Fact Sheet 046

Lake Erie water quality: Past, present and future

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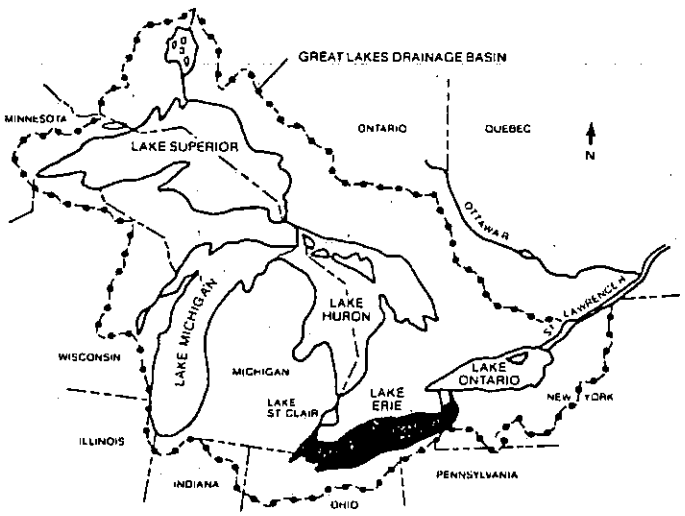
The Great Lakes contain one-fifth of the world's surface freshwater. Lake Erie, the shallowest of the Great Lakes accounts for only about four percent of this. Yet, the demands upon this water resource are very large. The lake, touted as the "walleye capital of the world," is a center for recreational and industrial activity.

Approximately 17 million people live in its drainage basin. With this amount of usage, it is no surprise that Lake Erie has had to withstand the adversity and abuse that has been so well-documented. Toxic chemical discharges and accelerated eutrophication—the natural aging of a body of water—are the two most serious water quality problems that the lake region has faced and is still facing. Although these water problems are thought to be products of the twentieth century, the seeds were planted much earlier.



GREAT LAKES — ST. LAWRENCE RIVER DRAINAGE BASIN

Early history of the lake

Lake Erie was known to Indians as one of the "sweetwater seas." Before colonization, its waters teemed with fish such as northern pike, lake sturgeon, smallmouth bass, walleye, blue pike, cisco and whitefish. The Great Black Swamp covered nearly 1500 square miles southwest from the lake. Dense flocks of waterfowl blackened the skies as they flew over this region of bountiful natural resources. Vast marshes, covering over 240 miles of its southern shoreline and thousands of acres of wild rice, present at the mouth of every river and stream, helped to filter and prevent sediment from entering Lake Erie.

From the first white man to see the lake in 1669 to the settlers of the 1820s, conditions in the region seemed to remain about the same. However, the colonization which took place from the 1820s to the turn of the century had a profound impact upon the quality of the water and the aquatic life so prevalent in and around the lake.

Mill damns were constructed on nearly every stream entering Lake Erie. These damns spelled doom for many of the abundant species of fish which needed to be able to migrate up tributaries to reproduce. The human population soared in cities such as Cleveland bringing with them lake pollution loadings of oil, sawdust, animal carcasses, agricultural chaff and flour and human waste. Swamps and marshes were drained and forests cut down. The taming of the wild Lake Erie Basin was in full swing.

By the early 1970s, life along the lake bore little resemblance to that enjoyed by the native Americans and pioneers. Years of indiscriminate chemical and wastewater dumping by industry and the release of millions of gallons of untreated sewage had fouled the once great lake. Lake Erie was "officially" declared dead. Rivers flowing into the lake, such as the Cuyahoga and Black were so polluted that advisories were issued warning against any contact with the water. The Cuyahoga was so loaded with oily sludge, that it had caught fire in 1969. Even Johnny Carson saw the plight of the lake as he commented that Lake Erie was a place fish go to die.

The rebirth of the lake

The poor water conditions in Lake Erie, during the early 1970s, were a major factor in the decline of the fishing industry while also limiting the lakes recreational use. Dead fish and decaying algae were abundant. Only three beaches were stated as being clean along the entire shoreline.

Although many people thought of the lake as being dead because of chemicals and other pollutants, the largest problem was that it was overalive with algae growth. This overabundance was primarily caused by an excess loading of nutrients, such as phosphorus, into the lake.

When the huge mats of algae died, oxygen was depleted as the plants decomposed. This created large areas void of oxygen or anoxic. Only the most basic life forms survived. These anoxic conditions also speeded up lake eutrophication.

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When Canadian Prime Minister Pierre Trudeau and President Richard Nixon signed the Great Lakes Water Quality Agreement on April 15, 1972, both countries committed themselves to a cleaner Great Lakes environment. The agreement established guidelines for pollutants using the best available technology and knowledge. This agreement was the impetus for reducing Lake Erie phosphorus levels.

Limits were set which gradually reduced the amount of phosphorus entering the lake. To help meet these limits, program guidelines were developed to improve the treatment of human sewage. To further alleviate the problem, every Great Lake's state except for Ohio and Pennsylvania soon after passed a ban against detergents which use phosphorus.

