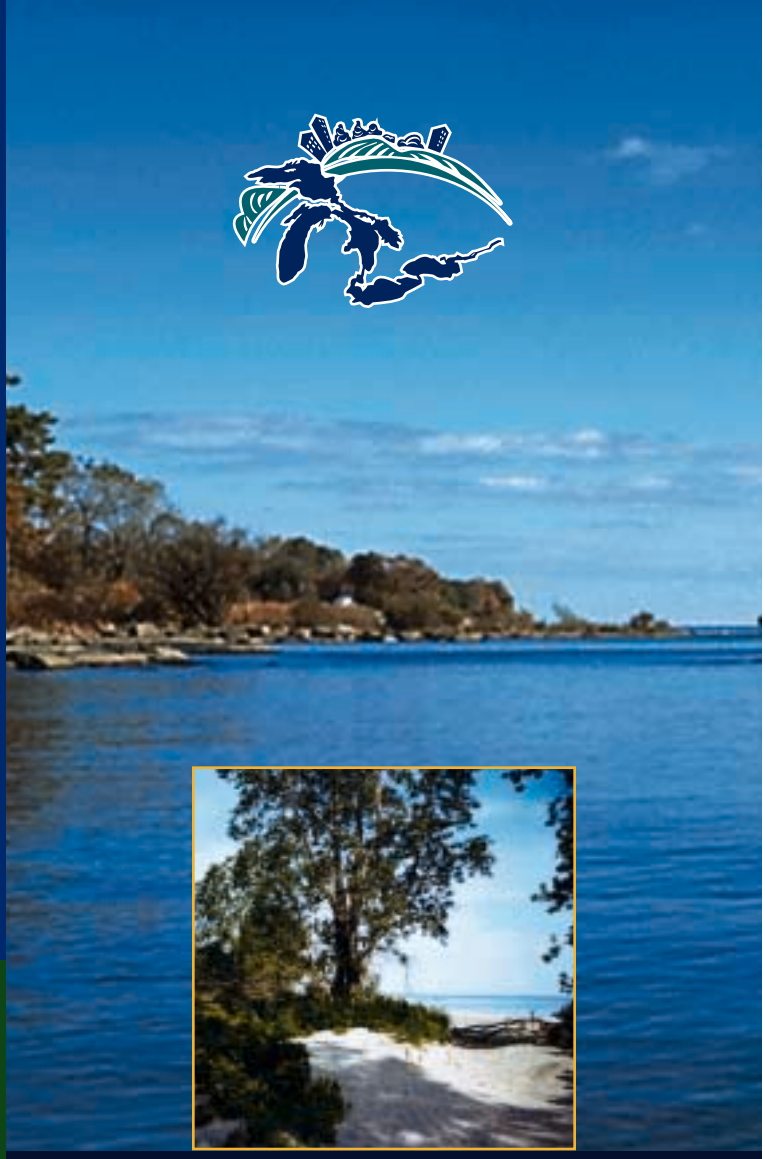

LAKE ERIE:
A Lake in Flux

CANADA-ONTARIO AGREEMENT RESPECTING
THE GREAT LAKES BASIN ECOSYSTEM

Canada Ontario

Lake Erie is the comeback kid. Over-fertilized with human waste, farm chemicals and phosphate detergents, the lake almost choked to death on masses of decaying algae back in the 1970s. Only concerted action by the governments of Canada and the United States, the Great Lakes states, the Province of Ontario and municipal governments, through the Canada-U.S. Great Lakes Water Quality Agreement and the Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA), pulled Lake Erie back from the brink.

By the mid-1980s, nutrient levels had dropped back to acceptable, sustainable levels. The blooming algae were under control, and within 10 years, the waters were clear again. Fish populations were restored, resuscitating a dormant fishing industry and attracting a new fleet of charter boats. It looked like clear trolling into the new millennium.

But Lake Erie is a lake in flux, a lake at the crossroads … again. In recent years, researchers have tracked some disturbing trends. Nutrient concentrations in inshore areas of the lake are beginning to creep back up, while productivity may be dropping in deeper waters. And some fish stocks, the hallmark of a healthy ecosystem, are declining once again.

The experts can point to a host of possible contributing factors. There is the influence of growing urban centres, the polluted run-off from area farms, on-going chemical contamination, loss of critical wetlands and other habitat, the invasion of non-native species, even the demands of an invigorated fishing fleet.

Under the Canada-U.S. Lake Erie Millennium Plan, scientists are working to more fully understand the complex interplay of the forces at work, and what can be done to safeguard the progress made so far. "The Millennium Plan is an attempt to draw together Canadian and American researchers – federal, provincial, municipal, non-governmental and academic – from all over the basin," says Environment Canada's Murray Charlton, one of four directors of the Millennium Plan. Identifying Lake Erie's most pressing environmental problems is part of implementing Lake Erie's action-oriented Lakewide Management Plan or LaMP.

