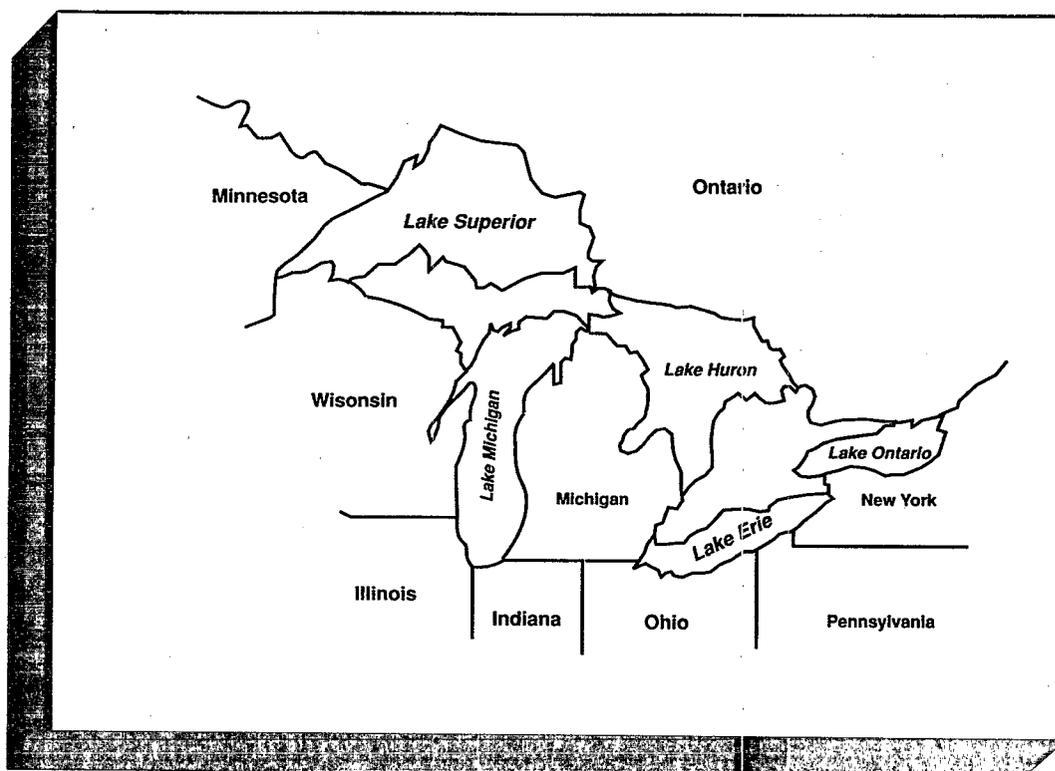




# The Great Lakes Fish Monitoring Program

## A Technical And Scientific Model For Interstate Environmental Monitoring

GREAT LAKES/NATIONAL ESTUARY PROGRAM TECHNOLOGY TRANSFER SERIES



### Summary

The Great Lakes Fish Monitoring Program is designed to support decisions on potential human exposure to pollutants and to provide indicators of the health of the Great Lakes ecosystem. The program monitors the presence of toxic contaminants in fish. Species are selected to represent a range of ages, locations, geographic dispersal, and sensitivity to pollutants. The sampling and analysis are conducted by numerous state and federal agencies coordinated by the Great Lakes National Program Office, and results are peer-reviewed, reported to public authorities, and published in scientific journals.

The Fish Monitoring Program is a flexible, low-cost way to monitor water quality. Other programs are adopting it as a model to monitor key environmental variables in coastal, estuarine, and riverine areas. Using the

standardized sampling and analysis techniques developed by the Fish Monitoring Program, states have improved the reliability and comparability of their internal data, raising public confidence in the results and promoting uniform and consistent health advisories.

The Great Lakes Fish Monitoring Program incorporates monitoring techniques of special interest to Technical Advisory Committees, health officials, and estuarine programs facing problems of baseline characterization or long-term monitoring strategies for measuring environmental results. Several states involved in regional marine or aquatic assessment programs have adapted the Great Lakes Fish Monitoring Program's techniques to their own needs.

## Introduction

The Great Lakes Water Quality Agreement between Canada and the United States (signed in 1972, amended in 1978 and 1987), places first priority on the design and implementation of a plan to restore the Great Lakes ecosystem. The other side of the restoration coin, however, is the need to protect current and future users from the effects of the degraded conditions of the Lakes. In the Great Lakes, this public health function is carried out first by the health departments of the affected states, and second, by the International Joint Commission, which was established in 1912 to address contamination by both the United States and Canada. Both planning and public health functions require documentation of pollution in the Great Lakes ecosystem. A common method of collecting such information is to measure pollutants found in fish, which accumulate toxins by virtue of their geographic mobility and their position near the top of the food chain. Although these data provide valuable information to the planner, the public health need is more visible. It is, after all, the public health advisory which will tell people to stop eating fish and which will determine the viability of current or future commercial fisheries.

