <http://www.epa.gov/glnpo/gl2000/lamps/index.html>



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PHOTOS

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Lake Michigan: Big Sable Point, Ludington State Park, Ludington, Michigan.

Lake Huron: Lake Huron viewed from Manitoulin Island, Ontario. © Claude Allaert.

Lake Erie: Lake Erie at Point Pelee National Park, Leamington, Ontario. © Cosmin
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