GREAT LAKES FACT SHEET

Fish and Wildlife Health Effects in the Canadian Great Lakes Areas of Concern

Early Findings for Wildlife in the Lower Great Lakes

In 2000, Health Canada compared the incidence of morbidity and mortality in human populations in the 17 Areas of Concern (AOCs) in Ontario to rates for the province as a whole. The Health Canada reports were based primarily on hospital and census databases. For each AOC, specific data were compiled on a variety of diseases and disorders, such as:

- cancer incidence;
- reproductive disorders; and,
- congenital deformities.

Different rates were reported across AOCs. A second, independent analysis of the Health Canada data focused on two highly industrialized AOCs, Windsor and Hamilton [see Environmental Health Perspectives 109 (6): 827-843 (2001)]. It hypothesized that the elevated rates of mortality, morbidity (illness) and congenital (birth) anomalies in the Windsor AOC might be related to ambient levels of pollution.

Historically, studies of wildlife have provided a useful early warning of effects that might occur in human populations. Since the early 1970s, there has been widespread interest in understanding toxic contaminants and their effects on animals. Early concerns stemmed from reproductive and developmental effects that were first reported in the Great Lakes, particularly in colonial fish-eating birds. However, research on fish and wildlife health effects has not been extensive and no systematic monitoring of health effects occurs in AOCs.

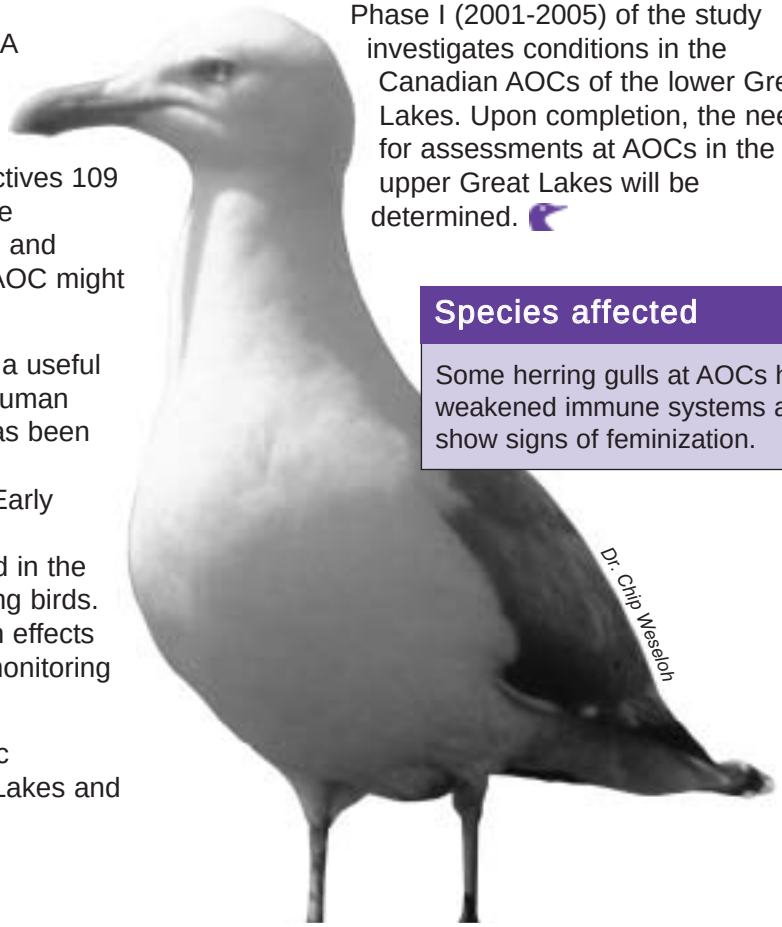
Programs to monitor levels of persistent toxic chemicals are well established in the Great Lakes and show significant reductions in most traditionally measured chemicals. However, levels of some new chemicals, such as PBDE flame retardants, commonly used in computer components, automotive parts and upholstery, are increasing at high rates and may be associated with health effects.

Environment Canada initiated the Fish and Wildlife Health Effects and Exposure Study in 2001. The goal of this systematic assessment in Canadian AOCs is to determine if there are fish and wildlife health effects, similar to those reported for the human population, that are associated with contaminants in the aquatic environment.

Phase I (2001-2005) of the study investigates conditions in the Canadian AOCs of the lower Great Lakes. Upon completion, the need for assessments at AOCs in the upper Great Lakes will be determined.