The Great Lakes Fish Monitoring Program provides trend data on toxic compounds in fish; it also provides specific information on the potential for human exposure to toxins in commonly eaten species. As a planning and assessment tool, it measures the overall success of bans, restrictions and other remedial actions to control lake pollution. It also provides information on new toxic compounds entering the lakes' ecosystem. These objectives are accomplished by a systematic program of harvesting and analyzing fish to ascertain the level of toxic pollutants in fish tissue. This has been a formal function of the Great Lakes National Program Office (GLNPO) since 1978.

This fact sheet by the U.S. EPA Office of Marine and Estuarine Protection and the Great Lakes National Program Office describes the conceptual, organizational, and managerial processes of the Great Lakes Fish Monitoring Program. Other fact sheets in this series describe the overall management framework for the Great Lakes Water Quality Agreement and the organization of the Green Bay Mass Balance Study. An earlier fact sheet covers the Great Lakes phosphorus strategy.

## Evolution of Great Lakes Fish Monitoring Programs

Fish contaminant monitoring began in the Great Lakes in the mid-1960s, when the Great Lakes Fishery Laboratory of the U.S. Fish and Wildlife Service began a program to measure the contamination of lake trout. This program continues today under the joint sponsorship of the the U.S. Fish and Wildlife Service and GLNPO and provides annual data on the contamination of lake trout by DDT, dieldrin, PCBs (starting in 1972), and chlordane (since 1977). Over the years, the number of lakes, sampling locations, species, and contaminants have been expanded to the point where the most recent agreement between the Fish and Wildlife Service and the Great Lakes National Program Office (August, 1989) specifies the collection of 50 lake trout (or walleye, where there are no lake trout) and 50 smelt, from each of eleven locations — two in each of the Great Lakes, and one in Lake St. Clair — every other autumn. The samples are analyzed for PCBs, DDT complex, dieldrin, chlordane, toxaphene, and mirex (Lake Ontario only). The list of contaminants being monitored continues to increase as scientific knowledge of the effects of these chemicals increases, and as they are observed in the environment.

The twenty-year progression of the lake trout monitoring program from an informal arrangement between EPA and the Fish and Wildlife Service to its role as a key measure of the effect of the Great Lakes Water Quality Agreement mirrors the gradual evolution of national support for a comprehensive water quality management program in the Great Lakes basin. There are now four elements to the fish monitoring program, each with different collection requirements.

There are no formal mechanisms for changing the procedures of the Great Lakes Fish Monitoring Program, but it has demonstrated a capacity to adapt to new conditions. Pressure for change comes from two sources: (1) changes in the policy recommendations of the International Joint Commission; and (2) changes in technology. These issues are raised in annual meetings to discuss fish monitoring issues, and in the course of peer reviews of scientific studies based on the analysis and reporting of findings from the monitoring program. Changes in procedures are generally endorsed and adopted by GLNPO when consensus exists that such changes are both congruent with the goals of the Great



Participants in the tumor monitoring program include the Great Lakes Fishery Laboratory, the Great Lakes National Program Office, the National Cancer Institute, and the Great Lakes Fisheries Commission.

## The Management Program

The Fish Monitoring Program is a flexible, relatively low-cost way to monitor water quality. Using the standardized sampling and analysis techniques developed by the Fish Monitoring Program, states have improved the reliability and comparability of their internal data, raised public confidence in the results, and promoted uniform and consistent health advisories. Standardized monitoring methods also help to produce commonly accepted measures of objectives and program performance for state and local groups participating in the Great Lakes Water Quality Agreement.

The success of the program is based on four elements:

- the overall structure and organization of the Great Lakes National Program Office, including its communication network and working relationships with the eight states involved;
- the benefits the states perceive in cooperation, including especially access to a database of geographically and historically dispersed information on pollution trends;
- a core staff who have worked with the program for a long time; and
- the application of sound scientific procedures to critical public policy questions.

Interstate programs similar to the Fish Monitoring Program are being adapted from the Great Lakes model by the states bordering the Ohio and Mississippi Rivers. In addition, New York State is leading an effort to standardize fish contamination monitoring protocols on the Atlantic Coast.

A large number of people are involved in the Great Lakes Fish Monitoring Program because the institutional pattern of involvement is now so broadly based. (See box.) Supervision and coordination of the program is accomplished by a senior scientist and two administrative staff. Other direct costs of the program to the Great Lakes National Program Office include approximately \$200,000 worth of contractor support for collection and processing of samples. Additional time and laboratory

support is contributed to the program by the various federal and state participants.