Cover: Lake Erie shoreline east of Nanticoke
Cover inset: Gull Point, Lake Erie

1. algae on the Lake Erie shoreline
2. zebra mussels, Lake Erie
3. The Lake Erie watershed is one of the most intensively farmed landscapes in North America.

When nutrient loadings are optimal, Lake Erie supports a rich foodchain with lots of game fish at the top.

Three lakes in one

Lake Erie is actually three-lakes-in-one, three distinct basins linked together along an east-west axis and separated by shoals and reefs. The Western Basin, which stretches from Toledo in the United States at the western tip of the lake to Point Pelee in Ontario, is the shallowest with an average depth of around seven metres. That drops to 18 metres in the large Central Basin, and down again to 25 metres in the Eastern Basin, hitting a maximum of 64 metres in the deepest holes. Because the whole lake is relatively shallow, the water warms quickly in the spring and cools again as quickly in the fall.

The smallest of the Great Lakes by volume, Lake Erie is still the most productive and the most biologically diverse of the five. Some 143 different species of fish have been identified in its watershed. The annual catch of the commercial fishery in Lake Erie is greater than the catch in the other four Great Lakes combined, making it the most valuable freshwater fishery in the world.

The topographic features that make Lake Erie a fishing paradise also place it in environmental jeopardy. "A shallow lake recycles nutrients better than a deep lake," says Charlton. "Every unit of nutrient put into the lake generates a higher level of biological production."

When nutrient loadings are optimal, Lake Erie supports a rich foodchain with lots of game fish at the top. Add too much of the nutrient phosphorus and you get more algae. Eventually those massive algal blooms die and drift to the bottom where they are decomposed by a very active bottom-dwelling community of micro-organisms. This process is called eutrophication and it can strip the water of oxygen making the lake very inhospitable. On the other hand, push nutrient levels too low and productivity drops. Again, the food chain collapses because there is not enough algae.

Invasion of the zebra mussel

"By the mid 1980s, we had achieved the targeted nutrient loading goals set under COA," says Charlton. "We had managed to cut nutrient levels in half in the Western Basin where the (algal) problem was the worst." Then the zebra mussel arrived in the ballast tanks of some overseas freighter and quickly spread through the lake, feeding on the rich phytoplankton and upsetting the delicate nutrient/algae balance.

The mussels were tremendously efficient in further reducing algal levels, and their impact was felt all the way up the food chain. The number of yellow perch, walleye and white perch declined across the lake, while smelt populations dropped in the Eastern Basin. Conservative harvest strategies have been adopted by the Lake Erie Committee of the Great Lakes Fisheries Commission in order to permit the recovery of these species to their former potential.

In addition to algae, the zebra mussels also filter out some of the suspended solids from the water column. "We have 32 years of data and you can see the water's clearer, especially in the shallower Western Basin and inshore areas of the lake," says Charlton.

However, after years of rapid population growth, the spread of the zebra mussel has slowed. They have already colonized all the suitable rocky outcroppings and hard surfaces on the lakebed; all that is left is the soft sediment where it is tougher (but not impossible) for the mussel to establish a foothold.

At the same time, phosphorus concentrations in Lake Erie's shallow waters are beginning to rise again. "Phosphorus levels were decreasing up till the mid-1990s," says Charlton, "but they've been on the way back up since 1995." It appears that zebra mussels can no longer be relied upon to keep eutrophication under control.

Even as scientists strive to understand the lake, the biological community continues to change. On average, another foreign species grabs a niche in the lake's ecosystem every 11 months. The invading zebra mussel, the round goby, the white perch, and the spiny water flea are each taking their best shot at grabbing a bigger share of the food web, upsetting the delicate energy cycling mechanisms. This makes life more difficult for native species.

The stress of urban and rural life

In the shallow basins of Lake Erie, the volume of water is limited and environmental stressors exert a proportionally larger impact. In the 1960s, the huge urban and industrial complex centered around Detroit had a devastating effect on the Western Basin. Municipal sewage fed an algal population explosion every summer, while effluents loaded with toxic chemicals contaminated the sediment and poisoned the food chain. Expensive sewage treatment plant upgrades, supplemented by bans on high phosphate detergents helped cut nutrient loadings.

Nutrient loadings from urban centres may be creeping back up. One-third of the total population of the Great Lakes Basin – nearly 12 million people – lives around Lake Erie. "You've got to keep doing a better job, increasing the level of sewage treatment, just to keep even with population growth," explains Charlton. In addition, the lake receives some 80 percent of its flow, and much of its nutrient load, from the Detroit River. Remedial Action Plans (RAPs) for the Detroit River and the St. Clair River are therefore critical links in efforts to clean up Lake Erie.