Species affected

Some herring gulls at AOCs have weakened immune systems and show signs of feminization.



Dr. Chip Weseloh

Environment Canada Environnement Canada

Fish and Wildlife Health Effects and Exposure Study


Glenn Barrett

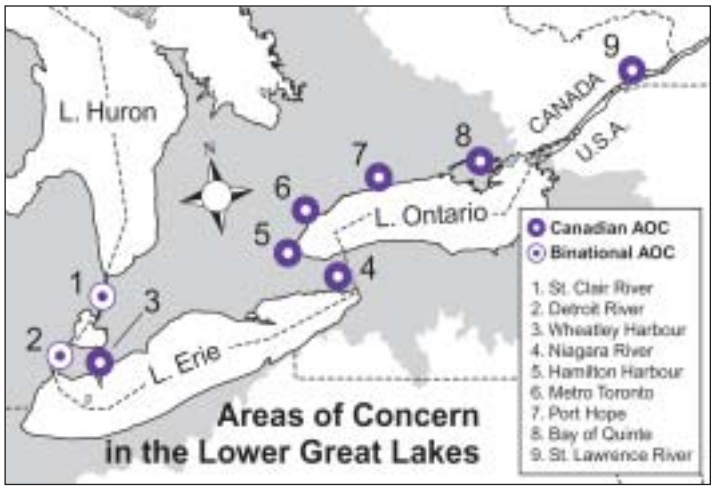
As a first step, a summary of existing water and sediment environmental exposure data was compiled. Information on health effects and contaminant levels in fish and wildlife throughout the Great Lakes was reviewed. Systematic information on fish and wildlife health effects was generally lacking, and exposure data for the biota in many of the AOCs were out of date. As well, the potential effects of new contaminants are poorly understood. The knowledge gaps pointed to the need for an integrated study of exposure and health effects in fish and wildlife.

Objectives

1. Document health effects in fish and wildlife by measuring specific indicators: endpoints that are fundamental to the development, growth and reproduction of individuals and population status. Because effects can occur at community, population, individual and subcellular levels, a range of indicators was chosen. Choice of indicators was based on sensitivity to chemical exposure, tangible results in previous studies, simplicity and cost effectiveness.
2. Measure current environmental contaminant concentrations in water, sediment, fish and wildlife in AOCs. Evaluate techniques in analytical chemistry to measure less persistent chemicals in water, sediment, fish and wildlife.
3. Integrate and assess results in lake-by-lake reports, and make recommendations for long-term monitoring strategies, if required.

Preliminary Results 2002: Effects in Wildlife

This fact sheet summarizes early results of wildlife health assessments from initial field studies in the Detroit River AOC, St. Clair River AOC, and western Lake Erie including Wheatley Harbour AOC.



1. Population Trends for Colonial Waterbirds

Populations of colonial waterbirds are surveyed binationally about every 10 years. Trends from 1977 to 1999 showed dramatic increases in the numbers of herring (4-fold) and ring-billed (5-fold) gulls, great egrets (4-fold), and double-crested cormorants (223-fold), but declines in the numbers of great blue herons (-16 percent), black-crowned night-herons (-87 percent) and common terns (-26 percent). Declining contaminant levels have been a major factor in the recovery and increase of cormorants. Habitat destruction (by cormorants) and habitat change have contributed to the declines in herons; declines in terns are influenced by competition with ring-billed gulls.

2. Reproductive Health

The reproductive success of snapping turtles was lower at AOC sites compared to reference sites, with hatching success being reduced at the St. Clair AOC and near the Wheatley Harbour AOC. Within the Wheatley Harbour AOC there were no signs of reproductive activity by snapping turtles, which echoes findings from similar investigations in the early 1990s. Growth and development of snapping turtles were altered at study sites compared to reference (clean) sites, with particularly poor growth seen in the juveniles from near the Wheatley Harbour AOC.

Precloacal length, an estimator of penis length, was shorter in male adult turtles from the Detroit River and in juvenile males from St. Clair and Wheatley Harbour AOCs than from reference sites.

The sex ratio of herring gull chicks at hatch may be influenced by contaminants in the egg. More males than females hatched at the AOCs in 2001, particularly on Fighting Island in the Detroit River. Balanced numbers, as expected, were seen at the reference sites. Contaminant-induced early embryonic mortality was an important factor contributing to the low reproductive success observed in Great Lakes herring gulls during the 1970s. This study found more dead herring gull embryos in the Detroit River AOC and western Lake Erie compared to reference sites.