### Fish Monitoring Program Participants

U.S. EPA Great Lakes National Program Office;  
U.S. Department of the Interior, Fish and Wildlife Service, National Fisheries Research Center — Great Lakes;  
U.S. Department of Health and Human Services, National Institutes of Health, National Cancer Institute;  
The Smithsonian Institution;  
U.S. Food and Drug Administration;  
Illinois Department of Conservation;  
Illinois Department of Public Health;  
Illinois Environmental Protection Agency;  
Indiana Department of Environmental Management  
Indiana Department of Natural Resources;  
Indiana State Board of Health;  
Michigan Department of Agriculture;  
Michigan Department of Natural Resources;  
Michigan Department of Public Health;  
Minnesota Department of Agriculture;  
Minnesota Department of Health;  
Minnesota Department of Natural Resources;  
Minnesota Pollution Control Agency;  
New York State Department of Environmental Conservation;  
New York State Department of Health;  
Ohio Department of Natural Resources  
Pennsylvania Department of Environmental Resources;  
Pennsylvania Department of Health;  
Pennsylvania Fish Commission;  
Wisconsin Department of Agriculture, Trade and Consumer Protection;  
Wisconsin Department of Health and Social Services;  
Wisconsin Department of Natural Resources

## Lessons Learned

The Great Lakes Fish Monitoring Program, a leader in the collection and use of long-term environmental monitoring data, offers numerous advantages to its participants:

- Its results, based on peer-reviewed scientific studies, are the most accurate that modern technology can achieve;

- (1) To highlight the introduction of "new" pollutants (i.e., not previously observed) into the lakes' ecosystem before they affect an entire lake, and
- (2) To identify source areas of compounds already causing pollution problems in a lake.

A second element of this project provides for the annual collection of young shiners (i.e., current-year hatchlings) to provide short-term trend data on the effects of remediation efforts at specific sites.

States collect the samples for this project, and the Great Lakes National Program Office provides the analysis and publishes the results.

### 3. Game Fish Fillet Monitoring

The element of the Great Lakes Fish Monitoring Program with the most public visibility is game fish fillet monitoring, which directly links the condition of the Great Lakes to the health of its users. Under the terms of the Great Lakes Water Quality Agreement and a variety of other laws, each State has the responsibility and authority to enact standards to protect the health and safety of its citizens. For the game fish monitoring element of the Great Lakes Fish Monitoring Program, each State collects a quota of fillets from coho or chinook salmon (or rainbow trout, if neither is available) under collection procedures designed by U.S. EPA. Laboratory analysis is supervised by the US Food and Drug Administration, and the Great Lakes National Program Office interprets and reports the data.

The Game Fish Fillet Monitoring program provides several benefits to environmental monitors:

- an estimate of human exposure to pollutants through the consumption of sport fish;
- trend indicators of human exposure over time;
- a basin-wide picture of fish contaminants in each lake, using fish of a single age (the open lake trend monitoring project uses fish of differing ages); and
- wide-scale environmental trends, based on the effects of toxicants on pelagic fish species.

This information is an important ingredient of the states' public health advisories on the consumption of fish caught in each of the lakes. For example, the state of Michigan advises people to eat *no* brown trout from Lake Michigan over 23 inches in length, and only one per week if the trout is less than 23 inches.

Most states conduct more extensive collection and analysis programs to support their overall monitoring systems. The collecting that the states perform for the Great Lakes National Program Office monitoring activities is only a small fraction of the states' overall monitoring. A major benefit of the Fish Monitoring Program, however, has been to standardize the collecting and analysis procedures around the methods employed in the Great Lakes National Program Office activities. Because the collection and analysis procedures are now the same, there is growing interest in establishing common exposure standards among the states, and eventually including the Canadian provinces in basin-wide advisories. This process is complicated by differences among the states and the federal agencies involved, and by the fact that some lakes have pollutants not found elsewhere (e.g., mirex in Lake Ontario), that may have both direct and synergistic interactions with other pollutants.

### 4. Fish Tumor and Ecosystem Health Monitoring

The newest element of the Great Lakes Fish Monitoring Program is tumor monitoring. It has its origin in two different trends. The first is the noticeable increase in the incidence of grotesquely deforming tumors in common fish, such as catfish or bullheads. These visible tumors create public pressure for better information. The second trend is associated with the increasing focus within the Great Lakes Water Quality Agreement on the issue of overall ecosystem health. Since it is too expensive to directly measure all the parameters of an ecosystem, indicators of relative health, such as species diversity, are needed. One negative indicator of ecosystem health in the Great Lakes is the incidence of observable tumors in common varieties of fish.

As a result of these converging trends, scientists in the Great Lakes National Program Office are working with other groups to design a fish tumor monitoring program that can:

- gauge the incidence of tumors;
- help identify causes of tumors;
- develop a standardized tumor reporting system and centralized database; and
- determine the feasibility of using biochemical and physiological tests to evaluate contaminant effects on fisheries.