Rural non-point source loadings are also cause for concern. The Lake Erie watershed is one of the most intensively farmed landscapes in North America. Nutrient, sediment and bacterial levels in the watershed tributaries often exceed government guidelines. "If nutrient levels in rural run-off could be better controlled," says Charlton, "these rivers and streams would provide better spawning grounds and fish populations in the lake would likely increase."

…Under the Millennium Plan, scientists throughout the basin are trying to unravel Lake Erie's perplexing ecosystem …

4. Lake Erie water snake; a species at risk

Some good news and some bad

Dr. Jan Ciborowski, professor of biological sciences at the University of Windsor, and the second of four Millennium Plan Directors, is interested in what benthic organisms can tell us about the state of Lake Erie's health. Paradoxically, it appears that "things are getting both better and worse," says Dr. Ciborowski.

The burrowing mayfly, *Hexagenia*, is an excellent bio-indicator of the lake's environmental recovery. Forty years ago, eutrophication wiped *Hexagenia* out of the polluted Western Basin. "The larvae need good levels of oxygen to survive," says Dr. Ciborowski. "Even 24 hours of conditions without oxygen can knock them out." Today, you can find *Hexagenia* throughout the Western Basin, all along the south shore of the lake, and in the muddy reaches along the north shore.

Hexagenia have made an incredible comeback, says Dr. Ciborowski. "Ten years ago there were none. Now we are measuring 80 to 90 kilograms of larvae per hectare," he says. "That's a lot of fish food that hasn't been there since the 1950s." Those *Hexagenia* are supporting a thriving walleye population through the winter and feeding perch all summer long.

In the "battle of the benthos", *Hexagenia* has gone head-to-head against the zebra mussel in the the soft muddy sediment in the Western Basin. So far, *Hexagenia* appears to be *(cont'd)*

5. *Hexagenia*
6. *Diporeia*

gaining the upper hand. The masses of mayfly larvae stir up a lot of silt while grazing through the bottom muck. Dr. Ciboorowski believes that this "micro-turbidity" might clog the gills of the mussels, slowing their incursion into *Hexagenia* turf.

While *Hexagenia* may be pinning its mussel to the mat, the little bottom-dwelling crustacean *Diporeia* may be losing its' bout. The shrimp-like macro-invertebrate is very high in calories and an important part of the diet of smelt, whitefish and young lake trout. As *Diporeia* disappears from the deep, cold waters of the Eastern and Central Basins, the fish populations there are starting to sag.

Along with competition from zebra mussels, there are other hypotheses that explain why *Diporeia* are in decline. They may be at a low point in their population cycle. Perhaps there is another non-native invader playing a role. "We really don't know," Dr. Ciborowski admits. The massive disruption caused by eutrophication may have masked other, more complex problems in Lake Erie. "The issue of fish and insect reproduction didn't really matter when all the fish and insects were dead," he says.

Under the Millennium Plan, scientists throughout the basin are trying to unravel Lake Erie's perplexing ecosystem. There is too much work for any one individual or agency to handle. "If we are to get anywhere, we have to coordinate our research and that research has to address the questions relevant to the people managing the lakes." The answers they uncover will be crucial to protecting Lake Erie, a lake at the crossroads again.

What is a LaMP?

It is a Lakewide Management Plan, and LaMPs have been created for lakes Erie, Ontario and Superior. Coordinated by the governments of Canada and the United States, the Lake Erie LaMP brings together the Province of Ontario, the Great Lakes states and a broad network of stakeholders to describe the lake's problems, identify the source(s) of those problems, and envision the preferred future state of the resource.

Established under the Canada-U.S. Great Lakes Water Quality Agreement, the LaMP process was designed to address and eliminate bioaccumulative toxic chemicals. The Lake Erie LaMP also covers habitat loss, nutrient and sediment loadings, and the invasion of non-native species. The Canada-Ontario Agreement Respecting the Great Lakes Basin (COA) is one of the main mechanisms used to determine government of Canada and Ontario contributions to the LaMP.

Canada and Ontario have identified three goals for lakewide management over the next five years:

- clearly understanding the environmental problems and causes of ecological impairment;
- having broad based support for priority actions; and, making progress on habitat restoration and protection, and;
- reducing the impact of harmful pollutants.

For more information on the Lake Erie LaMP, including tips on how you can get involved, visit the Environment Canada website at **www.on.ec.gc.ca/glimr/lakes/erie.**

Photo Credits:

5. Jan Ciborowski **6.** Donna Gibson, University of P.E.I.

Canada-Ontario Agreement
Respecting the Great Lakes Basin Ecosystem

To learn more about COA and Lake Erie, contact:

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