As the level of raw sewage and phosphorus entering the lake was reduced, water quality improved. Fish such as the walleye began to flourish again. By the time the 1980s arrived, Lake Erie had begun to play a significant role for recreation and in the economy of Ohio. In 1988 Ohio passed a bill which bans the sale of all detergents containing phosphorus in the 35 Lake Erie watershed districts in Ohio by 1990.

Although phosphorus and other nutrient levels have been reduced, nonpoint sources of phosphorus— those which have no single point of origin (see page 4)— continue to enter the lake. These problems are mainly caused by animal waste and fertilizer runoff. Better soil conservation practices such as "no-till" farming and improved farm operations have been shown to be effective in curbing phosphorus loading, although more of these practices need to be propagated in the farming industry.

Thanks to a cooperative effort by the people of Ohio, Lake Erie is no longer the butt of jokes, but is renowned worldwide for its walleye fishery and other recreational opportunities. However, new menaces and some old ones continue to threaten the water quality of Lake Erie and the other Great Lakes.

Present day problems

Although some people now consider Lake Erie to be the cleanest of the Great Lakes, it still faces many problems with water pollutants. Unlike nutrient problems that can be seen and smelled, present threats are mostly invisible to the eye. Chemicals such as PCBS, dioxin, mercury and DDT have been found in different levels throughout the lake. How these toxic chemicals are finding there way into Lake Erie, at what levels are they safe to humans and animals, and what can be done about them are questions that scientists and biologists are constantly researching.

Although the problems with toxins in the Great Lakes did not become the main focus of water quality studies until the 1980s, the 1978 Great Lakes Water Quality Agreement viewed them very seriously. This agreement explicitly stated:

"The philosophy adopted for control of imputs of persistent toxic substances shall be zero discharge."

This set the stage for other groups and agencies to implement research to find out the dangers of certain chemicals in the lake.

Over 50,000 chemicals have been identified as being in the Great Lakes system. Since it is nearly impossible to test this number of chemicals, the International Joint Commission (IJC), a cooperative unit of the United States and Canada, is working on procedures to reduce the list by singling out those chemicals which are most likely to cause environmental harm.

Achieving control of toxins will be much more difficult than the control of nutrients such as phosphorus. Whereas phosphorus can be controlled by upgrading treatment facilities, banning or restricting their use, and by changes in farming practices, controlling toxins will take major changes in industrial techniques. These changes are sure to come about very slowly unless stringent guidelines are developed and enforced.

Toxin effects

Many toxic chemicals have been linked to cancer and are known to cause birth defects in animals and humans. They accumulate in living tissue through biomagnification. This can be thought of as progressive accumulation through each member of the food chain. Many of these chemicals remain in the organism until it dies. In some instances, they are then again released into the environment.

Some of the most toxic chemicals in Lake Erie and the Great Lakes as identified by the IJC are:

PCBs This group of chlorinated hydrocarbons were developed for commercial use as electrical transformer insulation fluids, hydraulic fluids, fire retardants and plasticizers. Although banned in 1976, they continue to enter the environment by leaching from landfills, from products containing PCBs which are still being disposed of, and from atmospheric fallout. Because of their extreme stability, they have accumulated to significant levels in many fish species. Some states, such as Michigan, have advisories against eating certain types and sizes of fish because of the levels of PCBs which occur in these species. The U.S. Food and Drug Administration (FDA) has determined that eating fish containing more than 2 parts per million of this toxin pose a health threat. Both the United States and Canada have issued advisories against eating certain fish which are more likely to contain levels of PCBs which exceed this amount.

Mercury Mercury concentrations in walleye and smallmouth bass resulted in a temporary moratorium on commercial and sport fishing for these species in 1970. The FDA has set a tolerance limit of 1.0 part per million of mercury in fish. This metal is known to attack the brain and central nervous system. Mercury has entered the lake by way of affluents from paper industries, such as chlor-alkali plants, situated on waterways leading into Lake Erie. Although most of the dumping of mercury into the lake has been stopped, it is still a concern because of dredging activities which resuspend this toxin and from the flow of mercury-laden sediment from contaminated Lake St. Clair.

DDT This pesticide was banned in Ontario and most of the United States by 1972. It is known to cause deformities and reproductive failure in animals. Today its level in the lake has declined to concentrations less than the guidelines by the Great Lakes Water Quality Agreement of 1978. Because of its insolubility and retention in sediment, however, the amount of DDT has leveled off and shown no further decline.

Dioxin This is a class of chemicals of which 2,3,7,8-TCDD, one of the most toxic compounds known, causes the greatest concern. The largest source of this compound today is pulp and paper mills. The United States Environmental Protection Agency (USEPA) believes that health concerns begin when concentration levels of 2,3,7,8-TCDD reaches 1 part per trillion in fish.