Morphological abnormalities are seldom seen in adults. However, one adult male herring gull, nesting downstream from the Detroit AOC in 2001 had a significantly feminized reproductive tract.

3. Status of Endocrine Systems

The endocrine system helps control physiological functions under normal conditions and during periods of stress. Pollutants are known to interfere with these processes and therefore have an impact on health, development and reproduction.

The egg yolk protein, vitellogenin, is normally produced only by breeding females. Production of this protein in males is a form of endocrine disruption. Three of thirty adult male snapping turtles near the Wheatley Harbour AOC and two of fifteen adult male herring gulls in the Detroit River AOC had detectable levels of vitellogenin in their blood.

A hormone, corticosterone, is measured to indicate an animal's ability to respond to stress. Levels in herring gulls at AOCs were suppressed, indicating a reduced stress response.

Thyroids of adult gulls were enlarged (goiter) but produced smaller amounts of hormone, suggesting that thyroid function was disrupted. Thyroid function was also impaired in juvenile snapping turtles at all three AOCs in 2001.

Dr. Kim Fernie

Sampling

A spirited snapping turtle, one of the species to show changes in reproductive success.

4. Organ Function

Results for several diagnostic tests for organ function were significantly altered in adult snapping turtles and/or adult herring gulls, particularly from the Detroit River AOC, indicating changes in key processes important in the production of enzymes, hormones and energy. The liver enzyme, EROD, is produced in greater amounts if an animal is exposed to increased levels of dioxin-like pollutants. Once changes in EROD activity are detected, more specific endpoints are then measured. Liver EROD activity was increased in juvenile snapping turtles and adult herring gulls from the Detroit River AOC, which indicates activation of an important toxicological response system.

5. Immune Function

Immune systems are important to ward off and fight infection. They are known to be sensitive to pollutants. One indicator of immune function, the PHA skin test, was significantly suppressed in young herring gulls from the Detroit River and young herring gulls and young black-crowned night-herons from western Lake Erie. This immunosuppression suggests increased susceptibility to infectious diseases, reduced ability to grow, compete for food, and to withstand the rigors of weather and migration, thus reducing their fitness and potential survival to adulthood.

Common Tern
John Mitchell

Fish and wildlife health indicators

1. **Population trends over time across the Great Lakes basin**
2. **Reproductive health indicators**
3. **Status of endocrine systems, including thyroid structure and function, and stress response hormones**
4. **Organ function, including liver, kidney, pancreas, and bone**
5. **Immune function**

Wrap-up

Double-crested cormorant colony
John Mitchell

What have we learned so far?

Annual monitoring of contaminant concentrations in herring gull eggs across the lakes shows that levels of most contaminants continue to decline. Both obvious and subtle health effects, however, were observed in fish-eating birds and other wildlife.

The occurrence of specific toxic chemicals in other wildlife is also of concern. For example, current levels of PCBs in trapper-caught mink from Lake Erie show increases from 1979 when they were last sampled. In western Lake Erie, 24 percent of the animals trapped in 1979 had PCB levels that exceeded the lowest observable effect level for reproductive impacts, compared to 78 percent of the animals trapped in 2000. In eastern Lake Erie, results were mixed: exceedences decreased from 33 percent to 11 percent over the same 20-year interval, although at Long Point they increased from nil to 11 percent.

To date, this study has consistently documented health effects in wildlife, indicating that these endpoints are suitable for consideration in a long-term monitoring program. It is apparent that some of the subcomponents of the study require two years to ensure adequate data upon which to base conclusions and recommendations for future long-term monitoring. Measuring health effects in the field requires complex methods and study designs. The sampling 'window' is very narrow because of the need to measure at specific developmental stages. Timing of nesting and development can be highly weather dependant. One of the many factors that may confound the sampling effort is weather.

Future efforts will build from these findings, resulting in a fuller understanding and a better-integrated assessment of fish and wildlife health effects.

What's next?

The study is moving around the lower Great Lakes and the St. Lawrence River. Further fact sheets will include health effects in fish and information on current contaminant concentrations in the environment. More detailed reports by lake basin are planned, beginning with Lake Erie in 2004 and Lake Ontario in 2006.

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Great Lakes Fact Sheets

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