Lakes Water Quality Agreement and technically feasible. Quality control procedures ensure that such changes continue to meet the objectives of the program.

## Interstate Participation

States participate voluntarily in the program for two basic reasons: to gain access to the Great Lakes Fish Monitoring Program databases; and to benefit from the program's quality assurance systems. Cooperative agreements, usually covering a period of five years, are written to define the terms of participation for each major actor in each of the collection and analysis programs. States are most active in the coho/chinook collection and analysis phase of the overall program because this dovetails with the states' need to issue health advisories to residents consuming fish from the Great Lakes.

The Great Lakes Fish Monitoring Program has moved participating states toward common sampling protocols and common standards for assessing human risk when issuing public advisories on the consumption of contaminated fish. Protocols spell out the number, species, ages, and preparation techniques to be applied in each collection procedure. Standards include, for example, agreement on the maximum human exposure through eating contaminated fish that state health authorities should permit. The development of such protocols and standards is an evolutionary process encompassing discussion and consultation among all of the groups involved. Illinois, Indiana, Michigan and Wisconsin began issuing common advisories for consuming fish from Lake Michigan in 1985. All states meet annually — or more frequently — to exchange data and to issue common advice on bordering waters.

## Characteristics of the Fish Collection Programs

### 1. Open Lakes Trend Monitoring

The open lakes trend-monitoring program collects relatively frequent information on long-lived, wide-ranging

varieties of fish. In the past, this program has focused on lake trout and walleye as exemplars of the end of the food chain. In the most recent agreement between the Fish and Wildlife Service and the Great Lakes National Program Office, the collection of smelt — foragers, intermediate in the food chain — has been added to the collection scheme. With greater knowledge about the dynamic processing of pollutants through the Great Lakes, the collection of fish from both points in the food chain will contribute to improved forecasting and modeling of the lakes' pollution assimilation ability.

This program is designed to assess the overall effects of toxics on these fish. Therefore, testing for toxic pollutants is carried out on whole fish, including parts which are not usually eaten, such as the liver and bones.

These organs concentrate pollutants such as metals. Pollutants being measured must meet three standards:

(1) continuity of testing will be maintained, that is, the pollutants tested in the past must be tested in the future;

(2) the specific analysis techniques must be comparable to those used in the past, to preserve continuity; and

(3) the specific pollutants (and their precursor or breakdown products) should be known or expected to be found in the open lakes. This last criterion defines one of the explicit links between the open lake monitoring element and elements tested for "emerging problems" in harbors and tributaries, as discussed in the next section.

The Fish and Wildlife Service collects and prepares the samples for this analysis, while the Great Lakes National Program Office analyzes samples (some of which are cross-checked by the Fish and Wildlife Service as part of the Quality Control Program).

### 2. Emerging Problems in Harbors and Tributaries

The states and EPA regularly cooperate to collect and test whole fish (especially varieties which do not range widely) from major harbors and tributaries. This testing serves two specific purposes:

Monitoring Objective	Collection Requirements
Trend monitoring of fish from the open lakes	Collecting whole lake trout (or walleye) and smelt every two years.
Monitoring emerging problems in fish from harbors and tributary mouths	Collecting whole adult fish from selected harbors and river mouths in five-to-ten-year cycles
Monitoring potential human exposure to toxic substances found in the most commonly consumed species	Collecting coho and chinook salmon filets in alternate years
Monitoring fish tumors and other indicators of ecosystem health	Studying fish tumors in selected harbors and tributaries

- Its technology provides a set of processing standards that permits each participant to measure trace contaminants with a high degree of confidence and precision;
- Its accessibility provides states with an archive of test results produced by U.S. EPA, the U.S. Food and Drug Administration, and other states, with some fish samples stored for retrospective documentation of long-term changes in the condition of the Great Lakes;
- Its strategic design supports key information needs of basin-wide and state program managers through collecting the following data:
  - regular, comparable measures of fish contamination;
  - regular, comparable indicators of human exposure to major toxic pollutants;
  - identifiers of new pollutants and pollutant sources, before the substances are dispersed throughout the lakes;

- short-term measures of the impact of remediation efforts; and
- indicators of ecosystem health and investigations into the pathology of fish tumors;

- Finally, its structure requires relatively little added effort on the part of participating states.

The Great Lakes Fish Monitoring Program provides flexible, effective, low-cost scientific information to assist public policy makers in managing the environment. Managers use the program's applied technology to protect public health, and to support long-range planning and program design.

For further information on the Fish Monitoring Program, contact the Great Lakes National Program Office (312/353-3503) or the Office of Marine and Estuarine Protection, Technical Support Division (202/475-7102).