Acheiving a goal of eliminating all toxins entering our Great Lakes will not be an easy task. Many companies still feel that resources like Lake Erie are there to exploit. Also, as shown earlier, many of the toxins which are no longer discharged are still creating problems because of there insolubility and affinity to remain in the environment.

Several steps have been taken to help in the reduction and elimination of toxins.

The Water Quality Act of 1987 stressed the importance of controlling the discharge of toxic chemicals and compounds to surface waters. To facilitate this, one provision of the Act requires states to develop a list of streams impaired due to toxic discharges from point sources (see page 4). This list, called the 304(l) short list, contains 25 segments of waterways that must be brought into compliance with established discharge limits by February 1992. Three of these waterways flow directly into Lake Erie are the Maumee, Black and Ashtabula rivers.

The IJC has also singled out 42 Areas of Concern (AOC) within the Great Lakes which are grossly polluted and have targeted them for cleanup. Four of these are in Ohio. They include the Ashtabula, Black, Cuyahoga and Maumee rivers. The Remedial Action Plans being developed for these areas enable individuals and communities to better understand the cleanup efforts and also to become actively involved in these efforts. For more information about Ohio's AOC, obtain Ohio Sea Grant Fact Sheet 041.

Raising the quality of our Great Lakes water resources will not be an easy task. Information from the various programs and agencies involved in water quality cleanup and assessment need to be better coordinated. Also, pollution standards or benchmarks, especially for toxic substances, need to be established by governments in order to track and monitor discharges of pollutants. In addition, more binational strategies should be developed to aid in incomplete or underdeveloped programs in governments.

It will only be through a highly coordinated, cooperative effort between government, industries and individuals that the Great Lakes will continue to be the "sweetwater seas" for future generations.

Bibliography

Burns, Noel M. *Erie-The Lake That Survived.* Totowa, New Jersey: Rowman & Allanheld, 1985.

Frost, Sherman L. and Wayne S. Nichols. *Ohio Water Firsts.* Volume 1. Edited by Bea Cornelius. Columbus, Ohio: Water Resources Foundation of Ohio Inc., 1985.

Governors Report on Lake Erie. Columbus, Ohio: The Ohio Department of Natural Resources, the Ohio Department of Transportation and the Ohio Environmental Protection Agency, 1986.

The Great Lake Erie. Edited by Rosanne W. Fortner and Victor J. Mayer. Columbus, Ohio: The Ohio State University Research Foundation, 1987.

The Ohio Department of Natural Resources. *CPR For ODNR- Nonpoint Pollution Prevention.* 1989.

The Ohio Environmental Protection Agency. *Environment Ohio.* Vol. 3, No. 3 (May/June 1989): 11.

Point and nonpoint pollution sources

Water pollution costs millions of dollars a year to clean-up. Unfortunately, these efforts are still inadequate as research on the quality of the Great Lakes water resources has shown.

One of the problems stem from the fact there are two classifications of pollutants—those originating from point sources and those from nonpoint sources.

Point source pollution is identifiable to a certain place such as when an industry pollutes a stream or a wastewater plant isn't functioning correctly and the results can be seen and sometimes smelled downstream. Basically, the source of point pollution can be identified to a discharge pipe into the waterway.

When the exact origin of a pollutant is not known, such as when pesticides and fertilizers leech into waterways, they are referred to as **nonpoint sources**. Other types of nonpoint pollutants include chemicals leeching from storage sites, livestock waste, construction site erosion, acid mine drainage from abandoned coal mines, leaks from oil and gas wells, seepage from landfills, home fertilizers and calcium chloride used on roads for ice removal. Dredging, stream channelization, wetland draining and the removal of forests and cover from stream banks also add to nonpoint pollution.

Whereas point sources can be detected and corrected through testing and inspection of individual sites, nonpoint sources may be from such a large area that it is not possible to find the source of the pollution.

The United States Environmental Protection Agency (USEPA) has reported that nonpoint pollution sources account for 76 percent of the pollution in lakes and 65 percent of the pollution in streams. Nonpoint pollutants also are a threat to the water aquifers which provide about 45 percent of Ohio's drinking water.

The severe phosphorus problem that plagued Lake Erie in the 1970s was from point sources—mainly uncontrolled and untreated municipal sewage discharges. With the renovation of sewage treatment plants, phosphorus loadings were dramatically reduced. The main phosphorus problems today are caused by nonpoint sources such as agricultural runoff.

In response to Section 319 of the Water Quality Act of 1987, the Ohio Department of Natural Resources and the Ohio EPA teamed up to develop the Nonpoint Source Assessment program. This program determined the extent and causes for nonpoint source pollution problems across Ohio. Presented to the USEPA in 1988, this assessment involved the collective efforts of over 200 local, state and federal agencies. This program has led to the Ohio Nonpoint Source Management Program which will try to lessen the impact of this major source of pollution.

Most of us take for granted that when we turn on a faucet, clean water will come out. Few people realize that our individual habits such as spreading fertilizer on our lawns or disposing of used oil and antifreeze in our landfill-bound garbage directly affect the quality of our water resources through point and nonpoint pollution.

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